DOCUMENT 000110

TABLE OF CONTENTS

Section **Title**

DIVISION 01 - GENERAL REQUIREMENTS

Section 01000 Summary of Work
Section 01050 Project Survey Requirements
Section 01090 Abbreviations and Definitions
Section 01300 Administrative Requirements
Section 01310 Construction Progress Schedule
Section 01330 Submittal Procedures
Section 01400 Quality Requirements
Section 01500 Temporary Facilities and Controls
Section 01600 Product Requirements
Section 01700 Execution and Closeout Requirements
Section 01810 Testing and Commissioning

DIVISION 02 - EXISTING CONDITIONS

Section 02200 Site Preparation
Section 02222 Demolition and Removals
Section 02300 Excavation and Backfilling
Section 02345 Rock Removal
Section 02612 Transportation and Disposal
Section 02701 Aggregates
Section 02800 Erosion and Sedimentation Controls

DIVISION 11 - EQUIPMENT

Section 11010 Equipment General Requirements
Section 11441 MISA Sampling System

DIVISION 13 - SPECIAL CONSTRUCTION

Section 13105 Common Work Result Instrumentation
Section 13250 Open Channel Flowmeter-Radar
Section 13430 Control Panels
Section 13450 Programmable Controllers
Appendix A
Section 13460 UV Control System Upgrade
Appendix A
Section 13470 SCADA Hardware and Software
Section 13480 Process Control System Integrator
Section 13485 Process Control Software Programming
Section 13621 Control System Documentation
Section 13623 Control System Testing and Commissioning
Section 13720 pH Analyzer
Section 13730 Conductivity Analyzer

DIVISION 15

Section 15010	Mechanical General Requirements
Section 15060-00	Common Work Results for Process Piping
Section 15060-01	Stainless Steel Process Piping
Section 15060-02	HDPE PVC Process Piping Under 1034 kPa
Section 15060-03	PVDF Tubing and Carrier Piping
Section 15075	Mechanical Identification
Section 15081	Thermal Piping and Equipment Insulation
Section 15201	Pipe Support Systems
Section 15205-00	Common Work Results for Process Valves
Section 15205-01	Cast Iron Gate Valves
Section 15205-03	Stainless Steel Ball Valves
Section 15955	Piping Leakage Testing

DIVISION 16

Section 16000	Scope of Work Appendix A
Section 16010	Electrical-General
Section 16013	Arc Flash Hazard Assessment
Section 16060	Grounding and Bonding
Section 16070	Hangers and Support
Section 16075	Electrical Identification
Section 16123	Building Wire and Cable
Section 16131	Conduit
Section 16132	Duct Bank
Section 16133	Cable Tray
Section 16135	Boxes
Section 16150	Wiring Connections
Section 16160	Cabinets and Enclosures
Section 16445	Motor Control Centre
Section 16460	Duplex Pump Control Panel
Section 16857	Heat Tracing

END OF TABLE OF CONTENTS

SECTION 01000

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of the Project.

B. Location.

C. Scope of work.

D. Sequence of work.

E. Contract Times and Milestones.

F. Drawings.

G. CONTRACTOR use of the Site.

H. OWNER occupancy.

1.2 DESCRIPTION OF PROJECT

A. Treatment of domestic sewage (wastewater) at the Bruce Power LP site is facilitated by the Sewage Processing Plant (SPP). The SPP was constructed in the late 1970s. Since the original construction of the SPP a number of upgrades and retrofits to the facility have been completed. Such modifications include changes to the SPP control system. Despite upgrades to the SPP control systems (since original construction) a number of key control system elements are approach the end of their useful life and must be upgraded or replaced.

B. Upgrades to the SPP Controls systems includes (but are not limited to) upgrading of the SPP master PLC and SCADA systems, removal of existing control panels and control hardware, rewiring of field devices to new SPP master PLC, removal of the existing MISA sampling pumps and MISA sampling system, upgrading of the UV system feed pump VFDs, refurbishment of the existing UV system control panel, provision and installation of new MISA sampling pumps and monitoring systems, upgrading of the SPP RAS/WAS actuated valves, provision of new master PLC cabinet with local HMI, upgrading of the SPP raw sewage pump VFDs, and replacement of the existing east/west treatment train final effluent flow meter systems.

C. Refer to Section 16000 Electrical Scope of Work for Complete delineation of project scope and suggested work sequence.

1.3 LOCATION

A. The sewage pumping stations sites are located on the Bruce Power L.P. Site at 177 Tie Road in Tiverton Ontario.

1.4 SCOPE OF WORK

A. The Works to be performed under the Contract consists of the Bruce Power L.P. SPP Controls Upgrade and associated work.

B. The Works include but are not limited to the following:
   1. Full compliance with all Bruce Power LP working requirements and procedures.
   2. Mobilization and;
   3. Construction administration/Health and Safety Activities – all in accordance with Bruce Power LP requirements.
   4. Implementation of Site preparation works including the implementation of sediment erosion controls associated with the Proposed Works.
   5. MISA System Upgrades:
      a. Removal of Existing MISA sampling pumps and MISA monitoring skid.
      b. Provision and installation of new MISA sampling system including sample pump pumps and instrumentation.
      c. Integration of new MISA sampling system with SPP Exit Sump.
   6. Upgrading of the SPP RAS/WAS Wasting Valves:
      a. Provide and install four (4) new actuated valves on discharge of east/west treatment train sludge metering boxes.
      b. Insulate and heat trace sludge piping upstream/downstream of actuated valves.
   7. Provide and install flow metering instrumentation in existing discharge flumes of east/west treatment trains of SPP.
   8. Remove existing UV system feed pump VFDs and provide new VFDs.
   9. Remove existing raw sewage pump VFDs and provide new VFDs in new MCC section.
   10. Refurbish and upgrade existing UV system control panel including provision of new PLC.
   11. Rewire field devices which historically terminated in “annunciator panel” to new master PLC.
   12. Remove existing control panels/hardware as shown including SPP Outpost 5 panels/X-link panel etc.
   13. Provide and install new Master PLC control cabinet.
   14. Provide SCADA integration services for new SPP master PLC as well as UV system PLC.
   15. Installation of primary power and control systems and equipment as required.
   16. Supply, setup, operation, and takedown of bypass systems including installation of all equipment and testing of system as required.
   17. Testing and commissioning
   18. Decommissioning, demolition, and removals of existing station components
   19. Demobilization

1.5 SEQUENCE OF WORK

A. This Section includes mandatory construction sequencing constraints and a suggested sequence of construction that will satisfy the mandatory constraints required in the execution of the Works.

B. The suggested sequence of construction described in this Section is general in nature and illustrates the design intent with respect to the execution and progress of the Works. CONTRACTOR shall prepare and submit a proposed construction schedule for review by OWNER and ENGINEER. This review will serve to satisfy that all mandatory construction sequencing constraints have been properly addressed by CONTRACTOR but shall in no way

absolve CONTRACTOR of its complete responsibility for the execution of the Works in accordance with the requirements of the Contract Documents.

C. The suggested sequence of construction described in this Section outlines the intent of the design with respect to the general progress of Work. The descriptions of construction activities as outlined in this Section are not intended to be comprehensive or all-inclusive. Many other construction activities and work components, although not specifically noted in this Section, are integral parts of the Works and shall be scheduled and completed by CONTRACTOR in accordance with the Contract Documents.

D. The broad grouping of parts of the Works under phases, stages, or similar divisions in the suggested sequence of construction is intended to illustrate the general sequence for the execution of the Works as envisioned by ENGINEER. Such grouping shall in no way absolve CONTRACTOR of its complete responsibility for the construction means, methods, techniques, sequences, and procedures of construction, or the safety precautions and programs incidental thereto.

E. The Works at the Bruce Power SPS will entail multiple project components executed in parallel. CONTRACTOR shall coordinate schedule and resources as required. CONTRACTOR should assume multiple commissioning events for various components of the project (e.g. UV system control panel may be commissioned in advance of SPS master PLC).

F. The suggested sequence of construction is as follows:

G. Pre-Construction

Item No.	Description
1.	Contract Award
2.	Shop Drawing and Submittal Preparation and Review
3.	Equipment Lead Times
4.	Obtain any necessary permits
5.	Mobilization

H. SPP Controls Upgrade Construction Sequence

Item No.	Description
6.	Scanning and Daylighting for full confirmation of buried utilities and other pre-construction site investigations
7.	Installation of temporary facilities and site controls
8.	Required utility relocations
9.	**Electrical/Control Preparation (duct bank installation, wiring, conduit installation)**
10.	**SPP UV System Upgrades**
11.	MISA System Upgrades
12.	Raw Sewage Pump VFD Upgrades (new MCC Section)
13.	**RAS/WAS Valve Upgrades**
14.	Effluent Flow Measurement Upgrades
15.	Master Control Panel Integration
16.	Switchover from Old Control System to New Control System
17.	Existing Control Hardware Demo/Removal
18.	Integration of new SCADA Platform/System Integration

I. General Project Finalization Work

Item No.	Description
1.	Substantial Performance and project closeout documentation

Item No.	Description
2.	Demobilization
3.	Warranty Period

J. Mandatory scheduling constraints include the following:
   1. SPP Control Upgrade Constraints:
      a. The bypass pumping/treatment systems associated with existing UV treatment system upgrades shall be installed and tested to the satisfaction of the OWNER prior to placing the UV system on bypass
      b. The bypass pumping/treatment system equipment shall remain at the site until the successful completion of the upgrade works and resuming operation of the existing UV treatment system is proposed by OWNER/ENGINEER.
      c. Bruce Power L.P. station operations shall take precedence over any and all construction activities. Upon initiation of the Works, Contractor shall develop and submit a <u>detailed</u> construction sequencing plan highlight impacts to SPP Operations (i.e. need for system shutdowns and durations, etc.). The sequencing plan shall align with the overall Contractor provided construction schedule. The Contractor shall allow for a construction sequencing plan review workshop with OWNER/ENGINEER. No works shall be executed on Site until the sequencing plan is finalized.
      d. Request for shutdown and/or operator assistance for any SPP systems shall be made in writing a minimum of 2 weeks prior to the planned event.

K. CONTRACTOR, OWNER, and ENGINEER shall complete a preconstruction survey at the beginning of the Contract and shall identify any and all items that OWNER wishes to take possession. CONTRACTOR shall provide all material, labour, and equipment to remove, store, and protect all identified items in accordance with the manufacturers recommendations for the duration of the Contract and until the OWNER takes possession of the items.

1.6 DRAWINGS

A. Drawings are issued with and form part of the Contract Documents.

B. Perform the Works according to the Drawings issued "Issued for Construction" by ENGINEER. Such Drawings will be issued to CONTRACTOR after the effective date of the Term of the Contract and will consist of bid Drawings revised as required by ENGINEER and additional Drawings if required by ENGINEER.

1.7 CONTRACTOR USE OF THE SITE

A. Refer to Form-13931 R003 – Construction Island Checklist for information and requirement on Use of Site

B. Access to the Site: Limited to the main access driveway as shown on the Drawings.

C. Hours of Operation: Limit on-Site hours of operation to the hours of 7 am to 5 pm.

D. Utility Outages and Shutdown: CONTRACTOR shall coordinate all utility outages and shutdowns with ENGINEER and OWNER and obtain written approval prior to proceeding with the shutdown.

E. Construction Operations: Limited to the area shown on the Drawings.

F. When unfavorable weather, soil, drainage, or other unsuitable construction conditions exist, continue operations which will not be adversely affected by such conditions. Do not construct or cause to be constructed any portion of the Works under conditions which would adversely affect the quality of the Works, unless special means or precautions are taken to perform the Works in a proper and satisfactory manner.

G. CONTRACTOR shall not enter upon or occupy with workers, equipment, tools or materials, any lands other than designated access routes and roadways and the area designated in the Contract Drawings unless written consent has been received from the OWNER.

H. The construction of the Works shall be carried out in such a manner that minimizes any inconvenience caused to the occupants of properties adjacent to the Site.

I. All materials shall be stored separately on the Site at locations agreed upon with OWNER. Provide all material, equipment and labour to suitably protect and prevent deterioration or the ingress of foreign matter in accordance with the manufacturer’s recommendations. Any material which, in the opinion of ENGINEER, has deteriorated or been damaged shall be removed immediately from the Site at CONTRACTOR's expense. On-Site stockpiling of materials will be allowed, but only with the consent of ENGINEER.

J. The flow in existing drains and ditches shall be maintained by Contractors at all times at no extra cost to OWNER. During the construction of the facilities, CONTRACTOR shall liaise with ENGINEER to schedule the Works in order to ensure continual flow.

K. CONTRACTOR shall obtain the prior written approval of OWNER for all tie-in work to the existing facilities. OWNER's staff will operate any valve, switch, or other control on existing facilities.

1.8 OWNER OCCUPANCY

A. OWNER will occupy the premises during the entire period of construction for the conduct of normal operations.

B. Cooperate with OWNER to minimize conflict, and to facilitate OWNER's operations.

C. CONTRACTOR shall maintain complete access and egress to the premises by OWNER at all times. CONTRACTOR shall supply, maintain, and remove any and all temporary materials, equipment, and labour as may be required to maintain full access and egress by OWNER.

D. The OWNER’s operation of the existing station system shall take precedence over all Construction Works.

E. Schedule and coordinate the Works to accommodate these requirements.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01050

PROJECT SURVEY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. Project survey.

C. Construction stake-out.

1.2 SURVEY REQUIREMENTS

A. CONTRACTOR shall follow Bruce Power survey requirements.

B. CONTRACTOR shall provide survey services to measure, establish construction control points, and stake out the Works.

C. CONTRACTOR shall establish a control benchmark based the NAD83 coordinate system.

D. CONTRACTOR shall complete the layout and stake-out work.

E. CONTRACTOR shall provide all other necessary survey required for the completion of the Works.

1.3 SURVEY REFERENCE POINTS AND MARKERS

A. CONTRACTOR shall locate, confirm, and protect all existing control points prior to starting any work on the Project.

B. CONTRACTOR shall locate and utilize existing benchmarks located on the Bruce Power LP property and transfer/tie-in those existing benchmarks to establish temporary control points at the construction site. Prior to the commencement of the Works, the CONTRACTOR shall verify the control elevations of its surveyor with the elevations noted in the Contract drawings and identify any discrepancies and provide resolution.

C. All points, structures, and markers shall be preserved and protected at all times during construction.

D. Changes, modifications, and/or removals of any points or markers will not be allowed without prior approval from ENGINEER. If ENGINEER authorizes such removals, the points shall be documented and tied-down by survey procedures to the satisfaction of ENGINEER prior to removal.

E. Report to ENGINEER when a reference point or legal survey marker is lost or destroyed, or requires relocation.

F. CONTRACTOR shall be responsible for replacement of control points in accordance with the original survey control.

G. CONTRACTOR shall be responsible for replacement of legal survey markers lost or destroyed as a result of construction operations.

1.4 RECORDS

A. CONTRACTOR shall maintain a complete, accurate log of control and survey work as it progresses.

B. CONTRACTOR shall submit an electronic copy of all survey files in AutoCAD and GIS map data as noted in part 1.6 of this section.

C. CONTRACTOR shall provide an accurate as-built survey complete with measurements for all components of the works above grade and below grade including but not limited to complete horizontal and vertical measurements of all buried infrastructure.

1.5 GIS DELIVERABLES

A. CONTRACTOR shall maintain a complete, accurate log of control and survey work as it progresses.

B. CONTRACTOR shall provide GIS map data for survey control points, buried piping and fittings, manholes, structures and all other features within the project scope.

C. CONTRACTOR shall adhere to the Geodatabase template for feature classes as provided by the GIS Department

D. CONTRACTOR shall adhere to the Bruce Power GIS data specifications as provided by the Bruce Power GIS department.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01090

ABBREVIATIONS AND DEFINITIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This is a standard abbreviations list therefore some abbreviations may appear on this list and not in the specifications.

B. Contact the OWNER/ENGINEER for abbreviations not listed

C. Abbreviations of Specifying Authorities:

AA	Aluminum Association (USA)
AAMA	American Architectural Manufacturers Association (USA)
AASHTO	American Association of State Highway and Transportation Officials
ABMA	American Boiler Manufacturers Association
ACI	American Concrete Institute
AHA	American Hardboard Association
AICS	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
AMCA	Air Movement and Control Association Inc.
ANSI	American National Standards Institute
API	American Petroleum Institute
ARI	Air Conditioning and Refrigeration Institute
ASHRAE	America Society of Heating, Refrigeration and Air Conditioning Engineers
ASA	Acoustical Society of Americal
ASME	American Society of Mechanical Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineering
ASTM	American Society for Testing & Materials
AWCI	Association of the Wall and Ceiling Industries
AWI	Architectural Woodwork Institute (USA)
AWMAC	Architectural Woodwork Manufacturer's Association of Canada
AWS	American Welding Society
AWWA	American Water Works Association
BCLMA	British Columbia Lumber Manufacturers' Association
CBM	Certified Ballast Manufacturer’s Association
CCA	Canadian Construction Association
CCDC	Canadian Construction Documents Committee
CEC	Canadian Electrical Code (published by CSA)
CFFM	Canadian Forces Fire Marshal
CFR	Code of Federal Regulations
CGA	Canadian Gas Association
CGL	Commercial General Liability
CGSB	Canadian General Standards Board
CISC	Canadian Institute of Steel Construction
CITC	Canadian Institute of Timber Construction
CLA	Canadian Lumbermen's Association

CMB	Construction Materials Board,
CMHC	Canadian Mortgage and Housing Corporation
COFI	Council of Forest Industries (British Columbia)
CPCI	Canadian Prestressed Concrete Institute
CPMA	Canadian Paint Manufacturers Association
CRCA	Canadian Roofing Contractors' Association
CS	Commercial Standard (USDC)
CSA	Canadian Standards Association
CSC	Construction Specifications Canada
CSDFMA	Canadian Steel Door and Frame Manufacturers' Association
CSI	Construction Specifications Institute (USA)
CSPI	Corrugated Steel Pipe Institute
CSSBI	Canadian Sheet Steel Building Institute
CWC	Canadian Wood Council
DIN	Deutsches Institut Für Normung
DFO	Department of Fisheries and Oceans
EEMAC	Electrical and Electronic Manufacturers' Association of Canada
EPA	Environmental Protection Act
ESA	Electrical Safety Authority
ETA	Electronics Technicians Association
FCC	Fire Commissioner of Canada
FDA	Food and Drug Administration (USA)
FM	Factory Mutual
FS	Federal Specifications and/or Federal Standards (USA)
ICEA	Insulated Cable Engineers Association
ICPI	Interlocking Concrete Pavement Institute
IEC	International Electrotechnical Comission
IEEE	Institute of Electrical and Electronics Engineers
ISA	Instrumentation, Systems and Automation Society
ISTA	International Safe Transit Association
LSRCA	Lake Simcoe and Region Conservation Authority
MIL	Military Specifications (Naval Publications and Forms Center) (USA)
MNR	Ministry of Natural Resources
MOECC	Ministry of the Environment and Climate Change Ontario
MTC	Ministry of Transportation and Communications (Ontario)
MTO	Ministry of Transportation Ontario.
MSS	Manufacturers Standardization Society of the Valve and Fittings Industry
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers International
NBC	National Building Code
NBFU	National Board of Fire Underwriters (USA)
NBS	National Bureau of Standards (USDC)
NFC	National Fire Code.
NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association (USA)
NFSA	National Fire Sprinkler Association
NHLA	National Hardwood Lumber Association (USA)
NLGA	National Lumber Grades Authority
NPS	National Pipe Straight Thread
NPSH	National Pipe Straight Hose Thread (Canadian fire hoses)
NPSM	National Pipe Straight Mechanical
NPT	National Pipe Tapered Thread
NST	National Standard Thread (US fire hoses)
NRC	National Research Council of Canada
NSC	National Standards of Canada

NSF	NSF International (formerly National Sanitation Foundation)
OBC	Ontario Building Code 'The Building Code', Ontario Regulation, including amendments thereto
ODVA	Open DeviceNet Vendors Association
OESC	Ontario Electrical Safety Code
OFC	Ontario Fire Code, 'The Fire Code', Ontario Regulation, including amendments thereto.
OFM	Ontario Fire Marshal
OIRCA	Ontario Industrial Roofing Contractors Association
OPCEA	Ontario Pollution Control Equipment Association
OPSD	Ontario Provincial Standard Drawing
OPSS	Ontario Provincial Standard Specification
OSHA	Occupational Safety and Health Administration (USA)
PDI	Plumbing and Drainage Institute
PEI	Porcelain Enamel Institute (USA)
PEO	Professional Engineers of Ontario
PCI	Prestressed Concrete Institute
QPL	Qualification Program List
SAE	Society of Automotive Engineers
SCC	Standards Council of Canada
SI	International System of Units
SJI	Steel Joist Institute
SMACNA	Sheet Metal and Air Conditioning Contractors' National Association,
SSPC	Society of Protective Coatings (formerly Structural Steel Painting Council)
TRCA	Toronto and Region Conservation Authority
TTMAC	Terrazzo, Tile and Marble Association of Canada
USDC	United States Department of Commence
UL	Underwriters' Laboratories (global)
ULC	Underwriters Laboratories of Canada
ULI	Underwriters Laboratories Inc. (USA)
USACE	United States Army Corps of Engineers
UNS	Unified Numbering System for Metals and Alloys (ASTM, SAE)
USDC	United States Department of Commerce
WEAO	Water Environment Federation of Ontario
WH	Warnock Hersey
WHSCC	Workplace Health, Safety and Compensation Commission (of Newfoundland and Labrador or New Brunswick)
WHMIS	Workplace Hazardous Materials Information System
WPCF	Water Pollution Control Federation
WSIB	Workplace Safety and Insurance Board

D. Technical Abbreviations

2PDT	Two Pole Double Throw
ABS	Acrylonitrile Butadiene Styrene
AC	Alternating Current
AI	Analog Input
ATS	Automatic Transfer Switch
AWG	American Wire Gauge
BIL	Basic Input Level
BTU	British Thermal Unit
c/c	Centre to Centre
CCO	Contract Change Order
CCS	Copper Clad Steel
CD	Compact Disk
CBR	California Bearing Ratio

CCTV	Closed Circuit Television
CFM	Cubic Feet per Minute
CMOS	Complementary Metal Oxide Semiconductor
CP	Control Panel
CPM	Critical Path Method
CPP	Concrete Pressure Pipe
CPT	Control Power Transformer
CS	Carbon Steel
CT	Current Transformer
c/w	Complete With
DC	Direct Current
DDC	Direct Digital Control
DFT	Dry Film Thickness
DI	Discrete Input
DIP	Dual In-line Package
DPDT	Double-Pole/Double-Throw
DR	Dimension Ratio
DVD	Digital Versatile Disk
EGS	Emergency Gas Scrubber
EMI	Electromagnetic Interference
EMT	Electric Metallic Tubing
EPDM	Ethylene Propylene Diene Monomer Rubber
ESC	Engine Start Contacts
ESR	Elevated Storage Reservoir
ET	Elevated Tank
Ex.	Explosion Proof / ATEX Explosion Protection Marking
FAT	Factory Acceptance Test
FD	Floor Drain
FE	Flow Element
FEC	Front End Communication Controller
FEP	Fluorinated Ethylene Propylene
FFF	Front Finished Floor, Finished First Floor
FIT	Flow Indicating Transmitter
FRP	Fibre Reinforced Plastic
FS	F-Series
GFI	Ground Fault Interrupter
GPM	Gallons per Minute
GPS	Global Positioning System
GS	Galvanized Steel
GWMP	Ground Water Management Plan
HART	Highway Addressable Remote Transducer
HEPA	High-Efficiency Particulate Air
HDPE	High Density Polyethylene
HHPP	Hex Head Pipe Plug
HMI	Human Machine Interface
HP, h.p.	Horsepower
HV	High Voltage
HVAC	Heating, Ventilation and Air Conditioning
I/O	Input/Output point(s)
i.d.	Inside Diameter
ID	Identification
IGBT	Insulated Gate Bipolar Transistor
IPS	Iron Pipe Size
IPT	Iron Pipe Thread
IR	Voltage (refers to current x resistance)

JB	Junction Box
JC	Junction Cabinets
L	Litre
LCD	Liquid Crystal Display
LED	Light Emitting Diode
LEL	Lower Explosive Limit
LV	Low Voltage
MCC	Motor Control Centre
MCL	Maximum Contaminant Level
MGS	Magnetic Guidance System
MIG	Million Imperial Gallons
MIGD	Million Imperial Gallons per Day
MISA	Municipal/Industrial Strategy for Abatement
MPDD	Modified Proctor Dry Density
MSDS	Materials Safety Data Sheets
MUTCD	Manual of Uniform Traffic Control Devices
MV	Medium Voltage
NPS	Nominal Pipe Size
NPT	National Pipe Thread
o.c.	On Centre
OCIP	Owner Controlled Insurance Program
OD, o.d.	Outside Diameter
O&M	Operations and Maintenance
OIT	Operator Interface Terminal
ONAN	Oil Natural Air Natural
OTM	Ontario Traffic Manual
PAC	Programmable Automation Controller
PCS	Process Control System
PE	Plant Exerciser
perm	measure of permeance
PF	Power Factor
PH or ph	Number of phases of AC
P&ID	Process and Instrumentation Diagram
PID	Process Identifier
PLC	Programmable Logic Controller
ppm	Parts per million
PT	Potential Transformer
PTFE	Polytetra fluoro-ethylene
PTTW	Permit to take water
PV	Process Variable
PVC	Polyvinyl Chloride
PVDF	Polyvinylidene Fluoride
PVMS	Portable Variable Message Signs
QPL	Qualification Program List
RC	Reverse Circulation
RCPP	Reinforced Concrete Pressure Pipe
RF	Radio Frequency
RFI	Request For Information
RFQ	Request For Quotation
RLC	Resistor/Inductance/Capacitor (filter)
RMS	Root Mean Square
RPU	Remote Processing Unit
RTD	Resistance Temperature Detector
RTU	Remote Terminal Unit
SAT	Site Acceptance Test

SCADA	Supervisory Control and Data Acquisition
SCR	Silicon Controlled Rectifier
SPDT	Single-Pole Double-Throw
SPMDD	Standard Proctor Maximum Dry Density
SPP	Sewage Process Plant
SS/SST	Stainless Steel
SWP	Steam Working Pressure
T/C	Thermocouple
TDDT	Time Delay During Transfer
TDEC	Time Delay Engine Cool-off
TDEN	Time Delay Emergency to Normal
TDES	Time Delay Engine Start
TDOE	Time Delay On Energizing
TDOD	Time Delay On De-energizing
TDH	Total Dynamic Head
TDNE	Time Delay Normal to Emergency
TEW	Thermoplastic Equipment Wire
TEFC	Totally Enclosed Fan Cooled (motor)
THD	Total Harmonic Distortion
THWN	Thermoplastic Heat and Water Resistant Nylon Coated
UPS	Uninterruptible Power Supply
UV	Ultraviolet
VCP	Visual Comfort Probability
VFD	Variable Frequency Drive
VOC	Volatile Organic Compounds
WAN	Wide Area Network
W/C	Water to Cement
WG	Water Gauge (pressure)
WOG	Water-Oil-Gas (valves, pressure)

E. Definitions

OWNER	Bruce Power L.P.
ENGINEER	Person or entity engaged by the OWNER to act as their representative

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01300

ADMINISTRATIVE REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. Specification language.

C. Mobilization and startup.

D. Coordination.

E. Pre-construction meeting.

F. Progress meetings.

G. Pre-installation meetings.

1.2 SPECIFICATION LANGUAGE

A. These Project Specifications are written in imperative mood and are in abbreviated or streamlined form and include incomplete sentences. This imperative language is directed to CONTRACTOR, unless specifically noted otherwise. Omission of words or phrases such as "CONTRACTOR shall", "shall be", "a", "the", and "all" are intentional. Omitted words or phrases shall be supplied by inference in the same manner as they are when a "note" occurs on the Drawings.

1.3 MOBILIZATION AND STARTUP

A. Do not mobilize to the Site without OWNER's prior written authorization.

B. Perform planning and scheduling activities as necessary for the performance of the Works.

C. Purchase materials and mobilize equipment, supplies, and incidentals to the Site.

D. Use the existing Site access roads to the designated work areas during mobilization. Complete improvements to roads as necessary for the performance of the Works.

E. Site temporary utilities and facilities in areas designated by OWNER. Obtain OWNER's approval prior to changing locations of temporary construction facilities. Do not use other areas without OWNER's prior approval. Relocate construction equipment or other materials or equipment as required for the performance of the Works.

F. Do not commence work involving contact with potentially contaminated materials until decontamination facilities are operational and approved by OWNER/ENGINEER.

G. Do not commence work until all required temporary facilities and site controls are in place.

1.4 COORDINATION

A. Coordinate scheduling, submittals, and work of all Sections of the Contract Specifications and other requirements of the Contract Documents to assure efficient and orderly sequence of the Works.

B. Coordinate work of any and all Sections having interdependent responsibilities for installing, connecting to, and placing in service such elements.

C. The Contract contains interdependent technical requirements between the various Contract documents. CONTRACTOR shall be responsible for all requirements of the Contract as a whole. Any and all costs related to not sufficiently reviewing and understanding the Contract documents shall be borne solely by CONTRACTOR.

D. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.

E. Coordinate completion and cleanup of work of separate Sections in preparation for Substantial Performance and for portions of the Works designated for OWNER's utilization.

F. Coordinate access to the Site for correction of defective Works and Works not according to the Contract Documents, to minimize disruption of OWNER's activities.

G. Continuous operation of OWNER's facilities is of critical importance to OWNER. CONTRACTOR shall schedule and conduct its activities in order to enable OWNER's existing facilities to operate continuously, unless specified otherwise in the Contract Documents. In the event of any conflict between construction activities and facility operations, the facility operations shall have priority unless specified otherwise in the Contract Documents.

H. CONTRACTOR shall perform the Works continuously during critical connections and changeovers, and as required in order to prevent interruption of OWNER's operations.

I. When necessary, CONTRACTOR shall plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, ventilation, access, and similar items in order to maintain the continuous operations of OWNER's facility.

J. CONTRACTOR shall not close any lines, open or close any valves, or proceed with any work or other action that would affect the operation of existing systems, except as specifically required by the Contract Documents, and only with the prior written authorization of OWNER and OWNER/ENGINEER. Such authorization will be considered within 3 weeks after receipt of CONTRACTOR's written request.

K. For construction constraints and the suggested sequence of construction, refer to Section 01000 - Summary of Work.

L. CONTRACTOR shall not proceed with any work affecting a facility's operation without obtaining OWNER's and OWNER/ENGINEER's advance written approval of the need for, and duration of, such work.

M. CONTRACTOR shall submit to OWNER for approval a written request for a shutdown of the existing systems and equipment a minimum of 2 weeks prior to the date of the requested shutdown.

N. Where shutdowns are required, the work shall be performed in an expedient manner which minimizes downtime of the services and utilizes time periods where the services are less active (i.e., late in the evening).

O. The Contract Documents shall be interpreted as one Contract and CONTRACTOR shall be wholly responsible for the coordination of construction to complete the Works.

P. CONTRACTOR shall examine the work of all Subcontractors to ensure that the condition of the Subcontractor's work is satisfactory for the completion of any subsequent Contract work.

Q. CONTRACTOR shall notify OWNER/ENGINEER or OWNER immediately of any adverse conditions which may affect subsequent work and shall not proceed with any subsequent work until such conditions are rectified.

R. CONTRACTOR shall coordinate the Works to allow for work to be completed by Other Contractors employed by OWNER. CONTRACTOR shall coordinate and schedule timing of the Works and shall supply, maintain, and remove any and all required materials and labour required to allow the work of Other Contractors employed by OWNER to be completed while maintaining a clear physical separation. At no time shall CONTRACTOR allow conditions to existing on Site that would make OWNER the Constructor.

1.5 PRE-CONSTRUCTION MEETING

A. OWNER/ENGINEER will schedule and administer a pre-construction meeting at the Site after the date of the effective date of the Term of the Contract and prior to start of construction at the Site.

B. OWNER/ENGINEER will make arrangements for meeting, prepare agenda with copies for participants, and preside at meeting. Provide data required to OWNER/ENGINEER and be prepared to discuss all items on the agenda.

C. Minimum Attendance Required of CONTRACTOR:
   1. CONTRACTOR's Project Manager.
   2. CONTRACTOR's Site Supervisor.
   3. CONTRACTOR's Health and Safety Officer.
   4. CONTRACTOR's major Subcontractors.

D. Agenda will include, but not necessarily be limited to, the following:
   1. Designation of responsible personnel.
   2. Lines of authority and communication.
   3. Health and safety.
   4. Construction Island requirements
   5. Use of the Site for storage, vehicle parking, access routes, and other Site requirements.
   6. OWNER's requirements and occupancy.
   7. Coordination with Other Contractors and OWNER.
   8. Temporary facilities and controls provided by CONTRACTOR.
   9. Temporary utilities and services provided by OWNER.
   10. Field offices.

11. Survey layout.
12. Security and housekeeping procedures.
13. Procedures for processing field decisions, submittals, substitutions, Applications for Payment, proposal requests, Field Orders, Work Change Directives, Change Orders, and closeout procedures.
14. Progress schedules.
15. Procedures for testing and inspection.
16. Procedures for maintaining Project record documents.
17. Requirements for startup, SAT, and commissioning of equipment.
18. Inspection and acceptance of equipment put into service during construction period.

E. OWNER/ENGINEER will record minutes and distribute copies to participants and those affected by decisions made. Identify errors in the minutes, if any, to OWNER/ENGINEER in writing within 3 days of receipt.

1.6 PROGRESS MEETINGS

A. OWNER/ENGINEER will schedule and administer progress meetings at the Site throughout the progress of the Works at minimum on weekly intervals or more frequently as required.

B. OWNER/ENGINEER will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings. Provide data required to OWNER/ENGINEER and be prepared to discuss all items on the agenda.

C. Attendance Required: CONTRACTOR's Health and Safety Officer, CONTRACTOR's superintendent, major Subcontractors and Suppliers, as appropriate to agenda topics for each meeting.

D. Agenda will include, but not necessarily be limited to, the following:
1. Review of minutes of previous meetings.
2. Review of work progress since last meeting.
3. Field observations, problems, and decisions.
4. Identification of problems which impede planned progress.
5. Review of submittals schedule and status of submittals.
6. Review of off-Site material fabrication/processing and delivery schedules.
7. Review of health and safety concerns and issues including air monitoring results.
8. Maintenance of progress schedule.
9. Corrective measures to regain projected schedules.
10. Planned progress during succeeding work period.
11. Coordination of projected progress.
12. Maintenance of quality and work standards.
13. Effect of proposed changes on progress schedule and coordination.
14. Change Orders.
15. Applications for Payment.
16. Other business relating to the Works.

E. CONTRACTOR to chair bi-weekly progress meetings. OWNER/ENGINEER will record minutes and distribute copies to participants and those affected by decisions made. All communication to Subcontractors, Suppliers, or others that CONTRACTOR is responsible for will be made through CONTRACTOR. Identify errors in the minutes, if any, to OWNER/ENGINEER in writing within 3 days of receipt.

1.7 PRE-INSTALLATION MEETINGS

A. When required in individual Sections, convene a pre-installation meeting at the Site prior to commencing work of the Section.

B. Require attendance of parties directly affecting, or affected by, work of the specific Section.

C. Notify OWNER/ENGINEER, in writing, a minimum of 2 weeks in advance of meeting date.

D. Prepare agenda and preside at meeting:
   1. Review conditions of installation, preparation, and installation procedures.
   2. Review coordination with related work.

E. OWNER/ENGINEER will record minutes and distribute copies to participants and those affected by decisions made.

F. Identify errors in the minutes, if any, to OWNER/ENGINEER in writing within 3 days of receipt.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01310

CONSTRUCTION PROGRESS SCHEDULE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. References.

C. Quality assurance.

D. Format.

E. Schedules.

F. Submittals.

G. Review and evaluation.

H. Updating schedules.

I. Distribution.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

1.3 QUALITY ASSURANCE

A. Scheduler: CONTRACTOR's personnel specializing in CPM scheduling with 5 years minimum experience in scheduling construction work of complexity comparable to this Project, and having use of computer facilities capable of delivering detailed graphic printout within 24 hours of request.

1.4 SCHEDULES

A. Illustrate order and interdependence of activities and sequence of work; how start of given activity depends on completion of preceding activities, and how completion of activity may restrain start of subsequent activities.

B. Illustrate complete sequence of construction by activity, identifying work of separate stages. Indicate dates for submittals and return of submittals; dates for procurement and delivery of critical products; and dates for installation and provision for testing. Include legend for symbols and abbreviations used.

C. Tabulate each activity using calendar dates, and identify for each activity:
   1. Preceding and following event numbers.
   2. Activity description.
   3. Estimated duration of activity.
   4. Earliest start date.
   5. Earliest finish date.
   6. Actual start date.
   7. Actual finish date.
   8. Total and free float; accrue float time to OWNER and to OWNER's benefit.
   9. Percentage of activity completed.
   10. Responsibility.
   11. List Critical Path.

D. Prepare sub-schedules for each stage of the Works.

E. Coordinate contents with monthly progress reports in Section 01330.

1.5 SUBMITTALS

A. Once the schedule has been accepted by OWNER the accepted schedule will be considered the project baseline schedule. All future updates shall be compared to the original accepted established baseline schedule.

B. Submit updated project schedules monthly and with each Application for Payment.

C. Submit updated project schedule for each bi-weekly construction progress meeting.

D. CONTRACTOR shall keep one copy of all submittals at the site in good order and available to OWNER and ENGINEER.

E. Submit with letter transmittal form as specified in Section 01 33 0.

1.6 REVIEW AND EVALUATION

A. Participate in joint review and evaluation of project schedule and analysis with ENGINEER at each submittal.

B. Evaluate Project status to determine work behind schedule and work ahead of schedule.

1.7 UPDATING SCHEDULES

A. Maintain schedules to record actual start and finish dates of completed activities.

B. Indicate progress of each activity to date of revision, with projected completion date of each activity.

C. Identify activities modified since previous submittal, major changes in the Works, and other identifiable changes.

D. Indicate changes required to maintain the date of Substantial Performance.

1.8 LOOKAHEAD SCHEDULES

A. In addition to the main project schedule submit rolling 3-week look ahead schedules that shall be updated and submitted weekly.

1.9 DISTRIBUTION

A. Following joint review, distribute copies of updated schedules to CONTRACTOR's Project file, to Subcontractors, Suppliers, ENGINEER, and OWNER.

B. Instruct recipients to promptly report, in writing, problems anticipated by projections shown in schedules.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01330

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. References.

B. Submittal procedures.

C. Progress schedules.

D. Monthly progress reports.

E. Construction quality control reports.

F. Shop Drawings.

G. Product data.

H. Samples.

I. Manufacturer installation instructions.

J. Manufacturer certificates.

K. Construction photographs.

L. Project organization.

M. Submittals for progress meetings.

N. Site layout.

O. Asbestos work plan.

P. Submittals schedule.

1.2 SUBMITTAL PROCEDURES

A. The CONTRACTOR shall provide submittals for review in an orderly sequence and sufficiently in advance so as to cause no delay in the Work. Any delays and/or additional costs resulting in the CONTRACTORS' failure to provide submittals for review sufficiently in advance shall be the sole responsibility of the Contractor.

B. Unless directed otherwise, transmit submittals electronically to the address provided by the OWNER.

C. Transmit each submittal using the transmittal form template provided to CONTRACTOR by the ENINGEER at the Pre-construction meeting. The CONTRACTORS' own transmittal form

shall not be allowed as a substitute for the aforementioned form to be provided to the CONTRACTOR.

D. Sequentially number the transmittal form. Revise submittals with original number and a sequential alphabetic suffix.

E. Identify the Project, CONTRACTOR, Subcontractor, or Supplier; pertinent Drawing and detail number and Specification number, as appropriate. Transmittals that do not contain Contract references will be returned as 'revise and resubmit' without review.

F. Apply CONTRACTOR's approval stamp prior to initial submission to OWNER/ENGINEER, signed and dated, certifying that CONTRACTOR has satisfied CONTRACTOR's obligations under the Contract Documents including but not limited to review and approval, verification of products required, field dimensions, adjacent construction work, and coordination of information with respect to CONTRACTOR's review and approval of that submittal. Unstamped or unsigned submittals will be returned by OWNER/ENGINEER without action.

G. Except as specified otherwise, for each submittal for review by OWNER/ENGINEER, OWNER/ENGINEER shall have 20 working days excluding delivery time to and from CONTRACTOR to process, review, and return the submittal. Schedule submittals to expedite the Contract and according to specified scheduling. Coordinate submission of related items.

H. Identify product or system limitations which may be detrimental to successful performance of the completed Works. Related work shall not proceed until a new product or system is proposed in the form of a submittal and approved by OWNER/ENGINEER and OWNER.

I. Provide space for OWNER/ENGINEER review stamp and comments on submittals.

J. Make corrections to each submittal required by OWNER/ENGINEER. Promptly revise and resubmit the required number of corrected copies of each submittal and submit new submittals required by such correction; identify changes made since previous submission and changes other than those requested by OWNER/ENGINEER. For each and every resubmitted submittal for review by OWNER/ENGINEER, OWNER/ENGINEER shall have 20 working days excluding delivery time to and from CONTRACTOR to process, review, and return the submittal.

K. CONTRACTOR shall confirm all field measurements depicted in submittals and ensure that all work adjacent to the work related to that submittal has been coordinated with the work of the submittal, as required.

L. Promptly distribute copies of reviewed submittals to Subcontractors, Suppliers, and other concerned parties as appropriate. Instruct parties to promptly report any inability to comply with provisions.

M. Submittals not requested will not be recognized or processed. Submittals received directly from Subcontractors, Suppliers, vendors, or other Representatives or without CONTRACTOR stamp will be returned by OWNER/ENGINEER without action.

N. Adjustments made on CONTRACTOR's drawings by OWNER/ENGINEER are not intended to change the Contract Price. If adjustments affect the Contract Price, state such in writing, as specified elsewhere in the Contract, to OWNER/ENGINEER for approval prior to proceeding with the Works.

O. It is the responsibility of CONTRACTOR to review submittals made by Suppliers and Subcontractors before transmitting them to OWNER/ENGINEER to assure proper coordination of the Works and to determine that each submittal is according to CONTRACTOR's desires and that there is sufficient information about materials and equipment for OWNER/ENGINEER to determine compliance with the Drawings and Specifications. Incomplete or inadequate submittals will be returned for revision without review.

P. The review and approval of submittals shall not relieve the CONTRACTOR of responsibility for errors and/or omissions in the submittals or for meeting all requirements of the Contract Documents. The CONTRACTOR shall not be intitled to any compensation for additional costs resulting from errors and/or omissions included in submittals despite having been reviewed by the ENINGEER.

Q. Unless specified otherwise submit digital, PDF copies of all submittals.

R. Requirements of this PART 1, SUBMITTALS PROCEDURES shall apply to all required submittals.

1.3 PROGRESS SCHEDULES

A. Section 01310 – Construction Progress Schedules.

B. Submit initial detailed progress schedule in duplicate within 10 days after the effective date of the Term of the Contract and prior to commencing work at the Site. Submit updated progress schedules monthly and with each Application for Payment, identifying changes since previous version and estimated percentage of completion for each item of the Works. If a schedule remains unchanged from one period to the next, submit a written notice to that effect.

C. Show complete sequence of construction by activity, identifying work of separate stages and other logically grouped activities, and include the Contract Times identified in Section 01000. Show coordination of interrelated work activities and items. Indicate the early and late start, early and late finish, float dates, and duration.

D. Provide sub-schedules to define critical activities which dictate the rate of progress.

E. Show accumulated percentage of completion of each item, and total percentage of the Works completed, as of the first day of each month.

F. If during performance of the Works CONTRACTOR believes it necessary or advantageous to change sequence of activities shown on CONTRACTOR's progress schedule, submit proposed revisions to OWNER/ENGINEER for approval prior to changing the sequence of work. No change shall be made in the order in which work activities are being performed until OWNER/ENGINEER's written approval for the revised schedule has been obtained. The schedule will be acceptable to OWNER/ENGINEER as providing an orderly progression of the Works to completion within any specified dates identified in Section 01000, but such acceptance will neither impose on OWNER/ENGINEER responsibility for the sequencing, scheduling, or progress of the Works nor interfere with or relieve CONTRACTOR from CONTRACTOR's full responsibility thereof.

G. Identify activities modified since previous submittal, major changes in scope, and other identifiable changes. Provide narrative report to define problem areas causing delay, anticipated delays and length, and impact on schedule. Report corrective action taken, or proposed, and its effect.

H. Distribute copies of reviewed schedules to Subcontractors, Suppliers, and other concerned parties. Instruct recipients to promptly report, in writing, problems anticipated by projections indicated in schedules.

1.4 MONTHLY PROGRESS REPORTS

A. Submit monthly progress report in a form acceptable to OWNER/ENGINEER indicating work accomplished, problems encountered, problems resolved, and work scheduled for the next month.

B. The key supplier deliverables shall be as follows;
   1. Construction management plans (as per the Construction Island Checklist):
   2. Bi-weekly project schedule updates
   3. Monthly construction progress reports
   4. Monthly financial spent / forecast reporting

C. The following documentation shall be part of the monthly progress report:
   1. Tabulated budget status listing the Contract tasks identified in the progress schedule, and consisting of the following column headings:
      a. Original Budget: Original estimated cost, including direct proportional amount of CONTRACTOR's overhead and profit, to accomplish the tasks. Total cost to complete the tasks shall equal the Contract Price.
      b. Approved Changes: Changes approved by Change Order to the original budget.
      c. Current Budget: Sum of original budget and approved changes.
      d. Percent Complete: Estimated fraction of the work that has been completed.
      e. Achieved Value: Dollar value of the work that has been completed, i.e., current budget multiplied by percent complete.
      f. Amount Spent: Dollar amount that has been spent on the task.
      g. Achieved/Spent Ratio: Comparison of achieved value to amount spent.
   2. Schedule in the form of a Gantt chart with highlighted critical path tasks. The schedule shall show the original schedule and the actual schedule.
   3. CONTRACTOR'S daily reports including daily work progress, conditions on site, and any problems encountered at the site.

1.5 CONSTRUCTION QUALITY CONTROL REPORTS

A. Record daily Construction Quality Control activities in CONTRACTOR's Site log book.

1.6 SUBMITTALS AND SHOP DRAWINGS

A. When specified in individual Sections, prepare detailed drawings of material and structures to be supplied by CONTRACTOR from typical details shown on "Approved for Construction" Drawings and/or from specified requirements.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

C. Indicate materials, methods of construction, attachment or anchorage, erection diagrams, connections, explanatory notes, and other information necessary for completion of the Works.

D. Where articles or equipment attach or connect to other articles or equipment, indicate that such work has been coordinated, regardless of the Section under which the adjacent items will be supplied and installed.

E. Confirm dimensions shown on CONTRACTOR's drawings with actual measurements of existing and/or completed associated structures and affected adjacent work at the Site.

F. Submit digital copy of CONTRACTOR's record drawings on USB memory stick or electronic file transfer compatible for use with Windows 7 and AutoCad 2010 or later edition.

G. After OWNER/ENGINEER completes its review, Shop Drawings will be stamped with one of the following notations:
   1. Reviewed.
   2. Reviewed as Noted.
   3. Revise and Resubmit.
   4. Not Subject to Review.
   5. Other Action.

H. If a Shop Drawing is acceptable, it will be marked "Reviewed" or "Reviewed as Noted". An electronic copy of the Shop Drawing will be returned to CONTRACTOR.

I. Upon return of a Shop Drawing marked "Reviewed" or "Reviewed as Noted", CONTRACTOR may order, ship, or fabricate the materials included on the Shop Drawing, provided it is in accordance with the corrections indicated. Upon receipt of Shop Drawings stamped "Reviewed" or "Reviewed as Noted", produce copies and distribute in accordance with PART 1, SUBMITTAL PROCEDURES and for Project record document purposes as described in Section 01700.

J. If a Shop Drawing marked "Reviewed as Noted" has extensive corrections or corrections affecting other drawings or Works, OWNER/ENGINEER may require that CONTRACTOR make the corrections indicated thereon and resubmit the Shop Drawings for Project record document purposes.

K. Shop Drawings that are for information only will be marked "Not Subject to Review" and one copy will be returned to CONTRACTOR.

L. If a Shop Drawing is unacceptable, an electronic copy will be returned to CONTRACTOR marked "Revise and Resubmit".

M. Upon return of a Shop Drawing marked "Revise and Resubmit", CONTRACTOR shall make the corrections indicated and repeat the initial approval procedure.

N. Shop Drawings lacking adequate details or information to allow OWNER/ENGINEER to determine whether or not the Shop Drawing meets the requirements of the Contract Documents will also be marked "Revise and Resubmit" and returned without further comment.

O. Shop Drawings not bearing OWNER/ENGINEER's "Reviewed" or "Reviewed as Noted" notation shall not be issued to Subcontractors nor utilized for construction purposes. No work requiring submission and approval of Shop Drawings shall be performed or equipment requiring submission and approval of Shop Drawings installed without Shop Drawings bearing one of these notations.

P. Submit Shop Drawings well in advance of the need for the material or equipment for construction and with ample allowance for time required to make delivery of material or equipment after data covering such is approved. CONTRACTOR shall assume the risk for all materials or equipment which are fabricated or delivered prior to the approval of Shop Drawings. No materials or equipment shall be incorporated into the Works nor included in progress payments until approval thereof has been obtained in the specified manner.

Q. Approval of Shop Drawings shall not relieve CONTRACTOR from the responsibility of furnishing materials and equipment of proper dimension, size, quality, quantity, and all performance characteristics to efficiently perform the requirements and intent of the Contract Documents. Approval shall not relieve CONTRACTOR from responsibility for errors of any sort on Shop Drawings. Approval is intended only to assure conformance with the design concept of the Project and compliance with the information given in the Contract Documents. CONTRACTOR is responsible for information that pertains solely to the fabrication processes, to the technique of construction, and for the coordination of the work of all trades.

R. CONTRACTOR shall not be relieved of any part of its responsibilities for correctness of its drawings or adequacy of its design bearing OWNER/ENGINEER's "Reviewed" or "Reviewed as Noted" notation. OWNER/ENGINEER's approval is for the sole purpose of ascertaining conformance with general design concepts, and in no way constitutes approval of the detail design inherent in CONTRACTOR's drawings, responsibility for which remains solely with CONTRACTOR. Drawings prepared by CONTRACTOR's representatives including Subcontractors, Suppliers, vendors, or other Representatives shall be considered CONTRACTOR's drawings.

1.7 PRODUCT DATA

A. Submit the number of copies which CONTRACTOR requires, plus two copies which will be retained by OWNER/ENGINEER.

B. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information unique to the Project.

C. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

D. After review, distribute according to PART 1, SUBMITTAL PROCEDURES and provide copies for Project record documents as described in Section 01700.

1.8 SAMPLES

A. The submittal of Samples shall conform to the requirements of the General Conditions and to procedures described in this article.

B. When specified in individual Sections, submit Samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate Sample submittals for interfacing work.

C. Samples and Shop Drawings which are related to the same unit of Works or specification Section shall be submitted at the same time. If related Shop Drawings and Samples are submitted at different times, they cannot be reviewed until both are furnished to OWNER/ENGINEER.

D. CONTRACTOR shall review, approve, and submit all Samples promptly. Samples shall be identified with correct reference to individual Section, page, article, and paragraph number, and Drawing number when applicable.

E. CONTRACTOR shall submit at least two Samples of each item required for OWNER/ENGINEER's approval. Submission of Samples shall conform to all applicable provisions under PART 1, SUBMITTAL PROCEDURES. One of the Samples shall be delivered to OWNER/ENGINEER's office identified in PART 1, SUBMITTAL PROCEDURES

unless otherwise authorized by OWNER/ENGINEER. One Sample shall be delivered to OWNER/ENGINEER's field office.

F. CONTRACTOR shall make all corrections required and shall resubmit the required number of new Samples until approved.

G. OWNER/ENGINEER's approval of Samples shall not relieve CONTRACTOR of responsibility for any deviation from the requirements of the Contract Documents. OWNER/ENGINEER's approval shall not relieve CONTRACTOR from responsibility for errors or omissions in the Samples.

H. No portion of the Works requiring a Sample submission shall be commenced until the submission has been approved by OWNER/ENGINEER. All such portions of the Works shall be according to approved Samples.

I. Submit Samples of finishes from the full range of manufacturers' standard colours for OWNER/ENGINEER's selection.

J. Reviewed Samples which may be used in the Works are indicated in individual Sections.

1.9 MANUFACTURER INSTALLATION INSTRUCTIONS

A. When specified in individual Sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, to OWNER/ENGINEER.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

C. Whenever the Specifications refer to manufacturer's instructions, such reference shall mean written instructions of the manufacturer.

1.10 MANUFACTURER CERTIFICATES

A. When specified in individual Sections, or when required by reference standards, submit certification and/or test results by manufacturer.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications, as appropriate.

C. Certificates may be recent or previous test results on material or product, but must be acceptable to OWNER/ENGINEER.

D.

1.11 SUBMITTALS FOR PROGRESS MEETINGS

A. At least 24 hours prior to scheduled progress meetings submit the following:
   1. Updated progress schedule detailing all activities. Include review of progress with respect to previously established dates for starting and stopping the various stages of the Works, major problems and action taken, injury reports, equipment breakdown, and material removal.
   2. Updated lookahead schedules
   3. Any other information required by OWNER/ENGINEER or relevant to the agenda for the upcoming progress meeting.

1.12 SITE LAYOUT

A. Within 10 days after the date of the effective date of the Term of the Contract and prior to mobilization to the Site, submit Site layout drawings showing existing conditions, facilities, proposed construction facilities, and temporary controls to be provided by CONTRACTOR including, but not limited to, the following:
   1. Existing property lines, structures, roads, utilities, and other existing Site feature or facility.
   2. Temporary facilities including portable washrooms to be placed or constructed.
   3. Field offices and sheds.
   4. The means of ingress and egress.
   5. Proposed location of Site access.
   6. Equipment and material staging areas.
   7. Stockpile areas.
   8. Temporary fencing
   9. Any other data deemed pertinent by CONTRACTOR or required by OWNER/ENGINEER.

1.13 LEAD PAINT MANAGEMENT PLAN

A. Within 10 days after the date of the effective date of the Term of the Contract and prior to commencing the Works at the Site, submit a detailed plan of work procedures as per the appropriate classification of lead-containing construction operations for this work as outlined in Ministry of Labour Guideline: Lead on Construction Projects.

B. The lead paint management plan shall be in accordance with the requirements provided in Section 02831, Lead Based Pain Abatement, included in the Contract Documents**.**

1.14 SUBMITTALS SCHEDULE

A. Submit a submittals schedule within 10 days after the effective date of the Term of the Contract.

B. The submittals schedule shall be in tabular form listing all submittals required by the Contract Documents and the date on which CONTRACTOR will make each submittal. As a minimum, the submittals schedule shall consist of the following columns:
   1. Submittal Number: Number consecutively.
   2. Section Number: Section number or description of location in the Contract Documents where submittal is requested.
   3. Item: Description of item or items to which submittals pertain.
   4. Scheduled submission date

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01400

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. Quality Control.

C. Tolerances.

D. Requirements for References.

E. Inspection and Testing Services.

F. Manufacturers Field Services and Reports.

1.2 QUALITY CONTROL

A. CONTRACTOR is solely responsible for establishing and implementing a quality control program to ensure that the Works is in accordance with the Contract Documents.

B. Monitor quality control over Suppliers, products, services, Site conditions, and workmanship, to produce Works of specified quality.

C. Comply with manufacturers' instructions, including each step in sequence.

D. Should manufacturers' instructions conflict with the Contract Documents the more stringent requirement shall govern and the CONTRACTOR shall not be entitled for any compensation for additional costs as a result. Request clarification from ENGINEER before proceeding.

E. Comply with specified standards as minimum quality for the Works except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

F. Perform work by persons qualified to produce workmanship of specified quality. Use persons licensed to perform the Works where required by these Specifications or Laws and Regulations.

G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

H. Materials furnished and finished or intermediate stages of the Works shall be sampled, tested, and inspected as specified in individual Sections and as required by reference standards.

1.3 TOLERANCES

A. Monitor tolerance control of installed products to produce acceptable Works. Do not permit tolerances to accumulate.

B. Comply with manufacturers' tolerances. Should manufacturers' tolerances conflict with the Contract Documents the more stringent requirement shall govern and the CONTRACTOR shall not be entitled for any compensation for additional costs as a result. Request clarification from ENGINEER before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.4 REQUIREMENTS FOR REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified or are required by applicable Laws and Regulations.

B. Conform to reference standard by date of issue current as of bid closing date, except where a specific date is established by Laws or Regulations or by an individual Section.

C. Specific provisions of Laws or Regulations may be referenced in the Project Specifications to assist CONTRACTOR and identify options selected by ENGINEER. Such references do not relieve CONTRACTOR from compliance with other applicable provisions of Laws or Regulations not specifically referenced.

D. No inference or provision of any reference document including, but not limited to any standard specification, manual, or code shall be effective to change the relationships, duties, and responsibilities of OWNER, CONTRACTOR, or ENGINEER from those set forth in the Contract Documents, nor shall it be effective to assign to OWNER or ENGINEER any duty or authority to supervise or direct the furnishing or performance of the Works or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract.

E. Reference standards referred to in these Specifications form part of the Specifications to the extent specified in individual Sections.

F. In case of conflict or discrepancy between a reference standard and the Project Specifications or with another reference standard, the more stringent requirements shall apply.

G. Should specified reference standards conflict with the Contract Documents, request clarification from ENGINEER before proceeding.

1.5 INSPECTION AND TESTING SERVICES

A. CONTRACTOR shall employ and pay for services of an independent testing firm to conduct field testing sampling, and laboratory analysis as specified in individual Sections and the following.
   1. Material sampling and analysis, proctor testing of imported aggregates, asphalt, engineered fill, native subbase, and all other materials requiring compaction. A min of three (3) samples per material will be taken and tested.
   2. Provide a min of 12 site visits to complete compaction testing of backfill materials.
   3. Provide a min of 4 site visits to complete compaction testing of asphalt materials.

4. Provide a min of 30 concrete cylinder compressive strength tests.

B. CONTRACTOR Coordination Responsibilities:
   1. Cooperate with personnel of independent testing laboratory, and provide safe access to the Works and to manufacturer's operations.
   2. Provide incidental labor and facilities:
      a. To provide access to the Works to be tested.
      b. To obtain and handle samples at the Site or at source of products to be tested.
      c. To facilitate tests and inspections.
   3. Retesting required because of CONTRACTOR negligence or non-conformance to specified requirements shall be performed by the same testing laboratory on instructions by ENGINEER at CONTRACTOR's expense and at no additional cost to OWNER.
   4. If defects or deficiencies are revealed during testing or inspecting, correct such defects and deficiencies and retest affected portions of the Works.

1.6 MANUFACTURER’S FIELD SERVICES AND REPORTS

A. When specified in individual Sections, require Suppliers to provide qualified personnel to observe Site conditions, conditions of surfaces and installation, quality of workmanship, startup of equipment, testing, adjusting, and balancing of equipment as applicable, and to initiate instructions when necessary.

B. Report observations and Site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.

C. Submit report within 14 days of observation to ENGINEER for information.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. UV Disinfection Bypass Operations and Switchovers.
   1. Temporary long duration UV bypass system.
   2. Dewatering in excess of 50,000 L/day.

C. Temporary Utilities:
   1. Electricity.
   2. Water service.
   3. Telephone service.
   4. Facsimile service.
   5. Portable radios.
   6. Construction lighting.
   7. Heat.
   8. Temporary ventilation.
   9. Fire protection.

D. Construction Facilities:
   1. CONTRACTOR's field office and sheds.
   2. Sanitary facilities.
   3. Storage/stockpiling facilities.

E. Vehicular Access and Parking:
   1. Access roads.
   2. Parking.
   3. Traffic regulation.

F. Temporary Barriers and Enclosures:
   1. Exterior enclosures.
   2. Security.

G. Temporary Controls:
   1. Water control.
   2. Dewatering.
   3. Erosion and sediment control.
   4. Noise control.
   5. Dust and particulate control.
   6. Pollution control.

H. Project identification.

I. Removal of temporary facilities and controls.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Occupational Health and Safety Act (OHSA).

C. Ontario Electrical Safety Code.

D. O. Reg. 213-07 – Fire Code.

1.3 UV DISINFECTION BYPASS OPERATIONS AND SWITCHOVERS

A. Temporary Long Duration UV Bypass System: CONTRACTOR shall supply, install, maintain, operate, monitor, remove and dispose of a complete temporary bypass system to allow complete isolation of the existing UV disinfection system in the UV Building. Temporary bypass equipment will be utilized during outages of the existing UV system to facilitate upgrading of the UV system feed pump VFDs and the existing UV system control panel. CONTRACTOR's system shall not use any of the existing UV disinfection system during required outages.
   1. General requirements:
      a. The OWNER’s operation of the existing UV disinfection system shall take precedence over all Construction Works.
      b. All components of the UV bypass system shall be suitable for the intended use including, but not limited to, pumping treated sewage (secondary effluent).
      c. Bypass system shall fully isolate the existing UV disinfection system to allow required construction Works to be complete.
      d. CONTRACTOR shall submit bypass plan for ENGINEER and OWNER review and approval prior to mobilization on Site.
      e. Bypass system shall be suitable for outdoor installation and operation and shall include all required equipment to operate in the summer and/or winter months, in all conditions.
   2. Existing UV Disinfection operating conditions – (per SPP operating permit):
      a. Liquid: Treated Sewage (Secondary effluent)
      b. Approximate Average Daily Flow: 18.4 L/s (1,590 m^3/day).
      c. Approximate Peak Flow: 55.2 L/s (4,770 m^3/day).
      d. Bypass systems (pumping and treatment) shall be configured to allow variation in flow through the SPP. Note: the point of bypass is a relatively small sump. Suction lift pumps may be required due to space constraints in the sump for submersibles.
      e. Approximate Key System Elevations:
         1) Bypass Source Location (Exit Sump, invert): 611.0 ft
         2) Existing Grade Surrounding UV Building: 618 ft (approx.)
   3. Minimum UV system bypass criteria:
      a. System Performance: Capacity: 15-56 L/s with minimal surcharge in the Exit Sump (source for bypass pumping). Surcharge shall not exceed a level of 0.5m (1.65 ft) above the invert elevation of Exit Sump.
         1) Bypass pumps shall be sized to pump at the required capacity from the bottom of the Exit Sump (North side of sump) into temporary piping/hose (provided by Contractor) to a temporary UV disinfection system. The temporary UV disinfection system may discharge by gravity back to the discharge side (south side) of the Exit Sump.

b. Bypass system shall be fully redundant and shall include as minimum two (2) bypass pumps each capable of providing the required pumping capacity over the specified flow range.
c. CONTRACTOR shall be responsible to supply temporary power and backup power to the bypass pumping system. Contractor will be required to provide step down transformer (575V to 480V) for temporary UV disinfection system.
d. Bypass Pumping System shall include automated control of the pumps and as a minimum provide the following local alarm/status:
    1) Pump running status.
    2) Pump fault.
    3) High water level condition.
    4) Number of pumps running.
e. CONTRACTOR shall submit proposed bypass pumping system and plan complete with design data sheets and drawings (including temporary piping configuration) for review and approval by ENGINEER and OWNER prior to implementing the system.
f. Contractor shall provide a temporary UV disinfection equipment to facilitate inactive of *E.Coli* and fecal coliforms. The system shall be configured for gravity flow (once pumped) of secondary effluent through a trailer configured UV disinfection system. The UV disinfection system shall be capable of achieving an effluent quality of 200 organisms per 100 mL (or less) at a flow up to 56 L/s with an influent UV of 65% transmittance or higher. The temporary UV disinfection shall provide a UV dose of 48.6 mJ/cm^2. The temporary UV disinfection system shall include:
    1) Control panel for UV system operation, control and monitoring
    2) Influent Flow meter
    3) Hydraulic wiper system for cleaning of the UV lamp banks
g. The temporary UV treatment system shall be placed on a paved or hard packed gravel surface in a location so as to minimize the length of influent and discharge piping/hose.
h. CONTRACTOR shall supply, maintain, operate, and continuously attend and monitor the temporary bypass/UV treatment system for the duration of all required station isolation activities.
i. Bypass system shall include a means of remote communication and monitoring that shall alert the CONTRACTOR, OWNER, and ENGINEER or alarm conditions.
j. CONTRACTOR shall respond to Site with appropriate personnel to an alarm condition at site within a minimum of 1 hour of having received notification of the condition.
k. Coordinate setup and run test of temporary pumping and bypass UV system in presence of OWNER/ENGINEER. Testing shall be completed a minimum 5 days prior to shut down of existing UV treatment system.
l. CONTRACTOR shall provide as a minimum “Class 2” Ontario licensed wastewater operator to submit the detailed plan of the system and start-up and operate and monitor and be “in charge” of the bypass pumping system for the duration of the bypass system operation.
m. Acceptable temporary pumping facility suppliers include:
    1) Aquatech Dewatering Company
    2) Atlas Dewatering Corporation
    3) ASI
n. Acceptable temporary bypass UV treatment equipment suppliers include:
    1) Trojan UV (London, ON)

1.4 Dewatering in excess of 50,000 L/day (if required)

A. The CONTRACTOR shall provide, operate and maintain adequate pumping equipment and drainage and disposal facilities. All required pumping, drainage and disposal shall be done without damage to the environment, to adjacent property or structures, and without interference with the rights of pedestrian and vehicular traffic and to the satisfaction of all appropriate agencies.

B. Discharge water quality and erosion control requirements shall be provided by the CONTRACTOR and shall be monitored and maintained throughout the dewatering duration.

C. The CONTRACTOR shall obtain the services of a licenced and qualified Hydrogeologist through a recognized and reputable and registered/licenced consulting firm to plan and monitor the implementation of the dewatering.
   1. The CONTRACTOR's Hydrogeologist shall prepare all documentation and plan requirements.
   2. The dewatering plan shall include but not be limited to:
      a. location of extraction points
      b. schedule and duration of dewatering
      c. rate of dewatering
      d. discharge points
      e. water quality monitoring program
   3. The CONTRACTOR shall collect and record volumes of daily water takings and submit records to OWNER.
   4. The CONTRACTOR shall submit detailed shop drawings of the entire dewatering system for review and approval prior to the system's installation or implementation.
   5. The CONTRACTOR shall submit all reporting requirements as required by the OWNER's permit to take water.

1.5 TEMPORARY UTLITIES

A. Electricity:
   1. Provide all required labour, materials, and equipment to connect to OWNER's existing power service and disconnect at the end of the Contract; do not disrupt OWNER's need for continuous service. Apply for and obtain any permits, as required to connect to the existing service. Exercise measures to conserve energy. Provide separate metering and reimburse OWNER for cost of energy used. The following conditions shall apply:
      a. Any power service provided by OWNER for CONTRACTOR's use will be provided on an as-is-where-is basis. The CONTRACTOR shall satisfy themselves of the adequacy of the existing power supply prior to the close of the RFP/Bid period and shall provide all additional temporary power as required for the completion of the works at no additional cost to the OWNER.
      b. OWNER does not guarantee continued or uninterrupted service and OWNER will not be responsible for consequences of any unintentional interruptions to continuity of such services.
   2. Provide any and all temporary power outlets for construction operations, with branch wiring and distribution boxes located as necessary.
   3. Permanent convenience receptacles may be utilized during construction.

B. Water Service:
   1. Provide, maintain, and pay for suitable temporary quality water service as required for all construction operations.

2. Provide, maintain, and remove all materials, equipment and labour to protect all water piping from freezing during construction operations.
3. Connections to OWNER's Source: Comply with all relevant requirements and bylaws, include backflow protection valves, temperature and pressure rated for operation at the temperatures and pressures encountered; after completion of use, remove connections and fittings without damage or alteration to existing water piping and equipment. OWNER's source is provided on an as-is-where-is basis. The CONTRACTOR shall satisfy themselves of the adequacy of the existing water supply prior to the close of the RFP/Bid period and shall provide all additional temporary water as required for the completion of the works at no additional cost to the OWNER.

C. Telephone Service:
1. Provide, maintain, and pay for telephone service and equipment including a minimum of one telephone unit and one answering machine to CONTRACTOR's field office at time of mobilization to the Site.
2. Post emergency numbers including police, fire, ambulance, hospital, poison control center, and appropriate regulatory agencies in prominent location near each telephone.

D. High Speed Internet Service:
1. Provide, maintain, and pay for high speed Internet service for CONTRACTOR's field office.

E. Portable Radios:
1. Provide and maintain, 2 two-way portable radios for Site communications, capable of clearly transmitting and receiving communications over a 5 km radius at time of mobilization to the Site.

F. Construction Lighting:
1. Provide and maintain lighting for construction operations.
2. Provide and maintain lighting to exterior staging and storage areas after dark as required for security purposes.
3. Provide branch wiring from power source to distribution boxes with lighting conductors, pigtails, and lamps as necessary.
4. Maintain lighting and make routine repairs.
5. Permanent building lighting may be utilized during construction.

G. Heat:
1. Provide temporary heat devices as needed to maintain specified conditions for construction operations and storage of equipment and materials.
2. Exercise measures to conserve energy. Provide separate metering and reimburse OWNER for cost of energy used.
3. Maintain minimum ambient temperature of 10 degrees C in buildings and outdoor electrical panels while construction is in progress, unless specified otherwise.

H. Temporary Ventilation:
1. Supply, maintain, and remove equipment as required to ventilate enclosed areas to the outside of the facility to assist cure of materials, dissipate humidity, and prevent accumulation of dust, fumes, vapors, or gases and as required by health and safety requirements.

I. Fire Protection:
1. Take precautions to prevent fires. Provide and maintain temporary fire protection equipment of a type appropriate to the hazard anticipated in accordance with

O. Reg. 213/07 Fire Code and to the satisfaction of ENGINEER and insurance authorities.

2. Bulk storage of flammable liquids and other hazardous materials is not allowed on Site. Handle flammable liquids in approved containers.
3. Open burning of rubbish is not permitted on Site.
4. Deliver, use, and dispose of flammable materials as required by authorities having jurisdiction.
5. Prohibit smoking within buildings under construction. Designate an area on Site where smoking is permitted. Provide approved ashtrays in designated smoking areas.
6. Establish a fire watch for cutting and welding and other hazardous operations capable of starting fires. Maintain the fire watch before, during, and after hazardous operations until threat of fire does not exist.
7. Comply with National Building Code, Part 8 and O. Reg. 213/07 – Fire Code.
8. Include on-Site fire protection specified in CONTRACTOR's Site-specific Health and Safety Plan.

1.6 TEMPORARY UTLITIES, EQUIPMENT, AND MATERIALS REQUIRED FOR TESTING AND COMMISSIONING

A. CONTRACTOR shall provide all labour, materials, and equipment to supply any and all temporary utilities, equipment, and materials required to fully commission the works including but not limited to test water, potable water, test air, power, controls, pumps, instrumentation, communications/network connections etc.

1.7 CONSTRUCTION FACILITIES

A. CONTRACTOR's Field Office and Storage Sheds:
   1. Provide CONTRACTOR's field office with the minimum facilities specified. Provide all required storage and work sheds.
   2. Field Office and Furnishings:
      a. As required by CONTRACTOR and with sufficient room for Project meetings.
      b. Include conference table and chairs sufficient for 12 persons.
      c. Telephone, internet, and facsimile service.
      d. Temperature Control: Heating and cooling equipment to maintain an ambient temperature of 20 to 23 degrees C.
      e. Lighting: 540 lx at desktop height; exterior light at entrances
      f. Four CSA approved protective helmets for visitors' use.
      g. Exterior identifying sign.
      h. Other furnishings at CONTRACTOR's option.
      i. Repair immediately any damage, leaks, or defective service.
   3. Sheds and Storage Enclosures: Weathertight for protection of products and materials and to prevent entry of unauthorized persons. Provide access doors with locks. Provide temporary heating as required by stored product manufacturers written recommendations.
   4. Remove field office and sheds upon completion unless otherwise approved by ENGINEER.

B. Sanitary Facilities:
   1. Provide and maintain required temporary sanitary facilities and enclosures in accordance with OHSA. Existing facility use is not permitted.

2. Remove and dispose of sanitary wastes off Site on a periodic basis as required and in accordance with applicable Laws and Regulations.

C. Storage/Stockpiling Facilities: Provide, maintain, and operate storage/stockpiling facilities as required.

D. Drums (as required):
1. CONTRACTOR shall designate a storage area for waste drums. Prior to commencing storage the designated area must be approved by OWNER.
2. Storage of Liquid Waste: 200 L steel drums meeting the Transportation of Dangerous Goods Act, closable lids, complete with labels for marking contents and date filled.
3. Storage of Solid Waste: 200 L steel drums meeting Transportation of Dangerous Goods Act, closable lids, complete with labels for marking contents and date filled.

1.8 TEMPORARY BARRIERS AND ENCLOSURES

A. Exterior Enclosures: Provide temporary weathertight enclosure of exterior openings to accommodate acceptable working conditions and protection for products, to allow for temporary heating, cooling, and maintenance of required ambient temperatures identified in individual Sections or otherwise required to produce Works of specified quality, and to prevent entry of unauthorized persons. Provide access doors with self-closing hardware and locks.

B. Fencing: Provide commercial grade 1.8 m high self-supporting interlocking modular steel fencing around the perimeter of the site equipped with lockable vehicular and personnel gates.
1. Manufacturers:
a. Modu-Loc Fence Rentals
b. Approved equivalent

C. Security:
1. Provide facilities to protect the Works and the Site from unauthorized entry, vandalism, and theft.
2. Restrict entrance of persons and vehicles into the Site.
3. Allow entrance only to authorized persons with proper identification.

1.9 TEMPORARY CONTROLS

A. Water Control:
1. Maintain excavations free of water.
2. Protect the Site from puddling or running water.
3. Prevent precipitation from infiltrating or from directly running off stockpiled materials. Cover stockpiled materials with an impermeable liner during periods of work stoppage including at the end of each working day and as directed by ENGINEER.
4. Control surface drainage including ensuring water is not directed across or over pavements or sidewalks except through approved pipes or properly constructed troughs, and runoff from unstabilized areas is intercepted and diverted to a suitable outlet.
5. Dispose of water in a manner not injurious to public health or safety, to property, or to any part of the Works completed or under construction.
6. Provide, operate, and maintain necessary equipment appropriately sized to keep excavations and other work areas free from water.

B. Dewatering (<50,000 L/day):
   1. Dewater the various parts of the Works including, without limitation, excavations, structures, foundations, and work areas.
   2. Employ construction methods, procedures, and precautions that will ensure the Works, including excavations, are stable, free from disturbance, and dry.
   3. Provide sufficient and appropriate labor and equipment necessary to keep the Works free of water including standby equipment necessary to ensure continuous operation of dewatering system.
   4. Take precautions necessary to prevent uplift of any structure or pipeline and protect excavations from flooding and damage due to surface runoff.
   5. Meter and monitor dewatering amounts on a daily basis. In the event dewatering exceeds 50,000 L/day promptly notify the OWNER and ENGINEER and comply with the requirements for dewatering in excess of 50,000 L/day.
   6. Provide. monitor, and maintain as a minimum a splash pad and means of siltation control (dewatering bag, cover dams, silt fence, settling tanks) sufficient to prevent silt from entering the environment.

C. Erosion and Sediment Control:
   1. Plan and execute construction by methods to prevent erosion and sedimentation.
   2. Minimize the amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical. Strip vegetation, regrade, or otherwise develop in such a way as to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and water courses, and repair damage caused by soil erosion and sedimentation as directed by ENGINEER.
   3. Plan construction procedures to avoid damage to, or work or equipment encroachment onto water bodies or drainage ditch banks. In the event of damage, promptly take action to mitigate the effects of such damage. Restore affected bank or water body to its existing condition.
   4. Installation:
      a. Construct temporary erosion control items in accordance with design Drawings.
      b. Check erosion and sediment control measures weekly and after each rainfall. During prolonged rainfall, check daily.
      c. Whenever sedimentation is caused by stripping vegetation, regrading, or other development, remove it from adjoining surfaces, drainage systems, and watercourses, and repair damage as quickly as possible.
      d. Unless otherwise shown on the Drawings or directed by ENGINEER, remove temporary erosion and sediment control devices upon completion of the Works to the satisfaction of ENGINEER. Materials once removed become the property of CONTRACTOR.

D. Dust and Particulate Control:
   1. Execute the Works by methods to minimize raising dust from construction operations.
   2. Implement and maintain dust and particulate control measures during all concrete work.
   3. Provide positive means to prevent airborne dust from dispersing into atmosphere. Use potable water for dust and particulate control.
   4. As a minimum, use appropriate covers on trucks hauling fine or dusty material and use watertight vehicles to haul wet materials.
   5. Prevent dust from becoming a nuisance to adjacent property owners or occupants.
   6. ENGINEER or OWNER may stop work at any time when CONTRACTOR's control of dusts and particulates is inadequate.
   7. In the event that CONTRACTOR's dust and particulate control is not sufficient for controlling dusts and particulates work shall be discontinued and a meeting held between ENGINEER and CONTRACTOR to discuss the procedures that CONTRACTOR

proposes to resolve the problem. Make all necessary changes to operations prior to resuming any work that may cause a release of dusts or particulates.

8. Protect all existing electrical and PAC panels to remain free from dust.

E. Pollution Control:

1. Provide methods, means, and facilities to prevent contamination of soil, water, and atmosphere from discharge of noxious toxic substances and pollutants produced by construction operations.
2. Be prepared to intercept, clean up, and dispose of spills or releases that may occur, whether on land or water. Maintain materials and equipment required for cleanup of spills or releases readily accessible on Site.
3. Promptly report spills and releases potentially causing damage to the environment to:
   a. Ministry of the Environment and Climate Control.
   b. Owner of the pollutant.
   c. The person having control over the pollutant.
   d. OWNER.
4. Contact the manufacturer of the pollutant, if known, and ascertain the hazards involved, precautions required, and best measures to be used in any cleanup or mitigating action.
5. Take immediate action using available resources to contain and mitigate the effects on the environment and persons from any spill or release.

1.10 REMOVAL OF TEMPORARY FACILITIES AND CONTROLS

A. Remove temporary utilities, equipment, facilities, materials, prior to final Application for Payment inspection.

B. Clean and repair damage caused by installation or use of temporary work.

C. Restore existing and permanent facilities used during construction to specified condition and if not specified retore as a minimum to existing conditions or better.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01600

PRODUCT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. Basic product requirements.

C. Product options.

D. Product substitutions.

E. Product delivery and handling requirements.

F. Product storage and handling requirements.

1.2 BASIC PRODUCT REQUIREMENTS

A. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

1.3 PRODUCT SUBSTITUTIONS

A. CONTRACTOR shall submit its bid price based on Contract Documents. CONTRACTOR may submit a proposal requesting substitutions as noted below.

B. Written proposals for substitutions shall be submitted prior to the close of the RFP. The OWNER shall review the submitted proposals and may approve or reject the proposals at the OWNER’s sole discretion. The CONTRACTOR shall only include written approved product substitutions in its bid price.

C. Document each proposal for product substitution with complete data substantiating compliance of proposed substitution with the Contract Documents.

D. A proposal for substitution constitutes a representation that CONTRACTOR:
   1. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.
   2. Will provide the same warranty for the substitution as for the specified product.
   3. Will coordinate installation and make changes to other Works which may be required for the Works to be complete at CONTRACTOR's expense and at no additional cost to OWNER.
   4. Waives claims for additional costs or time extension which may subsequently become apparent.
   5. Will reimburse OWNER for review or redesign services as may be required.

E. Proposal for Product Substitution Procedure prior to close of RFP :
   1. Submit three copies of proposal for substitution for consideration. Limit each request to one proposed substitution.
   2. Submit Shop Drawings, product data, and certified test results and other data as required by OWNER, attesting to the proposed product equivalence. Burden of proof is on CONTRACTOR.
   3. OWNER will notify CONTRACTOR in writing of decision to accept or reject request.
   4. OWNER will be sole judge as to the acceptance or rejection of CONTRACTOR's request.
   5. In the event CONTRACTOR obtains OWNER's approval for the use of products other than that shown or specified, CONTRACTOR shall, at CONTRACTOR's own expense and using methods approved by OWNER/ENGINEER, make all changes to the Works, including structures, piping, electrical, equipment, and controls, that may be necessary to accommodate this product.

1.4 PRODUCT DELIVERY AND HANDLING REQUIREMENTS

A. Comply with all OWNER site access and security requirements.

B. Make all arrangements for transportation, delivery, and handling of products required for prosecution and completion of the Works.

C. Shipments of products to CONTRACTOR or Subcontractors shall be delivered to the Site only during regular working hours. Shipments shall be addressed and consigned to the proper party giving name of Project, street number, and city. Do not deliver shipments to OWNER except where otherwise directed in writing.

D. Provide advance notice of delivery of products to the Site as required in other Sections.

E. Arrange delivery of products to the Site in accordance with work sequence and in ample time to facilitate inspection prior to installation. Schedule deliveries to limit requirement for storage at the Site to the practical minimum.

F. Coordinate deliveries to avoid conflict with the Works and conditions at the Site and to accommodate the following:
   1. Limitations of storage space.
   2. Availability of equipment and personnel for handling products.
   3. OWNER's use of the Site.

G. Do not have products delivered to the Site until related Shop Drawings or Samples have been reviewed by OWNER/ENGINEER.

H. Do not have products delivered to the Site until required storage facilities have been provided.

I. Transport and handle products in accordance with manufacturers' instructions.

J. Immediately on delivery, inspect shipments to ensure that products comply with requirements of the Contract Documents and reviewed submittals, quantities are correct, and products are undamaged.

K. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.5 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Limit on-Site storage of products to areas shown on the Drawings or otherwise approved by OWNER.

B. Make all arrangements and provisions necessary for storage of materials and equipment.

C. Place all excavated materials, construction equipment, and materials and equipment to be incorporated into the Works so as not to injure any part of the Works or existing facilities and so that free access can be had at all times to all parts of the Works.

D. Store and protect products in accordance with manufacturers' recommendations/instructions and instructions and requirements of Specifications, with seals and labels intact and legible. Provide all labour, materials, and equipment required to store products in accordance with manufacturers' recommendations/instructions.

E. Store sensitive products in weathertight, climate-controlled enclosures. Protect products subject to ultraviolet degradation from direct exposure to sunlight.

F. For exterior storage of fabricated products, place on sloped supports, above ground.

G. Provide bonded off-Site storage and protection when the Site does not permit on-Site storage or protection.

H. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to avoid condensation or potential degradation of product.

I. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.

J. Furnish equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

K. Arrange storage of products to permit easy access for inspection. Periodically inspect to verify products are undamaged and are maintained in acceptable condition.

L. Protect delivered products from contamination or damage.

M. CONTRACTOR shall be fully responsible for loss or damage to stored products, materials, and equipment.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01700

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. Examination.

C. Preparation.

D. Field surveying.

E. Cutting and patching.

F. Restoration.

G. Alteration Project procedures.

H. Progress cleaning.

I. Final cleaning.

J. Final decontamination.

K. Removal and disposal.

L. Starting and adjusting.

M. Protection of installed work.

N. Closeout procedures.

O. Project record documents.

P. Spare parts, maintenance materials, and extra materials.

Q. Operation and maintenance data.

R. Warranties.

S. Equipment Identification

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Occupational Health and Safety Act (OHSA).

1.3 EXAMINATION

A. Prior to commencement of work at the Site, inspect the Site with OWNER/ENGINEER to review and establish the condition of surface features including existing roads, parking areas, buildings, trees and other plants, grassed areas, service poles, wires, paving, and survey bench marks. This inventory shall be mutually agreed between OWNER/ENGINEER and CONTRACTOR and shall not thereafter be subject to dispute. Such inventory, as may be amended from time to time, will be used by OWNER/ENGINEER to check compliance by CONTRACTOR with the requirements of the Contract Documents.

B. Provide ongoing review, inspection, and attendance during performance of the Works to properly document conditions. Promptly inform OWNER/ENGINEER of any existing condition at the Site affected by the Works which may require restoration, repair, or replacement. Do not cover up any of the Works without prior approval from OWNER/ENGINEER.

C. Maintain and protect existing Site structures and facilities from damage which may be affected by the Works while work is in progress. Repair or replace damage resulting from the Works to OWNER/ENGINEER's approval.

D. Verify that existing Site conditions and substrate surfaces are acceptable for subsequent work. Beginning new work means acceptance by CONTRACTOR of existing conditions.

E. Verify that existing substrate is capable of structural attachment of new work being applied or attached or that existing or previously constructed surfaces are ready to receive subsequent work.

F. Examine and verify specific conditions described in individual Sections.

G. Verify that utility services are available, of the correct characteristics, and in the correct location.

1.4 PREPARATION

A. Clean substrate surfaces prior to applying next material or substance.

B. Seal cracks or openings of substrate prior to applying next material or substance.

C. Apply manufacturer required or recommended substrate primer, sealer, or conditioner prior to applying new material or substance in contact or bond.

1.5 FIELD SURVEYING

1.6 FIELD SURVEYING

A. Comply with the requirements of Section 01050

B. Quality Assurance:
   1. CONTRACTOR's registered land surveyor shall complete pre-construction, in-progress, final grade, and as-built topographic surveys necessary for layout and design verification.
   2. OWNER/ENGINEER may, at any time, check CONTRACTOR's survey and layout work but this shall not relieve CONTRACTOR of any of its responsibilities to carry out the Works to the lines and grades set out according to the Drawings and the Project Specifications or as otherwise necessary for performance of the Works according to the Contract Documents.
   3. CONTRACTOR shall be responsible for establishing reference bench marks and base lines adjacent to the Works as well as laying out the Works from established reference points.

C. Submittals:
   1. Submit paper and digital copies of Site drawing and certificate signed by the land surveyor engaged by CONTRACTOR that the elevations and locations of the Works are in conformance with the Contract Documents. Information shall include surface (xml) files, point files, CAD drawings, and PDF figures. Provide digital copy, on USB memory stick or electronic file transfer or Compact Disc (CD) compatible for use with Windows 7, 64 bit and three (3) dimensional Automated Computer Aided Design/Drafting format accepted by OWNER/ENGINEER.
   2. On request, submit documentation verifying accuracy of survey work.

D. Record Documents: Maintain a complete and accurate log of control and survey work as it progresses.

E. Survey Reference Points:
   1. Locate, preserve, and protect survey control and reference points.
   2. Promptly report to OWNER/ENGINEER the loss or destruction of any reference point or relocation required because of changes in grades or other reasons.
   3. Make good any errors entering into the Works through CONTRACTOR failure to notify OWNER/ENGINEER concerning lack of preservation of such survey reference points.
   4. Accurately replace or relocate disturbed reference or survey control points based on original survey control. Make no changes without prior written notice to and approval from OWNER/ENGINEER.

F. Survey Requirements:
   1. Utilize recognized survey practices acceptable to OWNER/ENGINEER. Locate and lay out the Works using properly calibrated instrumentation.
   2. Establish elevations, lines, and levels.
   3. Periodically verify layouts by same means and methods.

G. Examination:
   1. Verify locations of survey control points prior to starting work.
   2. Verify set-backs, easements, and clearances, confirm Drawing dimensions and elevations.
   3. Promptly notify OWNER/ENGINEER of any discrepancies discovered.

1.7 CUTTING AND PATCHING

A. Employ skilled and experienced installers to perform cutting and patching.

B. Submit written request in advance of cutting or altering elements which affects:
   1. Structural integrity of element.
   2. Integrity of weather exposed or moisture resistant elements.
   3. Efficiency, maintenance, or safety of element.
   4. Visual qualities of sight exposed elements.

C. Include in request:
   1. Location and description of the affected work.
   2. Necessity for cutting or alteration.
   3. Description of proposed work and products to be used including materials, methods, and procedures.
   4. Alternatives to cutting and patching.
   5. Effect on work of OWNER or Other Contractors.
   6. Written permission of affected Other Contractors.
   7. Date and time work will be executed.

D. Execute cutting, fitting, and patching, including excavation and fill, to complete the Works, and to:
   1. Fit several parts together and/or to integrate with other work.
   2. Uncover work to install or correct ill-timed work.
   3. Remove and replace defective or nonconforming work.
   4. Remove samples of installed work for testing.
   5. Provide openings in elements of work for penetrations of mechanical and electrical work.

E. Execute work by methods to avoid damage to other Works, and which will provide proper surfaces to receive patching and finishing.

F. Provide temporary supports to ensure structural integrity of the Works. Provide devices and methods to protect other portions of the Project from damage.

G. Provide protection from weather and the elements for areas which may be exposed by uncovering work.

H. Cut masonry and concrete materials using masonry saw or core drill. Do not use pneumatic tools without prior approval. CONTRACTOR shall X-ray prior to coring and/or cutting existing concrete structures and verify location of steel reinforcement and/or embedded utilities. Do not cut or otherwise damage the steel reinforcement without prior written approval from OWNER/ENGINEER.

I. Restore work according to the requirements of the Contract Documents.

J. Identify any hazardous substance or condition exposed during performance of the Works to OWNER/ENGINEER for decision or remedy.

K. Refinish surfaces to match adjacent finish. For continuous surfaces, refinish to nearest intersection or natural break. For an assembly, refinish entire unit.

1.8 RESTORATION

A. As a minimum, restoration shall mean replacement, repairs, or reconstruction to a condition at least as good as or better than the condition prior to commencement of the Works.

B. Except where specifically required otherwise by other Sections, restore areas of the Works and areas affected by the performance of the Works to conditions that existed prior to commencement of the Works and to match condition of similar adjacent, undisturbed areas.

C. Ensure that restored areas match existing grade and surface drainage characteristics, except as otherwise specified, and ensure a smooth transition from restored surfaces to existing surfaces.

D. Do not alter original conditions without prior written approval from OWNER/ENGINEER.

E. Without limiting the generality of the foregoing or other requirements of the Contract Documents, preserve and protect existing features encountered at the Site during performance of the Works including, but not limited to buildings, structures, curbs, pavement, manholes, catch basins, utilities, walks, grassed areas, and trees.

F. Utilize construction methods and procedures during performance of the Works which keeps disturbance and damage of existing conditions to the practical minimum. Where work necessitates root or branch cutting, do not proceed without OWNER/ENGINEER's prior written approval.

G. Ensure that quality, grades, elevations, and the extent of bedding, cover, and other backfill materials including subgrades, finish grades, and thickness of pavements for roadways and parking areas are properly documented during their removal to ensure reconstruction to at least their original and functional condition.

H. Restoration Material: New, except as otherwise specified, not damaged or defective, and of the best quality for the purpose intended. Furnish evidence as to type, source, and quality of materials or products furnished when requested by OWNER/ENGINEER or specified in other Sections.

I. Should any dispute arise as to the quality or fitness of materials, whether obtained on or off Site, whether previously inspected by OWNER/ENGINEER prior to use or not, the decision to use any material or product in the finished Works will rest solely with OWNER/ENGINEER.

J. Remove from the Site clean material not approved for reuse.

K. Handle and store products and materials in a manner to prevent damage, adulteration, deterioration, and soiling and according to manufacturers' instructions when applicable.

L. Prior to commencement of restoration work, inform OWNER/ENGINEER of proposed material, methods, and procedures to repair, replace, or reconstruct disturbed, damaged, or suspected damage to the Works.

M. Perform cutting, fitting, remedial, and coordination work to make the several parts of the Works fit together.

N. Except as specified otherwise, dismantle and salvage materials for reuse where practicable. Exercise due care when removing material for salvage. Repair or replace materials damaged through improper handling or through loss after removal.

O. Store and protect removed material approved for reuse in approved locations. Beginning of restoration work means acceptance of existing conditions.

P. Unless otherwise specified, restore pavement by:
   1. Removing and replacing the entire portions between joints or scores and not merely refinishing or patching localized areas.
   2. Saw cutting surfaces, curbs and gutters, and similar structures or surfaces.
   3. Protecting adjacent joints and load transfer devices and underlying granular materials.

1.9 ALTERATION PROJECT PROCEDURES

A. Products for Patching and Extending Works:
   1. New Materials: As specified in Sections; match existing products and work for patching and extending work.
   2. Type and Quality of Existing Products: Determine by inspecting and testing products where necessary, referring to existing Works as a standard.

B. Examination:
   1. Verify that demolition is complete and areas are ready for installation of new Works.
   2. Beginning of restoration work means acceptance of existing conditions.

C. Preparation:
   1. Cut, move, or remove items as necessary for access to alterations and renovation work. Replace and restore at completion.
   2. Remove unsuitable material not marked for salvage, such as corroded metals, and deteriorated masonry and concrete. Replace materials as specified for finished Works.
   3. Remove debris and abandoned items from area and from concealed spaces.
   4. Prepare surface and remove surface finishes to provide for proper installation of new work and finishes.
   5. Close openings in exterior surfaces to protect existing work from weather and extremes of temperature and humidity. Insulate ductwork and piping to prevent condensation in exposed areas.

D. Installation:
   1. Coordinate work of alterations and renovations to expedite completion.
   2. Remove, cut, and patch work in a manner to minimize damage and to provide a means of restoring products and finishes to specified condition.
   3. Refinish visible existing surfaces to remain in renovated rooms and spaces, to specified condition for each material, with a neat transition to adjacent finishes.
   4. Install products as specified in individual Sections.

E. Transitions:
   1. Where new Works abuts or aligns with existing, perform a smooth and even transition. Patch the Works to match existing adjacent Works in texture and appearance.
   2. When finished surfaces are cut so that a smooth transition with new Works is not possible, terminate existing surface along a straight line at a natural line of division and make recommendation to OWNER/ENGINEER.

F. Repair of Damaged Surfaces:
   1. Patch or replace portions of existing surfaces which are damaged, lifted, discolored, or showing other imperfections.
   2. Repair substrate prior to patching finish.

G. Finishes:
   1. Finish surfaces as specified in individual Sections.
   2. Finish patches to produce uniform finish and texture over entire area. When finish cannot be matched, refinish entire surface to nearest intersections.

1.10 PROGRESS CLEANING

A. Execute cleaning during progress of the Works and as required by the General Conditions.

B. Requirements of Regulatory Agencies:
   1. In addition to the requirements herein, maintain the cleanliness of the Works and surrounding premises within the Works limits to comply with Ontario Health and Safety Act and local fire and safety laws, ordinances, codes, and regulations.
   2. Comply with O. Reg. 347 – General Waste Management and local anti-pollution laws, ordinances, codes, and regulations when disposing of waste materials, debris, and rubbish.

C. Coordinate cleaning operations with disposal operations to prevent accumulation of dust, dirt, debris, rubbish, and waste materials on or within the Works or on the premises surrounding the Works.

1.11 FINAL CLEANING

A. Execute final cleaning prior to Substantial Performance of the Works in accordance with General Conditions and Supplementary Conditions.

B. Clean interior and exterior surfaces exposed to view; remove temporary labels, stains, and foreign substances.

C. Clean equipment and fixtures to a sanitary condition with cleaning materials appropriate to the surface and material being cleaned.

D. Clean debris from roofs and drainage systems.

E. Clean the Site; sweep paved areas and rake clean landscaped surfaces.

F. Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.

G. Maintain cleaning until acceptance and occupation by OWNER.

1.12 REMOVAL AND DISPOSAL

A. Remove surplus materials and temporary facilities and controls from the Site.

B. Dispose of all non-contaminated waste materials, litter, debris, and rubbish off Site.

C. Do not burn or bury rubbish and waste materials on Site.

D. Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.

E. Do not discharge wastes into streams or waterways.

F. Dispose of the following materials at an appropriate off-Site facility identified by CONTRACTOR and approved by OWNER:
   1. Debris including excess construction material, non-contaminated litter, and rubbish.
   2. Spent disposable personal protective equipment worn during final cleaning.
   3. Volatile or hazardous wastes such as mineral spirits, oil, or paint thinner.

1.13 ADJUSTING

A. Adjust operating products and equipment to ensure smooth and unhindered operation.

1.14 PROTECTION

A. In accordance with the requirements of document BP-1-11 Rev 3– Schedule 5 – Commercial Terms and Conditions for Building Construction Services.

B. Submit written certification that the Contract Documents have been reviewed, the Works has been inspected, and that the Works is complete according to the Contract Documents and ready for OWNER/ENGINEER's review.

C. Submit final Application for Payment identifying previous payments and amounts remaining due.

D. Complete and furnish submittals to OWNER/ENGINEER that are required by the Contract Documents. Payment shall not become due and payable until all submittals have been made acceptable to OWNER/ENGINEER.

E. OWNER will occupy all portions of the Site as specified in Section 01300.

1.15 CLOSEOUT PROCEDURES

A. In accordance with the requirements of the General Conditions and Supplementary Conditions.

B. Submit written certification that the Contract Documents have been reviewed, the Works has been inspected, and that the Works is complete according to the Contract Documents and ready for OWNER/ENGINEER's review.

C. Submit final Application for Payment identifying previous payments and amounts remaining due.

D. Complete and furnish submittals to OWNER/ENGINEER that are required by the Contract Documents. Payment shall not become due and payable until all submittals have been made acceptable to OWNER/ENGINEER.

E. OWNER will occupy all portions of the Site as specified in Section 01 30 0.

1.16 PROJECT RECORD DOCUMENTS

A. Maintain one set of the following Project record documents on Site; record actual revisions to the Works:
   1. Addenda.
   2. Drawings.
   3. Specifications.
   4. Change Orders and other modifications to the Contract.
   5. Reviewed Shop Drawings, product data, and Samples.
   6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by OWNER.

C. Store Project record documents separate from documents used for construction.

D. Record information concurrent with construction progress.

E. Specifications: Legibly mark and record, at each Section of the Specifications, a description of actual products installed, including the following:
   1. Manufacturer's name and product model and number.
   2. Product substitutions or alternates utilized.
   3. Changes made by modifications.

F. Project Record Documents and Shop Drawings: Legibly mark each item to record actual construction including:
   1. Measured depths of foundations in relation to finished floor datum.
   2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
   3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Works.
   4. Field changes of dimension and detail.
   5. Details not on original Drawings.

G. Complete as-built record drawings in both PDF and AutoCAD format complete with final survey of all materials, structures, equipment and utilities both above grade and below grade. Provide surveyed horizontal and vertical alignments. Comply with the requirements of Section 01050.

H. Submit documents to OWNER/ENGINEER with claim for final Application for Payment..

1.17 SPARE PARTS, MAINTENANCE MATERIALS, AND EXTRA MATERIALS

A. Provide products, spare parts, maintenance and extra materials in quantities specified in individual Sections.

B. Deliver to the Site and place in location as directed by OWNER/ENGINEER for acceptance by OWNER; obtain receipt from OWNER/ENGINEER or OWNER.

C. Provide list of spare parts and maintenance and extra materials furnished prior to final Application for Payment.

1.18 OPERATION AND MAINTENANCE DATA

A. Submit CONTRACTOR's operation and maintenance manual in accordance with the operation and maintenance manual template included in Appendix B.

B. Submit data bound in 216 mm by 279 mm text pages, 3-D side ring binders with durable plastic covers.

C. Prepare binder cover with printed title in accordance with the operation and maintenance manual template.

D. Internally subdivide the binder contents with permanent page dividers, logically organized as per the operation and maintenance manual template, with tab titling clearly printed under reinforced laminated plastic tabs.

E. Contents: Prepare a Table of Contents for each volume, with each product or system description identified, typed on 11 kg white paper, in accordance with the operation and maintenance manual template.

F. In addition to the items listed in the operation and maintenance manual template include the following:
   1. Directory, listing names, addresses, and telephone numbers of OWNER/ENGINEER, CONTRACTOR, Subcontractors, and major equipment Suppliers.
   2. Operation and maintenance instructions, arranged by component. For each component identify names, addresses, and telephone numbers of Subcontractors and Suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
   3. Maintenance instructions for equipment and systems.
   4. Project documents and certificates, including the following:
      a. All reviewed shop Drawings and product data.
      b. As-built information.
      c. All certificates.
      d. Copies of all warranties.
      e. Selected Project pictures.

G. Submit one draft copy of completed volumes 15 days prior to the SAT. This copy will be reviewed and returned, with OWNER/ENGINEER's comments. Revise content of all document sets as required prior to final submission.

H. Submit three sets of revised final volumes within 10 days after the SAT.

I. Submit digital copy of final approved operation and maintenance manual on memory stick in PDF format. The format of the PDF shall match the operation and maintenance manual table of contents and individual sections of the PDF document shall be indexed and searchable.

1.19 WARRANTIES

A. The Contractor shall provide warranty for the Works as per the requirements in document BP-1-11 – Schedule 5 – Commercial Terms and Conditions for Building Construction Services Rev (3) and the following:
   1. The warranty period shall be 2 years.
   2. The warranty period shall commence on the date of substantial completion. The Contractor shall obtain any and all necessary additional warranties from equipment manufacturers that shall cover the period from the procurement of equipment and materials to the date of substantial completion.

B. Contractor shall obtain any and all additional available manufacturer warranties that extend beyond the 2 year period as stated in clause 1.19.A, executed in duplicate by responsible Subcontractors and Suppliers, within 14 days after completion of the applicable item of work. The date of the beginning of the warranty period shall be the date of Substantial Performance.

C. Verify that documents are in proper form, contain full information, and are notarized.

D. Co-execute submittals when required.

E. Retain warranties until time specified for submittal.

F. Bind in CONTRACTOR's operation and maintenance manual.

G. For items of the Works for which acceptance is delayed beyond the date of Substantial Performance, furnish updated submittal within 10 days after acceptance of the affected item. The date of acceptance of such item shall be the start of the warranty period for that item.

1.20 EQUIPMENT IDENTIFICATION

A. All equipment shall be identified by nameplates in accordance with Bruce Power’s standards. Labels shall include the equipment codes as noted on the Contract Drawings and as changes occur throughout the construction execution.

B. Minimum Requirements:
   1. Engraved laminated plastic
   2. Black lettering on a white background.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION (Not Used)

END OF SECTION

SECTION 01810

TESTING AND COMMISSIONING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Measurement and payment.

B. References.

C. Definitions

D. Testing and Commissioning description.

E. Meetings.

F. Reports.

G. Sequencing.

H. Scheduling.

I. Progress submittals.

J. Closeout submittals.

K. Qualifications.

L. Testing and Commissioning responsibilities.

M. Examination.

N. Deficiencies.

O. Demonstration.

P. Training.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

1.3 DEFINITIONS

A. CT: Commissioning Team.

B. FAT: Factory Acceptance Testing

C. SAT: Site Acceptance Testing

1.4 TESTING AND COMMISSIONING DESCRIPTION

A. Testing and Commissioning: Systematic process that includes all activities required to test, verify, demonstrate, and transfer the completed works to OWNER. Testing and commissioning activities shall be completed as described by the requirements of this specification and document BP-1-11 Rev (3) - Schedule 5 - Commercial Terms and Conditions for Building Construction Services.

B. Due to the need to keep the Bruce Power SPP operational during the Controls Upgrade, multiple commissioning events will be required. CONTRACTOR shall make provisions in the commissioning schedule/effort to accommodate multiple commissioning events.

C. Testing and Commissioning Intent:
   1. Verify that equipment and systems are installed in accordance with manufacturers' instructions; industry accepted minimum standards, and the Contract Documents.
   2. Verify that equipment and systems receive adequate operational checkout by CONTRACTOR.
   3. Verify that and document proper performance of equipment and systems.
   4. Verify that complete operation and maintenance documentation is delivered to OWNER.
   5. Verify that OWNER's operating personnel are adequately trained.

D. The testing and commissioning activities do not relieve CONTRACTOR of responsibility to provide a finished and fully functioning Project.

E. General Testing and Commissioning Process Overview:
   1. Startup Phase
      a. Process Control Narrative complete and documentation submitted.
      b. SCADA software FAT complete and documentation submitted.
      c. Equipment FAT complete and documentation submitted.
      d. Draft O&M Manuals submitted.
      e. Health and safety procedures in place and documentation submitted.
      f. Works installed and deficiencies corrected.
      g. Testing and commissioning plan including equipment startup list complete and documentation submitted.
      h. Equipment Startup Meeting complete and documentation submitted.
      i. Equipment and system startup and performance testing. Includes installation checks, equipment startup testing, calibration, I/O checks, communication checks, and documentation and sign-off completed by equipment manufacturers and CONTRACTOR.
   2. Testing Phase.
      a. OWNER Acceptance and sign-off that Startup Phase complete.
      b. Pre-SAT Meeting complete and documentation submitted.
      c. Pre-SAT items and document submissions complete including Pre-SAT report, SAT Plan, Revised Draft O&M manuals, OWNER training materials, correction of all deficiencies noted during equipment startup, equipment tagging and identification.
      d. SAT Testing Activities.
      e. SAT report completed and submitted.
      f. Complete OWNER training.
      g. Submit deficiency list and complete deficiency review meeting with OWNER.

h. Correction of deficiencies including items identified during the SAT. All major deficiencies shall be corrected prior to the start of the commissioning phase.

3. Commissioning Phase
   a. OWNER Acceptance and sign-off that Testing Phase complete.
   b. Complete commissioning period including uninterrupted 14-day trouble free run period.
   c. Correction of remaining minor deficiencies.
4. Substantial Performance Phase
   a. OWNER Acceptance and sign-off that Commissioning Phase complete.
   b. Completion of all required activities and submission of all required documentation for Substantial performance.
   c. Substantial Performance.
   d. OWNER handover meeting complete with documentation submitted.
5. Warranty Phase
   a. Completion of all outstanding deficiencies.
   b. Warranty Inspection (2 Month Prior to end of Warranty Period)
   c. Submission of final completion documentation.
   d. Final Completion.

1.5 MEETINGS

A. Section 01300 - Administrative Requirements: Requirements for progress meeting.

B. CONTRACTOR shall make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings.

C. Equipment Startup Meeting:
   1. Attendance Required: ENGINEER, OWNER, OWNER's facility operating personnel, CONTRACTOR, Subcontractors.
   2. Agenda:
      a. Designation of personnel representing parties for startup activities.
      b. Review startup process and responsibilities.
      c. Review startup plan and procedures.
      d. Review required startup submittals.
      e. Present initial startup schedule.

D. Pre-SAT Meeting:
   1. Attendance Required: ENGINEER, OWNER, OWNER's facility operating personnel, CONTRACTOR, Subcontractors.
   2. Agenda:
      a. Designation of personnel representing parties for Pre-SAT and SAT activities.
      b. Review Pre-SAT and SAT process and responsibilities.
      c. Review Pre-SAT and SAT plan and procedures.
      d. Review required Pre-SAT and SAT submittals.
      e. Present initial Pre-SAT and SAT schedule.

E. Deficiency Review Meeting:
   1. Attendance Required: ENGINEER, OWNER, Owner's facility operating personnel, CONTRACTOR, Subcontractors.
   2. Agenda:
      a. Review deficiencies.

b. Lessons learned meeting.
c. Confirm the start of the 14-day trouble free demonstration period.

F. OWNER handover meeting.

G. Warranty period deficiency review meeting (where required).

1.6 REPORTS

A. CONTRACTOR Startup and Performance Test Procedures: Develop test procedures including forms with the following information. Include completed documentation in operation and maintenance manuals.
1. System and equipment or component names.
2. Equipment location.
3. Unique test identification number and reference to unique verification checklist and startup documentation identification numbers for piece of equipment.
4. Date.
5. Project name.
6. Participating parties.
7. Reference to specification Section describing test requirements.
8. List specified parameters being verified.
9. Any formulas used in calculations.
10. Required pre-test field measurements.
11. Instructions for setting up test.
12. Special cautions, alarm limits, and safety concerns.
13. Specific step-by-step procedures to execute test, in clear, sequential, and repeatable format.
14. Acceptance criteria of proper performance with Yes/No check box to allow for marking whether or not proper performance of each part of test was achieved.
15. Section for comments.

B. CONTRACTOR shall submit all reports as required in the Contract Documents including but not limited to the following:
1. FAT Report.
2. Equipment Start-up Report.
3. Pre-SAT Report.
4. SAT Report.
a. All reports shall be submitted within two weeks of completion of testing.

1.7 SEQUENCING

A. Sequence work in accordance with OWNER's requirements and the requirements of the Contract Documents.

1.8 SCHEDULING

A. Section 01310 – Construction Progress Schedule.

B. Schedule work to allow adequate time for Testing and Commissioning activities.

C. Identify Testing and Commissioning milestones, activities, and durations on the Project schedule.
   1. Identify the following for each piece of equipment and system including:
      a. Operation and maintenance manual submittal.
      b. Manufacturer inspection and startup activities complete.
      c. Pre-SAT functional testing complete.
      d. SAT complete.
      e. Demonstration and training sessions.
      f. Completion of trouble free demonstration period.

1.9 PROGRESS SUBMITTALS

A. Section 01300 - Administrative Requirements: Requirements for progress submittals.

B. Qualifications Data: Submit the following prior to start of the Testing and Commissioning activities:
   1. Name of full time individuals assigned to the Project and assuming role as CT.

C. Submit a copy of the following reports and plans:
   1. FAT Reports.
   2. Startup Plan and Procedures.
   3. Pre-SAT Report.
   4. SAT Plan and Procedures.
   5. SAT Report.

D. The Pre-SAT report to include all required documentation listed in the Contract Documents including, but not limited, to the following for each component and system:
   1. CT's verification checklists with party responsible for each item indicated.
   2. Manufacturer's standard startup procedures copied from installation manuals.
   3. Manufacturer's standard field checkout sheets.
   4. Manufacturer's certificate of proper installation.
   5. Supplemental procedures and checklists prepared by equipment and system installers to accommodate Project conditions.
   6. Sensor and actuator calibration procedures.
   7. Include boxes or lines for recording and documenting checking and inspections of each procedure and summary statement with signature block at end of plan.

E. Submit written training plan for review and approval prior to conducting training including the following:
   1. Equipment included in training session.
   2. Location of training.
   3. Objectives.
   4. Subjects covered.
   5. Duration of training on each subject.
   6. Instructor for each subject.
   7. Instructional methods to be used.
   8. Training materials

1.10 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for closeout submittals.

B. Operation and maintenance data.

C. Final SAT Report.

1.11 QUALIFICATIONS

A. CT: Individual specializing in performing work of this Section.
   1. Responsible for successfully commissioning three facilities of similar complexity and systems in the past 5 years.
   2. Experienced in operation and troubleshooting mechanical and electrical systems, energy management control systems, and lighting controls systems.
   3. Knowledgeable in test and balance of air and water systems.
   4. Experienced in monitoring and analyzing system operation using energy management control system trending or stand-alone data logging equipment.
   5. Excellent verbal and written communication skills, highly organized and able to work with both management and installers.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 TESTING AND COMMISSIONING RESPONSIBILITIES

A. Responsibilities indicated for OWNER and ENGINEER are provided only to clarify Testing and Commissioning process.

B. ENGINEER Responsibilities:
   1. Perform Site observation of each system just before system startup.
   2. Clarify design intent of operation and control of commissioned equipment when Specifications, control drawings, or equipment documentation are not sufficient for writing detailed testing procedures.
   3. Coordinate resolution of design issues affecting system performance identified during commissioning.
   4. Coordinate resolution of system deficiencies identified during commissioning, according to the Contract Documents.
   5. Review operation and maintenance manuals.
   6. Review verification checklists for major pieces of equipment.
   7. Review startup functional test procedure forms for major pieces of equipment.

C. CONTRACTOR Responsibilities:
   1. Include all requirements for submittal data, operation and maintenance data, Testing and Commissioning tasks, and training in each purchase order and subcontract for equipment and systems to be commissioned.
   2. Require equipment and system installers to execute test to review and provide comments on functional test procedures.

3. Require manufacturers to review test procedures for equipment installed by manufacturer.
4. Provide all necessary temporary facilities, equipment, materials, and labour to complete all testing and commissioning activities.
5. Furnish qualified personnel to assist in completing Testing and Commissioning.
6. Ensure equipment and system installers execute Testing and Commissioning responsibilities according to the Contract Documents and schedule.
7. Coordinate and complete training of OWNER's personnel.
8. Prepare operation and maintenance manuals specified in Section 01 70 0. Update original sequences of operation reflecting actual installation.
9. Ensure equipment and system installers correct deficiencies and make necessary adjustments to operation and maintenance manuals and Project record documents.
10. Coordinate and direct startup, Pre-SAT, SAT, and commissioning activities.
11. Develop and coordinate execution of startup, Pre-SAT, and SAT plans. Revise plans to suit Project conditions.
12. Plan and conduct required meetings.
13. Write and distribute verification tests and checklists.
14. Develop startup plan in cooperation with ENGINEER, OWNER, and equipment and system installers.
15. Develop startup functional performance test procedures in cooperation with ENGINEER, OWNER, and equipment and system installers.
16. Document equipment and systems are installed and perform in accordance with design intent and the Contract Documents.
17. Notify OWENR and ENGINEER of deficiencies.
18. Develop operation and maintenance manuals.
19. Provide final SAT report.
20. Provide all required personnel including manufacturers' representatives to fully support all SAT activities including the SAT of the PLC and SCADA software with installed equipment and instrumentation.
21. Provide full SCADA system integration services.
22. Coordinate, witness, and approve manual functional performance tests performed by equipment and system installers.
    a. Coordinate re-testing until satisfactory performance is achieved.
    b. Perform actual functional testing on equipment as specified in equipment Sections.

D. OWNER Responsibilities:
1. Arrange for OWNER's personnel to attend Testing and Commissioning activities and training sessions according to startup, Pre-SAT, and SAT plans.

3.2 EXAMINATION

A. Section 01700 - Execution Requirements: Verification of existing conditions before starting work.

B. Verify that equipment and systems are installed in accordance with individual Sections.

3.3 DEFICIENCIES

A. Deficiencies:
1. OWNER and ENGINEER will record and report deficiencies to CONTRACTOR.

2. Minor deficiencies may be corrected during tests at OWNER’s and ENGINEER's discretion. Deficiency and resolution will be documented on procedure form.
3. Failure to attend scheduled startup, Pre-Sat, or SAT activities will be considered a deficiency.
4. When deficiency is identified the following procedure will be followed:
   a. OWNER and/or ENGINEER documents deficiency and CONTRACTOR's response.
   b. OWNER and/or ENGINEER submits deficiency report to CONTRACTOR.
   c. CONTRACTOR corrects deficiency; signs statement of correction on deficiency form certifying equipment is ready for re-testing and submits form to OWNER and ENGINEER.
   d. CONTRACTOR reschedules test and test is repeated until satisfactory performance is achieved.

B. Manufacturing Defects: When 10 percent, but not less than two identical pieces of equipment or equipment with only small size or capacity differences fail to perform to Contract Document requirements due to manufacturing defect, all identical units may be considered defective.
1. Within 1 week of notice, examine all other identical units and record findings. Submit findings within 2 weeks of original notice.
2. Within 2 weeks of original notification, provide signed and dated, written explanation of problem, cause of defect, and proposed solutions meeting Contract Document requirements. Include equipment submittals supporting solution.
3. OWNER will determine whether replacement or repair of all identical units is required.
4. Install two examples of proposed solution. Demonstrate installed solutions for up to 1 week, after which OWNER will decide if solution is acceptable.
5. Upon acceptance, replace or repair all identical items, at CONTRACTOR's expense. Extend warranty accordingly, when original equipment warranty had begun.
6. Complete repairs or replacements with reasonable speed beginning within 1 week from when parts can be obtained.

3.4 DEMONSTRATION

A. Section 01800 - Facility Operation: Requirements for demonstrating installed work.

B. Demonstrate equipment and systems and train OWNER's personnel as described below and specified in individual equipment and system specification Sections.
1. OWNER and ENGINEER will determine type and extent of training for each commissioned piece of equipment and system.
2. OWNER or ENGINEER will communicate training requirements to CONTRACTOR for benefit of equipment and system installers and manufacturers with training responsibilities.

C. ENGINEER will develop criteria for determining training was satisfactorily completed, including attending training sessions.

D. Demonstration period for all equipment and systems shall be 14 calendar days.

3.5 TRAINING

A. Course Materials: Provide sufficient written materials to support all demonstration and training sessions.

B. All materials provided for training shall conform to the following:
   1. Size: 8.5 by 11 inches.
   2. Paper: 20-pound minimum, white, for typed pages.
   3. Text: Manufacturer's printed data, or neatly word processed, and designed specifically for learning. Ample space for note-taking shall be provided.
   4. Double-sided.
   5. Drawings and Sketches:
   6. Provide a reinforced punched binder tab, bind in with text.
   7. Reduce larger drawings to not larger than 11 x 17 inches and fold to the size of the text pages.
   8. Use color prints to highlight key elements.

C. Cover to include:
   1. Contract number.
   2. Title of Project.
   3. Identity of the separate structure or system as applicable.
   4. Identity of the general subject matter covered in the manual.
   5. Locations or facility names.
   6. Publication date.
   7. Revision number.

D. Binders shall be:
   1. Commercial quality D-ring binders with durable and cleanable plastic covers.
   2. Maximum Post Width: 2 inches.
   3. When multiple binders are used, CONTRACTOR shall correlate the information into related consistent groupings and clearly number all volumes.

E. Video Training Material:
   1. The use of standard video materials will be considered provided it is professionally produced, and reviewed and approved by OWNER prior to its use. Videos shall be in DVD format and shall become the property of OWNER.
   2. The use of this material shall be viewed as an enhancement to the required face-to-face training and not as a substitute.
   3. OWNER reserves the right to record and re-broadcast all training sessions.
   4. CONTRACTOR shall provide a complete video recording of the entire training produced by a qualified professional hired by the CONTRACTOR. CONTRACTOR shall provide 5 DVDs of the completed training.

F. Required Training Session: Provide demonstration and training for the following equipment and systems as a minimum:
   1. Process valves and operators.
   2. Process pumps.
   3. Process mechanical systems.
   4. HVAC systems.
   5. Facility architectural systems.
   6. Process instrumentation.
   7. Electrical systems.
   8. SCADA systems.
   9. Safety Systems.

G. Provide sufficient demonstration to cover startup, operation, control, adjustment, calibration, troubleshooting, servicing, maintenance, and shutdown of all components of the Works.

H. Allow for three separate training sessions of OWNER's staff. Accommodate the shifts of OWNER's staff. CONTRACTOR shall verify with OWNER prior to scheduling of the training sessions. CONTRACTOR shall provide sufficient training materials for a minimum of 25 individuals from the OWNER's staff. Provide electronic copies of training materials at minimum two weeks in advance of scheduled training.

END OF SECTION

SECTION 02200

SITE PREPARATION

PART 1 GENERAL

1.1 SUMMARY

A. Removing surface debris.

B. Clearing and grubbing

C. Excavating topsoil.

D. Removing designated trees.

1.2 RELATED SECTIONS

A. Section 02320 – Rough Grading.

B. Section 02300 – Excavation and Backfilling.

C. Section 02345 – Rock Removal.

D. Section 02800 – Sedimentation and Erosion Control.

1.3 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. American Society for Testing and Materials (ASTM) International: ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).

1.4 PROGRESS SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for progress submittals.

B. Shop Drawings: Drawings clearly showing the clearing, grubbing, and stripping limits.

1.5 QUALITY ASSURANCE

A. Obtain approval from ENGINEER of all clearing, grubbing, and stripping limits prior to commencing any clearing, grubbing, and stripping.

1.6 SCHEDULING AND SEQUENCING

A. Prepare the Site only after adequate sedimentation and erosion controls are in place.

B. Clearing and grubbing operations shall be carried out as required within the limits of construction for the Site as shown on the Drawings.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that existing plant life designated to remain is tagged or otherwise identified.

3.2 PREPARATION

A. Coordinate with OWNER to complete utility locates and provide a minimum of 6 weeks written notice prior to performing work.
   1. Complete scanning and location of underground utilities marked within and the limits of construction.

B. Coordinate work with OWNER.

3.3 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Requirements for protecting installed work.

B. Locate, identify, and protect utilities designated to remain from damage including all required labour and materials.

C. Protect bench marks, survey control points, and existing structures from damage or displacement.

D. Control dust generation to avoid creating a nuisance in surrounding area.

3.4 REMOVALS

A. Remove all debris, rock, boulders, trash, and waste from the entire area within the limits of construction.

B. Clear and grub areas within excavations and areas to be graded to the limits as shown on the Drawings. Do not remove sod until after all clearing and grubbing is completed and debris removed.

C. Topsoil:
   1. Do not remove any topsoil until all scalping is completed.
   2. Strip areas within limits of the Site that are impacted by the Work and as shown on the Drawings. Do not remove any subsoil with the topsoil.
   3. Stockpile all stripped topsoil separately from any other excavated material. Cover topsoil with tarps and erect silt fences around the stockpiles. CONTRACTOR is to provide an estimate of the topsoil stripped and stockpiled at the Site.
   4. Where the topsoil piles are to be retained for a period exceeding three months, they shall be surface treated (pre-germinated seed and mulch) in order to prevent erosion.
   5. Dispose of any stripped material that is unsuitable for topsoil.

D. Designated Tree Removal:
   1. Cut off trees, stumps, roots, brush, and other vegetation in areas designated to be cleared, to a mine of 450 mm below final grade.
   2. Remove trees and shrubs as shown on the Drawings. Remove stump and main root ball.
   3. Chip or remove and dispose of trees, logs, and branches from site.

E. Fences:
   1. CONTRACTOR shall be responsible for erecting temporary barriers and fencing required in order to maintain Site security and protect OWNER personnel and the public to the satisfaction of OWNER.
   2. Upon the completion of the Work, restore all areas impacted by temporary barriers and fencing to their pre-construction condition or better and to the approval of ENGINEER.

F. Continuously clean up and remove waste materials from the Site; do not allow waste materials to accumulate.

G. Do not burn or bury waste materials on Site. Leave the Site in clean condition.

END OF SECTION

SECTION 02222

DEMOLITION AND REMOVALS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Demolishing and removal of designated materials, structures, equipment, wiring, conduit, and fixtures shown on the Drawings.

B. Dismantling, cutting and alterations for completion of work.

C. Disposal of materials.

D. Salvage Items Removing designated items for OWNER's retention.

E. Protecting items designated to remain.

F. Storage of removed materials.

G. Identification of PCB wastes, including:
   1. PCB containing light ballasts.

H. Removal of all lighting, luminescent signs, fluorescent light ballasts, and battery powered emergency lighting.

I. Removal of mercury-containing devices.

J. Lead Paint Management.

K. Asbestos Containing Materials

1.2 DEFINITIONS

A. Competent Person: A person, as defined under OHSA, who:
   1. Is qualified because of his knowledge, training, and experience to organize the work and its performance.
   2. Is familiar with the provisions of OHSA and the regulations that apply to the work.
   3. Has knowledge of any potential or actual danger to health or safety in the workplace.

B. Competent Worker: Means a worker who:
   1. Is qualified because of knowledge, training and experience to perform the work,
   2. Is familiar with OHSA and with the provisions of the regulations that apply to the work.
   3. Has knowledge of all potential or actual danger to health or safety in the work.

C. HEPA Filter: A high efficiency particulate aerosol filter that is at least 99.97 percent efficient in collecting a 0.3 aerosol.

D. ACM: Material containing 0.5 percent or more asbestos by dry weight.

E. Amended Water: Water to which an asbestos specific surfactant has been added to increase the ability of the liquid to penetrate ACM.

F. Asbestos:
   1. Any of the following fibrous silicates: actinolite, amosite, anthophyllite, chrysotile, crocidolite, or tremolite.

G. Type 1 Asbestos Work:
   1. Installing or removing ceiling tiles that are ACM, if the tiles cover an area less than 7.5 m^2 and are installed or removed without being broken, cut, drilled, abraded, ground, sanded, or vibrated.
   2. Installing or removing non friable ACM, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded, or vibrated.
   3. Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non friable ACM if:
      a. The material is wetted to control the spread of dust or fibers.
      b. The work is done only by means of non-powered hand held tools.
      c. Removing less than 1 m^2 of drywall in which joint filling compounds that are ACM have been used.

H. Type 2 Asbestos Work:
   1. Removing all or part of a false ceiling to obtain access to a work area, if ACM is likely to be lying on the surface of the false ceiling.
   2. The removal or disturbance of 1 m^2 or less of friable ACM during the repair, alteration, maintenance, or demolition of all or part of machinery or equipment or a building, aircraft, locomotive, railway car, vehicle, or ship.
   3. Enclosing friable ACM.
   4. Applying tape or a sealant or other covering to pipe or boiler insulation that is ACM.
   5. Installing or removing ceiling tiles that are ACM, if the tiles cover an area of 7.5 m^2 or more and are installed or removed without being broken, cut, drilled, abraded, ground, sanded, or vibrated.
   6. Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non-friable ACM, if:
      a. The material is not wetted to control the spread of dust or fibers.
      b. The work is done only by means of non-powered hand-held tools.
   7. Removing 1 m^2 or more of drywall in which joint filling compounds that are ACM have been used.
   8. Breaking, cutting, drilling, abrading, grinding, sanding, or vibrating non-friable ACM if the work is done by means of power tools that are attached to dust-collecting devices equipped with HEPA filters.
   9. Removing insulation that is ACM from a pipe, duct, or similar structure using a glove bag.
   10. Cleaning or removing filters used in air handling equipment in a building that has sprayed fireproofing that is ACM.
   11. An operation that:
      a. Is not mentioned in any of Paragraphs 1.3 B.5.a to 1.3 B.5.k.
      b. May expose a worker to asbestos.
      c. Is not classified as a Type 1 or Type 3 operation.

I. The following provisions apply if a dispute arises as to the classification of an operation under this Section:
   1. Notify an inspector at the office of the Ministry of Labour nearest the workplace of the dispute and obtain resolution.

J. Disposal Bag: 6-mil thick leak-tight plastic bags used for transporting asbestos waste from work area to disposal site and labeled as specified herein.

K. Encapsulation: The application of a sealant to ACM. The sealant may penetrate and harden the material (penetrants) or cover the surface with a protective coating (bridging sealants).

L. Friable: Capable of being crumbled, pulverized, or reduced to powder by hand pressure.

M. Examine: Carry out procedures according to Section 3 of O. Reg. 278 to establish materials asbestos content and type of asbestos.

N. Wet Cleaning: The process of eliminating asbestos contamination from building surfaces and objects by using cloths, mops, or other cleaning utensils which have been dampened with Amended Water or diluted removal encapsulant, and afterwards thoroughly decontaminated or disposed of as asbestos-contaminated waste.

1.3 PROGRESS SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for progress submittals.

B. Prior to commencement of works, submit a Demolition Plan which shall include demolition procedures, sequencing, scheduling, safety measures, and contingency plans.

C. Shop Drawings:
1. Indicate demolition and removal sequence.
2. Indicate location of items designate for reuse and OWNER's retention.
3. Indicate location and construction of temporary work.

D. Operating Licenses and Permits:
1. Include copies of valid operating licenses and permits for each proposed disposal facility 3 days prior to commencing the transportation of materials from the Site.
2. Include copies of valid operating licenses and permits from each transporter for each proposed transport vehicle/container 3 days prior to entry to the Site.

E. Lead Paint Management Plan:
1. Prior to mobilization to Site, submit a Lead Paint Management Plan for review to ascertain compliance with the requirements specified. Include the following information:
2. Procedures, schedules, and CONTRACTOR's drawings, as applicable.
3. Health and safety procedures required for safe handling, storage, and disposal of all painted materials as a Type 1 Operation.
4. Measures to be implemented to prevent releases of lead paint to the environment and final Site cleanup after completion of demolition activities.
5. Proposed scrap metal recycling and other disposal facilities and documentation that the facilities are permitted to accept and will accept metal and other materials with lead paint.
    a. Provide required scrap metal or waste characterization sampling and analysis required by recycling and disposal facilities to obtain acceptance for receiving materials.

F. Asbestos Removal Work Plan: Prior to mobilization to the Site, submit a detailed Asbestos Removal Work Plan prepared according to O. Reg. 278. Include types and methods to conduct specified ACM abatement activities, location and layout of containment areas, layout of decontamination areas, sequencing of asbestos related work, details of air monitoring plan,

methods to be used to assure the safety of building or area occupants and visitors to the Site, waste handling, storage, and loading plan, including the name and location of permitted disposal site for ACM and general debris, type of wetting agent and asbestos sealer to be used, and a description of the method to be employed in order to control pollution.

G. Asbestos Notices:
   1. Required by federal, provincial, and local regulations together with proof of timely transmittals to agencies requiring the notice.
   2. Send written notification prior to beginning the Works to regulatory authority.
   3. Include the following information in the notification:
      a. Name and address of OWNER or operator and CONTRACTOR.
      b. Description of facility being demolished or renovated, including size, age, and prior use of the facility.
      c. Summary of Asbestos Survey, including estimate of the approximate amount of friable and non-friable ACM present in the facility in terms of linear metres of pipe, and surface area on other facility components based on the Asbestos Survey conducted by CONTRACTOR.
      d. Location of the facility being demolished or renovated.
      e. Scheduled starting and completion dates of demolition or renovation.
      f. Nature of planned demolition or renovation and method(s).
      g. Procedures to comply with the requirements of O. Reg. 278.
      h. Name and location of waste disposal site where ACM will be deposited.

H. Each disposal facility shall disclose the name and telephone number of the contact at the lead agency responsible for the disposal facility primary permits who has knowledge of, and can verify, the existence of existing corrective action programs which may impact the ability of the disposal facility to accept materials from the Site.

I. Shipping and Disposal Documents: Include completed copies of shipping and disposal documents including manifests and/or bills of lading waste profiles on standard approved forms, including a copy of each form signed by the transporter prior to leaving the Site and a copy of each form signed by the disposal facility accepting the shipment.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Accurately record actual locations of capped utilities, concealed utilities and subsurface obstructions discovered during demolition operations.

1.5 REGULATORY REQUIREMENTS

A. Conform to the following codes for demolition work, dust control, and products requiring electrical disconnection:
   1. Ontario Building Code.
   2. Ontario Health and Safety Act.
   3. Electrical Safety Authority.
   4. Waste Management:
      a. O. Reg. 347 - General - Waste Management.
      b. O. Reg. 362 - Waste Management PCBs.
      c. Guidelines for the Management of Wastes Containing PCBs.

d. Ontario (R.R.O.) 1990, Chapter D.1 - Dangerous Goods Transportation Act.
e. O. Reg. 490 - Designated Substances.
f. O. Reg. 213/91, amended to O. Reg. 628/05 - Construction Projects.
g. O. Reg. 278/05 - Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations - made under the Occupational Health and Safety Act.
h. R.R.O. 1990, Regulation 837, amended to O. Reg. 279/05 and as amended by O. Reg. 509/92, O. Reg. 386/00, and O. Reg. 103/04 - Designated Substance - Asbestos - made under the Occupational Health and Safety Act.
i. Guideline C-6 (formerly 14-07) Handling, Transportation and Disposal of Asbestos Waste in Bulk - made under the Environmental Protection Act, RSO 1990, Section 27, O. Reg. 347, Section 17, April 1994.
j. MOL Guideline: Lead on Construction Projects - 2011

1.6 EXISTING CONDITIONS

A. Conduct demolition to minimize interference with adjacent building areas.

B. Cease operations immediately if structure appears to be in danger and notify ENGINEER. Do not resume operations until directed.

C. For the purposes of maintenance, renovation, or demolition activities all existing paint on the site shall be treated as containing lead (i.e., lead based paint).

D. Silica is present in concrete walls and concrete floors and foundations of the building. The Guideline for Silica on Construction Projects by the Ontario Ministry of Labour (MOL) dated April 2011 should be used to develop appropriate procedures to implement during maintenance, renovation or demolition activities which disturb silica containing materials and may generate silica containing dust.

E. Each light ballast shall be removed as if it contains polychlorinated biphenyls (PCBs) as part of maintenance, renovation or demolition activities, and if it cannot be confirmed that the ballasts do not contain PCBs, the ballasts shall be conservatively handled and disposed in accordance with O. Reg. 362/90 Waste Management - PCBs and O. Reg. 347/90 General Waste Management.

F. Man-made mineral fibre materials are present in fibreglass mechanical pipe insulation. Measures shall be taken to control man-made mineral fibre dust hazard when the potential for creating airborne man-made mineral fibre-containing dust arises from such processes as renovation or demolition. The Guideline for Silica on Construction Projects (MOL, April 2011) shall be used to develop appropriate procedures to implement during maintenance, renovation or demolition activities that will disturb man-made mineral fibre materials.

G. Mercury in small quantities is assumed to be present in electrical switches, water level switches, and thermostats on Site. Fluorescent light bulbs are assumed to contain small quantities of mercury vapor.

H. Flange gaskets shall be removed as if the contain Asbestos.

I. The forcemain piping material is asbestos cement and shall be cut, modified, and removed according to the regulatory requirements and the requirements of the Contract documents.

J. All paint shall be assumed to be lead containing paint.

K. Refer to the report “Designated Substance Survey Report for the Bruce Power Sewage Processing Plant.

1.7 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Coordinate and sequence demolition so as not to cause shutdown of operation of surrounding areas.

C. Coordinate utility and service interruptions with OWNER.
   1. Do not disable or disrupt fire or life safety systems without 10 days prior written notice and written approval from OWNER.
   2. Schedule tie-ins to existing systems to minimize disruption.
   3. Coordinate work to ensure fire alarms, smoke detectors, emergency lighting, exit signs, and other life safety systems remain in full operation in occupied areas. Provide, maintain and remove any and all temporary lighting and emergency lighting if existing lighting cannot be maintained.

D. Shutdown Periods:
   1. Arrange timing of shutdown periods of panels in service with ENGINEER. Do not shutdown any utility or existing panels without prior written approval from ENGINEER. Provide a minimum of 3 weeks written notice for all shutdowns prior to the start of the works.
   2. Keep shutdown period to minimum or use intermittent period as directed by ENGINEER.

E. Identify salvage items in cooperation with OWNER. OWNER retains the first right of refusal for all items to be removed from the Site.

1.8 AMBIENT CONDITIONS

A. Do not spill, leak, or otherwise release materials from work areas. Do not allow paint flakes to migrate from work areas.

B. Do not generate dust migrating outside of work areas.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT (LEAD MANAGEMENT)

A. Make materials and equipment required to complete the Project available on Site. Submit a description of the materials and equipment required, including material safety data sheets for material brought on Site to perform the Works.

B. Expendable Supplies: Submit a description of the expendable supplies required.
   1. Polyethylene Bags:
      a. Disposable Bags:
         1) Polyethylene plastic, minimum 0.15 mm thick, or 0.1 mm thick if double bags are used; or other thick plastic material shown to demonstrate at least equivalent performance.
         2) Capable of being made leak-tight. Leak-tight means that solids, liquids, or dust cannot escape or spill out.
   2. Polyethylene Leak-tight Wrapping:
      a. Wrapping Used to Wrap Lead-contaminated Debris: Polyethylene plastic, minimum 0.15 mm thick; or other thick plastic material shown to demonstrate at least equivalent performance.
   3. Polyethylene Sheeting:
      a. Polyethylene plastic, minimum 0.15 mm thick; or other thick plastic material shown to demonstrate at least equivalent performance.
      b. Provide in the largest sheet size reasonably accommodated by the Project to minimize the number of seams.
      c. Where the Project location constitutes an out of the ordinary potential for fire, or where unusual fire hazards cannot be eliminated, provide flame-resistant polyethylene sheets conforming to the requirements of NFPA 701.
   4. Tape and Adhesive Spray:
      a. Capable of sealing joints between polyethylene sheets and for attachment of polyethylene sheets to adjacent surfaces. After dry application, tape or adhesive shall retain adhesion when exposed to wet conditions, including Amended Water.
      b. Size: Minimum 50 mm wide, industrial strength.
   5. Containers: Leak-tight and labeled according to OHSA standards.
   6. Signage: Warning signs indicating lead hazard in work area and restricted access.
   7. Detergents and Cleaners:
      a. Trisodium phosphate free.
      b. Demonstrated effectiveness in lead control work using cleaning techniques.

2.2 MATERIALS AND EQUIPMENT (ASEBESTOS MANAGEMENT)

A. Disposal Bags: Minimum 1.5 mm thick leak-tight polyethylene.

B. Reinforced Polyethylene Sheet:
   1. Minimum 1.5 mm thick, translucent, nylon reinforced, laminated, flame resistant, polyethylene film.
   2. Largest size possible to minimize seams.

C. Waste Containers: Contain waste in two separate containers.
   1. Inner Container: 1.5 mm thick sealable polyethylene bag or, where the glove bag method is used, the glove bag itself.
   2. Outer container: Sealable metal or fiber type drum where there are sharp objects included in the waste material; otherwise the outer container may be sealable metal or fiber type drum or a second 1.5 mm thick sealable polyethylene bag.
   3. Waste containers shall have a preprinted cautionary asbestos warning, in both official languages, clearly visible when ready for removal to the disposal site.

D. Tub (Roll-off Box) Liner:
   1. For Bulk Solid Shipments of Non-friable Floor Tile, Linoleum, and Mastic: Pre-manufactured fitted polyethylene tub liner or continuous single sheet of polyethylene sheeting at least 1.5 mm thick and sufficiently durable to ensure that punctures or tears do not develop during handling, transportation, and disposal.

E. Duct Tape: In 75 mm widths with an adhesive which is formulated to aggressively stick to sheet polyethylene.

F. Spray Adhesive: Spray adhesive in aerosol cans which is specifically formulated to stick tenaciously to sheet polyethylene.

G. Wetting Agents:
   1. Amended Water or a removal encapsulant.
   2. For Amended Water, provide water to which a surfactant has been added.
   3. A mixture of surfactant and water which results in wetting of ACM and retardation of fiber release during disturbance of the material.

H. Glove Bag:
   1. Safe-T-Strip bags, or approved equivalent, and equipped with a tool pouch, latex gloves with sleeve collars, or molded attachment to bag, and provisions for spray wand and HEPA vacuum connections. Provide supports for bag as necessary to prevent separation due to weight of wet debris falling into the bag.
      a. Thickness: 1.5 to 3 mm.

I. Signage/Labels:
   1. Provide signage/warning notices in conspicuous locations and at work area entry points indicating that asbestos work is in progress and that respiratory protection is required, and as otherwise required by federal, provincial, and local regulations.
   2. Package and label removed ACM according to federal, provincial, and local regulations.
   3. Individually label each bag or separately wrap ACM according to applicable regulations, guidelines, and policies as specified in PART 1, REFERENCES. At a minimum, label each item with three labels with text as follows:
      a. First Label:

CAUTION

CONTAINS ASBESTOS FIBERS

AVOID OPENING OR BREAKING CONTAINER

BREATHING ASBESTOS IS HAZARDOUS TO YOUR HEALTH

b. Second Label:

DANGER

CONTAINS ASBESTOS FIBERS

AVOID CREATING DUST - CANCER AND LUNG DISEASE HAZARD

BREATHING AIRBORNE ASBESTOS, TREMOLITE,

ANTHOPHYLLITE, OR ACTINOLITE FIBERS

IS HAZARDOUS TO YOUR HEALTH

c. Third Label:

THIS MATERIAL REMOVED FROM:

BUILDING _____

LOCATION _____

DATE _____

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify with ENGINEER all items designated for demolition and removal.

C. Verify salvage items in cooperation with OWNER.

D. Verify that surfaces and the Site conditions are ready for demolition and removal work.

E. Verify termination points for demolished services.

F. Verify that the temporary storage area is prepared to receive anticipated waste generated prior to disposal.

3.2 PREPARATION

A. Field verify the location of all above grade and below grade utilities including termination points prior to the commencement of demolition and removals. Coordinate with OWNER to complete scanning and marking of all below grade utilities.

B. Notify affected OWNER before starting work and comply with their requirements.

C. Erect, and maintain temporary safeguards for protection of the public, OWNER, ENGINEER, CONTRACTOR's employees, and existing utilities and items to remain including all required labour and materials.

D. Do not close or obstruct egress width to any building or the Site exit.

E. Protect existing materials and structures which will not be demolished.

F. Prevent movement of structure; provide all required bracing and shoring.

G. Mark location and termination of utilities.

H. Provide appropriate temporary signage including signage for access and egress.

I. Provide ventilation of equipment exhaust to the exterior of the structures.

J. Erect and maintain weatherproof closures for exterior openings.

K. Erect and maintain dust control equipment and procedures. Protect all panels and equipment designated to remain or salvage from dust throughout the demolition and removals work.

L. Obtain and maintain a mercury spill kit in each area where mercury-containing devices may be handled by CONTRACTOR.

3.3 DEMOLITION AND REMOVALS

A. Maintain protected egress from and access to the Site and stations at all times.

B. Do not close or obstruct roadways or access ways without OWNER written approval.

C. Cease operations immediately when structure appears to be in danger and notify ENGINEER.

D. Cap and identify abandoned utilities at termination points when utility is not completely removed. Annotate record drawings indicating location and type of service for capped utilities remaining after demolition.

E. Disconnect, remove, and identify designated utilities within demolition areas.

F. Demolish in an orderly and careful manner. Protect existing supporting structural members and equipment to remain.

G. Demolition and removal drawings are based on field observation and existing record documents. Report discrepancies to ENGINEER before disturbing existing installation.

H. Remove all existing exposed conduit and wiring. Cut conduit flush with walls and floors as required and patch surfaces.

I. Remove all existing conduit, wire, boxes, and fastening devices. Avoid any interference with new installation.

J. Reconnect equipment being disturbed by the works and required for continued service.

K. Disconnect or shut off service to areas where electrical work is to be removed. Remove electrical fixtures, equipment, and related switches, outlets, conduit, and wiring which do not form part of the final constructed works.

L. Install temporary wiring and connections to maintain existing systems in service during construction.

M. Perform work on energized equipment or circuits with experienced and trained personnel.

N. Repair adjacent construction and finishes damaged during demolition and extension work.

O. Remove exposed abandoned grounding and bonding components, fasteners and supports, and electrical identification components. Cut embedded support elements flush with walls and floors.

P. Clean and repair existing equipment to remain.

Q. Remove demolished materials from the Site except where specifically noted otherwise. Do not burn or bury materials on the Site.

R. Remove materials as work progresses. Upon completion of work, leave areas in clean condition.

S. Remove temporary work.

3.4 LIGHTING REMOVAL

A. Remove fluorescent light tubes and high intensity lamps from all fixtures.

B. Segregate fluorescent light tubes by length.

C. Package fluorescent light tubes and high intensity lamps in cardboard boxes acceptable to the storage or recycling facility to which they will be sent.

3.5 LUMINESCENT SIGN REMOVAL

A. Remove fluorescent light tubes/bulbs from all luminescent signs (i.e., exit signs).

B. Package fluorescent light tubes in cardboard boxes acceptable to the storage or recycling facility to which they will be sent.

3.6 FLUORESCENT LIGHT BALLASTS REMOVAL

A. Remove fluorescent light ballasts from fixtures.

B. Inspect labeling on light ballasts to identify year of manufacturer and/or the presence of a "No PCB" label.

C. Containerize and store fluorescent light ballasts suspected to contain PCBs in a steel drum(s) in accordance with the regulations listed in Article 1.5.

D. Label and identify the date of removal of light ballasts on drums. Comply with all other marking requirements of the regulations listed in Article 1.5.

E. Store all removed fluorescent light ballasts on Site in preparation for their transportation to a registered storage facility.

3.7 BATTERY POWERED EMERGENCY LIGHTING REMOVAL

A. Remove batteries from emergency lighting.

B. Identify the type of battery – Lead Acid or Nickel Cadmium.

C. Containerize batteries in approved steel drums.

D. Label drums for disposal.

3.8 MERCURY-CONTAINING DEVICES REMOVAL

A. Locate mercury-containing devices.

B. Remove the mercury-containing component from each device, as applicable. Assess each component for damage or leaks.

C. If the mercury-containing component is not damaged or leaking, place the component in a sealable, non-leaking plastic container. If the mercury-containing component is damaged or leaking, place the entire device in a sealable, non-leaking plastic container.

D. Remove any mercury-containing sludges or buildup from the inside of the device, any surrounding equipment or flooring, using a hand-held scraper. Place the sludges in a sealable, non-leaking plastic container. Dispose of the entire device, if necessary.

E. Clean any surrounding contaminated equipment and any surrounding contaminated flooring.

F. Label all containers prior to, or at the time of, their removal. Recyclable mercury containers with mercury sludges or residue waste destined for disposal should be identified as hazardous waste.

G. Mercury contaminated materials, including personal protection equipment, shall be containerized and stored to satisfy the regulations listed in Article 1.5. Mercury contaminated materials and sealable, non-leaking plastic containers containing mercury, shall be placed in secondary, sealable, non-leaking containers approved for shipment. Label all containers appropriately.

3.9 LEAD-BASED PAINT REMOVAL

A. PREPARATION
   1. Establish work zones and install dust barriers as required.
   2. Containment: Plastic sheeting, portable partitions, colored caution tape, roped-off boundary perimeter, using caution tape or a barrier installed at ENGINEER approved distance from where the lead management work is performed and/or the property line.

3. Place 0.15 mm plastic sheeting in areas where lead paint flakes shall be generated such that all lead debris will be captured. Overlap all layers of plastic sheeting by a minimum of 300 mm.
4. Establish a decontamination area outside of work are as required.
5. Remove all miscellaneous trash and general debris from inside the exclusion zone to prevent contamination with lead paint. Dispose of such waste with general municipal waste in approved containers.
6. Operate equipment within the lead management area in a manner that will minimize migration of lead paint flakes and dust beyond the lead management area boundaries.

B. LEAD PAINT REMOVAL
1. Before or during demolition activities conduct lead paint removal activities described in CONTRACTOR's Lead Paint Management Plan.
2. Upon completion of demolition activities and removal of all scrap metal and waste conduct HEPA vacuuming to collect loose paint flakes or paint dust in work area.

C. Transportation and disposal of Lead contaminated waste shall be in accordance with Section 02612 - Transportation and Disposal.

3.10 ASBESTOS ABATEMENT

A. Procedures for Type 1 and Type 2 Operations: In accordance with O.Reg 278

B. Proceed with asbestos abatement work only after all submittals have been completed and the approval of OWNER/ENGINEER has been obtained. Prior to commencing asbestos removal work in each area, CONTRACTOR shall perform jointly with ENGINEER a detailed inspection to ensure all requirements have been met.

C. Remove asbestos in accordance with the approved Asbestos Removal Work Plan and the applicable regulations listed in this Section.

D. Before beginning work, at each access to work areas, install warning signs reading as follows, or equivalent: "Caution Asbestos Hazard Area/No Unauthorized Entry/Wear Assigned Protective Equipment/Breathing Asbestos Dust May Cause Serious Bodily Harm".

E. Before beginning work, remove visible dust from surfaces in the work area where dust is likely to be disturbed during the course of the work. Use a HEPA vacuum, or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate. Do not use compressed air to clean up or remove dust from any surface.

F. Prevent the spread of dust from the work area using measures appropriate to the Works to be done. Use reinforced polyethylene drop sheets over flooring such as carpeting that absorbs dust and over all flooring in work areas where dust or contamination cannot otherwise be safely contained. Erect an enclosure of polyethylene sheeting around the work area, when removing ACM from piping or equipment and the "glove-bag" method is not used.

G. Other than loose material which shall be removed by HEPA vacuum, friable material containing asbestos to be removed or disturbed shall be thoroughly wetted before and during work unless wetting creates a hazard or causes damage. Use a garden reservoir type low velocity fine mist sprayer. Perform work in a manner to reduce dust creation to the lowest levels practicable.

H. Where practicable keep dust and waste containing asbestos wet.

I. Procedures to be followed when using glove bags are outlined in the document entitled, Designated Substances in the Workplace: A Guide to the Regulation respecting Asbestos on Construction Projects and in Buildings and Repair Operations, MOL, May 2011.

J. Remove or clean up ACM in small sections to prevent excessive exposure potentials. Place removed materials including plastic sheeting, tape, cleaning materials, clothing, and other disposable materials or items used on the Site in minimum 1.5 mm thick plastic bags, sealed and labeled for disposal.

K. Cleanup:
   1. Frequently during the work and immediately after completion of the Works clean up dust and waste containing asbestos using a HEPA vacuum or by damp mopping.
   2. Place dust and waste containing asbestos in sealed dust-tight waste bags.
   3. Immediately before their removal from the work area, and disposal, clean each filled waste bag using damp cloths or a HEPA vacuum and place in a second clean waste bag.
   4. Seal, label, and remove double-bagged waste from the Site. Dispose of it in accordance with the requirements of provincial and federal authorities having jurisdiction.
   5. Perform a final thorough cleanup of the work areas and adjacent areas affected by the Works using a HEPA vacuum or damp wiping.

L. ACM Holding Area: Provide an on-Site secure temporary ACM holding area at locations selected by CONTRACTOR. Obtain OWNER's and ENGINEER's approval for such areas prior to their use for ACM holding.

M. Wet Removal:
   1. To the maximum extent possible, use wet methods to remove ACM.
   2. Apply a fine spray of Amended Water and/or removal encapsulant to prevent fiber releases during removal. Sufficiently saturate ACM to prevent emission of airborne fibers in excess of applicable exposure standards. At a minimum, apply Amended Water and/or removal encapsulant in accordance with the manufacturer's written instructions.
   3. Accomplish wetting by a fine spray (mist) of Amended Water or removal encapsulant. Saturate the material sufficiently to wet the substrate without causing excess dripping. Allow sufficient time for water or removal encapsulant to penetrate the material thoroughly. If Amended Water is used, spray the material repeatedly during the work process to maintain a continuously wet condition. If a removal encapsulant is used, apply it in strict accordance with the manufacturer's written instructions. Carefully perforate the outer covering of any installation which has been painted and/or jacket in order to allow the penetration of Amended Water or removal encapsulant or, where necessary, carefully strip away the covering while simultaneously spraying Amended Water or removal encapsulant on the installation in order to prevent fiber release.
   4. Mist work areas with Amended Water and/or removal encapsulant whenever necessary to prevent fiber release.
   5. Remove saturated ACM in small sections from all areas. Do not permit ACM to dry out. As it is removed, pack the material simultaneously, while still wet, into disposal bags. Twist, bend over, and seal the neck of each bag with a minimum of 3 wraps of duct tape. Place the bag into another bag.
   6. Equip power tools with HEPA filtered dust collection device.
   7. Cease using power tools if visible dust escapes from HEPA filtered dust collection device.

N. Bulk Removal:
   1. Adequately wet ACM to be removed with Amended Water or install leak-tight seal around entire surface of equipment, piping, and structural feature. Triple wrap polyethylene

sheeting around piping to be removed and adequately seal both ends with encapsulant and three wraps of duct tape.
2. Suspend pipe section by sufficient means and methods to prevent uncontrolled falling of pipe section during removal and to allow pipe section to be safely removed.
3. Install leak-tight seals on each end of pipe section and safely move onto transport vehicle.

3.11 TRANSPORTATION AND OFF-SITE DISPOSAL

A. Comply with DGTA, and Laws and Regulations, including those relating to containers, markings, and PCB waste transportation requirements.

B. Transportation of lead contaminated and other contaminated materials shall comply with the requirements of Section 02612 - Transportation and Disposal.

C. Do not change the transporter, the route of transportation, or the storage facility without OWNER's prior written approval.

D. CONTRACTOR is fully responsible for cleaning up any spills or other releases of materials during all loading and unloading operations or while in transit from the Site to a disposal facility.

E. CONTRACTOR shall be responsible for, and do all work necessary to ensure that materials removed from the Site are properly prepared and will be accepted by the disposal facility.

F. Transport and dispose of all materials at a registered waste site in accordance with the regulations of Article 1.5.

G. Segregate and prepare materials for transportation and disposal in accordance with the delivery acceptance requirements of the transporter and disposal/recycling facility.

H. Transport material removed from the Site directly to the disposal facility approved by OWNER. Do not change either the route or mode of transport after commencing off-Site operations without OWNER's prior written approval. Follow OWNER's procedures.

I. Materials shall be transported using vehicles licensed for the waste stream being transported.

J. Dispose of non-hazardous liquid and solid wastes at a disposal facility appropriately licensed to receive non-hazardous liquid and solid wastes.

3.12 SALVAGE REQUIREMENTS

A. Coordinate with OWNER to identify building components and equipment required to be removed and delivered to OWNER.

B. Tag components and equipment OWNER designates for salvage.

C. Protect designated salvage items from demolition operations until items can be removed.

D. Carefully remove components and equipment designated to be salvaged.

E. Disassemble as required to permit removal from station.

F. Package small and loose parts to avoid loss.

G. Mark equipment and packaged parts to permit identification and consolidation of components of each salvaged item.

H. Prepare assembly instructions consistent with disassembled parts. Package assembly instructions in protective envelope and securely attach to each disassembled salvaged item.

I. Deliver salvaged items to OWNER. Obtain signed receipt from OWNER.

3.13 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning.

B. Remove demolished materials as work progresses. Legally dispose.

C. Keep workplace neat.

3.14 CONTRACTOR USE OF SITE

A. Construction Operations: Limited to areas noted on the Drawings. Do not unreasonably encumber the Site with equipment or materials.

B. OWNER will continue to occupy the site for the duration of Construction. Operation of the wastewater pumping station shall take precedence over all Construction activities. Continuous wastewater pumping service shall be maintained at all times during Construction.

C. Hours of Operation: Limit on-Site hours of operation, including trucking hours, to the hours of 7 a.m. to 5 p.m., Monday to Friday, unless otherwise approved in writing by OWNER. Operations on Saturdays, Sundays, or Statutory holidays will not be permitted, unless approved by OWNER.

D. When unfavorable weather or other unsuitable construction conditions exist, continue operations which will not be adversely affected by such conditions. Do not construct or cause to be constructed any portion of the Works under conditions which would adversely affect the quality of the Works, unless special means or precautions are taken to perform the Works in a proper and satisfactory manner.

END OF SECTION

SECTION 02300

EXCAVATION AND BACKFILLING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section includes all work and items necessary to perform, for the purpose of constructing structures, conduits, pipelines, grading, and other facilities required to complete the work of this Contract including the following:
   1. Excavation.
   2. Backfill.
   3. Disposing of materials.
   4. All temporary means needed to prevent discharge of sediment to watercourses because of dewatering systems or erosion.

B. No classification of excavated materials will be made. Excavation includes all materials regardless of type, character, composition, moisture, or condition thereof.

C. Related Sections:
   1. Section 02222 Demolition and Removals
   2. Section 02345 Rock Removal
   3. Section 02701 Aggregates

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Definitions:
   1. Excavatable Flowable Fill: Lean cement concrete fill used where future excavation may be required such as fill for utility trenches and culverts.
   2. Non-excavatable Flowable Fill: Lean cement concrete fill used where future excavation is not anticipated such as fill below structure foundations and filling abandoned utilities.
   3. Utility: Any buried pipe, duct, conduit, manhole, tank or cable.

C. ASTM International:
   1. ASTM A36/A36M - Standard Specifications for Carbon Structural Steel.
   2. ASTM A328/A328M - Standard Specification for Steel Sheet Piling.
   3. ASTM C117 - Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.
   4. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   5. ASTM D422 - Standard Test Method for Particle-Size Analysis of Soils.
   6. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).
   7. ASTM D1556/D6938 - Density of Soil in Place by the Sand-Cone Method, or Nuclear Method.
   8. ASTM D1557M - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

9. ASTM C33 - Standard Specification for Concrete Aggregates.
10. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
11. ASTM C150 - Standard Specification for Portland Cement.
12. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
13. ASTM C403/C403M - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance.
14. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
15. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
16. ASTM C1017/C1017M - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
17. ASTM C1040 - Standard Test Methods for Density of Unhardened and Hardened Concrete In Place By Nuclear Methods.
18. ASTM D4832 - Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.

D. Canadian Institute of Steel Construction (CISC).

E. Ontario Provincial Standard Specifications (OPSS).

F. Canadian General Standards Board (CAN/CGSB).

1.3 DEFINITIONS

A. SMDD: Standard Maximum Dry Density and in the context of this Contract means the maximum dry unit weight determined according to ASTM D698.

B. Unsuitable Materials:
   1. Weak, chemically unstable, and compressible materials.
   2. Frost Susceptible Materials:
      a. Fine grained soils with plasticity index less than 10 when tested according to ASTM D4318; gradation within limits specified when tested according to ASTM D422 and ASTM C136; and sieve sizes according to CAN/CGSB 8.1, CAN/CGSB 8.2M.

Sieve Designation (inches [mm])	**Percent Passing**
0.08 (2.00)	100
0.004 (0.10)	45 – 100
0.0008 (0.02)	10 – 80
0.0002 (0.005)	0 - 45

      b. Coarse grained soils containing more than 20 percent by mass passing 0.003 inch (0.075 mm) sieve.

C. Waste Material: Excavated material unsuitable for use in work or surplus to requirements.

1.4 PROGRESS SUBMITTALS

A. Section 01300 - Administrative Requirements: Requirements for progress submittals.

B. Submit information regarding the following applicable items:
   1. Sheeting, shoring and bracing.
   2. Dewatering system and MOECC EASR Registration for Water Taking.
   3. Protection methods anticipated.
   4. Flowable Fill Mix Design:
      a. Furnish flowable fill mix design for each specified strength.
      b. Furnish separate mix designs when admixtures are require for the following:
         1) Flowable fill work during hot and cold weather.
         2) Air entrained flowable fill work.
      c. Identify design mix ingredients, proportions, properties, admixtures, and tests.
      d. Furnish test results to certify flowable fill mix design properties meet or exceed specified requirements.

C. Delivery Tickets: Furnish duplicate delivery tickets indicating actual materials delivered to the Site.

D. Qualifications Statements: Submit qualifications for Supplier.

E. All Drawings shall be prepared and stamped by an independent professional engineer recognized as expert in the specialty involved and licensed to practice in the Province of Ontario. The Drawings shall be submitted to the ENGINEER to establish compliance with the terms of the Specifications. Calculations shall not be submitted. Drawing submissions will not be checked and will not imply approval by ENGINEER of the work involved. CONTRACTOR shall be wholly responsible for designing, installing, and operating the system necessary to accomplish satisfactory sheeting, bracing, protection, and dewatering.

F. Test Reports - Borrow, Backfill, and Compaction: Submit three copies of each of the following test reports as required for each soil type used.
   1. Gradation Analysis: ASTM D422.
   2. Field Density Tests: ASTM D1556 and/or ASTM D6938.
   3. Optimum Moisture - Maximum Density Curve: ASTM D1557 modified.
   4. Material source.

1.5 QUALITY ASSURANCE

A. The services of a qualified testing laboratory shall be retained by the CONTRACTOR to make tests and determine acceptability of the fill or material as listed below.

B. Flowable Fill Supplier: Company specializing in supplying products specified in this Section with minimum 5 years documented experience.

C. Minimum Conditions: Do not install flowable fill during inclement weather or when ambient temperature is less than 4 degrees C.

D. Select Backfill Samples: Refer to Article 2.1.

1.6 REGULATORY REQUIREMENTS

A. Permits and Regulations: Perform excavation work in compliance with applicable requirements of the Occupational Health and Safety Act.

B. MOECC: Obtain and pay for all costs including required studies and reports to complete a EASR registration for Water Taking.

1.7 REGULATORY REQUIREMENTS

A. Verify field measurements before installing flowable fill to establish quantities required to complete work.

PART 2 PRODUCTS

2.1 BACKFILL AND PIPE BEDDING MATERIALS

A. Pipe Bedding and Encasement Material.
   1. Pipe bedding and encasement material shall be Granular "A" material as in accordance with OPSS.MUNI 1010, Table 2.
   2. Pipe bedding shall be placed around HDPE pipe from UV Building to Exit Sump – refer to drawing M-103.
   3. Pipe bedding shall be placed around PVC carrier pipe installed under East Duct Bank (refer to drawing E-109). A minimum of 150 mm of pipe bedding shall be placed under and around carrier pipe.

B. Structural Base and Sub-Base.
   1. Base Material: Granular "A" material as in accordance with OPSS.MUNI 1010, Table 2.
   2. Sub-Base Material: Granular "B" Type 1 material as in accordance with OPSS.MUNI 1010, Table 2

C. General Backfill and Fill Materials (Native Backfill):
   1. The term general backfill and fill materials used herein these Specifications shall mean "native backfill material".
   2. General backfill and fill materials (native backfill) shall be obtained on Site from excavations or from a source approved by ENGINEER.
   3. Materials shall be unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, organics, refuse, or other deleterious materials.
   4. Any materials found to have a moisture content in excess of 5 percent over the plastic limit will not be approved for use as backfill materials. Replace the unsuitable backfill material with suitable material.

2.2 FLOWABLE FILL

A. Conform to the requirements of OPSS.MUNI 1359 November 2016.

B. Flowable Fill: Excavatable type.

2.3 MATERIALS

A. Portland Cement: ASTM C150 Type I - Normal

B. Fine Aggregates: ASTM C33.

C. Water: Clean and not detrimental to concrete.

2.4 MIXES

A. Mix and deliver flowable fill according to ASTM C94/C94M, Option C.

B. Flowable Fill Design Mix:
   1. Cement Content:
      a. Excavatable: (45.5 to 59.3 kg/m3).
   2. Fly Ash Content:
      a. Excavatable: None.
   3. Air Entrainment:
      a. Excavatable: 5 to 35 percent.
   4. 28-Day Compressive Strength:
      a. Excavatable: Maximum 690 kPa.
   5. Temperature, Minimum, at Point of Delivery:
      a. Excavatable: 10 degrees C.

C. Provide water content in design mix to produce self-leveling, flowable fill material at time of placement.

D. Design mix air entrainment and unit mass are for laboratory design mix and source quality control only.

2.5 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements: Testing, inspection, and analysis requirements.

B. Test and analyze properties of flowable fill design mix and certify results for the following:
   1. Design mix proportions by weight of each material.
   2. Aggregate: ASTM C33 for material properties and gradation.
   3. Properties of plastic flowable fill design mix including:
      a. Temperature.
      b. Slump.
      c. Air entrainment.
      d. Wet unit mass.
      e. Yield.
      f. Cement factor.
   4. Properties of hardened flowable fill design mix including:
      a. Compressive strength at 1 day, 7 days, and 28 days. Report compressive strength of each specimen and average specimen compressive strength.
      b. Unit mass for each specimen and average specimen unit mass at time of compressive strength testing.

C. Prepare delivery tickets containing the following information:
   1. Project designation.
   2. Date.
   3. Time.
   4. Class and quantity of flowable fill.
   5. Actual batch proportions.

6. Free moisture content of aggregate.
7. Quantity of water withheld.

PART 3 EXECUTION

3.1 JOB CONDITIONS

A. Existing Structures: Shown on the Drawings are certain surface and underground structures adjacent to the Works. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of CONTRACTOR. CONTRACTOR shall explore in advance of the required excavation to determine the exact location of all structures. They shall be supported and protected from injury by CONTRACTOR. If they are destroyed or damaged, they shall be restored immediately by CONTRACTOR at the CONTRACTOR's expense.

B. Existing Utilities: Locate existing underground utilities in the areas of work. CONTRACTOR is responsible for execution of all SUE investigations associated with the locating of all buried utilities in the required work areas. Bruce Power Engineering will provide available drawing identifying known buried utilities at the Sewage Processing Plant (SPP). If utilities are to remain in place, provide adequate means of protection during earthwork operations.
   1. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, consult ENGINEER immediately for directions as to procedure. Cooperate with OWNER in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of the OWNER at the CONTRACTORS expense.
   2. Do not interrupt existing utilities serving facilities occupied and used by OWNER or others, except when permitted in writing by ENGINEER and then only after acceptable temporary utility services have been provided and all affected customers of the utility notified of the proposed interruption.
   3. Demolish and completely remove from the Site existing underground utilities indicated to be removed. Coordinate with OWNER for shutoff of services if mains are active.
   4. Protect, support, and maintain all gas, water, sewers, forcemains, laterals, telephone ducts, electrical ducts, and utility poles and towers during the course of the Works. Should any services or laterals be damaged, they shall be repaired or replaced in a manner satisfactory to ENGINEER and OWNER. All costs of repair or replacement shall be the responsibility of CONTRACTOR.
   5. Utility service connections to properties such as gas, water, sewer, electricity, and telephone are not shown on the Drawings. This includes such subsurface facilities as water, sewer, telephone, electric, and gas services and above ground facilities as telephone and electrical power lines. These facilities shall be protected at all times and, if necessary, relocated without cost to OWNER in order to complete the Works.

3.2 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. ENGINEER will examine the areas and conditions under which excavating, backfilling, and grading are to be performed and notify CONTRACTOR of conditions he may find that are detrimental to the proper and timely completion of the Works. CONTRACTOR shall not proceed with the Works until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

C. Verify utility installation is complete and tested before placing flowable fill.

3.3 SITE PREPARATION

A. Identify required lines, levels, contours, and datum locations.

B. Protect bench marks, survey control points, existing structures, fences, paving, and curbs from excavating equipment and vehicular traffic.

C. Protect existing structures where temporary unbalanced earth pressures may develop on walls or other structures utilizing bracing, shoring, or other approved method to counteract imbalance.

D. Subgrades for fills and embankments shall be cleaned and stripped of vegetation, sod, topsoil, and organic matter. All waste materials shall be removed from the Site and disposed of by CONTRACTOR. Burning will not be permitted. Topsoil shall be salvaged, stockpiled in an approved location, and reused for landscaping if approved by ENGINEER.

E. All environmental controls shall be in place as shown on the Drawings and shall be inspected and approved by the ENGINEER prior to the start of any excavation work.

F. Support and restrain utilities to prevent movement and flotation during installation of flowable fill.

G. Protect structures and utilities from damage caused by hydraulic pressure of flowable fill before fill hardens.

H. Protect utilities to prevent intrusion of flowable fill.

3.4 TOPSOIL REMOVAL

A. Strip topsoil from areas to be further excavated or regraded without mixing with foreign materials, for use in finish grading.

B. Do not strip wet topsoil.

C. Stockpile in designated on-Site area to maximum 2.5 m high and protect from erosion. Stockpile material on impervious material and cover over with same material until disposal.

D. Remove excess topsoil not intended for reuse from the Site.

3.5 EXCAVATION

A. CONTRACTOR shall perform all excavation required to complete the Works. Excavations shall include the removal of earth, sand, clay, gravel, hardpan, boulders, rock, pavements, rubbish and all other materials encountered during the Works.

B. Excavation for Exterior Structures, Pipelines, Swales, and other Facilities:
   1. Excavations for structures, swales, and pipelines shall be open excavations, shored and braced where necessary to prevent possible injury to workmen and/or the public and

damage to new and existing structures or pipelines. Sheeting and bracing shall be installed in accordance with Article 3.8 (where required).

2. Grade top perimeter of excavation to prevent surface water from draining into excavation.
3. Pumping in excavations shall be done in such a manner to prevent the carrying away of unsolidified concrete or other materials, and to prevent damage to the existing sub-grade.
4. The elevation of the bottom of footings or structures shown shall be considered as approximate only and ENGINEER may order such changes in dimensions and elevations as may be required to secure a satisfactory installation. All structure excavations shall be hand-trimmed to permit the placing of full widths and lengths of footings on horizontal beds. Rounded and undercut edges will not be permitted. When excavations are made below the required grades, without the written order of ENGINEER, or where required due to the actions of CONTRACTOR, they shall be backfilled with select backfill material or concrete as directed by ENGINEER at the expense of CONTRACTOR.
5. Excavation shall be extended sufficiently on each side of structures, footings, etc., to permit setting of forms, installation of sheeting or the safe sloping of banks.
6. Subgrades for roadways, structures, and trench bottoms shall be firm, dense, and thoroughly compacted and consolidated; shall be free from mud, muck, and other soft or unsuitable materials; and shall remain firm and intact under all construction operations. Subgrades which are otherwise solid, but which becomes soft or mucky on top due to construction operations, shall be reinforced with select backfill material meeting the requirements of Article 2.1. The finished elevation of stabilized sub-grades shall not be above sub-grade elevations shown or required.
7. Stability of Excavations: Slope sides of excavations to comply with the requirements of the Occupational Health and Safety Act. Shore and brace where sloping is not possible either because of space restrictions or stability of material excavated. Maintain sides and slopes of excavations in a safe condition until completion of backfilling.
8. Material Storage: Stockpile satisfactory excavated materials in approved areas, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.
    a. Locate and retain soil materials away from edge of excavations.
    b. Dispose of excess soil material and waste materials as specified herein.
9. Where the existing material beneath the bedding material or sub-base material is considered unsuitable by ENGINEER, CONTRACTOR shall remove and replace it with native backfill approved by ENGINEER. The additional excavation and native backfill material, when ordered in writing by ENGINEER, shall be included for payment under the applicable bid items of the Contract.

3.6 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown on the plans and which is not approved by ENGINEER, together with the removal and disposal of the associated material shall be at CONTRACTOR'S expense. The unauthorized excavation shall be filled and compacted with approved native backfill by CONTRACTOR at its expense.

3.7 DRAINAGE AND DEWATERING

A. Prevent surface and subsurface water from flowing into excavations and from flooding adjacent areas.

B. Remove water from excavation as fast as it collects.

C. Provide and maintain pumps, sumps, suction and discharge mains and other dewatering system components necessary to convey water away from excavations.

D. As a minimum the dewater system shall include dewatering pump(s), piping, flow meter, filter bag and splash pad.

E. All dewatering in excess of 50,000 L/day shall comply with MOECC requirements. CONTRACTOR shall comply with all requirements of the OWNER's existing permit to take water. Disposal of Water Removed by Dewatering System:
   1. Dispose of all water removed from the excavation in such a manner as not to endanger public health, property, or any portion of the Works under construction or completed.
   2. Dispose of water in such a manner as to cause no inconvenience to OWNER, ENGINEER, or others involved in work about the Site.
   3. Convey water from the construction site in a closed conduit. Do not use trench excavations as temporary drainage ditches.

3.8 SHEETING, SHORING, AND BRACING

A. Excavations for structures and pipelines shall be open excavation, sheeted, shored and braced where necessary to prevent injury to workmen, the public, structures, or pipe lines.
   1. Structures within 60 m of sheeting installations shall be subject to a pre-construction survey to identify and record existing structural conditions.

B. All local, provincial, and federal ordinances, codes, regulations, and laws shall be observed. CONTRACTOR shall provide all sheeting, shoring, and bracing which conform to Ontario's Labor Relations Laws and all applicable sections of Ontario's Occupational Health and Safety Act and any other requirements as necessary.

C. Used material shall be in good condition, not damaged or excessively pitted. All steel sheeting designated to remain in place shall be new. New or used sheeting may be used for temporary work.

D. All steel work for sheeting, shoring, bracing, cofferdams, etc., shall be designed in accordance with the provisions of Specifications of the Canadian Institute of Steel Construction (CISC) except that field welding will be permitted.

E. All sheeting, shoring, and bracing shall be designed by a Professional Engineer licensed to practice in the Province of Ontario. Shop drawings of the system shall be submitted bearing the seal of the Professional Engineer.

F. Maintain shoring and bracing in excavations regardless of time period excavations will be open. Carry down shoring and bracing as excavation progresses.

G. Unless otherwise shown, specified, or ordered, all materials used for temporary construction shall be removed when work is completed. Such removal shall be made in a manner not injurious to the structure or its appearance or to adjacent work or property.

H. Removal of Sheeting and Bracing: Remove sheeting and bracing from excavation unless otherwise ordered in writing by ENGINEER. Removal shall be done so as not to cause injury to the Works. Removal shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure.

3.9 SUBSOIL EXCAVATION

A. Excavate subsoil from areas to be further excavated, re-landscaped, or regarded.

B. Do not excavate wet subsoil or excavate and process wet material to obtain optimum moisture content.

C. When excavating through roots, perform work by hand and cut roots with sharp axe.

D. Remove excess subsoil not intended for reuse from the Site.

3.10 GENERAL BACKFILL

A. All backfill required for structures and trenches and required to provide the finished grades shown and as described herein shall be furnished, placed and compacted by CONTRACTOR. Unless otherwise required or specified, general backfill shall be obtained from on-Site excavations. If additional materials are required, they shall be furnished from off-Site sources at no additional cost to OWNER. All materials used for filling and backfilling shall be subject to the approval of ENGINEER and shall conform to specifications outlined under Article 2.1.

B. Backfill excavations as promptly as work permits, but not until completion of the following:
   1. Acceptance by ENGINEER of construction below finish grade including damp proofing, waterproofing, and perimeter insulation.
   2. Inspection, testing, approval, and recording of locations of underground utilities.
   3. Removal of concrete formwork.
   4. Removal of shoring and bracing, and backfilling of voids with satisfactory materials. Cut off temporary sheet piling driven below bottom of structures and remove in manner to prevent settlement of the structure or utilities, or leave in place if required.
   5. Removal of trash and debris.
   6. Permanent or temporary horizontal bracing is in place on horizontally supported walls.

C. Excavation shall be kept dry during backfilling operations. Backfill around structures and piping shall be brought up evenly on all sides.

D. Backfilling for Roadways and Driveways:
   1. The stability of the sub-grade shall be such that when materials above the sub-grade are deposited on the sub-grade, no rutting or displacement of the sub-grade will occur. No material shall be placed in sub-grades which are muddy, frozen or have water thereon.
   2. After final sub-grades for pavement and roadways have been established CONTRACTOR shall install and compact sub-base materials.
   3. Sub-base course material shall be Granular "B" material as specified under OPSS.MUNI 1010, compacted to 98 percent Standard Proctor Maximum Dry Density. Thickness of material shall be as identified on the Drawings.
   4. Base course material shall be Granular "A" material as specified under OPSS.MUNI 1010, compacted to 100 percent Standard Proctor Maximum Dry Density. Thickness of material shall be as identified on the Drawings.

E. Slab-on-grade: Place and compact materials in equal continuous layers not exceeding 200 mm thick loose lifts below proposed slab underside.

F. Apply potable water as necessary during compaction to obtain specified density. If material to be compacted is excessively moist, aerate with suitable equipment and method until moisture

content is corrected. In areas not accessible to rolling equipment, compact material to specified density using mechanical tamper. Supply and pay for water.

G. When granular material is wetted by sprinkling, do not direct jets of water at fill with such force that finer materials will be washed out.

H. Compaction Equipment: Use type, size, and efficiency of compaction equipment capable of achieving specified degree of compaction. When operating equipment adjacent to and immediately above structures, avoid causing damage or displacement of structure.

3.11 NATIVE BACKFILL MATERIAL

A. Native backfill necessary to replace sub-grade materials disturbed and softened as a result of CONTRACTOR's operations or to backfill unauthorized excavation shall be provided, placed and compacted at CONTRACTOR's expense.

3.12 FLOWABLE FILL BACKFILL INSTALLATION

A. Place flowable fill by chute, pumping or other methods approved by the ENGINEER.

B. Place flowable fill in lifts to prevent lateral pressures from exceeding structural capacity of structures and utilities.

C. Place flowable fill evenly on both sides of utilities to maintain alignment.

D. Place flowable fill to elevations shown on the Drawings without vibration or other means of compaction.

3.13 FLOWABLE FILL ABANDONED UTILITIES INSTALLATION

A. Verify all pipes and conduits are not clogged and are sufficiently empty to permit gravity installation of flowable fill for entire length indicated to be filled.

B. Seal lower end of pipes and conduits by method to contain flowable fill and to vent trapped air caused by filling operations.

C. Place flowable fill using method to ensure there are no voids.
   1. Fill pipes and conduits from high end.
   2. Fill manholes, tanks, and other structures from grade level access points.

D. After filling pipes and conduits seal both ends.

3.14 GRADING

A. General: Uniformly grade areas within limits of grading under this Section, including adjacent transition areas. Smooth sub-grade surfaces within specified tolerances, compact with uniform levels or slopes between points where elevations are shown, or between such points and existing grades.

B. Rough grade to levels, profiles, and contours allowing for surface treatment as shown on the Drawings.

C. Rough grade to following depths below finish grades:
   1. 500 mm for grassed areas.
   2. 500 mm for asphalt paving.
   3. 1,400 mm for concrete slabs.

D. Grade ditches to depth required for maximum runoff as shown on the Drawings and as directed by ENGINEER.

E. Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.

F. Compact filled and disturbed areas as follows:
   1. 95 percent SMDD under landscaped areas.
   2. 100 percent SMDD under paved and walk areas.

G. Do not disturb soil within branch spread of trees or shrubs designated to remain.

H. Grading Requirements:
   1. Pavements & Concrete Slabs: Shape surface of areas under pavement to line, grade and cross-section, with finish surface not more than 12.5 mm above or below the required sub-grade elevation.
   2. All existing drainage ditches and swales, if disturbed, shall immediately, upon completion of pipe installation, be restored to proper lines and grades. CONTRACTOR shall ensure that final drainage facilities are in working condition and acceptable to the agency of jurisdiction.

3.15 SURPLUS MATERIAL

A. Remove surplus material and material unsuitable for fill, grading, or landscaping off Site to the OWNER's designated landfill location or as directed by ENGINEER. Note: Bruce Power Site includes a Soils Management area for clean surplus material; CONTRACTOR is responsible for all material testing to demonstrate that soil is suitable for placement in the Soils Management area. Any soils deemed unsuitable for disposal shall be disposed of offsite per 3.16 below.

B. Prior to disposal of surplus material (whether on or off Site), CONTRACTOR shall execute analytical testing to demonstrate quality of surplus material. Testing shall include at minimum:
   1. Physical Tests: Moisture, pH
   2. Cyanides
   3. Saturated Paste Extractable
   4. Metals
   5. Volatile Organic Compounds
   6. Hydrocarbons
   7. Polycyclic Aromatic Hydrocarbons
   8. Semi-Volatile Organics
   9. Polychlorinated Biphenyls
   10. Soils samples will be collected and analyzed for every 10 cubic meters (m3) of surplus material do be managed or as directed by the OWNER/ENGINEER. CONTRACTOR

shall notify OWNER/ENGINEER immediately upon detection of soils with evidence of contamination (e.g. unusual odour or colour).

C. A surplus material management plan shall be submitted OWNER/ENGINEER at the initiation of the Works. Soil management plan will include, but not limited to, plans for the segregation of clean and impacted materials.

3.16 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations not designated for reuse on site shall be hauled away from the Site by CONTRACTOR and disposed of in compliance with local, provincial, federal rules, regulations at the OWNER's designate landfill location. Material designated for reuse on site shall be stockpiled for later use on the Project at an on-Site location to be determined by OWNER.

3.17 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Quality Control Testing During Construction: Testing services shall be performed by an independent testing company provided by CONTRACTOR at its own expense. Field density tests shall be conducted in accordance with ASTM D1556 and/or ASTM D6938. Testing of sub-grades and fill layers shall be taken as follows:
   1. If, based on reports of testing service and inspection, sub-grade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense to OWNER.
   2. Perform inspection and testing of flowable fill according to ASTM C94/C94M.
      a. Take samples for tests for every 115 m^3 of flowable fill, or fraction thereof, installed each day.
      b. Sample, prepare and test four compressive strength test cylinders according to ASTM D4832. Test one specimen at 3 days, one at 7 days, and two at 28 days.
      c. Measure temperature at point of delivery when samples are prepared.

C. Defective Flowable Fill: Fill failing to meet the following test requirements or fill delivered without the following documentation.
   1. Test Requirements:
      a. Minimum temperature at point of delivery.
      b. Compressive strength requirements for each type of fill.
   2. Documentation: Duplicate delivery tickets.

3.18 CLEANING

A. Remove spilled and excess flowable fill from the Site.

B. Restore facilities and Site areas damaged or contaminated by flowable fill installation to existing condition before installation or better to the satisfaction of the OWNER.

END OF SECTION

SECTION 02345

ROCK REMOVAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Section Includes:
   1. Removing identified and discovered rock during excavation.
   2. Expansive tools, excavator, and rock points to assist rock removal.

B. Related Sections:
   1. Section 02300 Excavation and Backfill
   2. Section 02612 Transportation and Disposal

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Reference Standards:
   1. Canadian Construction Safety Code.
   2. Ontario Provincial Standard Specifications:
      a. OPSS 515 – Construction Specification for Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut.
   3. Ontario Regulations Made Under the Occupational Health and Safety Act:
      a. O. Reg. 691 - Construction Projects.

1.3 DEFINITIONS

A. Rock: Limestone, sandstone, granite, dolostone or similar rock in solid beds or masses which can be removed only by continuous drilling, or the use of pneumatic tools.

1.4 PROGRESS SUBMITTALS

A. Section 01300 - Administrative Requirements: Requirements for progress submittals.

B. Rock Removal Operation:
   1. Submit Rock Removal Plan including types and quantities of equipment to be used, limits of excavation, removal method from excavation, protection from vibration, dust, and noise control.
   2. Transportation and Disposal: Conform to the requirements of Section 02612 for transportation and disposal requirements of excavated rock and other materials.

1.5 QUALITY ASSURANCE

A. CONTRACTOR shall provide the services of a qualified excavation firm with a minimum of 5 years relevant experience.

1.6 REGULATORY REQUIREMENTS

A. Permits and Regulations: Perform work in compliance with applicable requirements of the Occupational Health and Safety Act.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 GENERAL

A. Rock shall be removed using mechanical means only. No blasting of any kind shall be permitted.

3.2 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify Site conditions and note subsurface irregularities affecting work of this Section.

C. Verify that survey benchmarks and existing and intended elevations are as shown on the Drawings.

3.3 SITE PREPARATION

A. Identify required lines, levels, contours, and datum.

B. Locate, identify, and protect utilities from damage. Confirm locations of buried utilities and structures by suitable means.

C. Arrange for OWNER to identify utilities.

D. Maintain and protect benchmarks, survey control points, wells, utilities, and structures from damage; immediately notify ENGINEER in the event of disturbance or damage; repair or replace, as directed by ENGINEER, unless designated for demolition or removal.

E. Protect existing structures where temporary unbalanced earth pressures may develop on walls or other structures by bracing, shoring, or other approved method to counteract unbalance.

F. Avoid disturbing wells, surface features, and structures during excavation.

G. Protect excavations from contamination.

H. Obtain written confirmation from ENGINEER prior to moving or otherwise disturbing wells, surface features, and structures.

3.4 ROCK REMOVAL BY MECHANICAL METHODS

A. Excavate and remove rock by mechanical method. Blasting shall not be permitted.

B. Drill holes and use expansive tools, wedges, or other suitable mechanical methods to fracture rock.

C. Cut away rock at bottom of excavation to form level bearing.

D. Remove shaled layers to provide sound and unshattered base for foundations and utility bedding.

E. In utility trenches, excavate to 150 mm below invert elevation of pipe and 300 mm wider than pipe diameter on either side.

F. Remove and dispose of excavated materials from the Site.

G. Correct unauthorized rock removal with flowable fill according to Section 02300 as directed by the ENGINEER at the CONTRACTORS expense.

3.5 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations shall be hauled away from the Site by CONTRACTOR and disposed of in compliance with local, provincial, federal rules, and regulations at the OWNER’s designated landfill location.

END OF SECTION

SECTION 02612

TRANSPORTATION AND DISPOSAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supply, operation, maintenance, and coordination of transport vehicles/containers.

B. Preparing transport vehicles/containers for off-Site transportation.

C. Loading and securing materials in transport vehicles/containers.

D. Weighing transport vehicles/containers.

E. Decontaminating vehicles/containers prior to leaving the Site.

F. Transporting the following materials from the Site to approved off-Site disposal or storage facilities:
   1. Asbestos containing material.
   2. Lead-contaminated debris.
   3. Non-hazardous solid waste.
   4. Excavated soil and bedrock.
   5. Mercury containing equipment.
   6. PCB containing equipment.

G. Off-Site transportation and recycling of scrap metal.

H. Preparation of shipping documents including waste profiles, manifests, and bills of lading.

I. Maintaining transportation records as required by the Dangerous Goods Transportation Act.

J. Obtaining documents from disposal facilities.

1.2 RELATED SECTIONS

A. Section 02222 – Demolition and Removals

B. Section 02300 – Excavation and Backfill

C. Section 02345 – Rock Removal

1.3 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Ministry of Environment and Climate Change:
   1. MOECC Guideline for Use at Contaminated Sites in Ontario.

C. Ontario Regulations:
   1. Revised Regulations of Ontario (R.R.O.) 1990, Reg. 261, Dangerous Goods Transportation Act.
   2. O. Reg. 347, General Waste Management.

D. The Society for Protective Coatings (SSPC):
   1. SSPC Guide 7, Guide to the Disposal of Lead-Contaminated Surface Preparation Debris.

E. BP-1-11 Rev 3– Schedule 5 – Commercial Terms and Conditions for Building Construction Services OWNER requirements and guidelines.

1.4 DEFINITIONS

A. Wastewater:
   1. Water collected from equipment decontamination facilities.
   2. Any other potentially contaminated water as determined by ENGINEER.

1.5 PROGRESS SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for progress submittals.

B. Letters of Commitment:
   1. Include a copy of the letter of commitment from each proposed disposal facility prior to shipping material to the facility. State in each letter:
      a. That the facility is in compliance with its current and valid permit.
      b. That the facility can and will accept the materials contingent upon the acceptance of the waste profile proposed for disposal at the facility.
      c. Any disposal facility restrictions which may cause rejection of the transported materials.
      d. Any additional sampling and analysis of materials which are required prior to delivery to the facility.
      e. Any restrictions on delivery schedules.
   2. Each facility shall disclose information concerning any existing corrective action programs which may impact the ability of the disposal facility to accept materials from the Site.

C. Operating Licenses and Permits:
   1. Include copies of valid operating licenses and permits for each proposed disposal facility 3 days prior to commencing the transportation of materials from the Site.
   2. Include copies of valid operating licenses and permits from each transporter for each proposed transport vehicle/container 3 days prior to entry to the Site.

D. Disposal Facility Requirements:
   1. For each disposal facility accepted by OWNER or specified by OWNER, CONTRACTOR shall provide the disposal facility requirements to ENGINEER including:
      a. Any disposal facility specific packaging requirements for shipments.
      b. Disposal facility restrictions by wastestream which may cause rejection of transported materials.

c. Any wastestream specific pre approvals required by federal or provincial agencies prior to acceptance of wastestream by the disposal facility.
d. Restrictions on delivery schedules.
e. Type and frequency of routine additional sampling and analysis of materials by wastestream which are required during transport and disposal activities prior to delivery to the disposal facility.
f. Additional sampling and analysis of materials that will be conducted by the disposal facility during receipt of shipments to verify waste profiles.

2. Each disposal facility shall disclose the name and telephone number of the contact at the lead agency responsible for the disposal facility primary permits who has knowledge of, and can verify, the existence of existing corrective action programs which may impact the ability of the disposal facility to accept materials from the Site.

E. Agency Approvals: For any wastestream requiring agency pre approval, provide letters of approval from the applicable MOECC transit forms aerials from the Site at each proposed disposal facility 14 days prior to the off-Site transportation of materials.

F. Shipping and Disposal Documents: Include completed copies of shipping and disposal documents including manifests and/or bills of lading waste profiles on standard approved forms, including a copy of each form signed by the transporter prior to leaving the Site and a copy of each form signed by the disposal facility accepting the shipment.

G. Weigh Scale Documents:
1. Include copies of weigh scale tickets on approved forms signed by an authorized weigh scale operator including the following information:
a. Location, date, and time of weighing.
b. Measured weights.
c. Vehicle and container identification.
d. Shipment identification number.

H. All documentation required by OWNER.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Section 01500 - Temporary Facilities and Controls: Requirements for temporary controls.

B. Do not spill, leak, or otherwise release materials from transport vehicles and containers during loading and unloading operations or while in transit from the Site to the disposal facility.

C. Do not generate dusting conditions when loading bulk solids.

D. Do not generate fume or misting conditions when loading bulk liquids.

E. Clean up spills or leaks in transit and report any spills immediately to the MOECC Spills Action Centre and the OWNER.

PART 2 PRODUCTS

2.1 POLYETHYLENE SHEETING

A. Continuous sheeting, minimum 1.5 mm thick, fabricated from a single ply of construction grade polyethylene plastic.

2.2 TUB LINER

A. Tub Liners for Bulk Solid Shipments: Pre-manufactured fitted polyethylene tub liner or continuous single sheet of polyethylene sheeting.

2.3 CONTAINERS, PACKING MATERIAL, AND LABELS

A. Comply with federal, provincial, and local regulations.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 – Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Notify ENGINEER sufficiently in advance of its intention to commence activities at the Site that require attendance by ENGINEER as provided herein.

C. Activities requiring attendance by ENGINEER include:
   1. Placement of tub liner in bulk solid transport vehicles/containers.
   2. Final securement of loaded materials prior to transport from the Site.
   3. Decontamination of transport vehicles/containers prior to leaving the Site.

D. Do not cover up loaded material prior to ENGINEER's inspection.

3.2 PREPARATION AND SECUREMENT OF TRANSPORT VEHICLES

A. Do not load materials for transport for disposal without ENGINEER's approval.

B. Comply with federal, provincial, and local regulations concerning shipping vehicles, containers, and materials.

C. Clean the receiving box of the transport vehicle/container of any loose debris or foreign material. Line the receiving box or container with a minimum of one layer of 1.5 mm polyethylene sheeting continuous along the bottom and sides. Place the sheeting on the floor, run up the sides, and drape over the sideboards. Neatly push the polyethylene sheeting into corners to prevent tearing during loading and transport.

D. Visibly display the number for each transport vehicle/container.

E. Secure materials in transport vehicles/containers according to regulations governing the transportation of these materials.

F. Load bulk materials into transport vehicles or containers in a manner which will not damage the placed polyethylene sheeting. Limit the freefall of bulk materials being loaded.

G. Replace damaged sheeting which is incapable of providing containment.

H. Following loading, fold the box liner over the loaded materials and place an overliner of polyethylene sheeting over the materials prior to securing with an approved tarpaulin in a manner to prevent the loss of materials or fugitive dust emissions.

I. ENGINEER will waive the lining requirements where CONTRACTOR can demonstrate to the satisfaction of ENGINEER that all of the following conditions are met:
   1. The receiving box or container is of leakproof construction and capable of maintaining a leakproof condition.
   2. The cover to be placed over the receiving box or container is impermeable and will totally enclose the materials within.
   3. The cover to be placed over the receiving box or container will prevent fugitive dust emissions.
   4. The receiving box or container is constructed of materials which can be decontaminated.

3.3 DOCUMENTATION FOR OFF-SITE TRANSPORTATION

A. Document the transport and disposal of contaminated materials and wastewater, if required, to off-Site disposal facilities on appropriate bills of lading. Prepare and provide OWNER with copies of bills of lading for each shipment of materials from the Site. Be responsible for maintaining bills of lading, from the time the materials leave the Site to the time of release to the disposal facility. All bills of lading for the transportation and disposal of materials shall be signed by CONTRACTOR.

3.4 NOTIFICATION

A. Notify applicable federal, provincial, and local representatives, or authorities having jurisdiction over the route and mode of transport, in advance of commencing transportation.

3.5 TRANSPORTATION

A. Transport material removed from the Site directly to the disposal facility approved by ENGINEER. Do not change either the route or mode of transport after commencing off-Site operations without ENGINEER's prior written approval.

B. Where required, mark and placard shipments according to R.R.O. 1990, Reg. 261.

C. Comply with the requirements of federal, provincial, and local regulations as applicable.

D. Employ transport vehicle operators trained in conformance with R.R.O. 1990, Reg. 261.

E. Materials shall be transported using vehicles licensed for the wastestream being transported.

3.6 DISPOSAL

A. Make all arrangements with the disposal facility for the receipt and acceptance of materials removed from the Site.

B. Be responsible for, and do all work necessary to, ensure that materials removed from the Site are properly prepared and will be accepted by the disposal facility. Dispose of materials at the disposal facilities approved by ENGINEER, which are in compliance with applicable regulations and are permitted to receive materials from the Site.

C. Weigh transport vehicles/containers at the approved off-Site disposal facility weigh scales both before and after discharging their contents.

D. Such measurements will be used by ENGINEER to verify proper delivery of materials which have been removed from the Site and for payment purposes.

E. Return to the Site any transported material delivered to a disposal facility which is rejected by the disposal facility.

3.7 NON-HAZARDOUS SOLID WASTE

A. Dispose of non-hazardous solid wastes at a sanitary landfill approved by ENGINEER.

B. The facility shall be appropriately licensed to receive solid wastes, other than hazardous wastes.

END OF SECTION

SECTION 02701

AGGREGATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements for aggregates.

B. General requirements for base material.

C. General requirements for sub-base material.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Section 02300 – Excavation and Backfilling.

C. ASTM International:
1. ASTM C117 - Standard Test Method for Material Finer Than 0.075 mm Sieve in Mineral Aggregates by Washing.
2. ASTM C131 - Standard Test Method for Resistance to Degradation of Small Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.
3. ASTM C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
4. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12 400 ft-lbf/ft^3 (600 kN-m/m^3)).
5. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
6. ASTM D1883 - Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.
7. ASTM D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
8. ASTM D4791 - Standard Test Method for Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate.

D. Canadian General Standards Board:
1. CAN/CGSB 8.1 - Sieves Testing, Woven Wire, Inch Series.
2. CAN/CGSB 8.2 - Sieves Testing, Woven Wire, Metric.

E. Ontario Provincial Standard Specifications:
1. OPSS 1001 - Material Specification for Aggregates - General.
2. OPSS 1004 - Material Specification for Aggregates - Miscellaneous.
3. OPSS 1010 - Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.

1.3 PROGRESS SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for progress submittals.

B. Materials Source: Submit name of proposed imported fill material source at least 14 days prior to commencing transport of materials to the Site.

C. Analytical Results: Submit chemical analytical results for each imported fill material at least 7 days prior to commencing transport to the Site.

D. Test Reports: Submit test reports certifying compliance with specified requirements at least 7 days prior to commencing transport to the Site.

E. Certificates: Certify that products meet or exceed specified requirements.

F. Samples:
   1. Submit samples as requested by ENGINEER.
   2. Pay for the cost of sampling and testing of any aggregates that fail to meet the specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Stockpile a minimum of 50 percent of the total aggregate required prior to commencing the Works.

C. Store cement in weather tight bins or silos that provide protection from dampness and easy access for inspection and identification of each shipment.

1.5 REGULATORY REQUIREMENTS

A. Conform to the following codes for demolition work, dust control, and products requiring electrical disconnection:
   1. Ontario Building Code.
   2. Ontario Health and Safety Act.
   3. Electrical Safety Authority.

PART 2 PRODUCTS

2.1 MATERIALS

A. General:
   1. Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in a deleterious manner for the use intended.
   2. Flat and elongated particles of coarse aggregate: in accordance with ASTM D4791.
      a. The greatest dimension is to exceed four times the smallest dimension.

3. Fine aggregates satisfying the requirements of the applicable Sections are to be one, or a blend of, the following:
   a. Natural sand.
   b. Manufactured sand.
   c. Screenings produced in the crushing of quarried rock, boulders, gravel or slag.
4. Coarse aggregates satisfying the requirements of the applicable section to be one, or a blend of, the following:
   a. Crushed rock.
   b. Gravel and crushed gravel composed of naturally formed particles of stone.
   c. Light weight aggregate, including slag and expanded shale.

B. Granular A: OPSS 1001 and OPSS 1010.

C. Granular B: OPSS 1001 and OPSS 1010.

2.2 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements: Requirements for source testing and analysis.

B. Inform ENGINEER of the proposed source of all aggregates and provide access for sampling at least 10 working days prior to commencing production of aggregates.

C. If, in the opinion of ENGINEER, materials from the proposed source do not meet, or cannot reasonably be processed to meet the specified requirements, locate an alternative source or demonstrate, to the satisfaction of ENGINEER that the material from the source in question can be processed to meet the specified requirements.

D. Advise the ENGINEER 10 working days in advance of any proposed change of a material source.

E. Acceptance of material at the source does not preclude future rejection of the material if it fails to conform to the requirements specified in the Contract Documents, lacks uniformity, or if its field performance is found, by ENGINEER, to be unsatisfactory.

F. Chemical Analysis: Volatile organic compounds, semi-volatile organic compounds, petroleum hydrocarbon fractions, metals, pesticides and herbicides, sodium absorption ratio, and polychlorinated biphenyls according to Protocol for Analytical Methods Used in the Assessment of Properties under Part XV.1 of the Environmental Protection Act; two samples per source of each type of imported fill.

PART 3 EXECUTION

3.1 SEQUENCE OF OPERATION

A. Place the granular base after the sub-base surface is inspected and approved by ENGINEER.

B. Placing:
   1. Construct the granular base to the depth and grade in the areas indicated on the Drawings.
   2. Ensure that no frozen material is placed.
   3. Place material only on clean unfrozen surfaces, free from snow and ice.

4. Place material using methods which do not lead to segregation or degradation of the aggregate.
5. Place material to the full width in uniform layers not exceeding 150 mm of the compacted thickness.
6. Shape each layer to a smooth contour and compact to the specified density before the succeeding layer is placed.
7. Remove and replace that portion of the layer in which material becomes segregated or unsuitable during spreading.

C. Compaction Equipment: Capable of obtaining the required material densities.

D. Compacting:
1. Compact to a density of not less than 98 percent of Standard Maximum Dry Density (SMDD) in accordance with ASTM D698 unless noted otherwise.
2. Shape and roll alternately to obtain a smooth, even and uniformly compacted base.
3. Apply water as necessary during compacting to obtain the specified density.
4. In areas which are not accessible to rolling equipment, compact to the specified density with mechanical tampers approved by ENGINEER.
5. Correct surface irregularities by loosening and adding or removing material until the surface is within the specified tolerance.

E. Proof rolling will be completed at the discretion of ENGINEER:
1. For proof rolling use a standard roller of 45,400 kg gross mass with four pneumatic tires each carrying 11,350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to center spacing of 730 mm.
2. Obtain approval from ENGINEER to use nonstandard proof rolling equipment.
3. Proof roll at the level in the granular base as indicated on the Drawings. If the use of non-standard proof rolling equipment is approved, ENGINEER will determine the level of proof rolling.
4. Make sufficient passes with the proof roller to subject every point on the surface to 3 separate passes of loaded tire.
5. Where proof rolling reveals areas of defective subgrade:
    a. Remove base, sub-base and subgrade material to the depth and extent as directed by ENGINEER.
    b. Backfill excavated subgrade with approved common material and compact in accordance with Section 02300.
    c. Replace sub-base material and compact in accordance with Section 2300.
    d. Replace base material and compact in accordance with this Section.
6. Where proof rolling reveals a defective base or sub-base, remove the defective materials to the depth and extent as directed by ENGINEER and replace with new materials in accordance with Section 02300 and this Section at no extra cost.

F. Site Tolerances: The finished base surface is to be within plus or minus 5 mm of the established grade and cross section but not uniformly high or low.

G. Protection: Maintain the finished base in a condition conforming to the requirements of this Section until the succeeding material is applied or until acceptance by ENGINEER

END OF SECTION

SECTION 02800

EROSION AND SEDIMENTATION CONTROLS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Silt fence.

B. Sediment traps.

C. Silt Socks.

1.2 RELATED SECTIONS

A. Section 02200 – Site Preparation.

B. Section 02222 – Demolition and Removals.

C. Section 02300 – Excavation and Backfill.

D. Section 02701 – Aggregates.

1.3 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Ontario Provincial Standard Drawings: OPSD 219.130.

C. Ontario Provincial Standard OPSS 805.

1.4 PROGRESS SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for progress submittals.

B. Soil Erosion and Sediment Control Plan: Within 10 days after the date of the Notice to Proceed and prior to mobilization to the Site, submit a Soil Erosion and Sediment Control Plan. Address the following:
   1. Statement of erosion control and stormwater control objectives.
   2. Description of erosion control methods.
   3. Description of catchbasin silt protection.
   4. Description of the type and frequency of maintenance activities required for the chosen erosion control methods.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Accurately record the following:
   1. Record of measurements and findings for product failure, recommendations for repair, and products replaced.
   2. Maintenance work performed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Package and label materials prior to shipment to the Site. Indicate manufacturer, type of matting, thickness, lot number, roll number, and roll dimensions.

C. Handle materials as recommended by manufacturer during transportation to the Site.

D. Store and protect materials from deterioration, vandalism, and theft.

E. Use appropriate handling equipment when moving materials from one place to another.

F. Notify ENGINEER 5 days in advance of delivery of materials to the Site. Upon delivery, perform joint inspection with ENGINEER. Remove materials rejected by ENGINEER from the Site and replace with new material.

1.7 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. The work of this Section must be in place prior to executing any work related to exterior demolition or removals, excavation, backfill, construction of cast-in-place concrete, or any work which may produce sedimentation or soil erosion.

C. Ensure temporary erosion control measures are in place and functional prior to initiation of earthwork activities.

D. Schedule operations to minimize potential for erosion by minimizing number of disturbed areas at any one time and completing operations and restoring disturbed areas in shortest time possible.

PART 2 PRODUCTS

2.1 SILT FENCE

A. Heavy Duty Silt Fence:
   1. Geotextile: Uniform in texture and appearance with no defects, flaws, or tears that would affect its physical properties. Containing sufficient ultraviolet ray inhibitor and stabilizers

to provide a minimum 2-year service life from outdoor exposure. Attached to chain link with hog rings. In accordance with OPSS 805.

2. Control Measure Support:
   a. In accordance with OPSS 805.
   b. Plastic or wire mesh.
   c. Attached to stake with ties.
3. Posts:
   a. 50 mm heavy duty wooden stake.
   b. Post Spacing: Not to exceed 2 m.
   c. In accordance with OPSS 805.
4. OPSD 219.130.

2.2 CATCHBASIN SILT PROTECTION

A. Silt Filtration Sock:
   1. Materials shall be weed free and derived from a clean, separated source of organic matter.
   2. Organic materials shall be free of any refuse, contaminants or other materials toxic to plant growth, animals, humans. Non-organic products will not be accepted.
   3. Approved Manufacturers:
      a. Terrafix Geosynthetics Inc.: Siltsoxx.
      b. Corix: Bio-Log.
      c. Approved equal.

B. Silt filtration sack:
   1. Material: Woven fabric geotextile stabilized to resist UV degradation specifically designed to trap silt and other fines.
   2. Approved Manufacturers:
      a. Terrafix Geosynthetics Inc.: Siltsack.
      b. Corix: Silt Sacs.
      c. Approved equal.

2.3 DITCH PROTECTION

A. Straw Bales
   1. Straw Bale Material: In accordance with OPSS 805.05.01
   2. Anchoring Stakes: In accordance with OPSS 805.05.03

PART 3 EXECUTION

3.1 MANAGEMENT SEDMINATATION AND EROSION CONTROLS

A. Erosion and sediment control (ESC) measures will be implemented prior to, and maintained during all construction phases, to prevent migration of sediment.

B. All activities, including maintenance procedures, will be controlled to prevent the entry of petroleum products, debris, rubble, concrete or other deleterious substances into the water course or storm sewer system.

C. No dewatering shall be sent directly to a watercourse or storm sewer system.

D. All disturbed vegetated areas will be stabilized and restored with native/non-invasive species immediately upon completion of the work.

E. CONTRACTOR must monitor the weather several days in advance to ensure that work are conducted during favourable weather conditions. Should an unexpected storm arise, CONTRACTOR shall develop and implement a contingency plan for ensuring that no deleterious substances or materials that may be on Site throughout the performance of the Project are allowed to enter a watercourse or storm sewer system and for maintaining and repairing the sediment and erosion control measures that were on Site prior to the event and may have been damaged as a result of the event.

F. All works shall be conducted in dry conditions with appropriate erosion and sedimentation controls.

G. Erosion and sedimentation control measures defined in this Section and on the Drawings are not static and may need to be upgraded/amended as Site conditions change to minimize sediment laden runoff from leaving the work areas. If the prescribed measures in this Section or in the Drawings are not effective in preventing the release of a deleterious substance, then alternative measures shall be implemented immediately to minimize potential ecological impacts.

H. CONTRACTOR shall provide and maintain a spill kit on Site at all times during construction.

I. Additional ESC supplies shall be stockpiled on Site in order to upgrade the system, as required.

J. CONTRACTOR is responsible for the removal and disposal of excess unsuitable fill material.

K. The location that is to be occupied by CONTRACTOR's Site trailer shall be restored to its existing condition (or better) and elevation upon completion of this Project.

3.2 FIELD QUALITY CONTROL

A. Inspect erosion control devices on a weekly basis and after each runoff event. Make repairs necessary to ensure erosion and sediment controls are functioning.

3.3 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning.

B. When sediment accumulation in sedimentation structures has reached one-third depth of sediment structure or device, remove and dispose of sediment.

C. Do not damage structure or device during cleaning.

D. Do not permit sediment to erode into Site areas or natural waterways.

E. Clean channels when depth of sediment reaches approximately half channel depth.

END OF SECTION

SECTION 11010

EQUIPMENT GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 WORK OF THIS SECTION

A. The Work of this section covers the general clauses for the supply and installation of all process equipment and other works as specified herein and/or indicated on the Drawings.

B. Provide all labour and materials, obtain all necessary permits and pay all fees as may be required.

C. Fully coordinate the work of all related specification sections. Use equipment specifications together with all site Work, concrete, building, electrical and controls specifications as necessary in order to produce a fully coordinated product meeting all necessary specifications.

1.2 SUBMITTALS

A. Section 01300 - Administrative Requirements: Requirements for progress submittals.

B. Shop Drawings:
1. Submit shop drawings for all electric motors together with respective equipment indicating motor dimensions and characteristics, including efficiency, power factor, insulation class and details of winding protection.
2. Submit shop drawings for all equipment in this Division, including relevant installation and fabrication details.

C. Informational Submittals:
1. Factory Functional Test Report.
2. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.
5. Manufacturer's Certificate of Proper Installation.
6. Operating and Maintenance Data for all equipment in this Section.
7. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
8. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.

1.3 QUALITY ASSURANCE

A. The materials and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the ASTM, AWWA, CEC, TSSA, COSB and CSA. Canadian Standards shall take precedence over American Standards in the case of duplication or conflicting requirements.

B. All electrical motors and equipment shall be built to EEMAC (Electrical and Electronic Manufacturers' Association of Canada) standards with Canadian threads and bearings throughout and all motorized and electrical equipment shall be CSA approved or supplied in accordance with the rules and regulations of the local inspection authority and subject to its approval. Any Ontario Hydro inspection fees for equipment supplied by the Contractor to be paid by the Contractor.

1.4 DELIVERY, STORAGE AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Arrange with the suppliers for delivery of all items of equipment to the Site as required to meet the schedule.

C. Arrange for delivery of all anchor bolts, templates, embedded metals, and other materials required during the concreting placement and assembly of equipment.

D. Receive equipment at the site, unload and examine it upon arrival for damage or defects and be responsible for its safekeeping, storage and installation. Immediately notify the Engineer and the supplier of any damages or defects in the equipment delivered.

E. Special measures shall be taken to ensure that electrical motors do not suffer from moisture, dust, dirt or mechanical damage if stored or installed and inactive.

F. Equipment storage, safekeeping and relocation of equipment from one area of the site to another, for whatever reason, shall be the sole responsibility of the Contractor from the time of initial off-loading at the site until the date of completion and acceptance by Bruce Power.

1.5 SYSTEM STARTUP AND COMMISSIONING

A. Section 01800 – Facility Operation: Requirements for commissioning.

B. Where witnessed factory testing is specified, the Supplier shall give 10 Working day’s notice of the date when equipment will be ready for testing. Confirmation of the test date and time shall be provided 3 Working Days in advance of the tests. Equipment shall not to be delivered to the site until factory testing has been satisfactorily completed.

C. When certified factory testing of the equipment or any component is specified, the supplier shall provide the Engineer with 2 copies of required certified test reports showing that the equipment complies with the Specification, before the equipment is delivered to site. Additional copies are required for the Maintenance Data Manuals.

D. Unless otherwise specified, furnish a certificate of final inspection and approvals from the electrical inspection authority to the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

A. Material and equipment shall conform to the latest edition of applicable standards in force at the time of RFP. In the case of any conflict between the Specifications with any standards, the more stringent of the two applies.

B. Provide materials and equipment in conformance with the following:
   1. First class in every respect.
   2. Constructed and finished in a workmanlike manner.
   3. Fully suitable for the service intended.
   4. Selected and fabricated to best engineering practice.

C. Furnish safety devices, including shear pins, flexible coupling guards, beltguards and other pertinent items with the equipment.

D. Install machinery such that working parts are readily accessible for inspection and repair, and each part is suitable for the service required.

E. Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter.

F. Provide adequate and, as far as practicable, verifiable means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routine greasing. Indicate on the working Drawings submitted, the type of lubricants to be used (readily available in Canada). Use grease nipples of a consistent type (Alemite button head type or equivalent).

G. Make lubrication points readily accessible using grease nipples and Type 316 stainless steel tubing extensions where required. Secure the nipples and tubing to the equipment at appropriate locations.

H. Design equipment installed outdoors for service under climatic conditions typical for the area. Give particular attention to winter operating conditions.

2.2 SPECIAL TOOLS AND ACCESSORIES

A. Furnish a set of any special tools, wrenches and accessories required for removing worn parts, for carrying out maintenance and for making adjustments. Special tools are those tools which, because of their limited use or purpose-made design, are not normally readily available, but which are necessary for maintaining the equipment.

2.3 TEMPORARY SUPPORTS

A. Provide all necessary temporary supports and bracing to prevent the overloading of all floors and walls, while equipment is being installed. Ascertain the weights of all pieces of equipment from the manufacturer, and move equipment into position in a manner and at a time approved by the Engineer.

B. Provide eye bolts or hooks for the safe handling of the equipment during installation. Eye bolts shall be left in place.

2.4 LUBRICANTS, GREASE OIL AND FUEL

A. Provide the complete initial lubrication of all equipment in accordance with the manufacturer's recommendations.

B. Provide a complete schedule of all manufacturer's recommended lubricants.

C. Fill grease, oil and fuel tanks, as required for the initial operation of the equipment.

2.5 SMALL PIPING

A. Supply and install all small connecting pipework, fittings and valves whether shown on the Drawings or not. Perform all such Work strictly in accordance with the instructions of the manufacturer whose equipment is being installed or connected.

2.6 ANCHOR BOLTS

A. Unless otherwise specified, supply all stainless steel anchor bolts, such anchor bolts being of a diameter and size as recommended by the manufacturers of the equipment and machinery being installed. Generally use expansive type anchorages in setting small equipment. Set large pumps by means of bolts with sleeves cast into the concrete to a minimum depth of 150 mm. Elsewhere, cast in place anchor bolts may be used subject to the approval of the Engineer; these must be properly positioned by means of substantial templates.

2.7 PUMP AND MACHINERY BASES

A. Provide concrete bases for all equipment, including pumps, and mixers. Final setting of pump and machinery bases shall be on cement grout placed on concrete bases, or as otherwise recommended by the equipment supplier. Provide anchor bolts for all bases. Finish vertical sides of pump bases and bases to match adjacent floor.

B. The final shape and dimensions of bases and anchor bolt locations for the bases where not already finalized, will be determined by the Engineer after receipt of the equipment manufacturer's detail drawings. In general, the concrete bases shall be a minimum of 50 mm larger than the supplied equipment base in each direction.

C. Reinforced concrete bases shall be firmly fixed to the parent concrete slab by adequate dowels as shown on the Drawings or as recommended by the equipment supplier and approved by the Engineer.

2.8 EQUIPMENT CABINET BASES

A. Install all floor-mounted cabinets on concrete bases whether shown on the Drawings or not.

B. Anchor bases as recommended by manufacturer or as specified elsewhere in these Specifications.

C. Final shape and dimensions shall be determined by the Engineer after receipt of equipment manufacturer's detail drawings.

2.9 EQUIPMENT GUARDS

A. Provide removable protective guards for all open rotating equipment including pulleys, belts, drives, shafts and couplings, etc.

B. Ascertain the extent of the work for the installation and/or the supply etc., of equipment guards by direct contact with the equipment suppliers.

2.10 ESCUTCHEONS

A. Install escutcheons on pipes passing through walls, partitions, floors and ceilings.

B. Use chrome, plated brass or stainless steel 2 piece type escutcheons mechanically secured to adjacent surface.

C. Outside diameter of escutcheons shall cover the opening of the sleeve.

D. The inside diameter of the escutcheon shall fit around the finished pipe.

PART 3 EXECUTION

3.1 INSTALLATION OF EQUIPMENT

A. Furnish any appurtenant fittings and materials, not herein or elsewhere specifically mentioned or included, but necessary for the installation and operation of the equipment without additional payment.

B. Provide all materials, labour and equipment to install complete and in full operation all the equipment specified herein.

C. Install the equipment in strict accordance with the manufacturer's instructions and to the satisfaction of the Engineer.

D. Install all instruments with an in-line isolating valve and a tee and valve on their sample line to allow easy isolation from the process for maintenance and to allow air or moisture removal.

E. Be fully acquainted with all Work involved in the complete installation of all equipment. Misunderstandings in regard to the nature or amount of Work to be done will not constitute grounds for extra payment.

F. Ensure that no unnecessary strain is introduced into equipment due to connections with piping or other appurtenances.

3.2 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Vibration Monitoring:
   1. Without exception, all rotating equipment shall be checked and tested for vibration.
      a. The vibration level shall be within the specified limit as per the manufacturer's recommendations. (Generally, the peak vibration velocity shall not exceed 1 mm/sec measured in the filter-in mode. Measurement shall be carried out with a Real Time analyzer, Nicolet 100A. Provide a hard copy Vibration Signature Spectrum showing vibration velocities over a frequency range of 0 to 2000 Hz, measured in a filter-in mode.
      b. Provide ENGINEER with the original Vibration Monitoring reports and all copies necessary for the Maintenance Data.

3.3 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements: Requirements for preparing and starting systems.

B. Provide for all necessary services and expenses of trained personnel representing the manufacturers of various pieces of specified equipment, to ensure correctness of installation and include any start-up costs required by suppliers necessary to ensure satisfactory installation, testing and commissioning, and warranty of the equipment.

C. Provide all materials, labour and equipment necessary to make any adjustments to the installation as required by the manufacturer or the Engineer until the equipment is fully tested and commissioned.

D. On completion of installation and testing, obtain from the suppliers or the manufacturers concerned, certification that the equipment is installed correctly, is in full operational condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer and all copies necessary to comply with other submitted requirements. Certificates are to include a statement to the effect that any adjoining pipe is properly and independently supported and does not cause undue stress that would be detrimental to the equipment performance.

E. Coordinate the work of all equipment suppliers, fully commission all equipment and provide representatives from various manufacturers during plant testing and commissioning as required by the Engineer.

3.4 ADJUSTING

A. Section 01700 - Execution Requirements: Requirements for adjusting installed work.

B. Ascertain details of field welding and fabrication to be carried out for the erection and installation of the various items of equipment.

C. Fabricate the equipment in accordance with CSA Standard S16, Steel Structures for buildings and the manufacturer's instructions.

D. Have the welding shielded, conforming to CSA Standard W59.0, General Specifications.

E. Alignment:
   1. All rotating equipment shall be set and aligned in accordance with the more stringent requirements of either the equipment manufacturer's instructions or the following:
      a. Level base, use machinists level on all machined surfaces.

b. Base is to be true and leveled.
c. Alignment of shafts, soft foot or motor and couplings shall be performed by reverse dial, rim to rim and face to face. Soft foot will be rim to rim vertical and horizontal mode.
    1) Soft foot of motor shall be checked to be within a tolerance of 0.03 m.
    2) Shaft shall be aligned within a tolerance of ± 0.025 mm to 0.070 mm.
    3) Piping strains to pump shall be within a tolerance of ± 0.025 mm to 0.070 mm.
d. Provide the Engineer with alignment report.

3.5 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution Requirements: Requirements for protecting installed work.

B. After the equipment has been installed and prior to final acceptance, protect the equipment from damage, dust, moisture, and debris. Ensure that protection measures are to the satisfaction of the manufacturer and the Engineer.

END OF SECTION

SECTION 11441

MISA SAMPLING SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This section covers the new Municipal-Industrial Strategy for Abatement (MISA) sampling and monitoring system, including supply and installation of sampling pumps, control/analytical hardware, and appurtenances. The MISA sampling system will be provided for installation in the SPP UV Building as a complete, pre-plumbed, pre-wired skid.

1.2 DIMENSIONS

A. Prior to ordering materials and proceeding with the work, check and confirm that the dimensions indicated on Contract Drawings agree with the dimensions of equipment specified.

B. Notify the CONSULTANT of any discrepancy in dimensions and obtain clarification. Correct the dimensions as instructed.

1.3 SUBMITTALS

A. Submit Shop Drawings for all MISA system equipment, including:
   1. General system layout including plan, section, and isometric views with all key dimensions detailed.
   2. MISA sampling skid piping and instrumentation diagram (P&ID).
   3. Complete bill of materials (BOM) for all key components of MISA sampling system.
   4. Wiring diagram for local terminal box with selector switch.
   5. Equipment cut sheets, installation/operation/maintenance manuals for all key system components.
   6. Sizing calculations for the following components: system relief valves, pulsation dampener.

1.4 MAINTENANCE DATA

A. Submit Operation and Maintenance manuals and parts lists in accordance with Section 11010.

1.5 CERTIFICATION

A. Obtain from sampling pump system written certification that all wetted parts of the system are compatible with chemicals being conveyed.

PART 2 PRODUCTS

2.1 GENERAL

A. The MISA sampling systems include:
   1. SPP Final Effluent Sampling System.
      a. Service: Treated secondary effluent, domestic sewage.

B. The MISA sampling system shall include the following components:
   1. FRP Skid to support all MISA Sampling System Components.
   2. Final Effluent Sampling Pumps
   3. Sample Pot.
   4. pH, Conductivity, flow switch and sample pot high level switch instrumentation.
   5. Pressure relief valves, pulsation dampener, calibration column and feed/discharge line accessories.

C. All piping on pre-plumbed MISA sampling skid shall be 316 stainless steel. All MISA System valves (manual isolation valves, pressure relief valves, etc.) shall be of stainless steel construction.

2.2 SAMPLING PUMPS

A. Manufacturer: Watson Marlow Peristaltic Pumps., or approved equal. The MISA Sampling System shall be furnished as a fully assembled, pre-wired, pre-plumbed, and tested skid as furnished by SCG Metcon (Concord, ON).

B. Description: Final effluent sample pumps with optical leak detector and automatic duty/standby switchover capability. Each type with suitable trim for pumping the fluid medium at 5-100 percent of the following capacities:

Quantity	*Type*	*Capacity*	*Fluid Medium*	*Model*	*Pump Size*
2	Peristaltic	216 L/hr	Treated Domestic Sewage	W-M 600 Series	630UN/R E4

Proposed sampling pumps are to be configured in a duty/standby configuration with automatic switchover. Pumps shall be capable of overcoming a suction lift of 4 meters (m). The sampling pumps will draw treated effluent from the Exit Sump (located between Control Building and existing SPP treatment trains) or the Effluent Trough of the UV Building UV Treatment System (existing).

C. Motors: 115 volt, 1 phase, 60 Hz with suitable materials for continuous operation for pumping the fluid medium specified. NEMA 4X washdown enclosure to be provided.

D. Mounting: Sample pumps (and appurtenances) shall be mounted to an FRP skid/panel. Pumps and key appurtenances (valves/instrumentation, etc.) shall be mounted a minimum 610 mm of UV Building Floor. FRP skid shall be securely anchored to UV Building floor by installing Contractor.

E. Accessories: Provide calibration column, of suitable materials, one for skid, complete with valves, fittings, and piping or tubing such that each pump head may be calibrated separately by direct measurement. Provide manual SS ball isolation valves on suction and discharge of

each pump. The suction line to the skid should include a SS y-strainer and manual isolation valve. The discharge of each sample pump will include a check valve and SS pressure relief valve. The discharge of both pumps (one per skid) shall include a discharge pressure gauge (with manual isolation valve and diaphragm isolator) and pulsation dampener.

F. Programming and Control:
   1. Pump speed control shall be manually adjusted between 100 percent and 0 percent with a via the pump keypad (which displays operating RPM and flow).
   2. The pump shall be equipped with the programmable function of pressure levels to allow pump to operate at reduced pressures from the maximum rated pressure of the pump.
   3. Each pump will include a discharge flow switch to monitor that flow is discharging from pump.
   4. Microprocessor based pump controller with digital backlit LCD display of pumping operation, status and error, programming and calibration; membrane switch keypad for pump local operation and programming, auto fault diagnostics, auto restart feature to resume pump operation in the event of power outage, capable of accepting external alarm inputs, alarm relays, non volatile memory. Keypad to allow for scrolling and display such parameters as pump output in gallons per hour or liters per hour (default), dosing quantity, mA current input being received by pump, and indication of external mode.
   5. Each pump shall accept an analog signal such that RPM is proportional to 4 20 mA (into 0 750 Ω load) in automatic mode, the choice of which is programmable at the pump. The pump shall allow the setting of a maximum RPM, which corresponds to the maximum analog signal, with RPM proportional to signal strength below that rate. Programming for curve processing shall also be possible, in which any RPM ratio in proportion to the electrical signal can be configured.
   6. The MISA Sampling System shall include a local junction box for provision of power and input/output signals to/from the MISA Sampling system (including analytical instrumentation). The junction box will include a LOCAL-OFF-REMOTE switch for each sampling pump.

2.3 MISA COMPLIANCE INSTRUMENTATION

A. The sampling pumps will discharge treated effluent of the SPP to a sample pot in which MISA Compliance monitoring instrumentation (pH, conductivity) will be located. The MISA sample pot will continuously overflow to the existing UV Sump Pit in the UV Building.

B. Sample Pot: The MISA Sampling system shall include a 300 mm diameter x 300 mm tall stainless steel sample (open top) pot. The sample pot shall be integral to the MISA Sampling System Skid. The sample pot will include the following nozzles:
   1. Inlet: 25 mm, threaded
   2. Outlet, 50 mm, threaded
   3. Bottom drain (complete drain): 25 mm, threaded complete with manual SS isolation ball valve
   4. High Level switch, nozzle to suit tilt-type high-level switch installed at top (side) of sample pot.
   5. MISA Instrumentation: pH and Conductivity instrumentation shall be configured to measure quality of the collected effluent through open top of the sample pot.

C. MISA Compliance Instrumentation: Refer to Sections 13720 and 13730 for details of the pH and conductivity sensors that will be configured as part of the MISA Sampling System. The MISA Sampling System will also include a tilt-type high level switch that will facilitate termination of operation of the sample pumps to prevent overfilling of the sample pot.

PART 3 EXECUTION

3.1 GENERAL

A. It is the responsibility of the CONTRACTOR to fully coordinate delivery, installation and testing of all equipment.

3.2 INSTALLATION

A. Install MISA SAMPLING SYSTEM in accordance with manufacturer's instructions and to the satisfaction of the ENGINEER/OWNER.

B. Make all necessary piping and cable connections.

C. Employ skilled mechanics to supervise the installation.

3.3 TESTING AND COMMISSIONING

A. Arrange and pay for qualified technical representatives of the MISA SAMPLING SYSTEM to commission the installation.

B. Arrange for the ENGINEER and OWNER to be present at the time of commissioning.

C. Obtain a certificate from the supplier stating that their qualified representative has found the installation to be satisfactory.

3.4 WARRANTIES AND BONDS

A. CONTRACTOR warrants that all equipment covered by or supplied shall:
   1. Comply with the specifications for the said equipment.
   2. Be free from defects in design, manufacture, workmanship or materials.
   3. Perform efficiently and without unwanted interruption for a period of 24 months after the date of Total Completion. The date of Total Completion shall be established by the ENGINEER.
   4. Not have any breakage, damage, defects or deterioration (other than those due to the negligence of parties other than the supplier or the imposition on the equipment of extraordinary working conditions or to normal wear and tear that occurs that is reported to the CONTRACTOR repaired at the CONTRACTOR's expense for the duration of the warranty period).

END OF SECTION

SECTION 13105

COMMON WORK RESULTS FOR INSTRUMENTATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Common requirements for instrumentation specified under individual Sections.

B. Related Requirements:
1. The CONTRACTOR shall supply and install all instrumentation and control wiring.
2. Comply with the requirements of Division 1.
3. Refer to Division 11, Division 15 Mechanical and Division 16 Electrical for additional requirements.
4. Refer to the Contract Drawings to ensure completeness of installation for all items and that these items are compatible with the control and operational intent of the design of this project.
5. Refer to the Contract Drawings to ensure completeness of installation for all items and that these items are compatible with the control and operational intent of the design of this project.
6. Process control equipment and wiring as specified, or as shown on the drawings, are sized for the process, electrical and mechanical equipment as specified, or as may be necessary in the future. Any additional expense incurred because of approved substituted process control equipment from that specified shall be borne by the CONTRACTOR.
7. Provide all necessary equipment, tools, labour, etc., for installing and testing all equipment supplied under this Division.
8. Provide all necessary equipment, tools, labour, etc., for installing and testing all equipment supplied under this Division.

1.2 REFERENCES

A. Reference Standards:
1. Section 01600 - Product Requirements: Requirements for references.
2. International Society of Automation (ISA).
3. National Electrical Manufacturers Association (NEMA).
4. Ontario Electrical Safety Code (OESC).
5. National Fire Protection Association (NFPA).
6. Canadian Standards Association (CSA).
7. Ontario Electrical Safety Authority (ESA) and Safety Bulletins.
8. Ontario Technical Standards Safety Authority (TSSA).
9. Underwriters Laboratories (UL).
10. Underwriters Laboratories of Canada (ULC).

1.3 SUBMITTALS

A. Section 01330 - Submittal Procedures: Requirements for submittals.

B. Reference Data:
   1. Include process measurement device type, process tag, name, manufacturer's name, list of supplied items with complete model numbers (transmitter, sensor, mounting hardware, options and accessories), and process measurement device calibrated range.
   2. Canadian Registration Number for pressure related components when required, according to CSA B51.
   3. Provide Supplier/distributor contact and location of manufacturer's closest service location.

C. Description and Engineering Data: Indicate minimum/maximum range, operating, and performance data, application conditions and limitations of use, layout drawings with overall dimensions, clearance requirements, size and location of connections, wiring diagrams, materials, process connection, mounting details, control schematics with signals identified, wiring connection details, and other technical specifications required to describe product.
   1. Provide detailed description of operation, when applicable.
   2. Provide detailed product data and operating manuals, sheets or manuals for review when required to evaluate submittal, or requested by ENGINEER.

D. Test Reports: Process measurement device calibration certificates including process measurement device reference data; identify testing/calibration equipment, date of original calibration, subsequent calibrations, calibration method, and test laboratory/location.

E. Manufacturer's Instructions: Provide installation details, manufacturer's instructions, and instructions for storage, handling, protection, examination, preparation, setup, and installation of product.

F. Manufacturer's Field Reports: Commissioning report on field tests, including all test forms and confirming proper installation prior to introduction to process media and energization.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents:
   1. Indicate actual locations of process measurement devices (transmitters, sensors, and accessories) on building process equipment plans.
   2. Include actual setpoints and analog signal spans including any field modifications as specified in PART 1, SUBMITTALS.

C. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.
   1. Process measurement device reference data, and description and engineering data. As-built product data including any field modifications as specified in PART 1, SUBMITTALS.
   2. Copies of factory test/manufacturer's calibration report, field report, and process measurement device setup/parameter configuration (including passwords) datasheets for each process measurement device. Include data communication registers layout.
   3. Provide detail installation drawings.

4. Certificates or letters stating each piece of equipment has been installed to the satisfaction of the factory technical representative.
5. Include operating manuals, manufacturer's setup, calibration instructions and control descriptions. Recommended renewal parts list and service/calibration schedules.
6. Submit operation and maintenance data in printed and electronic Adobe Acrobat PDF format on electronic media. Upon approval, large manuals may be provided only in PDF format.
7. Furnish special inspection certificates, when applicable.

1.5 QUALITY ASSURANCE

A. Regulatory Requirements:
   1. Electrical components must comply with requirements of current edition of applicable electrical safety regulations of the Ontario ESA. The installation shall be in accordance with the OESC and Safety Bulletins, latest revisions.
   2. Process measurement devices with electrical components to be CSA, UL, or ULC certified. Refer to www.esasafe.com electrical product safety for complete list of recognized certification marks. Where there is no alternative to supplying equipment that is not certified, obtain special approval according to applicable regulations of the Ontario ESA. Manufacturers' and approval marks must be accessible and legible after equipment is installed.
   3. Mechanical components must comply with of current edition of applicable standards and safety regulations in accordance with the Ontario TSSA.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum 10 years documented experience and presence on Canadian market.

B. Installer: Company specializing in performing work of this Section with minimum five years experience.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 – Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Ship process measurement devices to the Site in factory containers. Store equipment on Site in clean, dry, temporary storage containers for security purposes. Indicate any specific requirements for storage of process measurement devices during proposal stage.

C. Do not purchase sensors, probes, reagents, etc. or install sensors which have short storage/life time until they are ready to be put into continuous operation.

PART 2 PRODUCTS

2.1 DESIGN CRITERIA

A. Furnish products listed and classified as suitable for purpose specified and indicated. Supplied process measurement devices must conform to the details specified. Except as specified elsewhere, equipment to be provided by acceptable manufacturers for each process measurement device or element as specified in equipment Sections.

B. Provide new devices unless otherwise specified. Provide process measurement devices of minimum specified design and quality, conforming to published ratings and for which replacement parts are readily available. Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified. Refurbished devices are not considered new.

C. Devices that are removed but not re-used are the property of OWNER and are to be disposed of or stored as directed by ENGINEER. Items to be re-used, when listed to be checked, recalibrated and cleaned, then shown to ENGINEER, before being re-installed. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.

D. Process measurement devices and components to be approved for the area classification and location in which it is being installed. Wetted parts of primary elements to be suited for process medium. External trim materials to be corrosion resistant. Internal parts to be assembled in watertight, shockproof, vibration-proof, assembly.

E. Process measurement devices ranges indicated are for general guidance only and do not limit the device. Coordinate requirements based on actually installed equipment.

2.2 ACCESSORIES

A. Include mounting hardware, sampling lines, fittings, tubing, check valves, vacuum, and pressure relief valves, pressure and flow reducing control valves, selection and isolation valves, and other appurtenances necessary for process measurement devices operation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Review, verify, and confirm compatibility and performance of the proposed instrument for treatment process and conditions.

C. Field verify process conditions and locations.

3.2 INSTALLATION

A. Install and assemble according to manufacturer's instructions. Exactly follow manufacturer's instructions and installation procedures for sensors directly interfacing process medium.

B. Install components of process measurement devices located as indicated. ENGINEER may change location of any process measurement device within process stream. Provide changes without extra cost if requested before installation.

C. Do not install process measurement devices at locations where other equipment is to be installed, obstruct walkway, or makes inaccessible or hard maintenance access. Maintain spacing and access.

D. Support process measurement devices, process connection lines, and sensors on pipe stands, plates, or channel brackets. Install and securely mount all devices in accessible locations with all gauges, dials, displays, or indicators visible and legible from floor level.

E. Provide electrical and control signals connections to all process measurement devices with manufacturer's instructions.
   1. Bond devices.
   2. Provide electrical identification.
   3. Wire process measurement device through junction box with terminal blocks if more than two wires have to be connected to a single terminal block inside process measurement device, or process measurement device terminal blocks require wire size reduction. Wire size reduction by cutting the strings is not acceptable.

F. Configure, calibrate, and test all process measurement devices.

G. Provide digital network communication devices (HART handheld terminal, modem with PC software), obtain instrument current electronic data/configuration files, and configure digital communication, and device variables (registers).

H. Touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Sequence, schedule, and coordinate work with other trades involved with process measurement device installation. Make arrangements for process measurement device process connection required to install electrical components.

B. Coordinate testing with SCADA integrator and verify data network communication.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01600 - Product Requirements: Requirements for manufacturer's field services.

B. Where specified, provide manufacturer's representative to inspect after installation and submit report prior to startup, verifying installation and operation of process measurement devices is according to specifications and manufacturer's instructions.

C. Provide manufacturer's representative to assist with facility SAT testing. Services to include generating a range of signals from field devices (4-20 mA, faults, etc.) for confirmation by monitoring/control systems.

3.5 SYSTEM STARTUP

A. Section 01810 – Testing and Commissioning: Requirements for commissioning.

B. Provide startup and commissioning support for all process measurement device testing and calibration.

C. Energize all process measurement devices and introduce to the process medium. Alternative procedures may be implemented for process measurement devices, which cannot be safely tested and energized.

D. Provide assistance during start up and rectify deficiencies, conduct troubleshooting and otherwise take corrective action of installed systems.

E. Perform operational tests using process media. Include operation of all process measurement devices by actuation of their controlling variable and monitoring of received signals. If the process media are not physically available or not available at required level (e.g., high pressure or temperature) provide testing means and media to simulate process conditions. Remove and reinstall sensors when required for testing.
   1. Provide digital meter, 4-20 mA signal readers and 24 VDC portable power supply for loop powered devices including accessories (alligator clips, metering leads, temporary wiring, etc.).
   2. Provide temporary tubing, fittings, and pressure regulators for testing.
   3. Provide testing solutions to verify operation of analytical process measurement devices.
   4. Provide movable targets to verify operation of level process measurement devices.
   5. Provide vacuum/pressure calibration pump complete with reference gauges to verify operation of pressure process measurement devices.
   6. Provide ice and hot water in suitable containers complete with reference thermometers to verify operation of temperature process measurement devices.

F. Keep copy of manufacturer's instructions on Site available for review during startup.

3.6 ADJUSTING

A. Section 01700 - Execution and Closeout Requirements and Section 01810 - Testing and Commissioning: Requirements for adjusting.

B. Calibration of analysis process measurement devices, sensors, gauges, and meters installed under the Contract must proceed on a system by system basis. No equipment or system performance acceptance tests to be performed until process measurement devices, gauges, and meters to be installed in that particular system have been calibrated, the calibration work has been witnessed by ENGINEER and reports have been submitted to ENGINEER.

C. Analytical process measurement devices and sensors used for performance testing to be subject to recalibration, if necessary, to confirm accuracy after completion, but prior to acceptance of each performance test. Recalibrate process measurement devices not meeting specifications or process conditions. Field change of process measurement device signal

range, units, display configuration, etc. to suit process is considered a part of calibration work and it will not be considered as an extra to the Contract.

D. Provide calibration tags complete with technician name and date of calibration performed, next date of calibration to be performed and range.

E. Adjust process measurement device set points as listed on process measurement device list and as directed by ENGINEER.

F. Provide assistance during start up to rectify deficiencies, conduct troubleshooting, and otherwise take corrective action of installed systems.

3.7 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning.

B. Prior to energization of process measurement devices, clean inside of all enclosures such that it is free of any dust and debris, cause corrosion, or arc (wire strings).

C. Clean process lines prior to process measurement device installation. Clean process measurement devices process connection components, manifolds, fittings, etc. from construction debris and chemicals to avoid sensor damage or contamination.

3.8 DEMONSTRATION AND TRAINING

A. Section 01810 - Testing and Commissioning: Requirements for demonstration and training.

B. Demonstrate process measurement devices operation.

C. Provide training services for operator training on proper operating and maintenance procedures after satisfactory startup and commissioning.

D. Provide two non-consecutive 8-hour days of training, spread over 4 days.

E. Operation and Maintenance Training:
   1. Class training with overview of process measurement devices, technology, and principles. Provide study and training materials and manuals.
   2. Field hands-on training. Provide presentation by instructor with plant operators. Include:
      a. Instrument overview.
      b. Sensor process connection.
      c. Operator interface.
      d. How to setup and configure process measurement device.
      e. How to calibrate instrument. Provide hands-on presentation by instructor with plant operators following and physically calibrating instrument mandatory for all analytical process measurement devices.
      f. Maintenance and basic checks.
      g. Troubleshooting; simulate alarms and explain causes and procedures.

F. Provide simulators for practice purposes.

3.9 PROTECTION

A. Section 01700 - Execution and Closeout Requirements: Requirements for protection of installed work.

B. Protect all process measurement devices from moisture, dust, debris, and environmental, mechanical or electrical damage during construction. Allow for mechanical protection, removals and reinstallation where required for construction activities.

END OF SECTION

SECTION 13250

OPEN CHANNEL FLOWMETER - RADAR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Open Channel Flowmeter-Radar Type Sensor.

B. Open Channel Flowmeter- Controller.

1.2 REFERENCES

A. Section 01600 – Product Requirements: Requirements for references Regulatory

B. American Society of Mechanical Engineers: ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

C. Canadian Standards Association (CSA).

D. National Electrical Manufacturers Association (NEMA).

E. ISO 9826: International Organization for Standardization, Measurement of liquid flow in open channels.

1.3 SUBMITTALS

A. Section 01330 – Submittal Procedure: Requirements for Submittals

B. Shop Drawings.
1. Submit under provisions of Section 01330 - Submittal Procedures.
2. Make, model, weight, of each instrument.
3. Complete catalog information, descriptive literature, and specifications.
4. Bill of materials for each instrument.
5. Manufacturer's calibration certificates.
6. Detailed dimensional drawings for the instrument.
7. Power and control wiring diagrams, including terminals and numbers, and other requirements of Section 13621.
8. List of configurable parameters c/w factory default settings, settings as shipped, and a blank for each field-adjusted setting.
9. Mounting and installation details.
10. Detailed mechanical schematics and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.

C. Information Submittals:
1. Submit under provisions of Section 01330 - Submittal Procedures.
2. Factory Functional and Performance Test Reports.
3. Calibration Reports.

4. Special shipping, storage, protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Manufacturer's Certificate of Proper Installation.
7. Spare parts list to maintain the equipment in service for a minimum period of 5 years.
8. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
9. Service records for maintenance performed during construction.
10. Operation and Maintenance Manual.
    a. Include complete catalog information and manufacturer's installation instructions including mounting and process connection details.
    b. Include detailed operations and maintenance instructions.

D. Project Record Documents - Submit under provisions of Section 01330 - Submittal Procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. VEGAPULS 64 series w/ VEGAMET 391 Controller.

B. Substitutions: Approved equivalent by Engineer.

2.2 DESCRIPTION

A. Volumetric fluid flow measurement, where rate is calculated based on the fluid level in the man-made, fixed hydraulic structure of known level-to-flow characteristics. Note: fixed hydraulic structure (parshall flumes) are existing and not within the scope of work.

2.3 CONTROLLER

A. Microprocessor based with backlit LCD integral display, pre-programmed curves of typical hydraulic structures (e.g., Parshall flume, rectangular and v-notch weirs, flumes) and flow totalizer values in engineering metric units, sensor and electronics failure mode and annunciation, field programmable, HART protocol and menu driven type software limit and control settings (e.g., configuration of fixed hydraulic structure, units, range, zero and span adjustment), self-calibration, non-volatile memory, remote mounted as indicated.

B. Environmental Requirements:
    1. Enclosure: Corrosive resistant, metal or polycarbonate, horizontal or vertical surface mounted, CSA, NEMA4X.
    2. Operating Temperature: Minus 20 degrees C to 50 degrees C, 0 to 95 percent relative humidity.

C. Control Interface:
    1. Analog Output Signals:
        a. AO1: Flow, 4-20 mA, linear and proportional to range analog current signal, isolated with superimposed HART protocol signal, into load between 250 and 1,000 Ω (HART).

2. Discrete Output Signals (independently programmable, SPDT type, dry contacts, rated 3A at 120 VAC and 1 A at 24 VDC):
   a. DO1: Instrument malfunction.
   b. DO2, DO3: Spare.
3. Digital Communication: HART Revision 5.0 or newer, data to include (as minimum):
   a. Flow (PV).
   b. Level (SV).
   c. Flow totalizer (volume).
   d. Instrument malfunction alarm.

D. Power requirements: less than 1 A at 120 VAC plus or minus 10 percent, 60 Hz.

E. Connections: Minimum three pre-stamped openings at the bottom for cable/raceway entries suitable for NPT sized fittings.

2.4 LEVEL SENSOR

A. Radar, integral horn antenna type, contactless fluid level measurement, for flow measurement in open flumes, where level is calculated based on the measurement of the travel time of short radar pulses emitted from sensor and received by the antenna as echoes. The transit time of the radar pulses from emission to reception is proportional to the distance and hence to the level.
   1. Range: Up to 30 m.
   2. Transmission distance (sensor to transmitter): minimum 200 m.
   3. Process fitting: Thread 3/4” NPT, vertical position. Provide adapter as needed to suite existing parshall flume stilling well.

B. Process connection: Installed on existing still well of existing parshall flumes

C. Process Measurement Performance Requirements:
   1. Accuracy: Plus or minus 0.25 percent of calibrated span.
   2. Resolution: 2 mm.
   3. Process Fluid Temperature: 0 to 20 degrees C.

D. Environmental Requirements:
   1. Enclosure: Sealed, capable of withstanding accidental submersion, corrosion resistant, polycarbonate, PVDF or metal, CSA, (NEMA) and explosion proof rated, suitable for location, as listed.
   2. Operating Temperature: Minus 40 degrees C to 50 degrees C, 0 to 100 percent relative humidity.

2.5 SENSORS AND CONTROLLER MOUNTING

A. Sensor shall be mounted in existing parshall flume stilling well that allows for threaded (NPT) sensor connection directly to stilling well.

B. Corrosion resistant stainless-steel sun and snow shield (minimum 900 by 900 mm, 3:4 slope) for outdoor installations.

C. Controller shall be installed in 2" pipe stand.

2.6 ACCESSORIES

A. Stainless-steel process ID tag.

B. Sensor to transmitter cables.

C. Required Software.

2.7 INSTRUMENT LIST

Process Tag	Service	Range	Options	Notes
WW-67961-LIT-9000	East Treatment Train Effluent Flowmeter	0 to 15m	Suspended mounting	LIT: Type 4X, LE/TE: NEMA 7, explosion proof rated for (Class 1, Zone 2, Group IIA)
WW-67961-LIT-9001	West Treatment Train Effluent Flowmeter	0 to 15m	Suspended mounting	LIT: Type 4X, LE/TE: NEMA 7, explosion proof rated for (Class 1, Zone 2, Group IIA)

General Notes:
LIT – transmitter/controller, LE – level sensor,
Hazardous Location: Class 1, Zone 2, Group IIA, Digester Gas Atmosphere.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution Requirements: Verification of existing conditions before starting work.

B. Review, verify, and confirm compatibility and performance of the proposed instrument and fixed hydraulic structure.

C. Ranges sized according to actual process conditions; instrument final spans and setpoints confirmed during construction.

3.2 INSTALLATION

A. The instrument must be stationary mounted and the antenna directed vertically downward.

B. Refer to manufacturer instruction manual for more details.

3.3 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspecting and testing.

B. Configure, calibrate, and test instruments.

C. Coordinate testing with SCADA integrator and verify HART data network communication.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements: Requirements for manufacturer's field services.

B. .Provide manufacturer's representative to inspect installation and submit written report prior to startup, verifying installation and operation of instruments is according to specifications and manufacturer's instructions.

C. CONTRACTOR shall include 1.0 person days of the manufacturer's services to perform start-up /commissioning on instrument to include basic operational training and certification of performance of the instrument.

END OF SECTION

SECTION 13430

CONTROL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section outlines the process needed to be undertaken to fabricate, wire, test, install, and commission the PAC control panel within this Project.

B. Control and instrumentation system panels, which may include within enclosure (when permitted) the control relays, and power control related devices (e.g., starters, contactors, drives), and other electrical equipment dedicated to specific equipment or machinery.

C. Factory and Site acceptance testing.

1.2 RELATED SECTIONS

A. Section 13450 – Programmable Controllers.

1.3 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Canadian Standards Association:
   1. CSA C22.1 - Canadian Electrical Code, Part I – Safety Standard for Electrical Installations.
   2. CSA C22.1 - Canadian Electrical Code, Part II – Safety Standard for Electrical Equipment.
   3. CSA C22.2 - No. 14 - Industrial Control Equipment.
   4. CSA C22.2 - No. 66 - Specialty Transformers.

C. International Electrotechnical Commission (IEC).

D. Institute of Electrical and Electronics Engineers (IEEE).

E. National Electrical Manufacturers Association (NEMA).

F. Ontario Electrical Safety Code (OESC) and Bulletins.

G. Underwriter's Laboratories of Canada (ULC).

1.4 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Provide detailed panel layouts including, but not limited to:
   1. Panel and physical layout drawings.

2. All hardware schematics, elementary and field wiring diagrams for all control panel and related systems.
3. Loop diagrams for all system loops.
4. Device and panel data connections, cabling and wiring schematics.

C. Shop Drawings: Refer to Section 13621 - Control System Documentation.

D. Product Data: Refer to Section 13621 - Control System Documentation.

E. Test Reports: Refer to Section 13623 - Testing and Commissioning.

F. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.

C. Record Drawings: Refer to Section 13621 - Control System Documentation.

D. Product Data: Refer to Section 13621 - Control System Documentation.

E. Test Reports: Refer to Section 13623 - Testing and Commissioning.

F. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 5 years documented experience.

B. Fabricator: Company specializing in fabrication of control panels with minimum 5 years documented experience.

1.7 QUALITY ASSURANCE

A. Provide all supervision, material, design, labour, procurement, fabrication, delivery and installation of all equipment required for a complete system as specified.

B. Final device location within the panel shall be CONTRACTOR's responsibility and shall be based on the guidelines provided by the equipment manufacturer.

1.8 REGULATORY REQUIREMENTS

A. Equipment and material to be in accordance with appropriate standards and must be CSA, ULC certified. Equipment should also be applicable national or local regulatory requirements as required. Refer to www.esasafe.com for a complete list of recognized certification marks. When no alternative exists to providing approved equipment based on the requirements above, the involved party shall obtain and pay for special approval from the Electrical Safety Authority (ESA) Special Inspection Department. All manufacturers' labels must be visible and legible after equipment is installed.

B. All components installed must comply with the requirements of the current edition of the respective electrical inspection authority. The installation must be completed with the latest edition of the OESC.

1.9 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution Requirements: Requirements for warranties.

B. Provide manufacturer's standard warranty.

1.10 SPARE PARTS AND MAINTENANCE MATERIALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for spare parts and maintenance materials.

B. Supply a list of recommended spares. Special tools required for maintenance shall be identified.

C. Each control panel supplied shall be furnished with the following spare parts (as applicable):
   1. Two indicating lights along with assembly for each type of light used within the control panel.
   2. Two switch assemblies for each type of switch used within the control panel.
   3. Ten fuses of each type of fuse used within the control panel.
   4. Five relays of each type and rating used within the control panel.

PART 2 PRODUCTS

2.1 GENERAL

A. Furnish Products listed and classified by CSA as suitable for purpose specified and shown.

B. Manufacturers listed are used for reference purposes to establish acceptance standards and establish minimum functional requirements for control device.

C. Provide products of exact manufacturer, if explicitly shown and described.

D. The control panel shall be based on Bruce Power requirements. Refer to the Drawings for details.

2.2 OPERATING CONDITIONS

A. Location:
   1. SPP Plant Electrical Room: Refer to the Drawings for location.

B. Ambient temperature 0 to 40 degrees C, 0 to 95 percent humidity.

2.3 CONTROL PANEL ENCLOSURES

A. Indoor Areas: Fabricated of high grade cold rolled steel (CRS) and paint with ANSI 61 Light Grey baked enamel outside and inside, except on stainless steel. Sub-panels to be on 12 gauge CRS finished with white baked-enamel.

B. Back plates to be 2.7 mm steel sheet, painted white, mounted on four 10 mm collar studs minimum with stainless steel hardware

C. Corrosion resistant stainless steel screws, bolts, fasteners, hinges, and door handles, etc.

D. Panel Dimensions: As show on the Drawings.

E. Exterior welds to a smooth finish free of burrs. Make surfaces free of ridges, nuts, bolt heads, and similar protrusions.

F. Print Pocket: On inside of door, rigid, for storing manual, layout drawings and wiring drawings.

G. Doors: Removable, continuous piano type hinges, three point latching, key lockable handle (keyed alike), padlock hasp. Three-point closure is required for indoor panels. Using screw clamps or quarter turn latches in conjunction with three-point handles to achieve or maintain a NEMA/EEMAC rating will not be acceptable. Seal all conduit entry points and openings through the use of gaskets and other means within the panel such that panels maintain their appropriate NEMA/EEMAC rating. No conduits may enter through the top of a control panel or WAN panel. To prevent the ingress of dirt or water into a PAC control panel, as well to maintain separation of field and in-panel wiring, conduit shall enter into the bottom of the PAC and WAN panels. Intrinsically safe wiring is exempt from this rule and may enter at the top right or top left (side closest to the intrinsically safe barriers) of a control panel 152 mm or less from the top of the control panel to maintain proper wiring separation. All other conduit entries must be approved by the OWNER, and may only be allowed if the panel has been designed to maintain separation of field and in-panel wiring.

H. Provide 50 mm stainless steel spacers between panel and wall.

I. All panel mounted equipment shall be complete with an engraved legend on a white lamacoid. This nameplate shall have black lettering no smaller than 6 mm.

J. All panel equipment shall be complete with an identification nameplate having letters no smaller than 12 mm. All details of inscriptions shall be approved by ENGINEER.

K. Manufacturers:
   1. Hammond.
   2. Hoffman.
   3. Rittal.
   4. Eurobex.

5. Approved equivalent.

2.4 CONTROL PANEL POWER LAYOUT AND ASSEMBLY

A. PAC control panel shall not have voltage higher than 120 VAC within the control panel.

B. PAC control panels are not to be used as a pass-through or junction box for other circuits or wiring external to the PAC control panel.

C. Provide a main power breaker (30 A maximum) which is not to exceed the breaker rating of the feeder circuit breaker. Provide branch circuit breakers for each individual circuit distributed from the panel. Branch circuit breaker current trip rating is not to exceed main breaker trip rating to ensure general co-ordination of breakers within the control panel. Breakers to have only one incoming and one outgoing wire termination. For common reference points, provide a finger safe jumper bar. Do not use wire jumpers.

D. Provide a surge protection/power filter device, rated 20 A minimum, to protect control panel components. This power filter is to be placed in circuit prior to UPS connection point. Acceptable Surge protection is Phoenix Contact SFP 1-20/120AC or approved equivalent.

E. Provide a brown, 120 VAC, 30 A simplex receptacle to power the UPS, hardwired to its own 30 A breaker. This receptacle must be labelled 'UPS' and located near the bottom of the enclosure.

F. No power splitters (i.e., aluminium/copper type lugs with one large feed screw and two or more smaller sub-feed lugs) are to be utilized within a PAC panel. Use only appropriate type terminal blocks with centre style bridge jumpers for power distribution.

G. To control or eliminate electrical noise in wiring systems, group wires of compatible signal or power levels together and run separately or electromagnetically isolated from wires of incompatible signal or power level.

H. Isolate 24 VDC digital and analog signals from 120 VAC power or signal wiring as much as is reasonably possible. Where not possible, Section 12-904(2) of the OESC 2012 to be followed.

I. Wiring to devices on hinged doors or panels: TEW wire, extra flexible, 49 strands minimum, wrapped in plastic spiral wrap fastened to the panel/door with Velcro® cable ties. Wiring to be installed with enough slack to allow the door to be fully opened. Wire ducts may also be stud welded to the control panel door provided this can be done without damaging the exterior surface of the door.

J. Control panel wiring ducts to be white, narrow slot, Panduit Type F series, or approved equivalent, and include a snap cover. Wiring duct to be filled no more than 50 percent at completion of the installation. Minimum duct width to be 2 inches, and minimum duct height to be 3 inches. Field wiring ducts are not to contain any internal panel wiring, and internal panel wiring ducts are not to contain any field wiring.

K. Identify each conductor, including spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance. Label all conductors at both ends using the same designation. Using different designations on the same conductor or on conductors that are commoned together is unacceptable, unless they are connected through a terminal block. Designations that are used on the wiring must match those shown on the Shop Drawings.

L. Identify PAC wiring at terminal blocks and connection points with PAC terminal (I/O) address numbers using the following formats:
   1. Digital Inputs: I:##/## (i.e., I:00/01, I:06/13, I:22/15, etc.).
   2. Digital Outputs: O:##/## (i.e., O:01/00, O:07/14, I:25/08, etc.).
   3. Analog Inputs: I:##.##+ or - (i.e., I:03.00+, I:03.00-, I:24.03+, I:24.03-, etc.).
   4. Analog Outputs: O:##.##+ or - (i.e., O:06.00+, I:06.00-, I:19.03+, I:19.03-, etc.).

M. Identify wiring at both ends with heat shrink type, indelible machine printed wire markers. Brady 'PermaSleeve' Markers, or approved equal. Refer to the SCADA Coding and Tagging Standard for details on wire marker requirements.

N. TECK cable entering the panel to have grounding lock nuts applied to all cables and be bonded to the panel ground.

O. PAC Control Panels are to have two dedicated #4 AWG ground cables be that are grounded back to the supply transformer. One of these cables will be connected to the panel electrical ground bar, and the other will be connected to the panel isolated ground bar.

2.5 WIRING

A. The following wire gauges are to be used within the control panels, defined by function.

Function	**Gauge***	**Voltage Rating**
120 VAC Power	#14 AWG	600 V
DC DI/DO Signals (Panel Side)	#16 AWG	600 V
DC DI/DO Signals (Field Side)	#14 AWG	600 V
AC DI/DO Signals (Panel Side)	#16 AWG	600 V
AC DI/DO Signals (Field Side)	#14 AWG	600 V
24 VDC Power	#16 AWG	600 V
Control Circuits where protected by 10 A fuse or less	#16 AWG	600 V
Control Circuits where protected by 15 A fuse or less	#14 AWG	600 V
4-20 mA Analog Signals, other Analog Signals	#18 AWG**	300 V
Grounding (Internal)	#14 AWG	600 V
Grounding (Panel to ground Grid)	#4 AWG	600 V

Notes:
*Wires to be minimum 16 strand with fire retardant insulation.
**Shielded conductors are to be used.

B. Wire colours for both in-panel wiring and field wiring and are to conform to the following:

Function	**Colour**
AC/DC Line and Load Power (Hot/Live)	Black
Current Carrying Grounded Conductor (Neutral)	White
AC Control & I/O Circuits	Red

Function	Colour
DC Control & I/O Circuits	Blue
Analog Pair (+, Feed)	Black
Analog Pair (-, Return signal to PLC)	White
Circuits Energized from External Source (24VDC and 120VAC)*	Yellow
Intrinsically Safe Wiring	Blue with White Stripe
DC Signal Ground	Green with Yellow Tracer
Electrical/Panel Ground	Green

Notes:

*Wiring that enters the Control Panel and is energized from a source other than the Control Panel.

C. TECK cable wire colours used for digital I/O wiring are expected to conform to the wire colour standards.

2.6 TERMINAL BLOCKS

A. Control panel terminal blocks are to conform to the following requirements:

Function	Required Type
I/O Card power supply	Fused with fuse blown indicator
Instrumentation power supply	Fused with fuse blown indicator
24 VDC power supply (where no CB used)	Fused with fuse blown indicator
Misc. Power Supply	Fused with fuse blown indicator
General control connections, power distribution	Non-fused
DI/DO field wiring interface	Non-fused
AI/AO field wiring interface	Non-fused, knife switch
Grounding	Non-fused, grounding

B. Based on the function and the identified required terminal block types as shown in the above table the following terminal block guidelines are as follows:

1. Fused Terminal Blocks with Fuse Blown Indicator: Modular, rated 300 V 12 A minimum, 81.3 mm DIN rail mounted, individually removable, with swing arm fuse access, LED or Neon blown fuse indicator. Allen-Bradley 1492-H5 for working voltage of 10-57 V AC/DC, Allen-Bradley 1492-H4 for working voltage of 100 to 300 VAC, or approved equivalent. Supply five spare fuses of each fuse type rating in DIN rail mountable utility box with each control panel.
2. Non-Fused Terminal blocks: Modular, rated 600 V 25 A minimum, tubular clamp type, 35 mm DIN rail mounted, individually removable, with removable insulating covers on exposed terminals carrying above 50 V, WDU4 Series by Weidmuller Ltd., 1492-J Series by Allen-Bradley, UT Series by Phoenix Contact Ltd., WK 4/U Series by Wieland Electric Ltd., or approved equivalent.

3. Non-Fused Knife Switch Terminal blocks: Modular, rated 300 V 10 A minimum, tubular clamp type, 35 mm DIN rail mounted, individually removable, with removable insulating covers on exposed terminals carrying above 50 V, WTR4 Series by Weidmuller Ltd., 1492-J Series by Allen-Bradley, UT Series by Phoenix Contact, WK 4/TKM Series by Wieland Electric Ltd, or approved equivalent.
4. Non-Fused Grounding Terminal blocks: Modular, rated 150 A, tubular clamp type, 35 mm DIN rail mounted, individually removable, with removable insulating covers on exposed terminals carrying above 50 V, WPE4 Series by Weidmuller Ltd., 1492-J Series by Allen-Bradley, UT Series by Phoenix Contact, WK 4 SL/U Series by Wieland Electric Ltd, or approved equivalent.
    a. Colour: Green and Yellow.

C. Additional terminal block design requirements are as follows:
1. A minimum of 5 cm space between terminal blocks and any other device or raceway.
2. Separate terminals and wiring by class of signal.
3. Provide a minimum 20 percent spare terminals for each signal class.
4. Finger-safe terminals are required.
5. Use jumper bars to connect common terminals where appropriate. The use of wire jumpers is to be kept to a minimum.
6. Major Devices are to be spread across I/O Modules such that a failure of one I/O module does not fault the entire facility as the PAC will be able to operate other like equipment that are on a different I/O module.
7. All spare PAC I/O is to be landed on the appropriate terminal block for future connections to the spare I/O points.
8. Use of double- or triple density, or double- or triple-stack blocks is not permitted without permission of the engineer and the OWNER.
9. Analog input terminal blocks shall have five terminals per input.
    a. One "+24 VDC" source terminal for loop powered instruments.
    b. One "0 VDC" common terminal for loop powered instruments.
    c. One "+" terminal to the positive signal terminal of the PAC card.
    d. One "–" terminal to the negative signal terminal of the PAC card.
    e. One isolated ground terminal for connecting of the shields to the panel isolated ground.
10. Analog I/O wiring shields for all instruments/devices shall be grounded in the panel to terminals connected to the isolated ground bar in the panel, which is connected to the building ground system via a separate cable. Analog I/O wiring shields are not to be grounded at the field end under any circumstances and the isolated ground in the control panel is not to be left floating. A separate ground cable of the same gauge as the electrical ground is to be run from the isolated ground bar to the same ground point as the panel electrical ground.
11. Terminal Blocks are to be labeled on both sides of the terminal using printed labels. Handwritten terminal block labels are not permitted.

2.7 PROGRAMMABLE LOGIC CONTROLLERS

A. Refer to Section 13450, Programmable Controllers for information.

2.8 CONTROL DEVICES - GENERAL

A. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

B. Pilot lights and control switches to be coloured in accordance with CAN/CSA Z431-96 Colours of Indicator Lights and Push- Buttons.

C. Pilot lights shall be coloured as follows (unless shown otherwise on the Drawings):
   1. Running/Open: Red.
   2. Stopped/Closed: Green.
   3. Power On: White.
   4. Fault: Amber.
   5. Auto Bypass: White.
   6. System Okay: Green.
   7. SCADA Alarm: Amber.

D. Push-buttons and selector switches shall be coloured as follows:
   1. Stop/Off/Close: Red.
   2. Start/Run/Open: Green.
   3. Other Functions: Black.

E. Manufacturers (in alphabetic order):
   1. Allen-Bradley, 800T.
   2. Cutler-Hammer.
   3. Square D.
   4. Approved equivalent.

F. Manufacturers listed above are used for reference purposes to establish acceptance standards and establish minimum functional requirements for control device.

G. Provide products of exact manufacturer, if explicitly shown and described in other Sections for specific application.

2.9 UPS BYPASS RELAY

A. Universal Pole Type: Electrically held with three poles minimum, convertible from NO to NC by changing wiring connections, break-before-make single pole double throw contacts, plug-in style with base, LED status indication.
   1. Coil Rating: 120 V, 3 VA.
   2. Contact Rating: 120 V, 15 A.

B. Manufacturers:
   1. Allen-Bradley, 700-HB33A1-4.
   2. Or ENGINEER approved equivalent.

2.10 AC GENERAL PURPOSE CONTROL RELAYS

A. Universal Pole Type: Electrically held with four poles minimum, convertible from NO to NC by changing wiring connections, plug-in style with base, LED status indication.1.1 VA.
   1. Contact Rating: 120 V, 7 A.

B. Manufacturers:
   1. Allen-Bradley, 700-HC series.
   2. Cutler Hammer.

3. Phoenix Contact.
4. Approved equivalent.

2.11 TIMING RELAYS

A. Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants. Plug-in style with base.

B. Potentiometer: Self-contained to provide time interval adjustment.

C. Supply Voltage: 120 VAC, 60 Hz.

D. Temperature Range: Minus 20 to 60 degrees C.

E. Output Contact Rating: Maximum voltage 120V ac or dc. Current: EEMAC B300.

F. Timing Ranges: Adjustable, minimum 0.05 second, maximum 300 hour, unless otherwise required by design.

G. Timing Function: To suit application (i.e., on-delay, off-delay, etc.)

H. Manufacturers:
1. Allen-Bradley, 700-HR.
2. Omron.
3. Phoenix Contact.
4. Approved equivalent.

2.12 INTERPOSING PAC PANEL INTERFACE RELAYS

A. DIN rail mounted, single pole, with LED status light. 6 A rated contacts minimum.

B. 120 VAC Relays:
1. Acceptable Manufacturers:
   a. Allen-Bradley 700-HLT1U1.
   b. Phoenix Contact, PLC-RSC-120UC/21AU.
   c. ABB, R500 Series, D2.5/5-OBIA-0030-115ac.
   d. Weidmuller, MRS 120VUC 1CO RC.
   e. Approved equivalent

C. 24 VDC Relays:
1. Acceptable Manufacturers:
   a. Allen-Bradley 700-HLT1U24.
   b. Phoenix Contact, PLC-RSC-24DC/21AU.
   c. ABB, R500 Series, D2.5/5-R121AL.
   d. Weidmuller, MRS 24Vdc 1CO C1D2.
   e. Approved equivalent.

2.13 INTRINSICALLY SAFE BARRIERS RELAYS (ISR)

A. DIN rail mounted.

B. To be used for interfacing with discrete devices located in hazardous areas.

C. Pepperl+Fuchs:
   1. Digital Inputs: KFA5- SR2-EX2.W, or approved equivalent.
   2. Analog Inputs: KFD0-CC-EX1, or approved equivalent.

D. All intrinsically safe wiring to be isolated from all other panel wiring and leave the control panel in its own conduit.

2.14 PUSH BUTTONS

A. Oil tight. Operator extend type, labeled as indicated, heavy duty, 30 mm diameter oil-tight standard operators, contact arrangement as indicated on the Drawings, button colour as per standards, rated 120 VAC.

B. Provide contact configurations as shown on the Drawings.

C. Manufacturers:
   1. Allen-Bradley, 800T.
   2. Cutler Hammer.
   3. Square D.
   4. Approved equivalent.

2.15 CONTROL SWITCHES

A. Maintained unless otherwise indicated, labeled as indicated, heavy duty, 30 mm diameter oil-tight standard operators, contact arrangement as shown on the Drawings, black in colour, rated 20 V, 720 VA ac.

B. Provide contact configurations as shown on the Drawings.

C. Manufacturers:
   1. Allen-Bradley, 800T.
   2. Cutler Hammer.
   3. Square D.
   4. Approved equivalent.

2.16 PILOT LIGHTS

A. Oil-tight, LED lamp, transformer type, 30 mm diameter, push-to-test. Lens colour as indicated by standards or as shown on the Drawings, supply voltage: 120 V, labels as indicated.

B. Manufacturers:
   1. Allen-Bradley, 800T.
   2. Cutler Hammer.
   3. Square D.

4. Approved equivalent.

2.17 CONTROL CIRCUIT BREAKERS

A. Rail mounted, thermomagnetic, toggle operated.

B. Manufacturers:
   1. Allen-Bradley, 1492-SP.
   2. ABB.
   3. Phoenix.
   4. Weidmuller.
   5. Approved equivalent.

2.18 RECEPTACLES

A. General Purpose Receptacle: Specification grade, 15 A, 125 VAC, duplex, flush, ivory, NEMA 5-15R receptacles. Hubbell HBL5262I, or approved equal.

B. UPS Fed Receptacle: Specification grade, 20 A, 125 VAC, simplex, flush, brown, NEMA 5-20R receptacle. Hubbell HBL5361, or approved equal.

2.19 24 VDC POWER SUPPLIES

A. Description: 24 VDC power supplies are to be redundant, complete with redundancy modules, and sized such that one of the power supplies can provide the current draw requirements of all 24 VDC devices connected to the power supplies plus an additional 20 percent spare capacity for future additions. Additionally, power supplies are to be no smaller than 5 A. Terminal blocks with finger-safe jumper bars for power distribution are required. Power supplies are required to have a 'DC OK' dry contact status output for SCADA monitoring. Redundancy modules are to incorporate load balancing between the two power supplies.

B. Supply two power supplies to operate in redundant configuration. No power interruption must occur in the event one of the two power supplies should fail.

C. Acceptable Manufacturers (5 A models shown, equipment to be sized as required):
   1. Phoenix Contact QUINT-PS/1AC/24DC/5 with QUINT-ORING/24DC/2X10/1X20 redundancy module.
   2. Weidmuller CP M SNT 12 W 24 V 5 A or CP M DM20 redundancy module.
   3. Approved equivalent.

2.20 UPS and UPS MAINTENANCE BYPASS UNIT

A. Description: The PAC Control Panel UPS is to be 3,000 VA minimum. The UPS is to provide a minimum of 1 hour back-up power in the event of a power failure. If a 3,000 VA UPS alone cannot provide the required backup time, install additional battery modules as required. Do not increase the size of the UPS. The following features are to be incorporated in the UPS:
   1. Built-in general fault relay output.
   2. Ethernet/SNMP interface module/card meeting RFC1628 SNMP MIB Standards.

3. Digital display.
4. Alarm silence feature.
5. UPS to be on-line double conversion type.

B. Acceptable UPS Manufacturers:
1. Eaton 5P Tower.

C. The UPS is to be installed in conjunction with a UPS Maintenance Bypass unit. The UPS bypass will have a manually operated bypass switch that allows for the isolation and removal of the UPS from the PAC Control Panel without interrupting downstream devices. Any equipment requiring UPS power must be plugged into the UPS bypass, not directly into the UPS.

D. Acceptable UPS Maintenance Bypass Manufacturers:
1. Powerware (Eaton) HotSwap MBP EHBPL2000R-PDU1U.

2.21 SPECIAL CONTROL DEVICES AND COMPONENTS

A. Communication/Programming Port:
1. The control panel door mounted communications/programming port to be a combination 120 VAC/5A NEMA 5-15R receptacle, RJ-45 Ethernet port, and dual USB port, located adjacent to or above the folding laptop tray.
2. Acceptable Manufacturers:
a. Phoenix Contact, 5526291.
b. Grace Engineered Products.
c. Hubbell.
d. Approved equivalent.

2.22 ACCESSORIES

A. LED light with door mounted switch.

2.23 IDENTIFICATION

A. Panel Identification:
1. Process Label: Lamicoid nameplate providing system identification. Panel tag identification shall have letters no smaller than 25 mm for key panels and 12 mm for marshalling panels.
2. Manufacturer's Label: Company name/info with 0 reference number and manufacturing date.
3. Electrical Label: Panel supply voltage, full load current amps, interrupting rating.

B. Internal Components: Each internal panel mounted devices shall be fitted with a permanent nameplate (lamacoid or equal) at the device, with the device identification imprinted. Fuses and breakers shall have the size indicated on the nameplate.

C. Terminal Blocks: Each terminal to be clearly marked with factory pre marked number and/or letter tag identifiers.

D. Cable, Wire Markers: Wire identification on both ends, white background with black lettering, sleeve type heat shrinkable plastic tags (or similar to provide firm fit on the conductor insulation), machine printed.

PART 3 EXECUTION

3.1 DESIGN

A. CONTRACTOR shall provide supervision, labor for the design, detailed execution, procurement, fabrication, and delivery of control panels.

B. Design control panels. Prepare and submit control drawings in accordance with Section 13621 - Control System Documentation.

C. Provide materials and perform work in accordance with the latest named published editions of codes and standards.

D. Use new materials and equipment unless otherwise specified. Refurbished materials are not considered new. Provide material and equipment of minimum specified design and quality. Conform to published ratings and for which replacement parts are readily available. Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified. All control and electrical components shall be standard stock items with 7-day parts or unit replacement available in Canada.

E. Listed manufacturers and models are used for reference purposes to establish acceptance standards and establish minimum functional requirements for control device. Provide products of exact manufacturer, if explicitly shown and described in other Sections for specific application.

F. Unless specified otherwise, separate control/power panel must be provided for each system (if more than one system provided). All power, control devices, and software for a given system to be contained independently within its associated control/power panel.

G. Design electrical power system to provide an overall efficiency of not less then 90 percent, leading power factor greater than 0.9 at full load.

3.2 CONTROL PANEL FABRICATION

A. Fabrication: Shop fabricate control panels to CSA C22.2 No. 14, using cabinets and terminal blocks furnished in accordance with Section 16010.

B. The panel dimensions given are the minimum required. Ensure items listed on the Bill of Materials can be mounted within given panel dimensions.

C. Install Products in accordance with manufacturer's written instructions.

D. Install programmable controllers furnished in accordance with Section 13450.

E. Any steel fasteners shall be hot-dip galvanized. Under no circumstances shall interior fasteners penetrate the panel skin.

F. Provide surge suppressers across each relay coil.

G. Equipment shall be mounted to ensure adequate clearance between both door and backplane mounted components with the panel door closed.

H. All internally mounted equipment shall be placed in an order such that all components can be removed easily for maintenance and replacement purposes.

I. Provide panel with a minimum of 0.18 m^2 blank panel space for installation of future panel mounted devices.

J. Relay base and terminal block rails shall be located square to the backpane. Door mounted instruments shall align horizontally and vertically on edges or centrelines as indicated.

K. Fastening of equipment assemblies to the panel backplanes shall be by means of appropriately sized drilled and tapped screw holes. Machine screws only with lock-washers are to be used; self-tapping hardware is not acceptable.

L. Determine the exact devices current and install fuses in accordance with manufacturer's specifications. Verify settings. Ensure circuit over current protective devices such as breakers, protective relays, fuses, etc. are installed and set to required values based on installed equipment.

3.3 CONTROL PANEL WIRING

A. Run wires in wireway and exit the wireway at the point nearest to the device to which it is wired.

B. Do not splice wires within a wireway.

C. Identify each wire at each termination point using markers bearing the complete wire number.

D. Neatly harness wires within wireways using tyrap fasteners with wire forming done such that there is no mechanical tension on wire terminations.

E. Provide cabling required to connect the PAC equipment mounted in the panel and as shown on the Drawings.

F. Route AC wiring separately from DC wiring. Make allowance for this in the manufacturer of the panel.

G. Provide wire duct sized for no more than 50 percent fill. Wiring ducting shall be separate for interconnections within cabinet and for exterior field cabling routing.

H. Maximum unshielded cable exposure shall be only 50 mm, to permit connection to device terminals and neat terminals of the drain wire.

I. Terminals shall be accessible for attachment of field connections. Each terminal shall be clearly marked with pre-marked factory numbers, and/or letter tag identifiers. Each field-connecting conductor shall be served by one terminal.

J. Provide a minimum of 20 percent spare terminals of each type of terminal assembly in each panel.

K. Flexible wiring harnesses with approved terminating connectors at both sides shall be provided for any hinged panel or door-mounted equipment (e.g., pilot lights, push-buttons).

L. Tapped copper bus bar for panel components and shield grounding shall be provided, including 20 percent spare.

M. Each terminal block wire shall be provisioned such that it is landed at 90 degrees to the terminal, and have adequate spare length such that the wire can reach up to four terminals above and below where the wire has been landed.

N. Terminal block identification shall match the conductor identification number where possible.

O. Spare terminals shall be installed at the end of each terminal assembly. I/O groups (in general) shall consist of: Digital Inputs (DI), Digital Outputs (DO), Analog Inputs (AI) and Analog Outputs (AO). Spare terminals shall be identified with the letters "SP" or "SPARE" on removable factory pre-marked tags.

P. Wiring that is not directly related to an I/O group, spare terminals shall be installed at the end of the terminal assembly (e.g., 24 VDC terminal rail, 120 VAC terminal rail grounding rail.).

Q. In addition to spare terminals identified above, each unused programmable controller I/O module point (discrete or analog) shall be wired to term to terminal blocks and identified with the I/O address.

R. All analog signals must be wired through fusible or isolation type terminal blocks.

S. All spare conductors shall be terminated on terminals.

T. Each panel shall be bonded to the building ground system:
   1. Firmly bond all panel devices (either on or within panel) to ground. Provide supplementary bonding conductors to the back panels and doors of the control panel.
   2. In the case of devices not firmly fastened to panels (e.g., meters), provide a separate bonding conductor with screws attached to the appropriate device.
   3. Provide No. 10 AWG conductor to PLC I/O chassis.

3.4 LABELING

A. Each terminal to be clearly marked with factory pre-marked number and/or letter tag identifiers.

B. Each conductor to be labelled on both ends with sleeve type heat-shrinkable plastic tags, machine-printed. Brady 'Permasleeve' or approved equivalent.

C. All panel-mounted devices to be labelled by means of engraved Lamacoid labels, black lettering on white.

D. Write-on labels are not acceptable.

3.5 INTERNAL COMPONENT IDENTIFICATION

A. Each internal panel device or instrument shall be fitted with a permanent lamacoid nameplate on, or above the device, with the device identification imprinted. Fuses and breakers shall have the size indicated on the nameplate.

3.6 PANEL FACEPLATE DEVICE IDENTIFICATION

A. Panel face devices shall be provided with lamacoid nameplates, black with white lettering in accordance with the Drawing schedules, or as otherwise specified or as indicated.

B. Final nameplate wording, colouring and sizes shall be approved during Shop Drawing submission reviews.

3.7 FACTORY ACCEPTANCE TEST (FAT)

A. All testing and calibration shall be documented on record sheets that display the results and dates of all tests required and performed.

B. Perform continuity checks on all wiring. This shall be documented.

C. After completing continuity checks a full operational test shall be performed of the panel. Operational tests shall be performed by simulating field wiring connections to each panel at the panel(s) terminal blocks.

D. Discrete/Digital panel inputs and outputs shall be verified with input switch simulation and output test load connections at the terminal blocks.

E. Analog inputs to the panel shall be simulated utilizing a 4-20 mA signal generator (as applicable). Full range (4-20 mA) response of all the panel analog devices and inputs shall be verified, deviations noted and recalibration performed where required.

F. Analog outputs from a panel shall be simulated by loading output circuits to their maximum impedance, (in 250 Ω multiples) and monitoring the loop current with a current calibrator or high-resolution digital meter. Full span capability of any analog output shall be verified and documented.

G. Analog inputs and outputs shall be tested for span and linearity (three-point test) by measurements at 4.0, 12.0, and 20.0 mA.

H. Mechanical checks shall be done to ensure that there are no broken parts, wires, mechanical binding, loose screws, etc. Mechanical tolerances shall be checked including contact grip on wires.

I. After completing all tests, the results shall be compiled in a Factory Test Report. Copies shall be retained for reference during field commissioning. One copy shall be submitted to ENGINEER.

J. An authorized representative of ENGINEER and/or OWNER shall witness parts of the factory acceptance testing. Vendor shall provide provision for the representatives to view aspects of the test and to sign off on the Factory Test Report.

K. Any devices that do not comply with the FAT, shall be replaced by CONTRACTOR. A re-test shall be performed on the specific device, with a copy of the testing submitted to ENGINEER for approval.

3.8 SITE ACCEPTANCE TEST (SAT)

A. Perform SAT of all panels after installation and field wiring has been completed.

B. Test:
1. Operation of all discrete panel inputs from the field instruments and devices by actuation of their controlling variable and monitoring of received signals at the local and/or area control panel.
2. Operation of all discrete panel outputs to the field devices by forcing them into their "on" state in manual mode at the local and/or area control panel. Any rotating equipment or valves, etc., which cannot be safely energized by testing of discrete panel outputs, shall be temporarily disconnected, and potential or continuity checks of the output circuits made while energized.
3. Analog circuits by creating a 4-20 mA signal at the field transmitter (e.g., loop calibrator) and verify feedback at the local and/or area control panel. All analog signals shall be verified for polarity, zero, span, and linearity
4. Analog output control signals shall be generated to test and verify proper device proportional response. Where such testing is done the actuated device shall, where possible, be isolated from the process by closing related isolating valves.
5. Generate analog output control signals to test and verify output signal response.
6. All logic circuit operational interlocks, protective interlocks and alarm interlocks.
7. All pushbuttons, selector switches, indicating lights and display devices. These devices shall be functioning according to the intended operational philosophy.
8. If the PLC is part of local and/or area control panel verify input signals at the PLC, and coordinate with ENGINEER to check PLC outputs to field drives and devices by forcing them "on".
9. Verify the safety and readiness of the cables, phasing and connections prior to energization.
10. System subcircuits and process subassemblies shall be group tested to verify control logic operation, alarm registration, sequence and timing operations. Logic circuit operational interlocks (auto start/stop signals), protective and alarm interlock operation shall be verified. Alarm registration, latching and reset operation shall be verified for all system alarms.

END OF SECTION

SECTION 13450

PROGRAMMABLE CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. PAC System / Programmable Controller.

B. Programming software.

C. Cables and accessories.

1.2 RELATED SECTIONS

A. Section 13430 – Control Panels.

B. Section 13460 - UV Control Panel.

C. Section 13480 - Process Control System Integrator

D. Section 13485 - Process Control Software Programming

E. Section 13621 - Control System Documentation.

F. Section 13623 - Control System Testing and Commissioning.

1.3 REFERENCES

A. Section 01600 - Product Requirements: Requirements for references.

B. Canadian Standards Association: CSA C22.2 No. 14 – Industrial Control Equipment.

C. Ontario Electrical Safety Code (OESC) and Bulletins.

1.4 QUALITY ASSURANCE

A. All work shall be completed in accordance with Ontario Clean Water Agency standards modified to suit Bruce Power requirements.

1.5 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Shop Drawings: Refer to Section 13621 - Control System Documentation.

C. Product Data: Refer to Section 13621 - Control System Documentation.

D. Test Reports: Refer to Section 13623 - Control System Testing and Commissioning.

E. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation of exothermic connectors.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.
   1. Identification: Manufacturing name, type, year, serial number, number of units, capacity, and identification of related systems.
   2. Data necessary for maintenance of equipment.
   3. Manufacturers' recommended list of spare parts.

C. Record Drawings: Refer to Section 13621 - Control System Documentation.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

E. Maintenance Manuals: Provide copies of all operating and maintenance manuals for all equipment. In addition to the requirements displayed in Section 13621 - Control System Documentation, the following shall also be furnished:
   1. Manufacturer's data sheets, installation and operations manuals for all I/O and CPU cards, and termination assemblies, communication interface cards, and power supplies.
   2. Software License and Media for each element of system and application software.

1.7 REGULATORY REQUIREMENTS

A. Equipment and material to be in accordance with appropriate standards and must be CSA or ULC certified. Equipment should also be applicable national or local regulatory requirements as required. Refer to www.esasafe.com for a complete list of recognized certification marks. When no alternative exists to providing approved equipment based on the requirements above, the involved party shall obtain and pay for special approval from the Electrical Safety Authority (ESA) Special Inspection Department. All manufacturers' labels must be visible and legible after equipment is installed.

B. All components installed must comply with the requirements of the current edition of the respective electrical inspection authority. The installation must be completed with the latest edition of the Ontario Electrical Safety Code.

C. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept products on the Site in factory containers. Inspect for damage.

C. Store products in clean, dry area; maintain temperature in accordance with CSA C22.2 No. 14.

1.9 ENVIRONMENTAL REQUIREMENTS

A. Section 01500 - Temporary Facilities and Controls: Requirements for temporary controls.

B. Maintain area free of dirt and dust during and after installation of products.

1.10 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution and Closeout Requirements: Requirements for warranties.

B. Provide manufacturer's standard warranty.

1.11 SYSTEM STARTUP AND COMMISSIONING

A. Section 01810 –Operations Asset Transfer Commissioning: Requirements for commissioning.

PART 2 PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLER

A. Description: PAC System RX3i, manufactured in accordance with C22.2 NO. 286-17 (Industrial Control Panels And Assemblies)

B. Manufacturer: GE Automation. No alternatives.

C. Configuration:
1. Universal Backplane: IC695CHS012, RX3I 12 Slot Universal Backplane.
2. PAC SYSTEM RX3i CPU: IC695CPE305 Built in Ethernet and RS-232 ports.
3. Power Supply: IC694PSA040.
4. Digital Input (DI) Module: IC694-MDL240, 120VAC Discrete Input, 16 Point (Quantity as Shown on I/O List-Appendix A).
5. Digital Output (DO) Module: IC694-MDL916, 120VAC/ 24 VDC Discrete Output, 16 Point Isolated Relay N.O. Form A / w IC694TBB032/TBS032 Box-Style Terminal Block. (Quantity as Shown on I/O List-Appendix A).
6. Analog Input (AI) Module with HART: IC695ALG626, 16 Channel Analog Input Module with HART Communication / w IC694TBB032/TBS032 Box-Style Terminal Block, (Quantity as Shown on I/O List-Appendix A).
7. Analog Output (AO) Module: IC695ALG808, 8 Channel Voltage/Current Isolated Analog Output w/ IC694TBB032/TBS032 Box-Style Terminal Block. (Quantity as Shown on I/O List- Appendix A).
8. Expansion Back Plane Module: IC695-LRE001, RX3i Expansion Back Plane Module.
9. Expansion Cable ĐC693CBL302, I/O Base Expansion, 2 Meter, Shielded
10. Expansion Back Plane: IC694CHS392, 10 Slot RX3i Expansion Backplane.
11. Expansion Power Supply Module: IC694-PWR321.
12. Expansion IO Terminator Plugs IC693ACC307.

D. Location:
   1. SPP: Control Panel. Refer to location and layout drawing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Refer to Section 13430 - Control Panels for Wiring and Section 13623 - Testing and Commissioning for details.

3.2 INSTALLATION

A. Refer to Section 13430 - Control Panels for details and fabrication details.

B. All works shall be tested and commissioned using Section 13623 - Testing and Commissioning.

C. Refer to Process Control Narrative and detailed I/O listing for PLC (Appendix A).

3.3 SOFTWARE PROGRAMMING

A. For those parts of the system which are software programmable, software programming shall be performed by CONTRACTOR.

3.4 FIELD QUALITY CONTROL

A. Section 01600 -Product Requirements: Field inspection and testing.

B. Refer to Section 13623 - Testing and Commissioning for details.

3.5 ADJUSTING

A. Section 01700 - Execution and Closeout Requirements: Requirements for adjusting installed work.

END OF SECTION

BRUCE MASTER PLC - I/O List

Control Panels (enclosure) and Racks Location

PCS 3XI

BKP	Slot	Card	Address	Type	Tag	Description
0	-	IC694-PSA040				GE Fanuc Power Supply
0	2	IC695-CPE305				GE Fanuc Processor
0	3	IC695-ALG626	I:3.1	AI	**WW_67961_LT1**	Equalization Tank Level Indication
			I:3.2	AI	**WW_67961_PH1000**	Equalization Tank PH
			I:3.3	AI	**WW_67961_TE1000_PH1000**	Equalization Tank Temp. Second Output of PH Transmitter
			I:3.4	AI	**WW_67961_FT1000**	Inlet Flow rate to SPP
			I:3.5	AI	**WW_67966_LIT1001**	Chemical Alum Tank1 Level
			I:3.6	AI	**WW_67966_LIT1002**	Chemical Alum Tank2 Level
			I:3.7	AI	**WW_67963_FT1**	Air Flow to EQ. Tank
			I:3.8	AI	**WW_67963_FT2**	Air Flow to West Train
			I:3.9	AI	**WW_67963_FT3**	Air Flow to East Train
			I:3.10	AI	**WW_67961_DOT1001**	Dissolved Oxy. Tank 3
			I:3.11	AI	**WW_67961_DOT1003**	Dissolved Oxy. Tank 4
			I:3.12	AI	**WW_67961_LT9008**	Dewatering Well Level Transmitter
			I:3.13	AI	**WW_67961_LT9013**	Tank 7 Level Transmitter
			I:3.14	AI	**WW_67961_LT9014**	Tank 8 Level Transmitter
			I:3.15	AI	**WW_67961_LT9015**	Tank 9 Level Transmitter
			I:3.16	AI	**WW_67961_LT9016**	Tank 10 Level Transmitter
0	**4**	**IC695-ALG626**	I:4.1	AI	**WW_79610_P9_SI**	East RAS/WAS Pump1 Speed Indication
			I:4.2	AI	**WW_79610_P10_SI**	East RAS/WAS Pump2 Speed Indication
			I:4.3	AI	**WW_79610_P11_SI**	East RAS/WAS Pump3 Speed Indication
			I:4.4	AI	**WW_79610_P12_SI**	West RAS/WAS Pump1 Speed Indication
			I:4.5	AI	**WW_79610_P13_SI**	West RAS/WAS Pump2 Speed Indication
			I:4.6	AI	**WW_79610_P14_SI**	West RAS/WAS Pump3 Speed Indication
			I:4.7	AI	**WW_79640_P01_SI**	MISA Sampling Pump1 Speed Indication
			I:4.8	AI	**WW_79640_P02_SI**	MISA Sampling Pump2 Speed Indication
			I:4.9	AI	**Spare**	
			I:4.10	AI	**WW_67170_LIT1000**	Basement Sump Level Transmitter
			I:4.11	AI	**WW_67961_FIT130**	East RAS/WAS Discharge Flow
			I:4.12	AI	**WW_67961_FIT131**	West RAS/WAS Discharge Flow
			I:4.13	AI	**WW_67961_LIT9000**	East Train RAS/WAS Pumps Outlet Flow
			I:4.14	AI	**WW_67961_LIT9001**	West Train RAS/WAS Pumps Outlet Flow
			I:4.15	AI	**BS_ 67099_AIT001**	MISA PH Transmitter
			I:4.16	AI	**BS_ 67099_CIT001**	MISA Conductivity Transmitter
0	5	IC695-ALG808	O:5.1	AO	**WW_79610_P1_SC**	Raw Wastewater P1 Speed Control
			O:5.2	AO	**WW_79610_P2_SC**	Raw Wastewater P2 Speed Control
			O:5.3	AO	**WW_79610_P3_SC**	Raw Wastewater P3 Speed Control
			O:5.4	AO	**Spare**	
			O:5.5	AO	**WW_79630_CP1_SC**	Blower CP1 Speed Control(Future)
			O:5.6	AO	**WW_79630_CP2_SC**	Blower CP2 Speed Control(Future)
			O:5.7	AO	**WW_79630_CP3_SC**	Blower CP3 Speed Control(Future)
			O:5.8	AO	**Spare**	
0	6	IC695-ALG808	O:6.1	AO	**WW_79610_P9_SC**	East RAS/WAS Pump1 Speed Control
			O:6.2	AO	**WW_79610_P10_SC**	East RAS/WAS Pump2 Speed Control
			O:6.3	AO	**WW_79610_P11_SC**	East RAS/WAS Pump3 Speed Control
			O:6.4	AO	**WW_79610_P12_SC**	West RAS/WAS Pump1 Speed Control
			O:6.5	AO	**WW_79610_P13_SC**	West RAS/WAS Pump2 Speed Control
			O:6.6	AO	**WW_79610_P14_SC**	West RAS/WAS Pump3 Speed Control
			O:6.7	AO	**WW_79640_P01_SC**	MISA Sampling Pump1 Speed Feedback
			O:6.8	AO	**WW_79640_P02_SC**	MISA Sampling Pump2 Speed Feedback
0	7	IC695-ALG626	I:7.1	AI	**WW_79630_CP1_SI**	Blower CP1 Speed Indication (Future)
			I:7.2	AI	**WW_79630_CP2_SI**	Blower CP2 Speed Indication(Future)
			I:7.3	AI	**WW_79630_CP3_SI**	Blower CP3 Speed Indication(Future)
			I:7.4	AI	**WW_79630_P4_SI**	Dewatering P4 Speed Indication(Future)
			I:7.5	AI	**WW_79630_P5_SI**	Dewatering P5 Speed Indication(Future)
			I:7.6	AI	**WW_79610_P1_SI**	Raw Wastewater P1 Speed Indication
			I:7.7	AI	**WW_79610_P2_SI**	Raw Wastewater P2 Speed Indication
			I:7.8	AI	**WW_79610_P3_SI**	Raw Wastewater P3 Speed Indication
			I:7.9	AI	**Spare**	
			I:7.10	AI	**Spare**	
			I:7.11	AI	**Spare**	

BKP	Slot	Card	Address	Type	Tag	Description
			I:7.12	AI	**Spare**	
			I:7.13	AI	**Spare**	
			I:7.14	AI	**Spare**	
			I:7.15	AI	**Spare**	
			I:7.16	AI	**Spare**	
0	8	IC694-ALG808	O:8.1	AO	**WW_79610_P6_SC**	NT RAS/WAS Pump1 Speed Control
			O:8.2	AO	**WW_79610_P7_SC**	NT RAS/WAS Pump2 Speed Control
			O:8.3	AO	**WW_79610_P8_SC**	NT RAS/WAS Pump3 Speed Control
			O:8.4	AO	**WW_79610_P15_SC**	North Train Sludge Wasting/Decant Pump #1 Speed Control
			O:8.5	AO	**WW_79610_P16_SC**	North Train Sludge Wasting/Decant Pump #2 Speed Control
			O:8.6	AO	**Spare**	
			O:8.7	AO	**WW_79630_P4_SC**	Dewatering P4 Speed Feedback(Future)
			O:8.8	AO	**WW_79630_P5_SC**	Dewatering P5 Speed Feedback(Future)
0	9	IC695-ALG808	O:9.1	AO	**WW_79630_CP4_SC**	North Train Aeration Blower 1 WW-79630-CP4 Speed Control
			O:9.2	AO	**WW_79630_CP5_SC**	North Train Aeration Blower 2 WW-79630-CP5 Speed Control
			O:9.3	AO	**WW_79630_CP6_SC**	North Train Aeration Blower 3 WW-79630-CP6 Speed Control
			O:9.4	AO	**WW_79630_CP7_SC**	North Train Aeration Blower 4 WW-79630-CP7 Speed Control
			O:9.5	AO	**Spare**	
			O:9.6	AO	**Spare**	
			O:9.7	AO	**Spare**	
			O:9.8	AO	**Spare**	
0	10	IC695-ALG626	I:10.1	AI	**WW-67961-PIT106**	Blowers' Header Pressure
			I:10.2	AI	**WW-67961-DOX1004**	North Train Dissolved Oxy. DOX1004 (AIT001_DOI)
			I:10.3	AI	**WW-67961-FE2000**	North Train Inlet Flow to Aeration Tank (FIT001)
			I:10.4	AI	**WW-67961-LIT10000**	North Train Parshall Flume Flow meter (FIT002)
			I:10.5	AI	**Spare**	
			I:10.6	AI	**WW-67961-LS100**	North Train Aerobic Digester Stage 1 Level Transmitter
			I:10.7	AI	**WW-67961-LS101**	North Train Aerobic Digester Stage 2 Level Transmitter(Future)
			I:10.8	AI	**WW-67961-LS103**	North Train Sludge wasting Sump Level Transmitter
			I:10.9	AI	**Spare**	
			I:10.10	AI	**Spare**	
			I:10.11	AI	**Spare**	
			I:10.12	AI	**Spare**	
			I:10.13	AI	**Spare**	
			I:10.14	AI	**Spare**	
			I:10.15	AI	**Spare**	
			I:10.16	AI	**Spare**	
0	11	IC695-ALG626	I:11.1	AI	**WW_79630_CP4_SI**	North Train Aeration Blower 1 WW-79630-CP4 Speed Indication
			I:11.2	AI	**WW_79630_CP5_SI**	North Train Aeration Blower 2 WW-79630-CP5 Speed Indication
			I:11.3	AI	**WW_79630_CP6_SI**	North Train Aeration Blower 3 WW-79630-CP6 Speed Indication
			I:11.4	AI	**WW_79630_CP7_SI**	North Train Aeration Blower 4 WW-79630-CP7 Speed Indication
			I:11.5	AI	**Spare**	
			I:11.6	AI	**WW_79610_P6_SI**	NT RAS/WAS Pump1 Speed Indication
			I:11.7	AI	**WW_79610_P7_SI**	NT RAS/WAS Pump2 Speed Indication
			I:11.8	AI	**WW_79610_P8_SI**	NT RAS/WAS Pump3 Speed Indication
			I:11.9	AI	**WW_79610_P15_SI**	North Train Sludge Wasting/Decant Pump #1 Speed Indication
			I:11.11	AI	**WW_79610_P16_SI**	North Train Sludge Wasting/Decant Pump #2 Speed Indication
			I:11.11	AI	**Spare**	
			I:11.12	AI	**Spare**	
			I:11.13	AI	**Spare**	
			I:11.14	AI	**Spare**	
			I:11.15	AI	**Spare**	
			I:11.16	AI	**Spare**	
0	12	Expansion Module IC695LRE001				
BKP	**Slot**	**Card**	**Address**	**Type**	**Tag**	**Description**
1	-	IC694-PWR321				GE Fanuc Power Supply
1	2	IC694-MDL240	I:2/1	DI	**WW_67961_LS1**	Equalization Tank LS1
			I:2/2	DI	**WW_67961_LS2**	Equalization Tank LS2
			I:2/3	DI	**WW_67961_LS3**	Equalization Tank LS3
			I:2/4	DI	**WW_67961_LS4**	Equalization Tank LS4
			I:2/5	DI	**WW_67961_LS5**	Equalization Tank LS5
			I:2/6	DI	**WW_67961_LS6**	Equalization Tank LS6
			I:2/7	DI	**WW_67961_LS7**	Outlet Well LS7
			I:2/8	DI	**WW_67961_LS9**	West Digester Stage Level Switch
			I:2/9	DI	**WW_67961_LS10**	East Digester Stage Level Switch
			I:2/10	DI	**BS_67099_LSH01**	MISA Pot High Level

BKP	Slot	Card	Address	Type	Tag	Description
			I:2/11	DI	WW_79610_P9_XB	EAST RAS/WAS Pump1 Leakage/Temp Fault
			I:2/12	DI	WW_79610_P10_XB	EAST RAS/WAS Pump2 Leakage/TempFault
			I:2/13	DI	WW_79610_P11_XB	EAST RAS/WAS Pump3 Leakage/Temp Fault
			I:2/14	DI	**WW_79610_P1_YA**	Raw Wastewater P1 General Fault (Now connected to IP)
			I:2/15	DI	**WW_79610_P2_YA**	Raw Wastewater P2 General Fault (Now connected to IP)
			I:2/16	DI	**WW_79610_P3_YA**	Raw Wastewater P3 General Fault (Now connected to IP)
1	3	IC694-MDL240	I:3/1	DI	**WW_79630_CP1_XI**	Blower CP1 Run Status
			I:3/2	DI	**WW_79630_CP2_XI**	Blower CP2 Run Status
			I:3/3	DI	**WW_79630_CP3_XI**	Blower CP3 Run Status
			I:3/4	DI	**WW_79630_CP1_XA**	Blower CP1 General Fault (Now connected to IP)
			I:3/5	DI	**WW_79630_CP2_XA**	Blower CP2 General Fault (Now connected to IP)
			I:3/6	DI	**WW_79630_CP3_XA**	Blower CP3 General Fault (Now connected to IP)
			I:3/7	DI	**WW_79610_P1_XI**	Raw Wastewater P1 Run Status
			I:3/8	DI	**WW_79610_P2_XI**	Raw Wastewater P2 Run Status
			I:3/9	DI	**WW_79610_P3_XI**	Raw Wastewater P3 Run Status
			I:3/10	DI	**WW_79610_P1_YI**	Raw Wastewater P1 Auto/Man
			I:3/11	DI	**WW_79610_P2_YI**	Raw Wastewater P2 Auto/Man
			I:3/12	DI	**WW_79610_P3_YI**	Raw Wastewater P3 Auto/Man
			I:3/13	DI	**WW_79610_P1_XA**	Raw Wastewater P1 General Fault
			I:3/14	DI	**WW_79610_P2_XA**	Raw Wastewater P2 General Fault
			I:3/15	DI	**WW_79610_P3_XA**	Raw Wastewater P3 General Fault
			I:3/16	DI	**Spare**	
1	4	IC694-MDL240	I:4/1	DI	**WW_79610_CMT1_XI**	Comminutor CMT1 Run Status
			I:4/2	DI	**WW_79610_CMT2_XI**	Comminutor CMT21 Run Status
			I:4/3	DI	**WW_79610_CMT1_XA**	Comminutor CMT1 General Fault (Now connected to IP)
			I:4/4	DI	**WW_79610_CMT2_XA**	Comminutor CMT2 General Fault (Now connected to IP)
			I:4/5	DI	**WW_71700_P1_XA**	Basement Sump Pump 1 General Fault (Now connected to IP)
			I:4/6	DI	**WW_71700_P2_XA**	Basement Sump Pump 2 General Fault (Now connected to IP)
			I:4/7	DI	**WW_5330_T1_TAH**	Transformer1 High Temp. (Now connected to IP)
			I:4/8	DI	**WW_79660_P1_XI**	Alum P1 Run Status
			I:4/9	DI	**WW_79660_P2_XI**	Alum P2 Run Status
			I:4/10	DI	**WW_79650_P1000_XI**	Polymer Pump Run Status
			I:4/11	DI	**WW_79610_CNV1_XI**	West Settlig Tank Colector Run Status
			I:4/12	DI	**WW_79610_CNV2_XI**	East Settlig Tank Colector Run Status
			I:4/13	DI	**WW_79610_CNV1_XA**	West Settlig Tank Colector General Fault (Now connected to IP)
			I:4/14	DI	**WW_79610_CNV2_XA**	East Settlig Tank Colector General Fault (Now connected to IP)
			I:4/15	DI	**WW_79610_P4_XI**	Dewatering P4 Run Status
			I:4/16	DI	**WW_79610_P5_XI**	Dewatering P5 Run Status
1	5	IC694-MDL916	O:5/1	DO	**WW_79610_P1_OC**	Raw Wastewater P1 Override
			O:5/2	DO	**WW_79610_P2-OC**	Raw Wastewater P2 Override
			O:5/3	DO	**WW_79610_P3_OC**	Raw Wastewater P3 Override
			O:5/4	DO	**WW_79610_P1_YC**	Raw Wastewater P1 St Command
			O:5/5	DO	**WW_79610_P2-YC**	Raw Wastewater P2 St Command
			O:5/6	DO	**WW_79610_P3_YC**	Raw Wastewater P3 St Command
			O:5/7	DO	**WW_79610_P4_YC**	Dewatering P4 Stop Command
			O:5/8	DO	**WW_79610_P5_YC**	Dewatering P5 Stop Command
			O:5/9	DO	**WW_79610_MV13_YCC**	East Train WAS Motorized Valve1 Close Command
			O:5/10	DO	**WW_79610_MV13_YCO**	East Train WAS Motorized Valve1 Open Command
			O:5/11	DO	**WW_79610_MV14_YCC**	East Train WAS Motorized Valve2 Close Command
			O:5/12	DO	**WW_79610_MV14_YCO**	East Train WAS Motorized Valve2 Open Command
			O:5/13	DO	**WW_79610_MV11_YCC**	West Train WAS Motorized Valve1 Close Command
			O:5/14	DO	**WW_79610_MV11_YCO**	West Train WAS Motorized Valve1 Open Command
			O:5/15	DO	**WW_79610_MV12_YCC**	West Train WAS Motorized Valve2 Close Command
			O:5/16	DO	**WW_79610_MV12_YCO**	West Train WAS Motorized Valve2 Open Command
1	6	IC694-MDL240	I:6/1	DI	**WW_79610_MV13_ZIC**	East Train WAS Motorized Valve Closed Indication
			I:6/2	DI	**WW_79610_MV13_ZIO**	East Train WAS Motorized Valve Open Indication
			I:6/3	DI	**WW_79610_MV13_YI**	East Train WAS Motorized Valve Local/Remote Status
			I:6/4	DI	**WW_79610_MV13_XA**	East Train WAS Motorized Valve General Fault(Now connected to IP)
			I:6/5	DI	**WW_79610_MV14_ZIC**	East Train WAS Motorized Valve2 Closed Indication
			I:6/6	DI	**WW_79610_MV14_ZIO**	East Train WAS Motorized Valve2 Open Indication
			I:6/7	DI	**WW_79610_MV14_YI**	East Train WAS Motorized Valve2 Local/Remote Status
			I:6/8	DI	**WW_79610_MV14_XA**	East Train WAS Motorized Valve2 General Fault
			I:6/9	DI	**WW_79610_MV11_ZIC**	West Train WAS Motorized Valve Closed Indication
			I:6/10	DI	**WW_79610_MV11_ZIO**	West Train WAS Motorized Valve Open Indication
			I:6/11	DI	**WW_79610_MV11_YI**	West Train WAS Motorized Valve Local/Remote Status
			I:6/12	DI	**WW_79610_MV11_XA**	West Train WAS Motorized Valve General Fault(Now connected to IP)
			I:6/13	DI	**WW_79610_MV12_ZIC**	West Train WAS Motorized Valve Closed Indication
			I:6/14	DI	**WW_79610_MV12_ZIO**	West Train WAS Motorized Valve Open Indication
			I:6/15	DI	**WW_79610_MV12_YI**	West Train WAS Motorized Valve Local/Remote Status

BKP	Slot	Card	Address	Type	Tag	Description
			I:6/16	DI	**WW_79610_MV12_XA**	West Train WAS Motorized Valve General Fault2
1	7	IC694-MDL240	I:7/1	DI	WW_79610_P9_XI	East RAS/WAS Pump1 Run Status
			I:7/2	DI	WW_79610_P9_XA	East RAS/WAS Pump1 General Fault
			I:7/3	DI	WW_79610_P9_YI	East RAS/WAS Pump1 Local/Remote Status
			I:7/4	DI	WW_79610_P10_XI	East RAS/WAS Pump2 Run Status
			I:7/5	DI	WW_79610_P10_XA	East RAS/WAS Pump2 General Fault
			I:7/6	DI	WW_79610_P10_YI	East RAS/WAS Pump2 Local/Remote Status
			I:7/7	DI	WW_79610_P11_XI	East RAS/WAS Pump3 Run Status
			I:7/8	DI	WW_79610_P11_XA	East RAS/WAS Pump3 General Fault
			I:7/9	DI	WW_79610_P11_YI	East RAS/WAS Pump3 Local/Remote Status
			I:7/10	DI	**WW_79640_P01_XI**	MISA Sampling Pump1 Run Status
			I:7/11	DI	**WW_79640_P01_XA**	MISA Sampling Pump1 General Fault
			I:7/12	DI	**WW_79640_P01_YI**	MISA Sampling Pump1 Local/ Remote
			I:7/13	DI	**WW_79640_P02_XI**	MISA Sampling Pump2 Run Status
			I:7/14	DI	**WW_79640_P02_XA**	MISA Sampling Pump2 General Fault
			I:7/15	DI	**WW_79640_P02_YI**	MISA Sampling Pump2 Local/ Remote
			I:7/16	DI	**Spare**	
1	8	IC694-MDL240	I:8/1	DI	WW_79610_P12_XI	West RAS/WAS Pump1 Run Status
			I:8/2	DI	WW_79610_P12__XA	West RAS/WAS Pump1 General Fault
			I:8/3	DI	WW_79610_P12__YI	West RAS/WAS Pump1 Local/Remote Status
			I:8/4	DI	WW_79610_P13_XI	West RAS/WAS Pump2 Run Status
			I:8/5	DI	WW_79610_P13_XA	West RAS/WAS Pump2 General Fault
			I:8/6	DI	WW_79610_P13_YI	West RAS/WAS Pump2 Local/Remote Status
			I:8/7	DI	WW_79610_P14_XI	West RAS/WAS Pump3 Run Status
			I:8/8	DI	WW_79610_P13_XA	West RAS/WAS Pump3 General Fault
			I:8/9	DI	WW_79610_P13_YI	West RAS/WAS Pump3 Local/Remote Status
			I:8/10	DI	**WW_71700_P1_XI**	Basement Sump Pump 1 Run Status
			I:8/11	DI	**WW_71700_P2_XI**	Basement Sump Pump 2 Run Status
			I:8/12	DI	WW_79610_P12_XB	West RAS/WAS Pump1 Leakage/Temp Fault
			I:8/13	DI	WW_79610_P13_XB	West RAS/WAS Pump2 Leakage/Temp Fault
			I:8/14	DI	WW_79610_P14_XB	West RAS/WAS Pump3 Leakage/Temp Fault
			I:8/15	DI	WW_67964_FSL01	MISA Flow Alarm Low
			I:8/16	DI	**Spare**	
1	9	IC694-MDL916	O:9/1	DO	WW_79610_P9_YC	East RAS/WAS Pump1 St/Sp Command
			O:9/2	DO	WW_79610_P10_YC	East RAS/WAS Pump2 St/Sp Command
			O:9/3	DO	WW_79610_P11_YC	East RAS/WAS Pump3 St/Sp Command
			O:9/4	DO	WW_79610_P12_YC	West RAS/WAS Pump1 St/Sp Command
			O:9/5	DO	WW_79610_P13_YC	West RAS/WAS Pump2 St/Sp Command
			O:9/6	DO	WW_79610_P14_YC	West RAS/WAS Pump3 St/Sp Command
			O:9/7	DO	**WW_79640_P01_YC**	MISA Sampling Pump1 St/Sp Command
			O:9/8	DO	**WW_79640_P02_YC**	MISA Sampling Pump2 St/Sp Command
			O:9/9	DO	**WW_71700_P1_YC**	Basement Sump Pump 1 St/Sp Command
			O:9/10	DO	**WW_71700_P2_YC**	Basement Sump Pump 2 St/Sp Command
			O:9/11	DO	**WW_71700_P1_OC**	Basement Sump Pump 1 Override
			O:9/12	DO	**WW_71700_P2_OC**	Basement Sump Pump 2 Override
			O:9/13	DO	**Spare**	
			O:9/14	DO	**Spare**	
			O:9/15	DO	**Spare**	
			O:9/16	DO	**Spare**	
1	10	IC694-MDL240	I:10/1	DI	**WW_5330_T1_XA**	T1 Income BKR Trip (Now connected to IP)
			I:10/2	DI	**WW_5330_CB4A_XA**	Standby Supply Incinerator Bld. Trip (Now connected to IP)
			I:10/3	DI	**WW_5330_CB5A_XA**	MCC 5334MCC1 Trip (Now connected to IP)
			I:10/4	DI	**WW_5330_CB6A_XA**	MCC 5334MCC2 Trip (Now connected to IP)
			I:10/5	DI	**WW_5330_CB7A_XA**	Trip (Now connected to IP)
			I:10/6	DI	**WW_55100_RF9000_XA**	Battery Charger Trouble (Now connected to IP)
			I:10/7	DI	**Spare**	
			I:10/8	DI	**WW_Gen_XI**	Generator Running Status
			I:10/9	DI	**WW_Gen_YI**	Generator Not in Auto Status
			I:10/10	DI	**WW_Gen_Aut**	Generator Auto Start Active
			I:10/11	DI	**WW_Gen_OVC**	Generator Overcrank
			I:10/12	DI	**WW_Gen_SAH**	Generator Over Speed
			I:10/13	DI	**WW_Gen_PAL**	Generator Low Oil Pressure
			I:10/14	DI	**WW_Gen_TAH**	Generator High Coolant Temp.
			I:10/15	DI	**WW_Gen_EST**	Generator Emergency Stop
			I:10/16	DI	**WW_Gen_LAL**	Generator Low Fuel Level
1	11	IC694-MDL240	I:11/1	DI	**WW_Gen_BAL**	Generator Low Battery Voltage
			I:11/2	DI	**WW_Gen_IAH**	Generator Overload
			I:11/3	DI	**WW_Gen_FAH**	Generator Over Frequency

BKP	Slot	Card	Address	Type	Tag	Description
			I:11/4	DI	WW_Gen_FAL	Generator Under Frequency
			I:11/5	DI	WW_Gen_AXA	Generator Air Flap Failure
			I:11/6	DI	WW_Gen_VAH	Generator Voltage High
			I:11/7	DI	WW_Gen_VAL	Generator Voltage Low
			I:11/8	DI	WW_5330_BUA_XA	BUA BKR Trip (Now connected to IP)
			I:11/9	DI	WW_5334_MCC1_XA	MCC1 UnderVoltage (Now connected to IP)
			I:11/10	DI	WW_66400_CP101_XA	Mater PLC GENERAL FAUJLT
			I:11/11	DI	WW_FIELDPOWR_XA	Field Power Alarm
			I:11/12	DI	WW_66400_CPT1000_XA	Plant Computer Failure (Now connected to IP)
			I:11/13	DI	WW_67170_LS1000_LAH	Base Sum High Level(Now connected to IP)
			I:11/14	DI	WW_66400_UPS_XI	UPS Power Status
			I:11/15	DI	WW_66400_UPS_XA	UPS Power Alarm
			I:11/16	DI	WW_66400_UPS_YAL	UPS Power Low Battery
BKP	Slot	Card	Address	Type	Tag	Description
2	-	IC694-PWR321				GE Fanuc Power Supply
2	2	IC694-MDL240	I:2/1	DI	WW_79630_CP4_XI	North Train Aeration Blower 1 Run
			I:2/2	DI	WW_79630_CP4_YI	North Train Aeration Blower 1 Local/Remote
			I:2/3	DI	WW_79630_CP4_XA	North Train Aeration Blower 1 Fault
			I:2/4	DI	WW_67963_TS110_TAH	North Train Aeration Blower 1 Motor OverTemp TAH
			I:2/5	DI	WW_67963_PS109_PAH	North Train Aeration Blower 1 Discharge High Pressure PAH
			I:2/6	DI	WW_79630_CP5_XI	North Train Aeration Blower 2 Run
			I:2/7	DI	WW_79630_CP5_YI	North Train Aeration Blower 2 Local/Remote
			I:2/8	DI	WW_79630_CP5_XA	North Train Aeration Blower 2 Fault
			I:2/9	DI	WW_67963_TS115_TAH	North Train Aeration Blower 2 Motor OverTemp TAH
			I:2/10	DI	WW_67963_PS114_PAH	North Train Aeration Blower 2 Discharge High Pressure PAH
			I:2/11	DI	WW_79630_CP4_ES	North Train Aeration Blower 1 E-Stop Active
			I:2/12	DI	WW_79630_CP5_ES	North Train Aeration Blower 2 E-Stop Active
			I:2/13	DI	WW_67963_PS108_PAL	North Train Aeration Blower 1 Suction Low Pressure PAL
			I:2/14	DI	WW_67963_PS113_PAL	North Train Aeration Blower 2 Suction Low Pressure PAL
			I:2/15	DI	WW_79610_CNV3_XC	Final Settling Tank Collector Over-Torque Alarm
			I:2/16	DI	WW_79610_CNV3_XI	Final Settling Tank Collector Running Status
2	3	IC694-MDL240	I:3/1	DI	WW_79630_CP6_XI	North Train Aeration Blower 3 WW-79630-CP6 Run
			I:3/2	DI	WW_79630_CP6_YI	North Train Aeration Blower 3 WW-79630-CP6 Local/Remote
			I:3/3	DI	WW_79630_CP6_XA	North Train Aeration Blower 3 WW-79630-CP6 Fault
			I:3/4	DI	WW_67963_TS120_TAH	North Train Aeration Blower 3 Motor OverTemp TAH
			I:3/5	DI	WW_67963_PS119_PAH	North Train Aeration Blower 3 Discharge High Pressure PAH
			I:3/6	DI	WW_79630_CP7_XI	North Train Aeration Blower 4 WW-79630-CP7 Run
			I:3/7	DI	WW_79630_CP7_YI	North Train Aeration Blower 4 WW-79630-CP7 Auto/Man
			I:3/8	DI	WW_79630_CP7_XA	North Train Aeration Blower 4 WW-79630-CP7 Fault
			I:3/9	DI	WW_67963_TS125_TAH	North Train Aeration Blower 4 Motor OverTemp TAH
			I:3/10	DI	WW_67963_PS124_PAH	North Train Aeration Blower 4 Discharge High Pressure PAH
			I:3/11	DI	WW_79630_CP6_ES	North Train Aeration Blower 3 WW-79630-CP6 E-Stop Active
			I:3/12	DI	WW_79630_CP7_ES	North Train Aeration Blower 4 WW-79630-CP7 E-Stop Active
			I:3/13	DI	WW_67963_PS118_PAL	North Train Aeration Blower 3 Suction Low Pressure PAL
			I:3/14	DI	WW_67963_PS123_PAL	North Train Aeration Blower 4 Suction Low Pressure PAL
			I:3/15	DI	WW_79610_CNV3_XA	Final Settling Tank Collector Fault Signal
			I:3/16	DI	WW_79610_CNV3_YI	Final Settling Tank Collector Local/Remote Mode Status
2	4	IC694-MDL916	O:4/1	DO	WW_79630_CP4_YC	North Train Aeration Blower 1 WW-79630-CP4 St/Sp Command
			O:4/2	DO	WW_79630_CP5_YC	North Train Aeration Blower 2 WW-79630-CP5 St/Sp Command
			O:4/3	DO	WW_79630_CP6_YC	North Train Aeration Blower 3 WW-79630-CP6 St/Sp Command
			O:4/4	DO	WW_79630_CP7_YC	North Train Aeration Blower 4 WW-79630-CP7 St/Sp Command
			O:4/5	DO	WW_79610_CNV3_YC	Final Settling Tank Collector St/Sp Command
			O:4/6	DO	Spare	
			O:4/7	DO	WW_79610_P6_YC	NT RAS/WAS Pump1 St/Sp Command
			O:4/8	DO	WW_79610_P7_YC	NT RAS/WAS Pump2 St/Sp Command
			O:4/9	DO	WW_79610_P8_YC	NT RAS/WAS Pump3 St/Sp Command
			O:4/10	DO	Spare	
			O:4/11	DO	Spare	
			O:4/12	DO	WW_79610_P15_YC	North Train Sludge Wasting/Decant Pump #1 St/Sp Command
			O:4/13	DO	WW_79610_P16_YC	North Train Sludge Wasting/Decant Pump #2 St/Sp Command
			O:4/14	DO	Spare	
			O:4/15	DO	Spare	
			O:4/16	DO	Spare	
2	5	IC694-MDL240	I:5/1	DI	WW_79610_V46_ZIC	NT WAS Motorized Valve V46 Closed Indication
			I:5/2	DI	WW_79610_V46_ZIO	NT WAS Motorized Valve V46 Open Indication
			I:5/3	DI	WW_79610_V46_YI	NT WAS Motorized Valve V46 Local/Remote Status
			I:5/4	DI	WW_79610_V46_XA	NT WAS Motorized Valve V46 General Fault
			I:5/5	DI	WW_79610_P6_YA	NT RAS/WAS Pump1 Leakage/Temp Fault

BKP	Slot	Card	Address	Type	Tag	Description
			I:5/6	DI	WW_79610_P6_XI	NT RAS/WAS Pump1 Run Status
			I:5/7	DI	WW_79610_P6_XA	NT RAS/WAS Pump1 General Fault
			I:5/8	DI	WW_79610_P6_YI	NT RAS/WAS Pump1 Local/Remote Status
			I:5/9	DI	WW_79610_P7_XI	NT RAS/WAS Pump2 Run Status
			I:5/10	DI	WW_79610_P7_XA	NT RAS/WAS Pump2 General Fault
			I:5/11	DI	WW_79610_P7_YI	NT RAS/WAS Pump2 Local/Remote Status
			I:5/12	DI	WW_79610_P8_XI	NT RAS/WAS Pump3 Run Status
			I:5/13	DI	WW_79610_P8_XA	NT RAS/WAS Pump3 General Fault
			I:5/14	DI	WW_79610_P8_YI	NT RAS/WAS Pump3 Local/Remote Status
			I:5/15	DI	WW_79610_P7_YA	NT RAS/WAS Pump2 Leakage/Temp Fault
			I:5/16	DI	WW_79610_P8_YA	NT RAS/WAS Pump3 Leakage/Temp Fault
2	6	IC694-MDL240	I:6/1	DI	WW_67961_LS102_LAH	North Train Aerobic Digester Stage 1 Level Switch High
			I:6/2	DI	WW_67961_LS104_LAH	North Train Sludge wasting Sump Level Switch High
			I:6/3	DI	WW_67961_LS105_LAL	North Train Sludge wasting Sump Level Switch Low
			I:6/4	DI	WW_79610_P15_YA	North Train Sludge Wasting/Decant Pump #1 Leakage/Temp Fault
			I:6/5	DI	WW_79610_P15_XI	North Train Sludge Wasting/Decant Pump #1 Run Status
			I:6/6	DI	WW_79610_P15_XA	North Train Sludge Wasting/Decant Pump #1 General Fault
			I:6/7	DI	WW_79610_P15_YI	North Train Sludge Wasting/Decant Pump #1 Auto/ Manual
			I:6/8	DI	WW_79610_P16_XI	North Train Sludge Wasting/Decant Pump #2 Run Status
			I:6/9	DI	WW_79610_P16_XA	North Train Sludge Wasting/Decant Pump #2 General Fault
			I:6/10	DI	WW_79610_P16_YI	North Train Sludge Wasting/Decant Pump #2 Auto/ Manual
			I:6/11	DI	WW_79610_P16_YA	North Train Sludge Wasting/Decant Pump #2 Leakage/Temp Fault
			I:6/12	DI	WW_79610_V47_ZIC	NT RAS Motorized Valve V47 Closed Indication
			I:6/13	DI	WW_79610_V47_ZIO	NT RAS Motorized Valve V47 Open Indication
			I:6/14	DI	WW_79610_V47_YI	NT RAS Motorized Valve V47 Local/Remote Status
			I:6/15	DI	WW_79610_V47_XA	NT RAS Tank Motorized Valve V47 General Fault
			I:6/16	DI	Spare	
2	7	IC694-MDL916	O:7/1	DO	WW_79610_V46_YYC	NT WAS Motorized Valve V46 Close Command
			O:7/2	DO	WW_79610_V46_YYO	NT WAS Motorized Valve V46 Open Command
			O:7/3	DO	Spare	
			O:7/4	DO	WW_79610_V47_YYC	NT RAS Motorized Valve V47 Close Command
			O:7/5	DO	WW_79610_V47_YYO	NT RAS Motorized Valve V47 Open Command
			O:7/6	DO	Spare	
			O:7/7	DO	Spare	
			O:7/8	DO	Spare	
			O:7/9	DO	Spare	
			O:7/10	DO	Spare	
			O:7/11	DO	Spare	
			O:7/12	DO	Spare	
			O:7/13	DO	Spare	
			O:7/14	DO	Spare	
			O:7/15	DO	Spare	
			O:7/16	DO	Spare	
2	8	IC694-MDL240	I:8/1	DI	WW_79630_CP1_YI	Blower CP1 Auto/ Manual Status
			I:8/2	DI	WW_79630_CP2_YI	Blower CP2 Auto/ Manual Status
			I:8/3	DI	WW_79630_CP3_YI	Blower CP3 Auto/ Manual Status
			I:8/4	DI	WW_79610_CMT1_YI	Comminutor CMT1 Auto/ Man
			I:8/5	DI	WW_79610_CMT2_YI	Comminutor CMT2 Auto/ Man
			I:8/6	DI	WW_79660_P1_YI	Alum P1 Auto/ Manual Status
			I:8/7	DI	WW_79660_P2_YI	Alum P2 Auto/ Manual Status
			I:8/8	DI	WW_79650_P1000_YI	Polymer Auto/ Manual Status
			I:8/9	DI	WW_WEST_CNV1_YI	West Settlig Tank Colector Auto/ Manual Status
			I:8/10	DI	WW_EAST_CNV2_YI	East Settlig Tank Colector Auto/ Manual Status
			I:8/11	DI	WW_79610_P4_YI	Dewatering P4 Auto/Manual
			I:8/12	DI	WW_79610_P5_YI	Dewatering P5 Auto/Manual
			I:8/13	DI	WW_79630_P4_XA	Dewatering P4 General Fault
			I:8/14	DI	WW_79630_P5_XA	Dewatering P5 General Fault
			I:8/15	DI	WW_79650_P1000_XA	Polymer Pump General Fault
			I:8/16	DI	Spare	
2	9	IC694-MDL916	O:9/1	DO	WW_79630_CP1_YC	Blower CP1 St/Sp Command
			O:9/2	DO	WW_79630_CP2_YC	Blower CP2 St/Sp Command
			O:9/3	DO	WW_79630_CP3_YC	Blower CP3 St/Sp Command (FUTURE)
			O:9/4	DO	WW_79610_CMT1_YC	Comminutor CMT1 St/Sp Command
			O:9/5	DO	WW_79610_CMT2_YC	Comminutor CMT2 St/Sp Command
			O:9/6	DO	WW_79610_CNV1_YC	West Settlig Tank Colector St/Sp Command
			O:9/7	DO	WW_79610_CNV2_YC	East Settlig Tank Colector St/Sp Command
			O:9/8	DO	WW_79660_P1_YC	Alum P1 St/Sp Command
			O:9/9	DO	WW_79660_P2_YC	Alum P2 St/Sp Command
			O:9/10	DO	WW_79650_P1000_YC	Polymer St/Sp Command

BKP	Slot	Card	Address	Type	Tag	Description
			O:9/11	DO	**WW_79610_P4_YC**	Dewatering P4 Run Command
			O:9/12	DO	**WW_79610_P5_YC**	Dewatering P5 Run Command
			O:9/13	DO	**Spare**	
			O:9/14	DO	**Spare**	
			O:9/15	DO	**Spare**	
			O:9/16	DO	**Spare**	
2	10	IC694-MDL240	I:10/1	DI	**TBD**	HEAT TRACE FAULT - WEST TREATMENT TRAIN
			I:10/2	DI	**TBD**	HEAT TRACE FAULT - EAST TREATMENT TRAIN
			I:10/3	DI	**TBD**	HEAT TRACE FAULT - RAS/WAS PIPPING EAST AND WEST TRAINS
			I:10/4	DI	**TBD**	HEAT TRACE FAULT - RAW WASTEWATER SUPPLY LINE
			I:10/5	DI	**TBD**	HEAT TRACE FAULT - NORTH TRAIN RAS/WAS PIPPING
			I:10/6	DI	**TBD**	HEAT TRACE FAULT - WEST SLUDGE WASTING LINE
			I:10/7	DI	**TBD**	HEAT TRACE FAULT - EAST SLUDGE WASTING LINE
			I:10/8	DI	**Spare**	
			I:10/9	DI	**Spare**	
			I:10/10	DI	**Spare**	
			I:10/11	DI	**Spare**	
			I:10/12	DI	**Spare**	
			I:10/13	DI	**Spare**	
			I:10/14	DI	**Spare**	
			I:10/15	DI	**Spare**	
			I:10/16	DI	**Spare**	
2	11	Spare				

	North Train Signals and Spares
	Controls Upgrade Signals
	Spare

SECTION 13460

UV CONTROL SYSTEM UPGRADE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section outlines the works to be undertaken to design, procure components, construct and assembly, install, test and commission new, PLC based control system for existing, (Bailey & Fisher Porter) ultraviolet disinfection system (UV).

B. This specification outlines overall performance requirements and not necessarily encompasses all details necessary to complete the works. It is the responsibility of Contractor to design and supply a fully operational control system for the existing UV system within this project.

C. Support of the Process Control System Integrator works.

D. UV lamp racks refurbishment including new UV lamps.

E. Factory and Site acceptance testing.

1.2 SECTION EXCLUDES

A. Programming of the UV control system PLC shall be provided by Process Control System Integrator as outlined under:
   1. Section 13480 - Process Control System Integrator, and
   2. Section 13485 - Process Control Software Programming.

1.3 RELATED SECTIONS

A. Section 13450 – Programmable Controllers.

B. Section 13621- Control System Documentation

C. Section 13623- Control System Testing and Commissioning

1.4 REFERENCES

A. Section 01600 - Product Requirements

B. Canadian Standards Association:
   1. CSA C22.1 - Canadian Electrical Code, Part I – Safety Standard for Electrical Installations.
   2. CSA C22.1 - Canadian Electrical Code, Part II – Safety Standard for Electrical Equipment.
   3. CSA C22.2 - No. 14 - Industrial Control Equipment.
   4. CSA C22.2 - No. 66 - Specialty Transformers.

C. International Electrotechnical Commission (IEC).

D. Institute of Electrical and Electronics Engineers (IEEE).

E. National Electrical Manufacturers Association (NEMA).

F. Ontario Electrical Safety Code (OESC) and Bulletins.

G. Underwriter's Laboratories of Canada (ULC).

1.5 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Provide detailed panel layouts including, but not limited to:
   1. All hardware schematics, elementary and field wiring diagrams for control panel and related systems.
   2. Loop diagrams for all system loops.
   3. Device and panel data connections, cabling and wiring schematics.

C. Shop Drawings: Refer to Section 13621 - Control System Documentation.

D. Product Data: Refer to Section 13621 - Control System Documentation.

E. Test Reports: Refer to Section 13623 - Testing and Commissioning.

F. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation, and installation.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.

C. Record Drawings: Refer to Section 13621 - Control System Documentation.

D. Product Data: Refer to Section 13621 - Control System Documentation.

E. Test Reports: Refer to Section 13623 - Testing and Commissioning.

F. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.7 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this Section with minimum 5 years documented experience.

B. Fabricator: Company specializing in fabrication of control panels with minimum 5 years documented experience.

1.8 QUALITY ASSURANCE

A. Provide all supervision, material, design, labour, procurement, delivery and installation of all equipment required for a complete system as specified.

B. Final device location within the panel shall be CONTRACTOR's responsibility and shall be based on the guidelines provided by the equipment manufacturer.

1.9 REGULATORY REQUIREMENTS

A. Equipment and material to be in accordance with appropriate standards and must be CSA, ULC certified. Equipment should also be applicable national or local regulatory requirements as required. Refer to www.esasafe.com for a complete list of recognized certification marks. When no alternative exists to providing approved equipment based on the requirements above, the involved party shall obtain and pay for special approval from the Electrical Safety Authority (ESA) Special Inspection Department. All manufacturers' labels must be visible and legible after equipment is installed.

B. All components installed must comply with the requirements of the current edition of the respective electrical inspection authority. The installation must be completed with the latest edition of the OESC.

1.10 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution Requirements: Requirements for warranties.

B. Provide manufacturer's standard warranty.

1.11 SPARE PARTS AND MAINTENANCE MATERIALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for spare parts and maintenance materials.

B. Supply a list of recommended spares. Special tools required for maintenance shall be identified.

C. The UV control panel supplied shall be furnished with the following spare parts (as applicable):
   1. Two indicating lights along with assembly for each type of light used within the control panel.
   2. Two switch assemblies for each type of switch used within the control panel.
   3. Ten fuses of each type of fuse used within the control panel.
   4. Five relays of each type and rating used within the control panel.

PART 2 PRODUCTS

2.1 GENERAL

A. Design the new UV Control System (Panel) based on existing system and Bruce Power requirements.

B. The design must comply with existing system. It is responsibility of contractor to obtain all required information for design and construction by visiting the site and coordination with Bruce Power. It is not acceptable to relay on existing documents and drawings.

C. All components shall be current, readily available in the marketplace and fully compatible with existing system components.

D. Furnish Products listed and classified by CSA as suitable for purpose specified and shown.

E. Provide products of exact manufacturer, if explicitly shown and described.

F. Manufacturers listed are used for reference purposes to establish acceptance standards and establish minimum functional requirements for control device.

2.2 APPROVED VENDORS:

A. IronBrookUV Corporation (A Division of Collcorp, Inc)
   1. Contact info:
      a. Address 1055 CR 6 North Tiny, Ontario L9M 0R4
      b. Telephone: 705 533 1853
      c. Fax: 705 533 3766
      d. Toll free 1 866 682 4442
      e. Sales/Service email: jammerc@rogers.com

B. Approved alternate. Approved alternate must demonstrate a minimum of 5 years of execution of refurbishment projects of Baileys & Fisher Porter UV Systems.

2.3 OPERATING CONDITIONS

A. Location:
   1. SPP Plant Electrical Building: Refer to the layout drawings for location.

B. Ambient temperature 0 to 40 degrees C, 0 to 95 percent humidity.

2.4 CONTROL PANEL ENCLOSURE

A. Indoor Areas: Fabricated of high grade cold rolled steel (CRS) (14 gauge) and paint with ANSI 61 Light Grey baked enamel outside and inside, except on stainless steel. Sub-panels to be on 12 gauge CRS finished with white baked-enamel.

B. Back plates to be 2.7 mm steel sheet, painted white, mounted on four 10 mm collar studs minimum with stainless steel hardware

C. Corrosion resistant stainless steel screws, bolts, fasteners, hinges, and door handles, etc.

D. Panel Dimensions as per existing panel.

E. Exterior welds to a smooth finish free of burrs. Make surfaces free of ridges, nuts, bolt heads, and similar protrusions.

F. Print Pocket: On inside of door, rigid, for storing manual, layout drawings and wiring drawings.

G. Doors: Removable, continuous piano type hinges, three point latching, key lockable handle (keyed alike), padlock hasp. Three-point closure is required for indoor panels. Using screw clamps or quarter turn latches in conjunction with three-point handles to achieve or maintain a NEMA/EEMAC rating will not be acceptable. Seal all conduit entry points and openings through the use of gaskets and other means within the panel such that panels maintain their appropriate NEMA/EEMAC rating. No conduits may enter through the top of a control panel or WAN panel. To prevent the ingress of dirt or water into a PAC control panel, as well to maintain separation of field and in-panel wiring, conduit shall enter into the bottom of the PAC and WAN panels. Intrinsically safe wiring is exempt from this rule and may enter at the top right or top left (side closest to the intrinsically safe barriers) of a control panel 152 mm or less from the top of the control panel to maintain proper wiring separation. All other conduit entries must be approved by the OWNER, and may only be allowed if the panel has been designed to maintain separation of field and in-panel wiring.

H. Provide 50 mm stainless steel spacers between panel and wall.

I. All panel mounted equipment shall be complete with an engraved legend on a white lamacoid. This nameplate shall have black lettering no smaller than 6 mm.

J. All panel equipment shall be complete with an identification nameplate having letters no smaller than 12 mm. All details of inscriptions shall be approved by ENGINEER.

K. Manufacturers:
   1. Hammond.
   2. Hoffman.
   3. Rittal.
   4. Eurobex.
   5. Approved equivalent.

2.5 CONTROL PANEL POWER LAYOUT AND ASSEMBLY

A. The UV control panel shall not have voltage higher than 120/208 VAC within the control panel based on the existing panel.

B. The UV control panel is not to be used as a pass-through or junction box for other circuits or wiring external to the PAC control panel.

C. Provide a main 3- phase power breaker as required, which is not to exceed the breaker rating of the feeder circuit breaker. Provide branch circuit breakers for each individual circuit distributed from the panel. Branch circuit breaker current trip rating is not to exceed main breaker trip rating to ensure general co-ordination of breakers within the control panel. Breakers to have only one incoming and one outgoing wire termination. For common reference points, provide a finger safe jumper bar. Do not use wire jumpers.

D. Supply a surge protection/power filter device if is required, to protect control panel components. This power filter is to be placed in circuit prior to UPS connection point. Acceptable Surge protection is Phoenix Contact SFP 1-20/120AC or approved equivalent.

E. Provide 3-phase TORODIAL transformer, 208VAC primary as required; refer to Appendix A. Investigate and design based on requirements and standards.

F. Separate the transformer section from PLC and electronic board section with splitter plate, refer to existing panel and Appendix A.

G. Supply two DC power supplies as required, refer to Appendix A. Based on existing drawings shall be 24 VDC and 12 VDC. Investigate for validation and appropriate design requirements.

H. Design, select and supply the Lamp Rack Controller Boards, based on the system requirements and compatibility as well as newest technology if applicable.

I. No power splitters (i.e., aluminum/copper type lugs with one large feed screw and two or smaller sub-feed lugs) are to be utilized within a PAC panel. Use only appropriate type terminal blocks with center style bridge jumpers for power distribution.

J. To control or eliminate electrical noise in wiring systems, group wires of compatible signal or power levels together and run separately or electromagnetically isolated from wires of incompatible signal or power level.

K. Isolate 24 VDC digital and analog signals from 120 VAC power or signal wiring as much as is reasonably possible. Where not possible, Section 12-904(2) of the OESC 2012 to be followed.

L. Wiring to devices on hinged doors or panels: TEW wire, extra flexible, 49 strands minimum, wrapped in plastic spiral wrap fastened to the panel/door with Velcro® cable ties. Wiring to be installed with enough slack to allow the door to be fully opened. Wire ducts may also be stud welded to the control panel door provided this can be done without damaging the exterior surface of the door.

M. Control panel wiring ducts to be white, narrow slot, Panduit Type F series, or approved equivalent, and include a snap cover. Wiring duct to be filled no more than 50 percent at completion of the installation. Minimum duct width to be 2 inches, and minimum duct height to be 3 inches. Field wiring ducts are not to contain any internal panel wiring, and internal panel wiring ducts are not to contain any field wiring.

N. Identify each conductor, including spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance. Label all conductors at both ends using the same designation. Using different designations on the same conductor or on conductors that are commoned together is unacceptable, unless they are connected through a terminal block. Designations that are used on the wiring must match those shown on the Shop Drawings.

O. Identify PLC wiring at terminal blocks and connection points with PLC terminal (I/O) address numbers using the existing formats.

P. Identify wiring at both ends with heat shrink type, indelible machine printed wire markers. Brady 'PermaSleeve' Markers, or approved equal. Refer to the existing Coding and Tagging Standard for details on wire marker requirements.

Q. TECK cable entering the panel to have grounding lock nuts applied to all cables and be bonded to the panel ground.

R. Design and provide minimum two grounding bar for UV control panel , one is dedicated to the panel electrical ground bar, and the other will be connected to the panel isolated ground bar.

2.6 WIRING

A. The following wire gauges are to be used within the control panels, defined by function.

Function	**Gauge***	**Voltage Rating**
120 VAC Power	#14 AWG	600 V
DC DI/DO Signals (Panel Side)	#16 AWG	600 V
DC DI/DO Signals (Field Side)	#14 AWG	600 V
AC DI/DO Signals (Panel Side)	#16 AWG	600 V
AC DI/DO Signals (Field Side)	#14 AWG	600 V
24 VDC Power	#16 AWG	600 V
Control Circuits where protected by 10 A fuse or less	#16 AWG	600 V
Control Circuits where protected by 15 A fuse or less	#14 AWG	600 V
4-20 mA Analog Signals, other Analog Signals	#18 AWG**	300 V
Grounding (Internal)	#14 AWG	600 V
Grounding (Panel to ground Grid)	#4 AWG	600 V

Notes:
*Wires to be minimum 16 strand with fire retardant insulation.
**Shielded conductors are to be used.

B. Wire colours for both in-panel wiring and field wiring and are to conform to the following:

Function	**Colour**
AC/DC Line and Load Power (Hot/Live)	Black
Current Carrying Grounded Conductor (Neutral)	White
AC Control & I/O Circuits	Red
DC Control & I/O Circuits	Blue
Analog Pair (+, Feed)	Black
Analog Pair (-, Return signal to PLC)	White
Circuits Energized from External Source (24VDC and 120VAC)*	Yellow
Intrinsically Safe Wiring	Blue with White Stripe
DC Signal Ground	Green with Yellow Tracer
Electrical/Panel Ground	Green

Notes:

*Wiring that enters the Control Panel and is energized from a source other than the Control Panel.

C. TECK cable wire colours used for digital I/O wiring are expected to conform to the wire colour standards.

2.7 TERMINAL BLOCKS

A. Control panel terminal blocks are to conform to the following requirements:

Function	**Required Type**
I/O Card power supply	Fused with fuse blown indicator
Instrumentation power supply	Fused with fuse blown indicator
24 VDC power supply (where no CB used)	Fused with fuse blown indicator
Misc. Power Supply	Fused with fuse blown indicator
General control connections, power distribution	Non-fused
DI/DO field wiring interface	Non-fused
AI/AO field wiring interface	Non-fused, knife switch
Grounding	Non-fused, grounding

B. Based on the function and the identified required terminal block types as shown in the above table the following terminal block guidelines are as follows:

1. Fused Terminal Blocks with Fuse Blown Indicator: Modular, rated 300 V 12 A minimum, 81.3 mm DIN rail mounted, individually removable, with swing arm fuse access, LED or Neon blown fuse indicator. Allen-Bradley 1492-H5 for working voltage of 10-57 V AC/DC, Allen-Bradley 1492-H4 for working voltage of 100 to 300 VAC, or approved equivalent. Supply five spare fuses of each fuse type rating in DIN rail mountable utility box with each control panel.
2. Non-Fused Terminal blocks: Modular, rated 600 V 25 A minimum, tubular clamp type, 35 mm DIN rail mounted, individually removable, with removable insulating covers on exposed terminals carrying above 50 V, WDU4 Series by Weidmuller Ltd., 1492-J Series by Allen-Bradley, UT Series by Phoenix Contact Ltd., WK 4/U Series by Wieland Electric Ltd., or approved equivalent.
3. Non-Fused Knife Switch Terminal blocks: Modular, rated 300 V 10 A minimum, tubular clamp type, 35 mm DIN rail mounted, individually removable, with removable insulating covers on exposed terminals carrying above 50 V, WTR4 Series by Weidmuller Ltd., 1492-J Series by Allen-Bradley, UT Series by Phoenix Contact, WK 4/TKM Series by Wieland Electric Ltd, or approved equivalent.
4. Non-Fused Grounding Terminal blocks: Modular, rated 150 A, tubular clamp type, 35 mm DIN rail mounted, individually removable, with removable insulating covers on exposed terminals carrying above 50 V, WPE4 Series by Weidmuller Ltd., 1492-J Series by Allen-Bradley, UT Series by Phoenix Contact, WK 4 SL/U Series by Wieland Electric Ltd, or approved equivalent.
    a. Colour: Green and Yellow.

C. Additional terminal block design requirements are as follows:

1. A minimum of 5 cm space between terminal blocks and any other device or raceway.

2. Separate terminals and wiring by class of signal.
3. Provide a minimum 20 percent spare terminals for each signal class.
4. Finger-safe terminals are required.
5. Use jumper bars to connect common terminals where appropriate. The use of wire jumpers is to be kept to a minimum.
6. Major Devices are to be spread across I/O Modules such that a failure of one I/O module does not fault the entire facility as the PAC will be able to operate other like equipment that are on a different I/O module.
7. All spare PAC I/O is to be landed on the appropriate terminal block for future connections to the spare I/O points.
8. Use of double- or triple density, or double- or triple-stack blocks is not permitted without permission of the engineer and the OWNER.
9. Analog input terminal blocks shall have five terminals per input.
   a. One "+24 VDC" source terminal for loop powered instruments.
   b. One "0 VDC" common terminal for loop powered instruments.
   c. One "+" terminal to the positive signal terminal of the PAC card.
   d. One "–" terminal to the negative signal terminal of the PAC card.
   e. One isolated ground terminal for connecting of the shields to the panel isolated ground.
10. Analog I/O wiring shields for all instruments/devices shall be grounded in the panel to terminals connected to the isolated ground bar in the panel, which is connected to the building ground system via a separate cable. Analog I/O wiring shields are not to be grounded at the field end under any circumstances and the isolated ground in the control panel is not to be left floating. A separate ground cable of the same gauge as the electrical ground is to be run from the isolated ground bar to the same ground point as the panel electrical ground.
11. Terminal Blocks are to be labeled on both sides of the terminal using printed labels. Handwritten terminal block labels are not permitted.

2.8 PROGRAMMABLE LOGIC CONTROLLERS

A. Refer to Section 13450, Programmable Controllers for information.

2.9 CONTROL DEVICES - GENERAL

A. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

B. Pilot lights and control switches to be coloured in accordance with CAN/CSA Z431-96 Colours of Indicator Lights and Push- Buttons.

C. Pilot lights shall be coloured as follows (unless shown otherwise on the Drawings):
   1. Running/Open: Red.
   2. Stopped/Closed: Green.
   3. Power On: White.
   4. Fault: Amber.
   5. Auto Bypass: White.
   6. System Okay: Green.
   7. SCADA Alarm: Amber.

D. Push-buttons and selector switches shall be coloured as follows:
   1. Stop/Off/Close: Red.
   2. Start/Run/Open: Green.
   3. Other Functions: Black.

E. Manufacturers (in alphabetic order):
   1. Allen-Bradley, 800T.
   2. Cutler-Hammer.
   3. Square D.
   4. Approved equivalent.

F. Manufacturers listed above are used for reference purposes to establish acceptance standards and establish minimum functional requirements for control device.

G. Provide products of exact manufacturer, if explicitly shown and described in other Sections for specific application.

2.10 UPS BYPASS RELAY (IF APPLICABLE)

A. Universal Pole Type: Electrically held with three poles minimum, convertible from NO to NC by changing wiring connections, break-before-make single pole double throw contacts, plug-in style with base, LED status indication.
   1. Coil Rating: 120 V, 3 VA.
   2. Contact Rating: 120 V, 15 A.

B. Manufacturers:
   1. Allen-Bradley, 700-HB33A1-4.
   2. Or ENGINEER approved equivalent.

2.11 AC GENERAL PURPOSE CONTROL RELAYS

A. Universal Pole Type: Electrically held with four poles minimum, convertible from NO to NC by changing wiring connections, plug-in style with base, LED status indication.1.1 VA.
   1. Contact Rating: 120 V, 7 A.

B. Manufacturers:
   1. Allen-Bradley, 700-HC series.
   2. Cutler Hammer.
   3. Phoenix Contact.
   4. Approved equivalent.

2.12 TIMING RELAYS

A. Construction: AC operated electronic timing relay with solid-state timing circuit to operate output contact. Timing circuit and output contact completely encapsulated to protect against vibration, humidity and atmospheric contaminants. Plug-in style with base.

B. Potentiometer: Self-contained to provide time interval adjustment.

C. Supply Voltage: 120 VAC, 60 Hz.

D. Temperature Range: Minus 20 to 60 degrees C.

E. Output Contact Rating: Maximum voltage 120V ac or dc. Current: EEMAC B300.

F. Timing Ranges: Adjustable, minimum 0.05 second, maximum 300 hour, unless otherwise required by design.

G. Timing Function: To suit application (i.e., on-delay, off-delay, etc.)

H. Manufacturers:
   1. Allen-Bradley, 700-HR.
   2. Omron.
   3. Phoenix Contact.
   4. Approved equivalent.

2.13 INTERPOSING PAC PANEL INTERFACE RELAYS

A. DIN rail mounted, single pole, with LED status light. 6 A rated contacts minimum.

B. 120 VAC Relays:
   1. Acceptable Manufacturers:
      a. Allen-Bradley 700-HLT1U1.
      b. Phoenix Contact, PLC-RSC-120UC/21AU.
      c. ABB, R500 Series, D2.5/5-OBIA-0030-115ac.
      d. Weidmuller, MRS 120VUC 1CO RC.
      e. Approved equivalent

C. 24 VDC Relays:
   1. Acceptable Manufacturers:
      a. Allen-Bradley 700-HLT1U24.
      b. Phoenix Contact, PLC-RSC-24DC/21AU.
      c. ABB, R500 Series, D2.5/5-R121AL.
      d. Weidmuller, MRS 24Vdc 1CO C1D2.
      e. Approved equivalent.

2.14 INTRINSICALLY SAFE BARRIER RELAYS (ISR)

A. DIN rail mounted.

B. To be used for interfacing with discrete devices located in hazardous areas.

C. Pepperl+Fuchs:
   1. Digital Inputs: KFA5- SR2-EX2.W, or approved equivalent.
   2. Analog Inputs: KFD0-CC-EX1, or approved equivalent.

D. All intrinsically safe wiring to be isolated from all other panel wiring and leave the control panel in its own conduit.

2.15 PUSH BUTTONS

A. Oil tight. Operator extend type, labeled as indicated, heavy duty, 30 mm diameter oil-tight standard operators, contact arrangement as indicated on the Drawings, button colour as per standards, rated 120 VAC.

B. Provide contact configurations as shown on the Drawings.

C. Manufacturers:
   1. Allen-Bradley, 800T.
   2. Cutler Hammer.
   3. Square D.
   4. Approved equivalent.

2.16 CONTROL SWITCHES

A. Maintained unless otherwise indicated, labeled as indicated, heavy duty, 30 mm diameter oil-tight standard operators, contact arrangement as shown on the Drawings, black in colour, rated 20 V, 720 VA ac.

B. Provide contact configurations as shown on the Drawings.

C. Manufacturers:
   1. Allen-Bradley, 800T.
   2. Cutler Hammer.
   3. Square D.
   4. Approved equivalent.

2.17 PILOT LIGHTS

A. Oil-tight, LED lamp, transformer type, 30 mm diameter, push-to-test. Lens colour as indicated by standards or as shown on the Drawings, supply voltage: 120 V, labels as indicated.

B. Manufacturers:
   1. Allen-Bradley, 800T.
   2. Cutler Hammer.
   3. Square D.
   4. Approved equivalent.

2.18 CONTROL CIRCUIT BREAKERS

A. Rail mounted, thermomagnetic, toggle operated.

B. Manufacturers:
   1. Allen-Bradley, 1492-SP.
   2. ABB.
   3. Phoenix.
   4. Weidmuller.
   5. Approved equivalent.

2.19 RECEPTACLES

A. General Purpose Receptacle: Specification grade, 15 A, 125 VAC, duplex, flush, ivory, NEMA 5-15R receptacles. Hubbell HBL5262I, or approved equal.

B. UPS Fed Receptacle (If applicable): Specification grade, 20 A, 125 VAC, simplex, flush, brown, NEMA 5-20R receptacle. Hubbell HBL5361, or approved equal.

2.20 24 & 12 VDC POWER SUPPLIES

A. Supply two DC power supplies as required. Based on existing drawings shall be 24 VDC and 12 VDC. Investigate for validation and appropriate design requirements.

B. Acceptable Manufacturers
   1. Phoenix Contact
   2. Weidmuller
   3. Approved equivalent.

2.21 UPS and UPS MAINTENANCE BYPASS UNIT (IF APPLICABLE)

A. Description: The UV Control Panel UPS is to be 2,000 VA minimum. The UPS is to provide a minimum of 1 hour back-up power in the event of a power failure. If a 2,000 VA UPS alone cannot provide the required backup time, install additional battery modules as required. Do not increase the size of the UPS. The following features are to be incorporated in the UPS:
   1. Built-in general fault relay output.
   2. Ethernet/SNMP interface module/card meeting RFC1628 SNMP MIB Standards.
   3. Digital display.
   4. Alarm silence feature.
   5. UPS to be on-line double conversion type.

B. Acceptable UPS Manufacturers:
   1. Powerware (Eaton) 9130 Tower.

C. The UPS is to be installed in conjunction with a UPS Maintenance Bypass unit. The UPS bypass will have a manually operated bypass switch that allows for the isolation and removal of the UPS from the PAC Control Panel without interrupting downstream devices. Any equipment requiring UPS power must be plugged into the UPS bypass, not directly into the UPS.

D. Acceptable UPS Maintenance Bypass Manufacturers:
   1. Powerware (Eaton) HotSwap MBP EHBPL2000R-PDU1U.

2.22 SPECIAL CONTROL DEVICES AND COMPONENTS

A. Communication/Programming Port:
   1. The control panel door mounted communications/programming port to be a combination 120 VAC/5A NEMA 5-15R receptacle, RJ-45 Ethernet port, and dual USB port, located adjacent to or above the folding laptop tray.
   2. Acceptable Manufacturers:
      a. Phoenix Contact, 5526291.

b. Grace Engineered Products.
c. Hubbell.
d. Approved equivalent.

2.23 ACCESSORIES

A. LED light with door mounted switch.

2.24 IDENTIFICATION

A. Panel Identification:
   1. Process Label: Lamicoid nameplate providing system identification. Panel tag identification shall have letters no smaller than 25 mm for key panels and 12 mm for marshalling panels.
   2. Manufacturer's Label: Company name/info with 0 reference number and manufacturing date.
   3. Electrical Label: Panel supply voltage, full load current amps, interrupting rating.

B. Internal Components: Each internal panel mounted devices shall be fitted with a permanent nameplate (lamacoid or equal) at the device, with the device identification imprinted. Fuses and breakers shall have the size indicated on the nameplate.

C. Terminal Blocks: Each terminal to be clearly marked with factory pre marked number and/or letter tag identifiers.

D. Cable, Wire Markers: Wire identification on both ends, white background with black lettering, sleeve type heat shrinkable plastic tags (or similar to provide firm fit on the conductor insulation), machine printed.

2.25 UV LAMP RACK REFURBISHMENT

A. Provide hardware, fittings and components required to refurbish UV lamp racks.

B. Provide and install new UV lamps.

PART 3 EXECUTION

3.1 DESIGN

A. CONTRACTOR shall provide supervision, labor for the design, detailed execution, procurement, fabrication, and delivery of control panels.

B. Design control panels. Prepare and submit control drawings in accordance with Section 13621 - Control System Documentation.

C. Provide materials and perform work in accordance with the latest named published editions of codes and standards.

D. Use new materials and equipment unless otherwise specified. Refurbished materials are not considered new. Provide material and equipment of minimum specified design and quality. Conform to published ratings and for which replacement parts are readily available. Use products of one manufacturer for equipment or material of same type or classification unless otherwise specified. All control and electrical components shall be standard stock items with 7-day parts or unit replacement available in Canada.

E. Listed manufacturers and models are used for reference purposes to establish acceptance standards and establish minimum functional requirements for control device. Provide products of exact manufacturer, if explicitly shown and described in other Sections for specific application.

F. Unless specified otherwise, separate control/power panel must be provided for each system (if more than one system provided). All power, control devices, and software for a given system to be contained independently within its associated control/power panel.

G. Design electrical power system to provide an overall efficiency of not less then 90 percent, leading power factor greater than 0.9 at full load.

3.2 SUPPORT OF THE PROCESS CONTROL SYSTEM INTEGRATOR WORKS

A. The following paragraph outlines activities required for programming and deployment of the new UV control system PLC program.

B. Vendor shall schedule and plan with Process Control System Integrator:
   1. Review of the new control system and functions related to operation, control and monitoring, interlocks and interactions with other systems, alarms, etc.
   2. Review and development of the new UV system control narrative,
   3. Review and development and review of the new PLC program,
   4. Installation and testing (FAT, SAT) of the new program code.
   5. Commissioning of the upgraded UV system.

C. Assistance and collaboration shall be understood as cooperation between both parties and presence of both parties during UV control system upgrade related activities:
   1. the Vendor personnel may not have knowledge specific to the programming, and vice versa,
   2. Process Control System Integrator may not have the knowledge of the Vendor understanding of the UV system operation.

3.3 CONTROL PANEL FABRICATION

A. Fabrication: Shop fabricate control panels to CSA C22.2 No. 14, using cabinets and terminal blocks furnished in accordance with Section 16010.

B. Install Products in accordance with manufacturer's written instructions.

C. Install programmable controllers furnished in accordance with Section 13450.

D. Any steel fasteners shall be hot-dip galvanized. Under no circumstances shall interior fasteners penetrate the panel skin.

E. Provide surge suppressers across each relay coil.

F. Equipment shall be mounted to ensure adequate clearance between both door and backplane mounted components with the panel door closed.

G. All internally mounted equipment shall be placed in an order such that all components can be removed easily for maintenance and replacement purposes.

H. Provide panel with a minimum of 0.18 m^2 blank panel space for installation of future panel mounted devices.

I. Relay base and terminal block rails shall be located square to the backpanel. Door mounted instruments shall align horizontally and vertically on edges or centrelines as indicated.

J. Fastening of equipment assemblies to the panel backplanes shall be by means of appropriately sized drilled and tapped screw holes. Machine screws only with lock-washers are to be used; self-tapping hardware is not acceptable.

K. Determine the exact devices current and install fuses in accordance with manufacturer's specifications. Verify settings. Ensure circuit over current protective devices such as breakers, protective relays, fuses, etc. are installed and set to required values based on installed equipment.

3.4 CONTROL PANEL WIRING

A. Run wires in wireway and exit the wireway at the point nearest to the device to which it is wired.

B. Do not splice wires within a wireway.

C. Identify each wire at each termination point using markers bearing the complete wire number.

D. Neatly harness wires within wireways using tyrap fasteners with wire forming done such that there is no mechanical tension on wire terminations.

E. Provide cabling required to connect the PAC equipment mounted in the panel and as shown on the Drawings.

F. Route AC wiring separately from DC wiring. Make allowance for this in the manufacturer of the panel.

G. Provide wire duct sized for no more than 50 percent fill. Wiring ducting shall be separate for interconnections within cabinet and for exterior field cabling routing.

H. Maximum unshielded cable exposure shall be only 50 mm, to permit connection to device terminals and neat terminals of the drain wire.

I. Terminals shall be accessible for attachment of field connections. Each terminal shall be clearly marked with pre-marked factory numbers, and/or letter tag identifiers. Each field-connecting conductor shall be served by one terminal.

J. Provide a minimum of 20 percent spare terminals of each type of terminal assembly in each panel.

K. Flexible wiring harnesses with approved terminating connectors at both sides shall be provided for any hinged panel or door-mounted equipment (e.g., pilot lights, push-buttons).

L. Tapped copper bus bar for panel components and shield grounding shall be provided, including 20 percent spare.

M. Each terminal block wire shall be provisioned such that it is landed at 90 degrees to the terminal, and have adequate spare length such that the wire can reach up to four terminals above and below where the wire has been landed.

N. Terminal block identification shall match the conductor identification number where possible.

O. Spare terminals shall be installed at the end of each terminal assembly. I/O groups (in general) shall consist of: Digital Inputs (DI), Digital Outputs (DO), Analog Inputs (AI) and Analog Outputs (AO). Spare terminals shall be identified with the letters "SP" or "SPARE" on removable factory pre-marked tags.

P. Wiring that is not directly related to an I/O group, spare terminals shall be installed at the end of the terminal assembly (e.g., 24 VDC terminal rail, 120 VAC terminal rail grounding rail.).

Q. In addition to spare terminals identified above, each unused programmable controller I/O module point (discrete or analog) shall be wired to term to terminal blocks and identified with the I/O address.

R. All analog signals must be wired through fusible or isolation type terminal blocks.

S. All spare conductors shall be terminated on terminals.

T. Each panel shall be bonded to the building ground system:
   1. Firmly bond all panel devices (either on or within panel) to ground. Provide supplementary bonding conductors to the back panels and doors of the control panel.
   2. In the case of devices not firmly fastened to panels (e.g., meters), provide a separate bonding conductor with screws attached to the appropriate device.
   3. Provide No. 10 AWG conductor to PLC I/O chassis.

3.5 LABELING

A. Each terminal to be clearly marked with factory pre-marked number and/or letter tag identifiers.

B. Each conductor to be labelled on both ends with sleeve type heat-shrinkable plastic tags, machine-printed. Brady 'Permasleeve' or approved equivalent.

C. All panel-mounted devices to be labelled by means of engraved Lamacoid labels, black lettering on white.

D. Write-on labels are not acceptable.

3.6 INTERNAL COMPONENT IDENTIFICATION

A. Each internal panel device or instrument shall be fitted with a permanent lamacoid nameplate on, or above the device, with the device identification imprinted. Fuses and breakers shall have the size indicated on the nameplate.

3.7 PANEL FACEPLATE DEVICE IDENTIFICATION

A. Panel face devices shall be provided with lamacoid nameplates, black with white lettering in accordance with the Drawing schedules, or as otherwise specified or as indicated.

B. Final nameplate wording, colouring and sizes shall be approved during Shop Drawing submission reviews.

3.8 FACTORY ACCEPTANCE TEST (FAT)

A. All testing and calibration shall be documented on record sheets that display the results and dates of all tests required and performed.

B. Perform continuity checks on all wiring. This shall be documented.

C. After completing continuity checks a full operational test shall be performed of the panel. Operational tests shall be performed by simulating field wiring connections to each panel at the panel(s) terminal blocks.

D. Discrete/Digital panel inputs and outputs shall be verified with input switch simulation and output test load connections at the terminal blocks.

E. Analog inputs to the panel shall be simulated utilizing a 4-20 mA signal generator (as applicable). Full range (4-20 mA) response of all the panel analog devices and inputs shall be verified, deviations noted and recalibration performed where required.

F. Analog outputs from a panel shall be simulated by loading output circuits to their maximum impedance, (in 250 Ω multiples) and monitoring the loop current with a current calibrator or high-resolution digital meter. Full span capability of any analog output shall be verified and documented.

G. Analog inputs and outputs shall be tested for span and linearity (three-point test) by measurements at 4.0, 12.0, and 20.0 mA.

H. Mechanical checks shall be done to ensure that there are no broken parts, wires, mechanical binding, loose screws, etc. Mechanical tolerances shall be checked including contact grip on wires.

I. FAT testing shall include simulation of the functionality of the new UV Control panel process logic controller (PLC).

J. After completing all tests, the results shall be compiled in a Factory Test Report. Copies shall be retained for reference during field commissioning. One copy shall be submitted to ENGINEER.

K. An authorized representative of ENGINEER and/or OWNER shall witness parts of the factory acceptance testing. Vendor shall provide provision for the representatives to view aspects of the test and to sign off on the Factory Test Report.

L. Any devices that do not comply with the FAT, shall be replaced by CONTRACTOR. A re-test shall be performed on the specific device, with a copy of the testing submitted to ENGINEER for approval.

3.9 SITE ACCEPTANCE TEST (SAT)

A. Participate and coordinate with client and system integrator to perform SAT of panel after installation and field wiring has been completed.

B. Test:
1. Operation of all discrete panel inputs from the field instruments and devices by actuation of their controlling variable and monitoring of received signals at the local and/or area control panel.
2. Operation of all discrete panel outputs to the field devices by forcing them into their "on" state in manual mode at the local and/or area control panel. Any rotating equipment or valves, etc., which cannot be safely energized by testing of discrete panel outputs, shall be temporarily disconnected, and potential or continuity checks of the output circuits made while energized.
3. Analog circuits by creating a 4-20 mA signal at the field transmitter (e.g., loop calibrator) and verify feedback at the local and/or area control panel. All analog signals shall be verified for polarity, zero, span, and linearity
4. Analog output control signals shall be generated to test and verify proper device proportional response. Where such testing is done the actuated device shall, where possible, be isolated from the process by closing related isolating valves.
5. Generate analog output control signals to test and verify output signal response.
6. All logic circuit operational interlocks, protective interlocks and alarm interlocks.
7. All pushbuttons, selector switches, indicating lights and display devices. These devices shall be functioning according to the intended operational philosophy.
8. Verify input signals at the PLC, and coordinate with ENGINEER to check PLC outputs to field drives and devices by forcing them "on".
9. Verify the safety and readiness of the cables, phasing and connections prior to energization.
10. System sub-circuits and process subassemblies shall be group tested to verify control logic operation, alarm registration, sequence and timing operations. Logic circuit operational interlocks (auto start/stop signals), protective and alarm interlock operation shall be verified. Alarm registration, latching and reset operation shall be verified for all system alarms.

END OF SECTION

HYDRO DWG. NO. NK37-DRAW-67969-10007 SUBTYPE IPL

99063B

DIM. = mm / INCHES

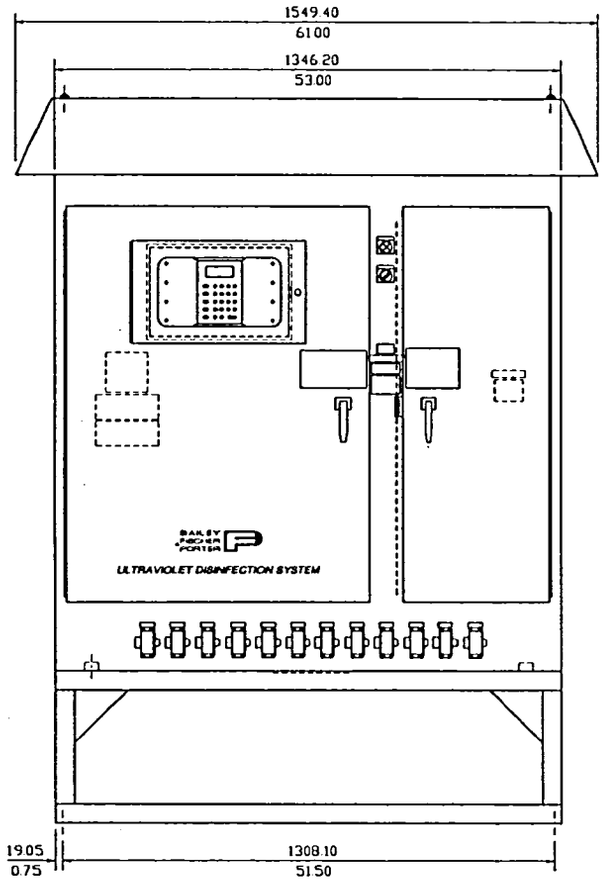
UNITS WW

REV	HYDRO	SUBMITTER
	00	

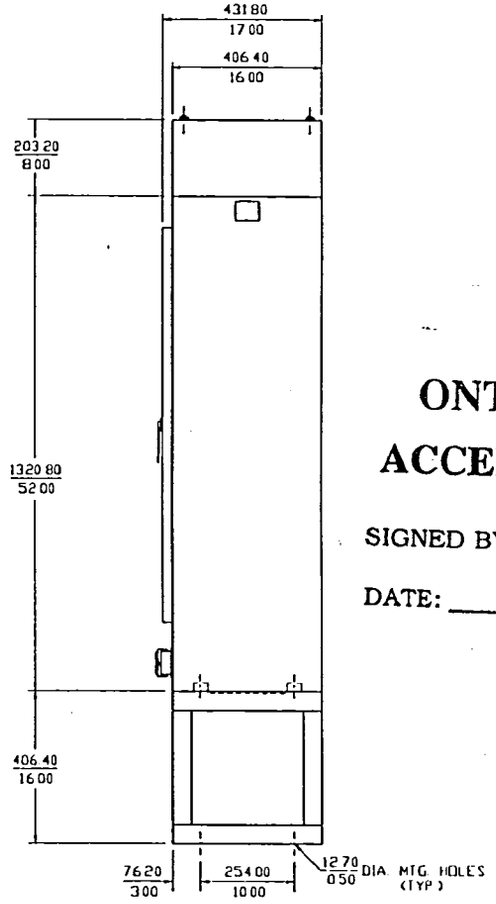
Sht. _____

NOTES:

1. MATERIAL TO BE 304 S.S. 12GA. 2B FINISH
2. CABINET HAS BEEN DESIGNED TO COMPLY WITH NEMA 4X ENCLOSURE RATING
3. EYEBOLTS ARE REMOVABLE AND HOLES ARE INTERNALLY CAPPED



FRONT VIEW
(FRONT OF CABINET)



SIDE VIEW RIGHT

ONTARIO HYDRO

ACCEPTED FOR ISSUE

SIGNED BY: C. Clutt

DATE: 22 July 1998

JUL 11 1997

AS BUILT

DESCRIPTION: POWER DISTRIBUTION CENTER c/w BASE OUTLINE DETAILS
ULTRAVIOLET DISINFECTION SYSTEM

CUSTOMER: ONTARIO HYDRO - BRUCE N.P.D.
PLANT: BRUCE NUCLEAR POWER DEVELOPMENT - U.D.F.

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REV.	YR.	MTH.	DAY	REVISION DESCRIPTION	DRAWN	CHKD.	APRV.

Elsag Bailey (Canada) Inc.

DRAWN I. BYSETTE
CHKD
APRV
DATE FEB. 13, 1997

CAD FILE	ORDER NO	SO NO	DWG NO	SCALE	PART NO	SHT.	REV.
32760011	9685-2	3276	A4-3276-01	1:20		1 OF 1	0

ISO (METRIC) A4 FLOPPY NO

HYDRO DWG. No. NK37-DRAW-67969-10008

UNITS-WW SUBTYPE-IPL SHT 0001 REV.00

990638

DIM. = mm / INCHES

NOTES:

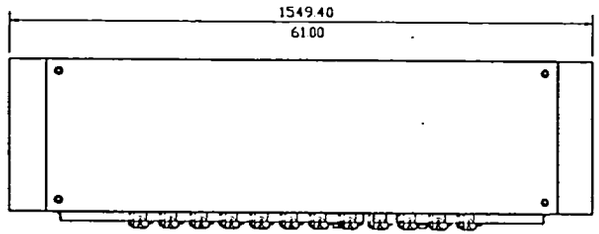
1. MATERIAL TO BE 304 S.S. 12GA 2B FINISH
2. CABINET HAS BEEN DESIGNED TO COMPLY WITH NEMA 4X ENCLOSURE RATING
3. EYEBOLTS ARE REMOVABLE AND HOLES ARE INTERNALLY CAPPED

ONTARIO HYDRO

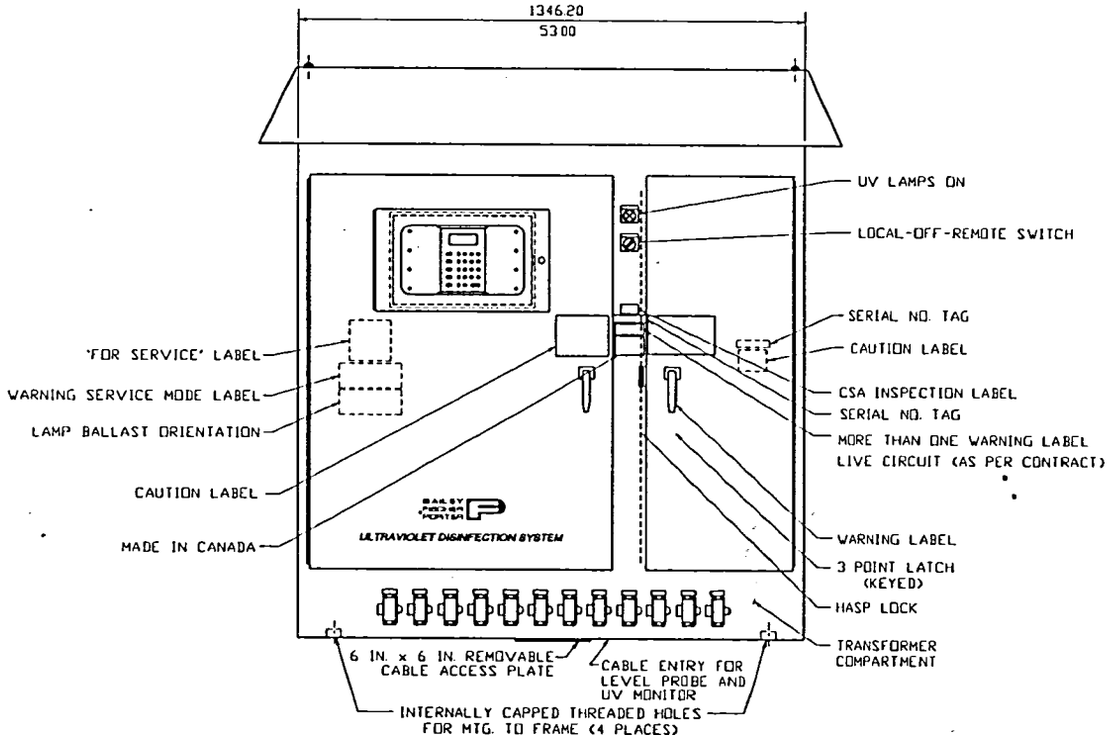
ACCEPTED FOR ISSUE

SIGNED BY: E. Platt

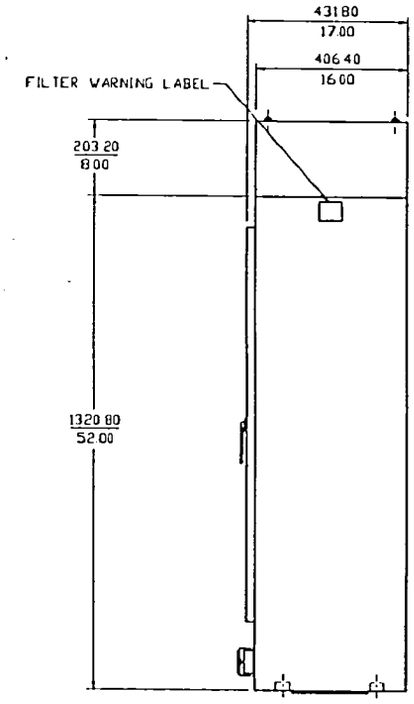
DATE: 22 July 1998



TOP VIEW



FRONT VIEW
(FRONT OF CABINET)



SIDE VIEW RIGHT

JUL 11 1997

AS BUILT

DESCRIPTION: POWER DISTRIBUTION CENTER EXTERNAL/INTERNAL LAYOUTS
ULTRAVIOLET DISINFECTION SYSTEM

CUSTOMER: ONTARIO HYDRO - BRUCE N.P.D.
PLANT: BRUCE NUCLEAR POWER DEVELOPMENT - U.D.F.

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REV.	YR.	MTH.	DAY	REVISION DESCRIPTION	DRAWN	CHKD.	APRV.

Elsag Bailey (Canada) Inc.

DRAWN: I. BSMYE
CHKD:
APRV:

CAD FILE	ORDER NO	S.O. NO	DATE
32760021	9685-2	3276	FEB. 13, 1997

DWG NO	SCALE	PART NO	SHT	REV
A4-3276-02	1:20		1 OF 2	0

ISO (METRIC) A4 FLOPPY_NO

990638

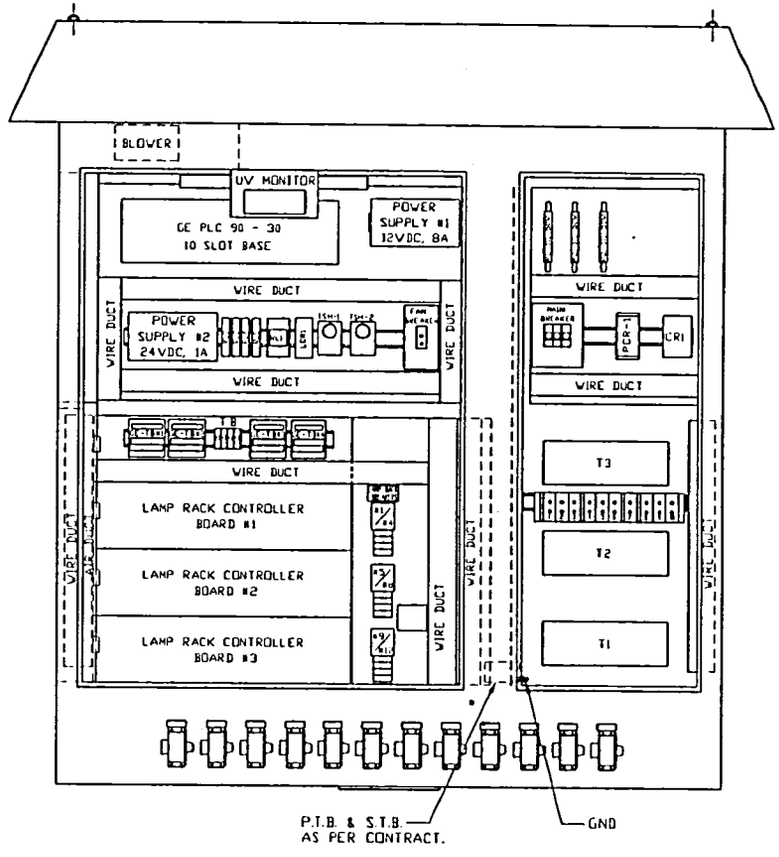
HYDRO DWG. NO.										SUBTYPE IPL
NK37 - DRAW - 47949 - 10008										
UNITS						REV	HYDRO	SUBMITTER	Sht. 0002	
W	W						00			

ONTARIO HYDRO

ACCEPTED FOR ISSUE

SIGNED BY: E.C. Mott

DATE: 22 July 1998



FRONT VIEW

(LIGHTS, SWITCHES AND DOORS REMOVED FOR CLARITY)

JUL 11 1997

AS BUILT

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DESCRIPTION: POWER DISTRIBUTION CENTER EXTERNAL/INTERNAL LAYOUTS
ULTRAVIOLET DISINFECTION SYSTEM

REV.	YR.	MTH.	DAY	REVISION DESCRIPTION	DRAWN	CHKD.	APRV.

CUSTOMER: ONTARIO HYDRO - BRUCE N.P.D
PLANT: BRUCE NUCLEAR POWER DEVELOPMENT - U.D.F.

Elsag Bailey (Canada) Inc.

CAD FILE	ORDER NO	SO NO	DRAWN N. KOSTKY
32760022	9685-2	3276	CHKD
DWG NO	SCALE	PART NO	APRV
A4-3276-02	1:15		DATE FEB. 19, 1997

SHT 2 OF 2 | REV 0

ISS UNDER AN ENGINEERING CHANGE NOTICE

FIELD

POWER DISTRIBUTION CENTER

CHANNEL

ONTARIO HYDRO
ACCEPTED FOR ISSUE
SIGNED BY:
DATE: 22 July 1998

GE MODEL 30 ANALOG OUTPUT SLOT #3
OUTPUT 1 PUMP 1 SPEED
OUTPUT 2 PUMP 2 SPEED
PUMP 1 SPEED
PUMP 2 SPEED
CABLE 6
CABLE 7
S.T.B
AC P.T.B
CUSTOMER SUPPLY 208V 60 Hz. 3 PHASE 4 WIRE
#12 GA.
CB1 UV SYSTEM MAIN BREAKER 20A
PCR 1
CR1
R1 10, 50W
R2 10, 50W
R3 10, 50W
#14 GA.
GRY (-)
G.E. PLC CPU BASE SERIES 90-30
+24VDC SUPPLY
CABLE #8
OPERATOR INTERFACE UNIT
DIU COMMUNICATION CABLE
GE MODEL 30 8 PT. OUTPUT MODULE SLOT #10
OUTPUT 1 MINOR ALARM
OUTPUT 2 MAJOR ALARM
OUTPUT 3 BANK STATUS
OUTPUT 4 PUMP RUN ON
OUTPUT 5 PUMP RUN OFF
P.T.B.
MINOR ALARM
MAJOR ALARM
BANK STATUS
PUMP RUN 1
PUMP RUN 2
RL2
RL3
RL4
RL5
RL6
CB2 FAN BREAKER 5A
POWER SUPPLY #2 24V DC 2 AMP
POWER SUPPLY #1 12V DC 5 AMP
BLU (+)
RED (+)
TO SHT. 2
UV LAMPS ON
ELAPSED TIME COUNTER GE MODEL 90-30 32 PT. 24VDC I/P MODULE SLOT 5
3 PHASE (4.5KVA) TOROIDAL TRANSFORMER ASSEMBLY 208V PRIMARY
184V Y SECONDARY
184V Δ SECONDARY
TO SHT. 2 LAMP RACK CONTROLLER BOARD #1 - 2
TO SHT. 2 LAMP RACK CONTROLLER BOARD #3
RED (+1)
+12VDC TO SHT. 2
RL1
REMOTE ENABLE GE 8 PT. RELAY O/P MODULE SLOT 10
LOCAL
REMOTE
POWER SUPPLY STATUS GE MODEL 90-30 32 PT. 24VDC I/P MODULE SLOT 5
REMOTE STATUS GE MODEL 90-30 32 PT. 24VDC I/P MODULE SLOT 5
UV INTENSITY PROBE
UV MONITOR
INPUT
NORMAL UV INTENSITY
LOW UV INTENSITY
LOW LOW UV INTENSITY
OUTPUT 4-20MA
ALARM 1
ALARM 2
CABLE #5
LOW UV INTENSITY GE MODEL 90-30 32 PT. 24VDC I/P MODULE SLOT 5
LOW LOW UV INTENSITY GE MODEL 90-30 32 PT. 24VDC I/P MODULE SLOT 5
HIGH TEMPERATURE GE MODEL 90-30 32 PT. 24VDC I/P MODULE SLOT 5
TSH-1 TEMP. SENSOR (40°C)
16 PT. ANALOG SLOT 2
SUMP LEVEL INPUT SIGNAL 4 - 20 mA.
UV INTENSITY
SUMP LEVEL INPUT SIGNAL
CABLE #4
GROUND
LCR1 LOW LEVEL
BLOWER (INTAKE)
10 μF CAP
TSH-2 TEMP. SENSOR (20°C)
LOW LEVEL ALARM GE MODEL 90-30 32 PT. 24VDC I/P MODULE SLOT 5
LEVEL PROBE
LOW LEVEL
GND

NOTES:

1. THE ULTRAVIOLET DISINFECTION SYSTEM IS ENERGIZED IF:
   a) THE LEVEL IN THE UV CHANNEL IS NOT LOW,
   b) THE FRONT PANEL SWITCH IS IN THE REMOTE POSITION AND
   c) THE CONTROL ALGORITHM REQUIRES THE BANK TO BE ON.

   THE SYSTEM IS ALSO ENERGIZED IF THE FRONT PANEL SWITCH IS IN LOCAL AND THE LEVEL IN THE UV CHANNEL IS NOT LOW.
2. TYPICAL WIRING DIAGRAM FOR ALL POWER DISTRIBUTION CENTERS.

WARNING

THE AUTO-OFF-MANUAL SWITCH ON THE LAMP RACK CONTROLLER BOARD IS INTENDED TO BE USED AS A SERVICE MODE ONLY. LEAVE SWITCH IN AUTO FOR NORMAL OPERATION

JUL 11 1997
AS BUILT

HYDRO DWG. NO. NK37 - DRAW - 1a 7 9 1a 9 - 10004
REV 00 01 HYDRO SUBMITTER
UNITS MM
Sht. 0 0 0 1
SUBTYPE EWD
9906638

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REV.	YR.	MTH.	DAY	REVISION DESCRIPTION	DRAWN	CHKD.	APRV.
1	1997	MAR	10	GENERAL REVISIONS	J. BEI		

DESCRIPTION: AC/DC POWER DISTRIBUTION & I/O WIRING DIAGRAM ULTRAVIOLET DISINFECTION SYSTEM

CUSTOMER: ONTARIO HYDRO - BRUCE N.P.D.
PLANT: BRUCE NUCLEAR POWER DEVELOPMENT - U.D.F.

Elsag Bailey (Canada) Inc.

Drawn J. BEI
CHKD. G. SHEEHAN
APRV. C. JONKER

CAD FILE 32761041 | ORDER NO. 9585-2 | S.O. NO. 3276 | DATE FEB. 14, 1997
DWG NO. A1-3276-04 | SCALE: NTS. | PART NO. | SHT. 1 OF 2 | REV. 1

ISO (Metric) A1 FLOPPY.MD

POWER DISTRIBUTION CENTER

FRONT LEFT

CHANNEL

FROM SHT. 1
12VDC 184VAC Y P.S.1 18VDC P.S.2 24VDC

GE MODEL 30
32 POINT TTL INPUT MODULES
SLOT 4

CONNECTOR A/B — STATUS LED

RACK 1 BALLAST #1 COMMON LAMP FAILURE	A1	A1
RACK 1 BALLAST #2 COMMON LAMP FAILURE	A2	A2
RACK 2 BALLAST #3 COMMON LAMP FAILURE	A3	A3
RACK 2 BALLAST #4 COMMON LAMP FAILURE	A4	A4
RACK 3 BALLAST #1 COMMON LAMP FAILURE	A5	A5
RACK 3 BALLAST #2 COMMON LAMP FAILURE	A6	A6
RACK 4 BALLAST #3 COMMON LAMP FAILURE	A7	A7
RACK 4 BALLAST #4 COMMON LAMP FAILURE	A8	A8
		A COM
RACK 5 BALLAST #1 COMMON LAMP FAILURE	B1	B1
RACK 5 BALLAST #2 COMMON LAMP FAILURE	B2	B2
RACK 6 BALLAST #3 COMMON LAMP FAILURE	B3	B3
RACK 6 BALLAST #4 COMMON LAMP FAILURE	B4	B4
RACK 7 BALLAST #1 COMMON LAMP FAILURE	B5	B5
RACK 7 BALLAST #2 COMMON LAMP FAILURE	B6	B6
RACK 8 BALLAST #3 COMMON LAMP FAILURE	B7	B7
RACK 8 BALLAST #4 COMMON LAMP FAILURE	B8	B8
		B COM

T.B.1: 1 WHT, 2 GRN, 3 RED, 4 ORN, 5 YEL, 6 GRY, 7 BLU, 8 VIO, 9 RED; 24 WHT, 23 GRN, 22 RED, 21 ORN, 20 YEL, 19 GRY, 18 BLU, 17 VIO, 16 RED

CONNECTOR C/D — STATUS LED

RACK 9 BALLAST #1 COMMON LAMP FAILURE	C1	C1
RACK 9 BALLAST #2 COMMON LAMP FAILURE	C2	C2
RACK 10 BALLAST #3 COMMON LAMP FAILURE	C3	C3
RACK 10 BALLAST #4 COMMON LAMP FAILURE	C4	C4
RACK 11 BALLAST #1 COMMON LAMP FAILURE	C5	C5
RACK 11 BALLAST #2 COMMON LAMP FAILURE	C6	C6
RACK 12 BALLAST #3 COMMON LAMP FAILURE	C7	C7
RACK 12 BALLAST #4 COMMON LAMP FAILURE	C8	C8
		C COM
RACK 1, 2, 3 & 4 GFI TRIP	D1	D1
RACK 5, 6, 7 & 8 GFI TRIP	D2	D2
RACK 9, 10, 11 & 12 GFI TRIP	D3	D3
SPARE	D4	D4
SPARE	D5	D5
SPARE	D6	D6
SPARE	D7	D7
SPARE	D8	D8
		D COM

T.B.2: 1 WHT, 2 GRN, 3 RED, 4 ORN, 5 YEL, 6 GRY, 7 BLU, 8 VIO, 9 RED; 24 BRN, 23 BRN, 22 BRN, 16 RED

CABLE 9

FROM SHT. 1
184VAC Δ

T.B. +1 BLK

(T4) (T5) (T6) (T7) (T8) (T9) (T10)

CABLE #1 — LAMP RACK #1,2,3&4 5A BREAKER — WHT / RED
CABLE #2 — LAMP RACK #5,6,7&8 5A BREAKER — GRN / RED
CABLE #3 — LAMP RACK #9,10,11&12 5A BREAKER — RED / RED

TB (+ −) BLK — G TB

LAMP RACK CONTROLLER BOARD #1
LAMP RACK CONTROLLER BOARD #2
LAMP RACK CONTROLLER BOARD #3

UV LAMP FAILURE SENSOR
FUSE 1A
GFI
AUTO OFF MAN. (R)
J1
TB L1 L2 L3 G
RECT.
P1 P2

1 LAMP 2 BALLAST 1
3 LAMP 4 BALLAST 2
1 LAMP 2 BALLAST 3
3 LAMP 4 BALLAST 4
BALLAST 1 1 LAMP 2
BALLAST 2 3 LAMP 4
BALLAST 3 1 LAMP 2
BALLAST 4 3 LAMP 4

CABLE #1 RACK #1 LAMP #4 LAMP #1
CABLE #2 RACK #2 LAMP #4 LAMP #1
CABLE #3 RACK #3 LAMP #4 LAMP #1
CABLE #4 RACK #4 LAMP #4 LAMP #1
CABLE #5 RACK #5 LAMP #4 LAMP #1
CABLE #6 RACK #6 LAMP #4 LAMP #1
CABLE #7 RACK #7 LAMP #4 LAMP #1
CABLE #8 RACK #8 LAMP #4 LAMP #1
CABLE #9 RACK #9 LAMP #4 LAMP #1
CABLE #10 RACK #10 LAMP #4 LAMP #1
CABLE #11 RACK #11 LAMP #4 LAMP #1
CABLE #12 RACK #12 LAMP #4 LAMP #1

FIELD

S.T.B.
1/4A 12 — 13 — 1/4A 14 — 15 — 1/4A 16 — 17 — 1/4A 18 — 19 — 1/4A 20 — 21 — 1/4A 22 — 23 — 1/4A 24 — 25 — 1/4A 26 — 27

GE MODEL 90 - 30
32 POINT 24VDC INPUT MODULES
SLOT 5

CONNECTOR A/B — STATUS LED

PUMP RUN STATUS	A1	A1
PUMP RUN STATUS	A2	A2
PUMP IN AUTO	A3	A3
PUMP IN AUTO	A4	A4
PUMP FAILURE	A5	A5
PUMP FAILURE	A6	A6
LOW SUMP LEVEL ALARM	A7	A7
SPARE	A8	A8
		A COM
ELAPSED TIME COUNTER	B1	B1
REMOTE STATUS	B2	B2
LOW UV INTENSITY	B3	B3
LOW LOW UV INTENSITY	B4	B4
POWER SUPPLY STATUS	B5	B5
HIGH TEMPERATURE	B6	B6
LOW LEVEL ALARM	B7	B7
SPARE	B8	B8
		B COM

T.B.3: 1–8, 9 GRY → TO SHT. 1 POWER SUPPLY #2 24V DC; 24 ORN (10), 23 ORN (11), 22 ORN (14), 21 ORN (15), 20 RED (+), 19 ORN (13), 18 ORN (09) → FROM SHT. 1; 16 GRY

CONNECTOR C/D — STATUS LED

BREAKER TRIP BOARD #1	C1	C1
BREAKER TRIP BOARD #2	C2	C2
BREAKER TRIP BOARD #3	C3	C3
SPARE	C4	C4
SPARE	C5	C5
SPARE	C6	C6
SPARE	C7	C7
SPARE	C8	C8
		C COM

T.B.4: 1 WHT, 2 GRN, 3 RED, 4–8, 9 GRY

WARNING

THE AUTO-OFF-MANUAL SWITCH ON THE LAMP RACK CONTROLLER BOARD IS INTENDED TO BE USED AS A SERVICE MODE ONLY. LEAVE SWITCH IN AUTO FOR NORMAL OPERATION

HYDRO DWG. NO. NK37-DRAW-L7969-10004 SUBTYPE EWD
UNITS WW | REV | HYDRO 00 | SUBMITTER 01 | Sht. 0002

990638

ONTARIO HYDRO
ACCEPTED FOR ISSUE
SIGNED BY: ____ 11 1997
DATE: 22 July 1998 **AS BUILT**

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DESCRIPTION: AC/DC POWER DISTRIBUTION & I/O WIRING DIAGRAM
ULTRAVIOLET DISINFECTION SYSTEM

REV.	YR.	MTH.	DAY	REVISION DESCRIPTION	DRAWN	CHKD.	APRV.
1	1997	MAR	11	GENERAL REVISIONS	J. BEI		

CUSTOMER: ONTARIO HYDRO – BRUCE N.P.D.
PLANT: BRUCE NUCLEAR POWER DEVELOPMENT – U.D.F.

Elsag Bailey (Canada) Inc.

DRAWN J. BEI
CHKD. G. SHEEHAN
APRV. C. JONKER

CAD FILE 32781042 | ORDER NO. 9585-2 | S.O. NO. 3276 | DATE FEB. 13, 1997
DWG NO. A1-3276-04 | SCALE: NTS. | PART NO. | SHT. 2 OF 2 | REV. 1

ISO (ANSI) A1 FLOPPY.MD

SECTION 13470

SCADA HARDWARE & SOFTWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. SCADA hardware and software.

B. Overview of SCADA software installation and programs deployment.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Definitions:
   1. “SCADA software” refers to the software components provided by the SCADA software manufacturer.
   2. “SCADA program” refers to the program (database, operator interface, visualization, etc.) created by Process Control System Integrator using SCADA software.

1.3 PROGRESS SUBMITTALS

A. Section 01300 - Administrative Requirements: Requirements for progress submittals.

B. Shop Drawings shall be provided and shall include, but not be limited to:
   1. SCADA deployment plan and schedule.
   2. Review, comments and endorsement of the proposed SCADA implementation.

C. Test Reports: Refer to Section 13413 – Testing and Commissioning.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.

1.5 QUALITY ASSURANCE

A. Process Control System Integrator will have to sign a non-disclosure, confidential, IT security agreement with the OWNER.

1.6 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution Requirements: Requirements for warranties.

PART 2 PRODUCTS

2.1 SCADA HARDWARE

A. OWNER will provide PC type SCADA computers hardware (servers, workstations, desktops, monitors, etc.) with Windows software.

2.2 SCADA SOFTWARE

A. OWNER will provide SCADA software. SCADA software for this project shall be Wonderware ArchestrA platform from AVEVA industrial software. No exceptions.

B. Process Control System Integrator shall have own copies of the SCADA software for the development, testing and commissioning of the SCADA programs.

C. Configuration overview:
   1. The SCADA software will be installed as virtual machines on Bruce Power IT, remotely located servers.
   2. The SCADA servers will communicate with new control system (Thin Clients, programmable controllers, etc.) over existing network.
   3. SCADA Thin Clients, located in control room and electrical room, will be used to control and monitor operation of SPP.
   4. SCADA Thick node (backup system) with independent, stand-alone Wonderware Intouch software will be installed at SPP control room to allow operation of the SPP upon failure of the servers, network, communication, etc. with the remotely located servers.
   5. Refer to SPP network architecture drawing for details.

PART 3 EXECUTION

3.1 EXAMINATION

A. The Process Control System Integrator shall coordinate with OWNER revisions and requirements of hardware, operating systems, and SCADA software to ensure full compatibility.

3.2 SCADA INSTALLATION & CONFIGURATION

A. The following paragraph outlines major steps required for installation of the SCADA software and deployment of the SCADA program.

B. Generally, SCADA software and SCADA program shall be installed by OWNER IT personnel with Process Control System Integrator assistance, as the software will become part of the OWNER Enterprise system.
   1. Process Control System Integrator shall schedule and plan with OWNER IT personnel installation and testing of the SCADA software and programs.
      a. All software deployment and development must be reviewed and created in collaboration with OWNER IT resources.

2. Assistance and collaboration shall be understood as cooperation between both parties and presence of both parties during SCADA software and program installation at OWNER locations, as:
    a. the OWNER IT personnel may not have knowledge specific to the SCADA software and program, and vice versa,
    b. Process Control System Integrator may not have the knowledge of the OWNER Enterprise system.
3. The intention of the cooperation is to provide OWNER IT personnel with understanding of the SCADA software operation to allow them to provide support at IT level.

C. Deployment of the SCADA program.
1. It is anticipated that Thick client (backup node) will be used during testing, ongoing modifications, updates, and verification of SCADA and PAC programs operation until completion of all related construction activities.
2. Upon successful completion of local testing using Thick node, SCADA software and programs shall be transferred to OWNER IT servers.
3. Process Control System Integrator shall verify operation of the SCADA program including application server, historian, and alarm server, etc.
4. Update SCADA Thick node to match Thin clients (as required). Perform testing.
5. Upon successful completion of verification, perform final Factory Acceptance Testing of the SCADA program. This activity shall include testing of SCADA Thick node.

3.3 DEMONSTRATION

A. Section 01800 - Facility Operation: Requirements for demonstrating installed work.

B. After completion of installation, provide testing to demonstrate compliance with operating requirements. Perform operational tests and Factory Acceptance Testing of the SCADA program.

END OF SECTION

SECTION 13480

PROCESS CONTROL SYSTEM INTEGRATOR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Process control system (PCS) integrator qualifications and work details.

1.2 RELATED REQUIREMENTS

A. Process Control Software Programming, Section 13485.

1.3 REFERENCES

A. Instrumentation, System and Automation Society (ISA).

1.4 SUBMITTALS

A. Submit documents in printed, and electronic, viewable and editable format.

B. Process Control Narrative (PCN). Include:
   1. FAT level - submitted prior to FAT.
   2. SAT level - submitted prior to SAT.

C. Process control system FAT and SAT checkout and verification forms.

D. Process control system startup and commissioning plan to include:
   1. Proposed timeline schedule and description of each task.
   2. Purpose of tasks, outline of tests to be performed, procedures.
   3. Evaluation of results, check lists, and sign-off sheets.

E. Process control system operator manual to include:
   1. 60% review level.
   2. 100% review level.

F. The request for progress payments during development shall be accompanied by the submittal of completed or work in progress Products (copies of documents, software, programs, code, etc.). Rate of recurrence: each payment.

G. Submit documents in printed, electronic viewable and electronic applicable editable format on electronic media (CD-R, DVD-R).
   1. Detailed Process Control Narrative (PCN) and revised version of PCN provided by GHD.
   2. Process Control System Operator Manual.

H. Programs, Code, Database, Configuration, and Support Files: Complete sets allowing future modifications. Submit electronic, editable, and/or compiled versions of program code (PLC, electronic operator interface, SCADA, etc.).

I. Programming, integration, and configuration records. Include documentation specific to the process control system implementation and programming work.

J. Network Data: Complete configurations of hubs, routers, switches, etc. Provide hardcopy documentation and software data files of the completed configuration for each piece of network equipment and application software used in the configuration. Include configuration addresses, identifications, and names, passwords, switch settings, and parameters.

K. Final I/O list including network points, data mapping, naming/tagging conventions, development and configuration, etc.

1.5 QUALITY ASSURANCE

A. Process control system integrator shall function as an expert in the field of process integration, instrumentation and control for process systems, SCADA control and architecture, associated hardware and software, programmable logic controllers, programming industrial networks and communication systems, instrumentation, process control systems, and various process equipment and treatment systems.

B. Process control system integrator shall have expertise in managing large projects in municipal/industrial water and wastewater systems including control system standard development and all work shall be completed in accordance with Ontario Clean Water Agency standards modified to suit Bruce Power requirements

C. Process control system integrator shall have minimum 10 years experience and at least two (2) projects of similar nature and magnitude. Proof of projects and references shall be required for process control system integrator approval.

D. PLC or SCADA programs or any other work listed under this specification section without proper documentation, even if fully operational and tested, will be considered work not completed.

E. Preferred vendor:
   1. Ontario Clean Water Agency

1.6 SEQUENCING AND SCHEDULING

A. Coordinate works with other specification Sections. Schedule activities with Section 16000, Electrical and Control System Scope of Work.

B. Start-up, testing, and commissioning (on-site / field works). Process control system integrator shall assume that:
   1. the proposed sequence of construction will be followed,
   2. control systems and equipment will be switched over, added, modified, or connected in multiple steps,
   3. each work item will require a dedicated time at site to support programming efforts,
   4. more than one person may be required during switchovers to accommodate maximum process shutdown time, and

5. temporary control and monitoring features (control program logic, visualization, code activation/deactivation, database tags, etc.) will be required to maintain SPP in continuous operation.

C. Process control system integrator shall assume that both control systems (new and existing one) will remain operational during construction activities - operational means that SPP can be controlled and operated from plant SCADA system like a common system, as controls and systems will be switched over in number of phases.
   1. It shall be noted that after completion of each task control system will remain live to accommodate plant operation;

D. Coordinate deployment of the control systems and software with plant operations. Schedule works so that disruption to the operations of the facilities is kept to a minimum. Plan and schedule work to minimize the interference with operations and to avoid disruptions to SPP control systems.

E. Schedule time required into Project construction and completion for functional testing, startup and commissioning of packaged systems.

F. In accordance with Contract Documents schedule time into project for regular site meetings and visits during construction. Administer and provide meeting notes related specifically to SCADA system integrator scope of work.

1.7 SYSTEM STARTUP AND COMMISSIONING

A. The specific information about type of tests are outlined under other sections. Allow for field modifications, programming and data checks and modifications, "test run", etc. to ensure the process control system function as intended and meets treatment process objectives.

B. Work shall be divided into multiple stages and include all packaged systems.

C. System verification is intended to demonstrate the complete operation of the process control/SCADA system under normal and failure operating conditions. Ensure that safety and fail safe interlocks are in place, and operate as designed and intended.

D. Proceed to the next stage of testing after approval of satisfactory system performance at the current stage. Rectify deficiencies, conduct troubleshooting and otherwise take corrective action of the installed systems.

E. Control and instrumentation work shall require completion and operational readiness of selected segment of Work prior to the beginning of SCADA system testing.

1.8 MANUFACTURER'S WARRANTY

A. Process control system integrator shall warrant against any malfunctioning or flawed code.

PART 2 PRODUCTS

2.1 PRODUCT OWNERSHIP

A. Ownership of any Products provided under this section (narratives, standards, programs, software, and applications developed, configured, or programmed) by the process control system integrator and paid under this Contract shall become property of the Owner. There shall be no additional support, maintenance, royalties, or license fees related to the programs or software code (excludes original software manufacturer support, upgrade fees, etc.).

2.2 INTEGRATION

A. Process control System Integrator shall lead, supervise, and support the overall process control system implementation, requirements and control aspects of the Project. The activities are not limited strictly to programming or SCADA work. System integrator shall participate in commissioning and start up. Coordinate with owner and contractor to resolve any outstanding issue.

B. Process control system integrator shall be fully responsible for the integration of the Project SCADA system, in its entirety including but not limited to the following:
   1. Finalize detailed design of the control system.
   2. Ensuring that proper interfacing is provided for the between system and application software, and protocol layers.
   3. Support all aspects of automation including instrumentation, process equipment, control systems, control panels, etc.
   4. Support all installation aspects of the Project including process, mechanical, instrumentation, control and electrical systems, environmental, health and safety and related services.
   5. Implementation of Supplier's specific equipment/process control requirements.
   6. Review of Contract Documents, Shop Drawings, and submittals for all systems provided under this Project for completeness and compliance with process control system standards.
   7. Coordinate programming efforts, data exchange, interface with ancillary systems, reviews and comments.

2.3 PROCESS CONTROL NARRATIVES

A. Process control narratives are integral part of the integration work. Develop and detail Project-specific process control narrative which preliminary has been provided by GHD .

B. Process narrative included in Contract Documents outlines general rules for system operation. The intention of the process narrative is to establish integrator with information on the control and monitoring of the process equipment and other facility systems that are directly or indirectly associated with the process systems. It should be used as an aid in developing the control strategy and integration into plant operation.

C. Integrator shall incorporate control details provided by equipment packaged systems and other Suppliers, and related to equipment/process control requirements in the process control narratives. Written description to include detailed instrumentation and control system including

list of functions monitored, controlled, and alarmed. Provide documents in editable file format for incorporation into Operation and Maintenance manual.

D. Process control narrative shall be treated as a "work in progress", where all future mark ups and modifications including "as constructed" documentation shall be completed by process control system integrator based on actual implementation.

E. Each process section of process control narrative shall consist of the following paragraphs:
   1. Process Overview: Paragraph provides basic (executive) description outlining treatment process.
   2. Process Equipment Table: Paragraph provides equipment table that lists key active and static equipment process system components that will be included on the operator interface. "Active" equipment - controlled or monitored by control system. "Static": manual type, not controlled or monitored, but critical from process control perspective (for example pump isolation valves).
   3. Operation of Process Equipment: Paragraph provides details on controls associated with each automated or monitored component associated within described treatment process, modes of operation, interlocks, events.
   4. List and Description of Control Tags: Paragraph provides tables/lists and description of control tags with information on monitoring and control functions, setpoints, events and records required for system control.
      a. Monitoring - system and devices statuses, process data.
      b. Controls - system and devices controls and setpoints.
      c. Events - alarms, warnings, notifications, and setpoints.
      d. Records - trending, data, reports.

2.4 PROCESS CONTROL SYSTEM OPERATOR MANUAL

A. Process control system operator manual is integral part of the integrator work. Manual shall provide "step-by-step" information on how to operate process control system and do not duplicate specific process type information included under process control narrative. Manual content shall include:
   1. Chapter 1, "Getting Started": Provide executive summary plant operation type guide on how to use control system. The guide shall be not more then twenty (20) pages in length and include:
      a. How to get around (access and security, screen navigation and functional overview).
      b. How to monitor system.
      c. How to control system.
      d. How to interface packaged systems.
      e. Event management (alarms, warnings, statuses).
      f. How to access process data (trending).
   2. Chapter 2, "System Access and Security": Include detailed information on access levels, locations, and security.
   3. Chapter 3, "Control and Monitoring": Include detailed information on how to get around, system monitoring, control, and configuration control system. List colour conventions, graphics and symbols interpretation, screen navigation.
   4. Chapter 4, "Packaged Systems": Include detailed information on how to interface, control and monitor.
   5. Chapter 5, "Events Management System": Include detailed information on events recording (alarms, warnings, statuses), storage, retrieval and organization.

6. Chapter 6, "Process Data": Include detailed information on trending and data logging, storage, retrieval and organization of current and historical process data, reports generation.
7. Chapter 7, "System Startup and Shutdown".
8. Chapter 8, "Graphical Interface" - Include colour printouts of operator interface screen.
9. Appendix A, "Process Control System Hardware Technical Data": include information on logic controllers, computers, operator interfaces, etc. including packaged systems.
10. Appendix B, "Process Control System Software": Include information on all software packages including packaged systems. Provide Supplier information, technical support information, full software name including list of all modules and revision level.

2.5 LOGIC CONTROL PROGRAMS

A. The facility control system includes programmable controllers communicating over network with HMI, SCADA and UV Control system.

B. The process control software shall perform controls and monitoring, startups, shutdowns, interlocking, etc. of the equipment and processes provided under this Project for "state of the art system" allowing fully automatic, unsupervised operation.

C. Refer to equipment specifications, packaged equipment specifications for details on operation, control requirements, start up and commissioning support services to be provided by the equipment Suppliers or Subcontractors, and work directly associated to be provided under this specification Section.

D. Provide programs with control and monitoring functions.

2.6 SCADA PROGRAMS

A. The facility control system includes programmable controllers communicating over network.

B. The SCADA software shall perform controls and monitoring, startups, shutdowns, interlocking, etc. of the equipment and processes provided under this Project for "a state of the art system" allowing fully automatic, unsupervised operation.

C. Refer to equipment specifications, packaged equipment specifications for details on operation, control requirements, start up and commissioning support services to be provided by the equipment Suppliers or Subcontractors, and work directly associated to be provided under this specification Section.

D. Provide SCADA programs with control and monitoring functions.

E. Provide HMI programs with control and monitoring functions.

2.7 UV CONTROL SYSTEM PAC PROGRAM

A. The following paragraph outlines activities required for programming and deployment of the upgraded UV control system.
   1. UV control system upgrade will be provided by a Vendor specializing in refurbishment of older generation UV systems, as outlined under Section 13460 – UV Control System Upgrade.
   2. The existing UV control system GE Fanuc 90-30 PLC controller will be replaced by a new GE RX3i PAC controller. Modifications may also include minor changes to the control and monitoring devices .

B. Process Control System Integrator shall provide new program code for the upgraded UV control system.
   1. Control System Integrator shall be fully responsible for migration and modifications of existing UV program from GE90-30 Series PLC to new RX3i PAC System.
   2. The Control System Integrator shall be aware of UV System controls logics and knowledgeable of system operation.
   3. The Control System Integrator shall function as an expert in this field and is responsible for all configuration and modification, which are required for UV system.

C. Process Control System Integrator shall schedule and plan with Vendor:
   1. Review of the new control system and functions related to operation, control and monitoring, interlocks and interactions with other systems, alarms, etc.
   2. Review and development of the new UV system control narrative,
   3. Review and development and review of the new PLC program,
   4. Installation and testing (FAT, SAT) of the new program code.
   5. Commissioning of the upgraded UV system.

D. Assistance and collaboration shall be understood as cooperation between both parties and presence of both parties during UV control system upgrade related activities:
   1. the Vendor personnel may not have knowledge specific to the programming, and vice versa,
   2. Process Control System Integrator may not have the knowledge of the Vendor understanding of the UV system operation.

2.8 MISA SAMPLING DATA MANAGEMENT SYSTEM

A. System integrator is responsible for programming and implementation of data management system for MISA sampling system.

B. The data management system is consisted of an application software to convert the data to CSV and ODBC-compliant file formats. The data will be used in spreadsheets and reports. The historical data is collected from historian server as un-edited binary data. The collected data is converted and appended to a CSV and/or ODBC-compliant database. The original binary historical data shall not be changed, in compliance with API 21 requirements.

   If data is missing due to a communication failure, it will be collected when the communication is reestablished. The PC historical database will be backfilled with the missing data.

C. Sampling records: shall comply with Ontario Reg.215/95 and must include but not limited to:
   1. Date and time of all sampling activity.
   2. Sample identification, e.g., wastewater stream, control point etc.

3. Malfunctions and corrective action taken;
4. identification of sampling staff;
5. Cleaning, reprogramming, programmer repairs etc;
6. Calibration, cleaning, repair log;

D. Trending Screen: The system shall be capable of showing the data in chart and trending screen.

2.9 OTHER PROGRAMMING AND CONFIGURATION

A. SCADA Configuration: integrator shall install required software and configure all computers (including server) and control equipment including but not necessarily limited to all field instrumentation, programmable controllers, control devices, process equipment, etc.

B. Network communication and switches configuration.

C. UPS with related software and automatic shutdown and re-start of SCADA computers.

2.10 SOFTWARE AND ACCESSORIES

A. The integrator shall have own copies of programming software.

B. Communication cables, wireless hubs, wiring accessories, etc. to suit Project requirements.

C. Data Backup Means: Hardware, software, and storage media.

2.11 MAINTENANCE SERVICE

A. Provide services to "fine tune" and modify process control system (programs code and operator interface, database, etc.) based on plant operational experiences.

PART 3 EXECUTION

3.1 INSTALLATION

A. Deploy SCADA system in accordance with manufacturer's latest written instructions and good engineering practice.

3.2 IMPLEMENTATION OF DETAILED PROCESS CONTROL NARRATIVES

A. System Integrator shall provide electronic versions of revised and detailed process control narrative and relative materials based upon preliminary version provided by Engineer.

B. Prepare and submit pre-programming process control narratives in accordance with the progress submittals schedule. The systems integrator shall carry out a review meeting to finalize controls at each stage.

C. The updated process control narratives shall be reviewed and approved before commencement of the programming work.

D. The system integrator shall allow for modifications including custom configuration to meet facility control practices.

E. Integrator shall maintain and keep updated process control narratives during development and construction. Make updated documents available upon request. Documents shall be available in electronic and/or printed format when requested.

F. Provide administration services associated with process control narratives Work including organization (including packaged systems' narratives) and documents revisions, tracking, etc.

3.3 DEMONSTRATION

A. Provide trained qualified "hands on" technical personnel to perform services herein specified including troubleshooting of other overall process control/SCADA related facility systems (instrumentation, controls, etc.) and not necessarily limited to programming. If a person with these qualifications is not part of the startup team, allow for services of mechanical, electrical, instrumentation, etc. trades to support start up and commissioning.

B. Prior to commencement of commissioning, review mechanical and electrical work to ensure that the equipment is correctly installed, supported, connected and wired. Immediately advise in writing of any deficiencies or deviations from the installation instructions.

C. OWNER will observe events, but they shall not be an active participant or responsible for the operation during startup and commissioning.

D. Perform factory acceptance test (FAT) of assemblies and software. Inspect, operate, test and adjust the equipment.

E. Perform site acceptance test (SAT) of assemblies and software in accordance. Inspect, operate, test and adjust the equipment.

F. Make any necessary changes and adjustments to the process control system.

G. The integrator shall specify personnel, the number of visits, and time at site that is required to complete all Project tasks.

H. Allow for time dedicated exclusively to integration of the packaged systems.

I. Contract Price shall include all expenses (travel, accommodation, meals, transportation, etc.) and cost of providing services as listed.

3.4 TRAINING

A. Provide training services for operator training on proper operating and maintenance procedures after satisfactory startup and commissioning.

B. Operation and maintenance training shall include:
   1. Class training with overview of process control system/SCADA operation, technology and principles. Provide study and training materials and manuals.

2. Hands on training. Provide presentation by the instructor with facility operators following and physically performing control operations (as minimum):
   a. System overview.
   b. How to navigate system.
   c. Operation and operator interface
   d. Security.
   e. How to monitor system
   f. How to control system
   g. Event management (alarms, warnings, statuses).
   h. Trending.
   i. Reporting.
   j. SCADA system start up and shutdown.
   k. Maintenance and SCADA checks.
   l. Troubleshooting; simulate alarms and explain causes and procedures.
   m. Provide simulators (software subroutines, etc.) for practice purposes.

3.5 PROTECTION

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

END OF SECTION

SECTION 13485

PROCESS CONTROL SOFTWARE PROGRAMMING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Guidelines for the software programming.

1.2 RELATED REQUIREMENTS

A. Process Control System Integrator, Section 13480.

1.3 REFERENCES

A. Instrumentation, System and Automation Society (ISA).

B. Confirming proper installation prior to introduction to process media and energization.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 IMPLEMENTATION OF LOGIC CONTROL SOFTWARE - PROGRAMMING PRACTICES

A. The following paragraphs outline general rules for programming of logic controllers. The intention of these paragraphs is to establish the process control system integrator with information on the project minimum requirements in regards to logic control software programming practices.

B. The control logic program shall allow and provide for comprehensive process control and interfacing with field and control devices in order to implement control and monitoring functions as outlined in process control narratives. The logic control program shall:
   1. Receive, evaluate, and store data through the input signals from field devices.
   2. Monitor connected equipment.
   3. Control connected equipment through the output signals to field devices.
   4. Sequence equipment based on the process cycle, duty, operator request, failure, etc.
   5. Provide control and safety interlocks.
   6. Interface with SCADA operator interface.

C. The logic control program shall be organized (structured) in clear, consistent, and easy to follow format. The logic control structure shall be:
   1. Divided into logical blocks and segments based on controlled processes.
   2. Use standard subroutines and functions for all devices/equipment of the same type.

D. Formatting/tagging of logic variables shall be consistent throughout all control programs:
   1. The I/O shall be processed by dedicated files and mapped into organized blocks. The processed and organized data shall also include all virtual points and calculated signals (information obtain based on number of I/O statuses, SCADA operator interface control requests, and any other related conditions).
   2. The analog I/O signals shall be processed in similar manner. The calculations shall include signal validity, scaling (including PIDs, engineering units), average (in time or number samples), and totalizer.
   3. The PLC logic shall use only mapped data tags. Direct use of I/O points within program files is not preferred.
   4. The SCADA operator interface shall have dedicated data files for reading and writing of analog and discrete data.
   5. The registers/memory locations/tags shall be allocated to equipment and functions in logical and orderly manner, and based on the function of the device. Example: if bit 1 of data structure or ‘EquipmentXY.AutoMode’ tag represents Auto status, this bit/tag shall be used for all equipment (pump, valve, mixer, conveyor, etc.) to represent this status; if bit 2 of data structure or ‘EquipmentXY.RunSts’ tag represents Running status, this bit/tag shall be used for all equipment to represent this status; similarly all control (output) signals shall be also organized in such a manner.

E. The logic programs and subroutines shall be consistent throughout all control programs:
   1. Each component of the system shall have own dedicated file and call standard control subroutines from within the file. Example: the standard "Start/Stop" subroutine shall be used for all equipment where applicable: pump, valve, mixer, conveyor, etc.
   2. The library of standard control subroutines shall be consistent throughout PLC programs and used for all control as much as possible to minimize development and commissioning efforts. The complete library shall be included in each PLC program and assigned to the same program files. The library of standard control subroutines shall include:
      a. Constant speed equipment Start/Stop.
      b. Variable speed equipment Start/ Stop/Speed Control (with Fwd/Rev and PID functionalities).
      c. Equipment Fwd/Rev.
      d. Equipment Lo Speed/Hi Speed or multi-speed control.
      e. Valve Open/Close.
      f. Valve Position Control (with PID functionality).
      g. Chemical pump.
      h. Discrete alarm (enable/disable with priority level).
      i. Analog alarm (four (4) levels (HiHi, Hi, Lo, LoLo), each alarm level enable/disable, dedicated setpoints, debounce time settings, over/under range filter (signal error), deadband).
   3. Each standard control subroutine shall have built in following features:
      a. Processing of statuses (including SCADA operator interface requests).
      b. Processing of related events (alarms) and interlocked with controls.
      c. Control functions as indicated.
   4. Standard control subroutine shall be called using organized blocks of data. Allow for suitable amount of bits/tags per equipment.
   5. Include in program organization and reserve spare program files for future equipment.

F. The selected program control logic and data files may have to be protected to prevent unauthorized access and modifications. The requirements in this matter shall be determined during construction.

G. The program control logic and data files shall be documented in the program code:
   1. The level of documentation shall be sufficient to allow understanding of the program code by the third party.
   2. All program and data files shall have name and brief description.
   3. Each program file shall have name (file comment) and instruction comments.
   4. Generally, commenting of every line of logic is not required, however each logical function block shall be commented with brief explanation describing the purpose.

H. Each database address used by the program code shall have address comment:
   1. The tags and address comments shall be structured and consistent. They shall include name, process tag, and function.
   2. The analog data comments shall include engineered units.
   3. All spare, future or reserved memory locations shall be properly described.

I. All points interfacing SCADA operator interface shall have symbol that exactly matches the SCADA operator interface database tag in addition to standard address comment.

J. When a rung or memory address is removed from the code, all relevant comments shall be removed from database.

3.2 LOGIC CONTROL PROGRAM FEATURES AND CODING PRACTICES

A. The operation of equipment shall be divided into number of steps with conditions for the transition clearly defined. The interlocks and conditions shall be grouped in organized manner allowing easy troubleshooting.

B. The logic in general shall meet fail safe principles. In the event of a failure or loss of signal, control shall revert to a pre-determined fail safe mode.

C. The alarms shall be generated and processed by the logic program, and "send" to the SCADA operator interface in discrete form. Alarms shall have debounce timers and they can only be reset when alarm condition does not exist and an acknowledgment has been received. The default alarm configuration data shall be stored in PLC memory in addition to the current setpoints, so the data can be easily restored. The default data shall be stored in dedicated data file(s) with protected memory.

D. Similarly, the PID default configuration shall be stored in dedicated data file(s) with protected memory.

E. The program logic shall allow bumpless transfer between control operating modes.

F. Each equipment, device, etc. shall have 6-digit elapse runtime meter. The runtimes shall be stored in dedicated data file(s) with protected memory (only PLC program can modify data).

G. The program shall allow for smooth startup of all equipment after power failure, or restart of the system. Each component of the system shall have SCADA configurable interlock enabling or disabling operation under emergency power conditions, with sequencing capabilities.

H. The equipment/device command (output signal) shall be programmed only once in the code.

I. Computing, analog scaling, and similar math extensive instructions can be executed in sequence, one or batch per scan using indexing if not critical for system safety.

J. The program logic shall verify communication network status.

3.3 IMPLEMENTATION OF SCADA SOFTWARE - PROGRAMMING PRACTICES

A. The following paragraphs outline general rules for programming of SCADA operator interface. The intention of these paragraphs is to establish process control system integrator with information on the project minimum requirements in regards to SCADA programming practices.

B. Supervisory Control and Data Acquisition (SCADA) system provides a means of gathering real time process data from controllers and presenting this information in a graphical manner to the process supervisor. The system also controls or sends process data to the controllers.

C. The SCADA shall provide plant operator with number of computer screens presenting process streams and equipment. SCADA screen graphics layouts shall be created using P&ID Drawings as a guideline. Provide a graphics standard guideline to be used as a basis for development of graphics screen. As a minimum, guideline to include for items such as screen layouts, colour convention, symbols, events management, trending, and data logging.
   1. The graphics shall be designed for color monitors using specifying standard or widescreen resolution (no scaling or object stretching) and shall use scalable true type fonts for all text and numbers displayed.
   2. The widows style controls like, buttons, selectors, pick boxes, scroll bars, drop down menus, etc. shall be used in design of SCADA system.
   3. In addition the function keys shall have pre assigned control system functions: Example only: F1 - Help (operating system), F4 - Process Overview, F5 -Control/Setpoints, F7 - Alarm Acknowledge, F9 Login, F10 Logout, Ctrl + F1- Process Help Screen. Allow for programming of all common functions into key combinations; the final convention shall be determined during construction.

D. SCADA operator interface (screens on PC computer) shall use customized ISA-based graphic symbols and other simple schematic graphics to depict the devices and their relative location with regards to the process layout. The graphic symbols for equipment other then basic type like pump, blower, mixer, and valve shall as closely as possible reassemble the appearance of actual device. The custom library of objects shall be created under this project and included within the SCADA system complete with written documentation, so they can be reused during future work.

E. The graphic objects shall include static and animated types:
   1. The static type shall provide information associated with process layout or physical equipment appearance following in general plant standards and general colour coding.
   2. The animated type objects shall provide the operator with a visual representation of the system through various animated visual properties like: colour, style, numeric value, fill, size, shape, position, visibility, etc., and include pick (select) option allowing opening of pop up windows (based on security level).

F. The SCADA system shall use "concept of windows" to present process, provide monitoring and control functions. Generally, the SCADA windows shall include:
   1. Process Overview Screens: process map (sort of flowchart) presenting overall process relations (connections), basic statuses and allowing access to detailed process screens.
   2. Process Detailed Screens: Details of process streams (piping), equipment, control devices, etc., equipment status, process data, connections to preceding and subsequent process detailed screens; the control functions shall not be presented directly on these type of screens (example: start/stop buttons, etc.). The click on the graphic object

representing equipment or process data shall open equipment pop up window (when security level permits such an action).

3. Equipment or Process Pop Up Windows: all control functions and monitoring statuses and alarms available for selected equipment. Example: mode selection, start, stop, forward/reverse, Lo/Hi speed, direction and speed indication, speed control and speed indication, alarm acknowledge, reset, runtime, associated alarms, etc.
4. Process Supervision Screens: Event management (alarms, warnings, statuses), current and history, trends, reporting, process help, etc.

G. The process screens shall be full size and have standard and consist layout. In general, each screen shall provide name of the presented process (or part of the process), screen ID, time and date, network communication status, log in/log out, security level, common screen controls, etc. in the screen top header, center part dedicated to presentation of the process, alarm banner (4 to 6 recent alarms).

H. The PLC program examines the various signal statuses associated with controlled device and determines a control mode and state that the device is in. This data is received by SCADA system and it shall be represented by different visual properties (colour, text, number) on the SCADA screens. The final convention shall be determined during construction.
1. Equipment control mode shall be indicated on the main screens:
    a. Local.
    b. Computer manual.
    c. Automatic.
2. Equipment operational statuses (matching functionality of PLC program standard control subroutines) shall be indicated on the main screens:
    a. Mode/Running/stopped/alarm.
    b. Mode/Running/stopped/alarm with numeric speed indication (direction).
    c. Running Fwd/running Rev/stopped/alarm.
    d. Running Lo speed/running Hi speed/stopped/alarm.
    e. Opened/closed/alarm.
    f. Opened/closed/modulating/alarm with numeric position indication.
    g. Chemical Pump: Running/stopped/alarm with numeric speed/dosage indication.
3. Analog alarms shall be indicated by change of a foreground colour of numeric display and/or colour of bar graph (if provided on the screen).

I. Generally, all equipment shall use standard popup windows for control and monitoring matching functionality of PLC program standard control subroutines.
1. The pop ups shall be designed in such a manner, that the "template" pop up window includes all control and monitoring functions, which if not used for particular equipment are not visible to the operator. Example: the source pop up for equipment with motor shall include mode selection, start, stop, forward/reverse, Lo/Hi speed, direction and indication, speed control and speed indication, alarm acknowledge, reset, runtime, associated alarms, etc. If this pop up is used for equipment with full speed motor, the forward/reverse, Lo/Hi speed, direction and speed indication, speed control and speed indication shall not be visible and available for operator control.
2. The pop ups shall allow plant operator to perform control actions by clicking on the graphic objects and review equipment status.
3. The analog alarm pop ups window shall allow plant operator to monitor analog transmitters and associated alarm settings. The operator shall be able to edit alarm setpoints (HiHi, Hi, Lo, LoLo) in engineering units, enable/disable each alarm level, set debounce timer, set over/under range filter, deadband, and acknowledge or reset alarm.

J. The SCADA tag names shall be structured (build from segments of predefined lengths and providing grouping of information). In general the SCADA tag shall include plant ID, plant process area (or process ID), equipment or device process tag, associated equipment or device process tag, and signal type (description, status, alarm, etc.). The final convention shall be determined during construction.

K. The SCADA system shall have integral security system. The security system shall have minimum 4 security levels, accessible through the passwords in order to obtain access to the control functions.
   1. Security Clearance Levels: Work Stations (runtime nodes):
      a. Level 1 (lowest) shall allow guest/supervision only and access to the various process screens.
      b. Level 2 (normal operation): In addition to the lower level permission shall allow control and configuration of standard setpoints (access to the pop up screens).
      c. Level 3 (supervisor): In addition to the lower level permissions shall allow configuration of standard setpoints, alarms, and access to the operating system, shutdown and restart of the system.
      d. Level 4 (highest, developer): In addition to the lower level permissions shall allow full access to the SCADA software required for editing and configuration of the operating system.
   2. Security Levels: Server (editing):
      a. Level 3 (supervisor): Access to the operating system, backup operations, shutdown and restart of the server.
      b. Level 4 (developer): In addition to the lower level permissions shall allow full access to the server configuration and SCADA software required for editing and configuration of the system.
   3. Security System Features:
      a. Security shall always default to the Level 1 after period of inactivity (timeout) or after incorrect password is entered.
      b. The security system shall allow assignment of unique (individual) password to each user or level password to the group of users. Operators shall be able to change their passwords by themselves following typical procedure.
      c. The software shall not display passwords when typed.
      d. The software shall not allow modifications of the system configuration without sufficient security clearance.
      e. After power failure the SCADA system shall boot all software automatically and default to Level 1.

L. The SCADA system shall have process events management. The process events are presented to the facility operator, logged into the system to assist in plant operation and record keeping. The SCADA system shall have various levels and event recording capability. The example below presents three (3) level process events management system; the final convention shall be determined during construction.
   1. The process events may be divided into three (3) priority groups.
      a. Alarms are events of high priority, in response to major process upset or equipment failure. Alarms require urgent operator attention and caution. They involve public safety, major process upset, or potential environmental damage.
      b. Warnings are events that shall not shut down the system, but the plant operators shall be informed through the SCADA about abnormal circumstances or process disturbance which could lead to an alarm condition and equipment shutdown.
      c. Statuses are events informing operator about system normal operation, but recorded for record keeping purposes (example: key equipment or batch sequence start and stop).

2. Events Management Features:
    a. All events shall be date/time stamped (yyyy mm dd 2h:mm format).
    b. All alarms and warnings remain active until they are both acknowledged and cleared.
    c. The current events shall be presented on separate active alarms screen. As minimum the screen shall have filtering capabilities including process area, equipment, date and time.
    d. The archive events shall be presented on separate event history screen. As minimum the screen shall have filtering capabilities including process area, equipment, date and time range.
    e. Events configuration shall include printing of the alarm logs in predefined configuration.

M. The SCADA system shall have trends. The trends shall be configured to allow operator to recall and graph selected data on a chart (screen).
1. The data used trends shall be logged and stored on the server. The trends may include current and history trending screens.
2. The chart Y axis shall provide data scaling (including multiple selections) and graph description, and X axis shall indicate date/time, when data was collected. Graphs shall be presented in different colours selected in such a manner that they can be recognized when printed on black and white printer.
3. The trending shall allow for selection of:
    a. Data (up four (4) graphs per chart).
    b. Scaling.
    c. Date/time range.
4. The trending screen shall have predefined time functions:
    a. Scrolling buttons allowing jumps by 30 minutes, 1 hour, 4 hours from displayed time in addition to standard forward/reverse scrolling buttons.
    b. Displayed range allowing presentation on the chart of last hour, last 24 hours, and last 7 days in addition to standard operator entered free date/time range.

N. The SCADA system shall have reporting capability. Allow for preparation of up to five (5) various reports on weekly, monthly, yearly basis. The report details shall be determined during construction.

O. The SCADA system shall have process help screens. Provide:
1. Process Overview Screen: Help screen briefly explaining "how to get around" SCADA software, access various screens, control functions and monitoring.
2. Process Detailed Screens: One (1) help for each screen providing brief overview and function of the presented system (mini process narrative).
3. Equipment or Process Pop Up Windows: One (1) help screen for each pop up providing details of control and monitoring functions.
4. Process Supervision Screens: One (1) for current event management, one (1) for history event management, one (1) for trends, one (1) for reporting briefly explaining "how to get around" screen functions.

END OF SECTION

SECTION 13621

CONTROL SYSTEM DOCUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section establishes standards and provides guidelines for technical documentation that shall be supplied with the control systems provided, including but not limited to:
   1. Production of Shop Drawings.
   2. Provision of product data.
   3. Submittals.

1.2 REFERENCES

A. Section 01600 - Product Requirements

B. Ontario Electrical Safety Code (OESC) and Bulletins.

C. International Electrotechnical Commission: IEC 60050-617 Ed 1.0, International Electrotechnical Vocabulary - Part 617: Organization/Market of electricity.

D. National Electrical Manufacturers Association: NEMA ICS 1-2000 (R2008), Industrial Control and Systems: General Requirements.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data:
   1. Provide control systems product data as outlined under this Section.
   2. Submit product data in electronic format (PDF).

C. Shop Drawings:
   1. Provide control systems Shop Drawings as outlined under this Section.
   2. All electrical, control system, and instrumentation drawings shall be done in electronic file format and submitted to ENGINEER and OWNER in printed and electronic editable format.

D. Test Reports: Factory tests report.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of products.

F. Manufacturer's Field Reports: Commissioning report on field tests, including all test forms and confirming proper installation.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.

C. Record Drawings:
   1. A set of "as-recorded" set of drawings consisting of all drawings as specified under Article 1.4. Record actual installation details, integrate changes and modifications implemented in the field during site acceptance tests. Include all field modifications and changes.
   2. As-built drawings shall be submitted in printed and electronic: Adobe Acrobat PDF, and editable (AutoCAD DWG) format on CD.

D. Product Data:
   1. As-built product data including any field modifications as listed under Article 1.4.
   2. Identification: Manufacturing name, type, year, serial number, reference number, and identification of related systems.
   3. Include complete bill of materials with catalog numbers. Provide operating manuals, manufacturer's instructions or control descriptions for each device type. Advertising or sales literature not acceptable.
   4. Manufacturer's instructions for maintenance and operation, control description and trouble-shooting documents.
   5. Manufacturer's recommended list of spare parts. Recommended renewal parts list and service schedules.
   6. Operation and maintenance data shall be submitted in printed and electronic Adobe Acrobat PDF format on CD. Upon approval, large manuals may be provided only in electronic Adobe Acrobat PDF format.

E. Regulatory Certificates:
   1. Copies of ESA certificate of final inspection.
   2. Copies of special inspection certificates, when applicable.

1.5 REGULATORY REQUIREMENTS

A. Design of control systems shall conform to national or local regulatory requirements to suite system requirements, whether specifically shown on the Drawings or called in the Specifications.

1.6 QUALITY ASSURANCE

A. Include prerequisites, standards, limitations, and criteria which established an overall level of quality for products and workmanship under this Section.

B. Perform work of this Section in accordance with good engineering practice.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 APPLICATION

A. Provide documentation for control system, equipment, components with control system, auxiliary systems provided under the Works. Integrate and cross-reference all documentation including Vendor systems.

B. Shop Drawings for control system shall not be limited to presentation of signals using only electrical properties. Shop Drawings must include and fully represent all other signals using any other properties for purpose of control including, but not limited to, pneumatic systems, hydraulic, light, visual, or voice systems, etc.

C. Documentation shall provide particulars of the system, and be detailed enough such that it shall aid OWNER in trouble-shooting, maintaining and expanding any part of the system as required. In addition to the documentation specified elsewhere in the Project Specifications, the requirements for technical documentation as specified in this Section shall be met.

3.2 PRODUCTION OF SHOP DRAWINGS

A. Provide examples of CONTRACTOR's typical schematics and shall carry out a drawing pre-production review meeting (2 hours) with ENGINEER and OWNER prior to producing any control and/or system drawings and to discuss and confirm specific control drawing formats.

B. Control system documentation. Include:
1. Dimensions, construction configurations and materials.
2. Complete performance and operating characteristics.
3. Mounting details.
4. Power and control schematics.
5. PLC I/O wiring diagrams.
6. PLC I/O schematics – loop diagrams.
7. Wiring and interconnection drawings.
8. Complete bill of materials.
9. Complete I/O list.

C. Control system drawings shall be prepared specifically for this Project. Any data that is not relevant to the Project shall be cause for rejection. Prior to submission of drawings verify all field dimensions, verify components including system/devices/etc. provided by other parties, and related to this work, verify catalogue and model numbers for devices.

D. Identify all equipment with exact reference to (e.g., tag references) to applicable Section. Supplied documentation shall use tagging and identification systems.

E. Prepare electrical and control drawings in AutoCAD or similar program that can export files into AutoCAD (DWG or DXF) file format. Drawings may be created using commercial electrical/controls generating software, however, the finished drawings must be fully compatible and able to be edited by a basic AutoCAD setup (no special libraries or plug-in requirements, scripts, databases, etc.). Provide drawings in editable file format. Allow for and provide drawings in graphic format to the specific OWNER drawings standard, when required.

F. Control panel layout(s) shall provide panel assembly details including interior and panel face component placement, wireways, terminal blocks complete with dimensions. The set shall include complete and detailed bill of materials including manufacturer's name, full model and catalog number. Include layouts of all control/marshalling panels and junction boxes with terminal blocks.

G. Control schematics, panel and field wiring diagrams shall identify all control and instrumentation system components and devices. The drawings shall include all inter connection devices and inter-panel wiring connections, wiring diagrams, and communication schematics.

H. Drawings Guidelines:
   1. Control drawings shall utilize North American graphic symbols (EEMAC E14-3, NEMA ICS 1) and follow standard left to right logic. Control drawings utilizing International symbols (IEC 617) and top to bottom logic may be allowed only upon OWNER and ENGINEER approval.
   2. Drawings to be formatted and printed on 11 by 17-inch size paper. No other drawing sizes are permitted. Electronic copies shall also be sized to 11 by 17-inch document size.
   3. Each I/O card shall be allocated a separate drawing. Empty rack slots shall be incorporated into the drawing set and numbering system. Provide a blank drawing, listing the spare slot complete rack and slot number for identification.
   4. Control Relay Type Logic Drawings: Indicate hardware configuration, control, sequencing, status and alarm logic.
   5. Terminal numbers or pin numbers shall be shown on the drawings and clearly identified for each subassembly or component. Where the internal wiring diagrams of subassemblies are furnished on separate sheets, they shall be clearly identified and referenced.
   6. Line reference numbers in sequential order shall be used on all drawings. For example, line Reference 0234 refers to Drawing number 02, line 34.
   7. Wire numbers shall follow the line numbers in general. For example: 0234A, 0234B, would represent two wire numbers for line 0234, etc.
   8. Drawings shall include cable and conduit schedule, detailing wire runs, as well as location of cables.
   9. I/O wiring from PLC card to the control panel terminal block shall follow standard controller addressing. For example: Local:1:I.Data.0, Local:2:O.Data.0, etc. The wiring from control panel terminal blocks to the connected device shall follow process tag number.
   10. In addition to the typical information like name, tag, etc. listed on the drawings, instruments and any other field device drawings shall also display any and all related inside connections and terminal blocks complete with numbers and wiring between sensor and transmitter/transducer. Indicate position of DIP switches, device software configuration (if applicable), and configuration of similar devices, where applicable.
   11. Drawings shall include pertinent data like voltage, current, and power data.
   12. Terminal numbers or pin numbers shall be shown on the Drawings and clearly identified for each subassembly or component. In the case of internal wiring diagrams of subassemblies are furnished on separate drawings that shall be clearly identified and referenced.
   13. Where colour coded or multi-conductor cable/wires are used, the colour code shall be listed and used as supplement to the identification.
   14. A cross referencing system shall be used in conjunction with devices, so the associated contacts may be readily located on the diagrams.
   15. Process limit contacts shall be shown turned off (in off state) with their function and control settings indicated on the Drawings.

16. Communication hardware (such as Ethernet Cards, Switches/Hubs, Patch Panels, etc.) shown on the drawings shall have detailed descriptions such as address listings, hardware and communication settings.

I. Include communication/network layout drawings, detailing devices used for communication as well as physical device addresses (e.g., Node number, IP address, etc.) and configuration where applicable.

J. Provide hardcopy documentation and software data files of the completed configuration for each piece of network equipment once testing is complete. Documentation shall include all configuration addresses, TCP/IP addresses and names, passwords, switch settings and parameters.

K. Provide Uninterruptible Power Supply (UPS) sizing calculations where applicable.

3.3 PROVISION OF PRODUCT DATA

A. Include description and engineering data for each component showing electrical characteristics and connection requirements. Advertising or sales literature not acceptable.
   1. Indicate setup, operating and performance data, materials, mounting details, dimensions and other technical specification, which describes the product. Indicate application conditions and limitations of use.
   2. Include control system electrical characteristics including, voltage, current, power, short circuit ratings, sizes and arrangements.
   3. Include mechanical characteristics including enclosure type, outline and support point dimensions, mounting arrangements, clearance requirements, wiring provisions, terminal sizes, size and location of connections, finishes, etc.
   4. Include complete bill of materials with catalog numbers. List all options and accessories furnished.

B. Catalog information, descriptive literature, and Shop Drawings of the manufacturer's construction and installation details for each piece of the control and instrumentation system. Each product should also bear the tag name of the associated device, including, but not limited to, instrumentation, transmitters, transducers, converters, sensors, analytical elements and monitors, actuators, controllers, switches, wiring, tubing, and software (as applicable).

C. Information sheets for each instrument and control element in the system (where applicable) displaying the tag name, citing specific features including: Input and Output Range and Span, Scale, Configuration Materials used for construction Alarm and Control Schemes.

D. Provide operating manuals, manufacturer's instructions, all overall dimensions, clearance requirements, size and location of connections, instructions for setup and installation of all control and instrumentation products where required to evaluate all submittals, or as requested by ENGINEER.

END OF SECTION

SECTION 13623

CONTROL SYSTEM TESTING AND COMMISSIONING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Product tests.

B. Factory Acceptance Test – Control Panel.

C. PAC Site Acceptance Test – Control Panel.

D. Site Acceptance Test – PAC/SCADA Software.

E. Site Acceptance Test – Instrumentation.

F. Facility startup and commissioning.

1.2 RELATED SECTIONS

A. Section 13621 - Control System Documentation.

1.3 REFERENCES

A. Section 01600 - Product Requirements.

B. Canadian Standards Association: CSA C22.1, Canadian Electrical Code, Part I – Safety Standard for Electrical Installations.

1.4 DEFINITIONS

A. Factory Acceptance Test (FAT): Validation test of the product (system, equipment, control panel, software hardware, etc.) performed at manufacturer/Supplier/CONTRACTOR facilities, conducted after the conclusion of the engineering phase on assembled system to assure particulars, completeness, and functionality of system according to the Contract Documents before system delivery to the Site. This test is done according to ENGINEER and OWNER approved FAT testing procedure by CONTRACTOR in the presence of ENGINEER and OWNER.

B. Site Acceptance Test (SAT): Validation test of the product (system, equipment, control panel, software hardware, etc.) performed at the Site, conducted at the conclusion of the Project after complete product assembly and introduction to process media, to verify functionality and assure performance of the product according to the Contract Documents before system acceptance, and Project substantial completion. This test is done according to ENGINEER and OWNER approved SAT testing procedure by CONTRACTOR in the presence of ENGINEER and OWNER.

1.5 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Project Documentation:
   1. FAT sign off sheets and tests documentation.
   2. SAT sign off sheets and tests documentation.
   3. Product startup and testing.

C. Complete Facility Startup and Commissioning Plan. Include:
   1. List of facilities/systems to be started, objectives.
   2. Sequence and schedule of events and startup schedule.
   3. Responsibilities of each party.
   4. Operating conditions and parameters (initial and intended final).
   5. Sampling and monitoring requirements. Testing services and laboratory arrangements.
   6. Safety and environmental considerations. Contingency plans to respond to potential emergencies.

D. Test Reports: FAT reports. SAT reports.

E. Manufacturer's Field Reports: Product certification forms.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.

1.7 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Schedule work to accommodate FAT tests to allow for implementation of corrections and modifications prior to product shipping.

C. Sequence and organize SAT tests in logical order (example: instrumentation SAT prior to control panel SAT).

D. Contractor to inform ENGINEER in writing 2 weeks prior to performing tests.

1.8 SYSTEM STARTUP AND COMMISSIONING

A. Section 01810 –Operations Asset Transfer Commissioning: Requirements for commissioning.

B. Conduct meeting to identify and integrate activities of all parties in startup of works and review Startup plan.

C. Provide qualified "hands-on" technical personnel to perform services herein specified including troubleshooting of control systems. Assemble a commissioning team to operate the facility

during the commissioning period. Include representatives of Vendor's, electrical and instrumentation staff, mechanical contractor, equipment Suppliers, and other trades, as appropriate to support startup and commissioning.

D. Group products into logical systems and sub-systems for orderly progression of startup activities. Conduct dry run and wet run tests in stages based on commissioning plan. Correct any deficiencies uncovered during testing.

E. The period of time for continuous operation of the complete facility for acceptance of commissioning is specified within this document. Commissioning is to be generally conducted in manual mode first. After successful commissioning of equipment in manual mode, the automatic commissioning will begin. The total operation in manual mode during commissioning shall not exceed 25 percent of total commissioning time.

F. During the commissioning all products and systems to operate without fault, and all control systems to function in accordance with specified rates, methods and performance.

G. Failure of any part of the Works during commissioning will require restart of that portion or system of work, following corrections, adjustment in equipment operation, or rectification of the fault or failure.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Prior to commencement of commissioning, review mechanical and electrical works to ensure that the equipment is correctly installed, supported, connected and wired. Verify that any other related/affected products/systems are ready for operation. Verify that all appropriate checks have been made, including but not limited to, cleaning, inspection, leakage testing, lubrication, rotation, calibration, adjustments. Immediately advice ENGINEER in writing of any deficiencies or deviations from the installation instructions.

3.2 PREPARATION

A. Prepare products (systems, equipment, control panels, software, hardware, etc.) for operation.

3.3 PRODUCT TESTS

A. Conduct and assist in tests as specified in individual product sections, when related, affected, controlled, or monitored by control system.

B. The verification of the product shall be deemed complete, when all features, functions and information required for complete control system have been checked, corrected and documented.

3.4 FACTORY ACCEPTANCE TEST – CONTROL PANELS

A. Perform control panel FAT as specified in Section 13430 - Control Panels.

B. The verification of the system shall be deemed complete, when all features, functions and information required for complete control system have been checked, corrected and documented including all Drawings.

3.5 SITE ACCEPTANCE TESTS - INSTRUMENTATION

A. Energize all instrumentation, field devices and introduce to the process medium. Demonstrate instruments operation.

B. Perform operational tests using process media. Include operation of all instruments by actuation of their controlling variable and monitoring of received signals. If the process media are not physically available or not available at required level (exp. high pressure or temperature) provide testing means and media to simulate process conditions. Remove and reinstall sensors when required for testing. Alternative procedures may be implemented for instruments, which cannot be safely tested and energized. Provide all necessary accessories for testing.

C. Rectify deficiencies, conduct troubleshooting and otherwise take corrective action of the installed systems. Tests will be repeated if significant deficiencies are discovered.

D. The verification of the system shall be deemed complete, when all features, functions and information required for complete control system have been checked, corrected and documented including all Drawings.

3.6 SITE ACCEPTANCE TEST - CONTROL PANELS AND FIELD DEVICES

A. Conduct control panel SAT as specified in Section 13430 - Control Panels.

B. Energize all control systems, panels and devices. Perform continuity checks on all wiring. On completion of installation of all panels, and connection of all field device and interconnect wiring for each panel, CONTRACTOR shall proceed with system testing.

C. Any equipment, which cannot be safely energized by testing of discrete panel outputs, shall be temporarily disconnected, and potential or continuity checks of the output circuits made while energized.

D. Rectify deficiencies, conduct troubleshooting and otherwise take corrective action of the installed systems. Tests will be repeated if significant deficiencies are discovered.

E. The verification of the system shall be deemed complete, when all features, functions and information required for complete control system have been checked, corrected and documented including all Drawings.

3.7 SITE ACCEPTANCE TEST – PAC AND SCADA SOFTWARE

A. Assist with demonstration of PAC software operation (programming by CONTRACTOR):
   1. Control Logic: Basic process control, batch and equipment sequencing, equipment monitoring and control, control mode changes and bumpless transfer, process setpoints and system configuration, changes to process variables, safety interlocks and shutdown procedures.
   2. Events (alarms, warnings, statuses): Processing and handling (analog, discrete), annunciation, time stamping, acknowledgement, reporting.
   3. Malfunction: Power failure, communication failure, safety interlocks, redundancy (as applicable), failsafe modes.

B. Assist with demonstration of SCADA/EOI program operation (programming by CONTRACTOR):
   1. Overall Structure of SCADA.
   2. Interface and communication with the PAC/RTU program(s), tags.
   3. Graphic interface, color standards, screen layouts, object control actions.
   4. Events (alarms, warnings, statuses): Format, annunciation, acknowledgement, acknowledged/un-acknowledge, archiving and retrieval, summary.
   5. Security: Levels, passwords, log-on/log-off procedures.
   6. Trending: Format, access, archiving and retrieval, summary.
   7. Reporting and documentation.

3.8 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. ENGINEER, OWNER, and facility operators will provide support services during startup and commissioning, and will observe events, but they will not be an active participant or responsible for the operation during startup and commissioning.

C. ENGINEER will inspect the Works.

3.9 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements: Requirements for preparing and starting systems.

B. Include Vendor's representatives to assist/operate product/system during the commissioning period.

END OF SECTION

SECTION 13720

pH ANALYZER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall furnish and install, ready to operate, the following pH analyzer equipment complete with all necessary accessories to measure pH as indicated herein in compliance with the following specifications and as shown on the Contract Drawings.

1.2 RELATED SECTIONS

A. Section 01300 - Administrative Requirements.

B. Section 01600 - Product Requirements.

C. Section 01700 - Execution and Closeout Requirements

D. Section 13105 – General Instrumentation Requirements.

E. Section 13621 - Control System Documentation.

1.3 REFERENCES

A. Section 01400 - Product Requirements

B. American Society of Mechanical Engineers:
   1. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

C. Canadian Standards Association (CSA).

D. National Electrical Manufacturers Association (NEMA).

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit under provisions of Section 01330 - Submittal Procedures.
   2. Make, model, weight, of each instrument.
   3. Complete catalog information, descriptive literature, and specifications.
   4. Bill of materials for each instrument.
   5. Manufacturer’s calibration certificates.
   6. Detailed dimensional drawings for the instrument.

7. Power and control wiring diagrams, including terminals and numbers, and other requirements of Section 13621.
8. List of configurable parameters c/w factory default settings, settings as shipped, and a blank for each field-adjusted setting.
9. Mounting and installation details.
10. Detailed mechanical schematics and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
11. External utility requirements such as air, water, power, etc., for each component.

B. Information Submittals:
1. Submit under provisions of Section 01330 - Submittal Procedures.
2. Factory Functional and Performance Test Reports.
3. Calibration Reports.
4. Special shipping, storage, protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Manufacturer's Certificate of Proper Installation.
7. Spare parts list to maintain the equipment in service for a minimum period of 5 years.
8. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
9. Service records for maintenance performed during construction.
10. Operation and Maintenance Manual.
    a. Include complete catalog information and manufacturer's installation instructions including mounting and process connection details.
    b. Include detailed operations and maintenance instructions.
11. Complete original warranty forms filled out in the OWNERS's name and registered with the manufacturer.

C. Project Record Documents – Submit under provisions of Section 01330 - Submittal Procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. HACH pHD sc digital differential probe with sc200 series controller.

B. Rosemount Analytical.

C. Evoqua.

2.2 DESCRIPTION

A. On line pH analyzer shall continuously monitor pH in the range 0.0 to 14.0 pH in aqueous solutions with automatic temperature compensation.

2.3 TRANSMITTER/CONTROLLER

A. Multi parameter type (pH, ORP, temperature) with "plug and play" sensor recognition, two channels (any instrument combination), microprocessor based with backlit LCD display of measured and correcting values in SI units, minimum 12 mm high characters, additional indicators for alarms and status conditions, keypad, menu driven type software, control settings, range and span adjustment, status, and error annunciation; menu driven automatic calibration with sensor diagnostics; user programmable control/alarm relays; non volatile memory.

B. Environmental Requirements:
   1. Operating Temperature: Minus 20 to 60 degrees C.
   2. Relative Humidity: 95 percent, non condensing.
   3. Type NEMA 4X (unless indicated otherwise in the summary table) corrosive resistant enclosure, horizontal or vertical surface mounted.

C. Control Interface:
   1. Analog Output Signals: Two 4 - 20 mA, linear and proportional to range analog current signals, isolated with superimposed HART protocol signal into load between 0 and 750 Ʊ (minimum) HART. First output signal shall be configured for pH measurement and second for temperature measurement.
   2. Discrete Output Signals: Three, programmable, dry contacts (SPDT type), rated 5A at 120 VAC and 2 A at 24 VDC. Independently programmable functions: high and low alarm in response to the measured parameter (adjustable setpoint and deadband), event/timer to control an external device on a timed basis (adjustable interval and duration), warning to indicate sensor problem.
   3. HART digital communication protocol. Data read/write with instrument configuration capabilities. As minimum data shall include both channels (process parameters, or process parameter and compensation parameter) and instrument fault/status signals.

D. Connections:
   1. Power Requirements: Less than 0.5 A at 120 VAC, 60 Hz.
   2. Receptacles for plug in sensor cables connection.

2.4 SENSOR

A. Differential electrode design, two glass process electrodes and titanium reference ground electrodes to provide continuous differential measurement of the pH; built in integrated preamp and NTC thermistor for automatic temperature compensation and analyzer temperature readout; replaceable salt bridge protecting the reference electrode from process condition; reagent and buffer-free sample stream.

B. Encapsulated construction, convertible sensor body to facilitate different mounting arrangements (flow-through, sanitary, immersion, submersible, etc.). Arrangement shall match specified installation method and mounting hardware.
   1. Materials:
      a. Chemical resistance PEEK body and sensor "head" materials (glass) compatible with process media.
      b. Alternative chemically resistance body materials include PVDF or Type 316 SST.

C. Process Measurement Performance Requirements:
   1. Measuring Range:
      a. pH: 0 – 14 pH units.
      b. Temperature: -10 – 100 degrees Celsius.
   2. Accuracy:
      a. pH: Plus or minus 0.02 pH units.
      b. Temperature: Plus or minus 0.5 degrees Celsius.
   3. Sensitivity: Plus or minus 0.01 pH units.
   4. Stability: 0.03 pH per 24 hours, non cumulative.
   5. Response Time: 90 percent of measurement value within 1 minute.
   6. Samples stream characteristics:
      a. Operating Temperature: 0 to 50 degrees C.
      b. Maximum pressure: Atmospheric.
      c. Flow Rate: <1 m/s, maximum.

D. Environmental Requirements:
   1. Ambient Air Temperature: Minus 20 to plus 50 degrees C.
   2. Ambient Relative Humidity: 95 percent, non condensing.

2.5 MOUNTING OPTIONS/HARDWARE

A. Sensor shall be mounted within the “sample pot” of the new MISA sampling system. Refer to Section 11441.

B. FRE – Submersion Type, Free Hanging Mounting:
   1. Include sensor mounting adaptor and stainless-steel U-shape fitting (shackle style), complete with stainless-steel nuts, washers, and chain (minimum 6 m).

2.6 ACCESSORIES

A. Stainless steel process ID tag.

B. Cable:
   1. Integral five-conductor cable with shields and XLPE jacket.
   2. Maximum transmission distance: 100 m.

2.7 INSTRUMENT LIST

Process Tag	***Service***	***Measurement and Range***	***Options***	***Notes***
BS-67099-AIT	pH Sampling System	0 - 14 pH units	NEMA 4X Enclosure	pH setpoint: xx-Immersion type mounting in MISA sample pot

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Install manufacturer supplied sensor mounting hardware and assemblies in accordance with manufacturer's requirements.

B. All electrical work performed in fabrication and installation of the pH analyzers shall be in full accordance with the requirements of the Division 16 specifications.

3.2 TESTING

A. Test all the pH analyzers to demonstrate that:
   1. The analyzers have been properly installed, properly calibrated, and are functioning as specified.
   2. Flow rate to the pH analyzer is within the manufacturer's suggested flow range.
   3. The analyzer indicates the correct pH for two known calibration standards.
   4. Setpoints and alarms are functioning correctly.

3.3 MANUFACTURER SERVICES

A. The following services shall be performed by manufacturer's factory-trained service personnel:
   1. CONTRACTOR shall include 1.0 person days of the manufacturer's services to perform start-up/commissioning on instrument to include basic operational training and certification of performance of the instrument.

3.4 FIELD QUALITY CONTROL

A. Configure, calibrate, and test pH analyzer.

B. Coordinate testing with SCADA integrator and verify data.

END OF SECTION

SECTION 13730

CONDUCTIVITY ANALYZER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. The Contractor shall furnish and install, ready to operate, the following conductivity analyzer equipment complete with all necessary accessories to measure conductivity as indicated herein in compliance with the following specifications and as shown on the Contract Drawings.

1.2 RELATED SECTIONS

A. Section 01300 - Administrative Requirements.

B. Section 01600 - Product Requirements.

C. Section 01700 - Execution and Closeout Requirements

D. Section 13105 – General Instrumentation Requirements.

E. Section 13621 - Control System Documentation.

1.3 REFERENCES

A. Section 01600: Product Requirements

B. American Society of Mechanical Engineers:
   1. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

C. Canadian Standards Association (CSA).

D. National Electrical Manufacturers Association (NEMA).

1.4 SUBMITTALS

A. Shop Drawings:
   1. Submit under provisions of Section 01330 - Submittal Procedures.
   2. Make, model, weight, of each instrument.
   3. Complete catalog information, descriptive literature, and specifications.
   4. Bill of materials for each instrument.
   5. Manufacturer’s calibration certificates.
   6. Detailed dimensional drawings for the instrument.

7. Power and control wiring diagrams, including terminals and numbers, and other requirements of Section 13621.
8. List of configurable parameters c/w factory default settings, settings as shipped, and a blank for each field-adjusted setting.
9. Mounting and installation details.
10. Detailed mechanical schematics and electrical drawings showing the equipment fabrications and interface with other items. Include dimensions, size, and locations of connections to other work, and weights of associated equipment.
11. External utility requirements such as air, water, power, etc., for each component.

B. Information Submittals:
1. Submit under provisions of Section 01330 - Submittal Procedures.
2. Factory Functional and Performance Test Reports.
3. Calibration Reports.
4. Special shipping, storage, protection, and handling instructions.
5. Manufacturer's printed installation instructions.
6. Manufacturer's Certificate of Proper Installation.
7. Spare parts list to maintain the equipment in service for a minimum period of 5 years.
8. List of special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
9. Service records for maintenance performed during construction.
10. Operation and Maintenance Manual.
    a. Include complete catalog information and manufacturer's installation instructions including mounting and process connection details.
    b. Include detailed operations and maintenance instructions.
11. Complete original warranty forms filled out in the OWNERS's name and registered with the manufacturer.

C. Project Record Documents – Submit under provisions of Section 01330 - Submittal Procedures.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. HACH, sc series digital conductivity sensor with sc200 series controller.

B. Rosemount Analytical.

C. Substitutions: According to Section 01600.

2.2 DESCRIPTION

A. Instrument that continuously measures conductivity and/or resistivity of aqueous solutions in 0 to 2,000,000 μS/cm with automatic temperature compensation within minus 10 to 200 degrees C temperature range.

2.3 TRANSMITTER/CONTROLLER

A. Multi-parameter type (pH, ORP, conductivity, suspended solids, turbidity, DO) with "plug and play" sensor recognition, two channels (any instrument combination), microprocessor based with backlit LCD display of measured and correcting values in engineering metric units, minimum 12 mm high characters, additional indicators for alarms and status conditions, keypad, field programmable, HART protocol and menu driven type software, control settings, range and span adjustment, status, and error annunciation; menu driven automatic calibration with sensor diagnostics; user programmable control/alarm relays; non-volatile memory.

B. Environmental Requirements:
   1. Operating Temperature: 0 to 50 degrees C.
   2. Relative Humidity: 95 percent, non condensing
   3. Type 4X (unless indicated otherwise in the summary table) corrosive resistant enclosure, horizontal or vertical surface mounted.

C. Control Interface:
   1. Analog Output Signals:
      a. AO1: conductivity, 4-20 mA, linear and proportional to range analog current signal, isolated with superimposed HART protocol signal, into load between 250 and 1,000 Ω (HART).
   2. Discrete Output Signals (SPDT type, dry contacts, rated 5 A at 120 VAC and 2 A at 24 VDC; independently programmable functions - high/low alarm in response to the measured parameter, event/timer to control a external device on a timed basis, malfunction):
      a. DO1: Instrument malfunction.
      b. DO2: External device control.
      c. DO3: Spare.
   3. Digital Communication: HART Revision 5.0 or newer, data to include (as minimum):
      a. Conductivity (PV).
      b. Temperature (SV).
      c. Instrument malfunction alarm.
      d. Calibration request.

D. Power Requirements: Less than 1 A at 120 VAC plus or minus 10 percent, 60 Hz.

E. Connections:
   1. Minimum three pre-stamped openings at the bottom for cable/raceway entries suitable for NPT sized fittings.
   2. Power Cord: 15 A, 120 VAC, 1.5 m length with encapsulated 5-15R plug.
   3. Receptacles for plug-in sensor cables connection.

2.4 SENSOR

A. Electrode-less/inductive conductivity type; inductive conductivity sensor induce a low current in a closed loop of solution, and then measure the magnitude of this current to determine the solution's conductivity.

B. Encapsulated construction, shape body to facilitate different mounting arrangements (e.g., sanitary, NPT threaded, convertible). Arrangement shall match specified installation method and mounting hardware.

1. Materials: Chemical resistance body (polypropylene, PVDF, PEEK, or PFA Teflon) compatible with process media.
2. Cable: Integral, factory sealed to probe, flexible, submersible, multi-conductor cable assembly with shield and polyurethane jacket; rated to 90 degrees C; minimum 3 m length with plug-in signal connector.

C. Process Measurement Performance Requirements:
1. Measuring Range: 0 to 200 μS/cm, up to 0 to 2,000,000 μS/cm.
2. Operating Temperature: 0 to 50 degrees C.
3. Sensor Pressure/Temperature Limits: 6.9 bar at 70 degrees C (100 psi at 158 degrees F).
4. Flow Rate: <1 m/s, maximum.

D. Environmental Requirements:
1. Ambient Air Temperature: Minus 5 degrees C to 50 degrees C
2. Process Fluid Operating Temperature: 0 to 50 degrees C.
3. Ambient Relative Humidity: 95 percent, non-condensing.
4. Transmission Distance: Up to 100 m from the transmitter/controller; up to 300 m with additional termination device/signal amplifier.

2.5 MOUNTING OPTIONS/HARDWARE

A. Sensor shall be mounted within the “sample pot” of the new MISA sampling system. Refer to Section 11441.

B. FRE – Submersion Type, Free Hanging Mounting:
1. 1. Include sensor mounting adaptor and stainless steel U shape fitting (shackle style), complete with stainless steel nuts, washers, and chain (minimum 6 m)..

2.6 ACCESSORIES

A. Stainless-steel process ID tag.

B. Corrosion resistant box in respective material to house termination device/signal amplifier with terminal strip for long run, complete with required cable assembly if specified.

C. Printed manual.

2.7 INSTRUMENT LIST

Process Tag	**Service**	**Range**	**Options**	**Notes**
BS-67099-CIT	Sampling System	0 to 100,000μS/cm	immersion mounting, AE - polypropylene body	CIT: Type 4X CE: Type 4X Immersion type mounting on tank

General Notes:

CIT – Conductivity transmitter/controller, CE – sensor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution Requirements: Verification of existing conditions before starting work.

B. Review, verify, and confirm compatibility and performance of the proposed instrument for treatment process and conditions.

C. Ranges sized according to actual process conditions; instrument final spans and setpoints confirmed during construction.

3.2 INSTALLATION

A. Install manufacturer supplied sensor mounting hardware and assemblies as required.

B. Connect wiring.

3.3 FIELD QUALITY CONTROL

A. Section 01600 -Product Requirements

B. Configure, calibrate, and test instruments.

C. Coordinate testing with SCADA integrator and verify HART data network communication.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01600 - Quality Requirements: Requirements for manufacturer's field services.

B. Furnish services of manufacturer's representative to inspect installation and submit written report prior to startup, verifying that installation and operation of instruments is according to specifications and manufacturer's instructions.

C. CONTRACTOR shall include 1.0 person days of the manufacturer's services to perform start-up /commissioning on instrument to include basic operational training and certification of performance of the instrument.

END OF SECTION

SECTION 15010

MECHANICAL GENERAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Mechanical general requirements.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. ASTM International: ASTM 307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

C. Canadian Standards Association: CSA Z423 – Safeguarding of Machinery.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Shop Drawings and Product Data:
   1. Shop Drawings requiring other components, or Shop Drawings not submitted in full (i.e., piping spool drawings without finalized equipment, valve without actuator, etc.) will not be reviewed and be returned for re-submission with all data as required. Delay due to incomplete Shop Drawings will be sole responsibility of CONTRACTOR.
   2. CONTRACTOR shall review all Shop Drawings prior to submittal and list all items in non-conformance with the Contract Documents prior to submission to ENGINEER.
   3. Shop Drawings and product data shall show:
      a. Mounting arrangements.
      b. Operating and maintenance clearances (e.g., access door swing spaces).
   4. Shop Drawings and product data shall be accompanied by:
      a. Detailed drawings of bases, supports, and anchor bolts.
      b. Acoustical sound power data, where applicable.
      c. Points of operation on performance curves.
      d. Manufacturer to certify as to current model production.
      e. Certification of compliance to applicable codes.
   5. Spare Parts List: Include component parts availability, names and addresses of spare part Suppliers, and list of specialized tools necessary for maintenance.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation Data:
   1. Control schematics for each system including environmental controls.
   2. Description of each system and its controls.
   3. Description of operation of each system at various loads together with reset schedules and seasonal variances.
   4. Operation instruction for each system and each component.
   5. Description of actions to be taken in event of equipment failure.

C. Maintenance Data:
   1. Servicing, maintenance, operation and troubleshooting instructions for each item of equipment.
   2. Recommended spare parts list.
   3. Data shall include schedules of tasks, frequency, tools required and task time.

D. Performance Data:
   1. Equipment manufacturer's performance data sheets with point of operation as left after commissioning is complete.
   2. Equipment performance verification test results.
   3. Special performance data as specified elsewhere.
   4. Testing, adjusting, and balancing reports.

E. Additional Data: Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

1.5 REGULATORY REQUIREMENTS

A. The Works shall accord strictly with all rules, regulations, by-laws, and the requirements and interpretations of all authorities having jurisdiction including, but not limited to the following:
   1. Ontario Occupational Health and Safety Act.
   2. The Ontario Building Code.
   3. Hydraulic Institute.
   4. American Water Works Association.
   5. The Ontario Water Resources Act, R.S.O. 1990, Chapter O.40.
   6. American Society of Plumbing Engineers (ASPE) Data Book.
   7. American Society of Heating and Air-Conditioning Engineers (ASHRAE) Guide and Data Books.
   8. Sheet Metal and Air Conditioning Contractors' National Association (SMACNA) "Low Velocity Duct Construction Standards" and "High Velocity Duct Construction Standards". Drawings and specifications should not conflict with the above regulations but where there are apparent discrepancies; CONTRACTOR shall notify ENGINEER in writing and obtain clarification before proceeding with the Works.
   9. National Plumbing Code of Canada.
   10. The CSA Group.
      a. All moving equipment shall comply with CSA Z432-04 – Safeguarding of Machinery.
   11. The Electrical Safety Authority (ESA).

B. Do not reduce the standard established by the Drawings and specifications by applying any of the codes and standards referred to herein.

C. Upon the request of ENGINEER, require Suppliers to provide proof of compliance with all applicable codes and standards.

D. Permits, Fees, and Inspections: Execute all work in accordance with all applicable rules, by-laws and regulations. Give all necessary notices, obtain all necessary permits, pay all required fees and furnish any certificates necessary as evidence that the Works conforms with the rules and regulations of all authorities having jurisdiction. Carry out all changes and alterations required by an authorized inspector of any authority having jurisdiction. Advise ENGINEER of any such changes.

E. Submit required documentation and Shop Drawings to authorities having jurisdiction in order to obtain approval for the Works. Copies of Contract Documents may be used for this purpose. Prepare additional information and details authorities require.

F. Where materials require special inspection and approval of CSA or local authorities, obtain such approval for particular installation.

G. All equipment shall be rated for the area classification where it is being installed.

1.6 PERMITS, FEES, AND INSPECTIONS

A. Execute all work in accordance with all applicable rules, by-laws and regulations. Give all necessary notices, obtain all necessary permits, pay all required fees and furnish any certificates necessary as evidence that the Works conforms with the rules and regulations of all authorities having jurisdiction. Carry out all changes and alterations required by an authorized inspector of any authority having jurisdiction. Advise ENGINEER of any such changes.

1.7 SYSTEM STARTUP AND COMMISSIONING

A. Section 01810 –Operations Asset Transfer Commissioning: Requirements for commissioning.

B. CONTRACTOR is responsible to provide commissioning assistance to the manufacturer's representative during commissioning of equipment in accordance with the manufacturer's startup instructions and the instructions of PART 3 of the applicable specification.

C. CONTRACTOR is responsible for complete commissioning of all equipment and piping supplied by CONTRACTOR.

1.8 MAINTENANCE MATERIALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for maintenance materials.

B. Provide one set of special tools required to service equipment as recommended by manufacturers.

PART 2 - PRODUCTS

2.1 EQUIPMENT SUPPORTS

A. Equipment Supports Not Supplied by Equipment Manufacturer:
   1. Supply and install piping and equipment supports fabricated from structural grade steel.
   2. Perform work in accordance with general requirements and Section 05 50 0.
   3. Prime and finish structural supports.
   4. Color: Black.

B. Provide all anchor bolts for equipment supplied equipment, as required by equipment vendors where not part of equipment vendor scope.

C. Provide all accessories and appurtenances as required to ensure complete and operational systems.

2.2 OPERATION AND MAINTENANCE MANUAL

A. Provide operation and maintenance data for equipment supplied by CONTRACTOR.

B. Operation and maintenance manual to be approved by ENGINEER, and final copies deposited with ENGINEER prior to final inspection.

C. Operation Data to include:
   1. Control schematics for each system including environmental controls.
   2. Description of each system and its controls.
   3. Description of operation of each system at various loads together with reset schedules and seasonal variances.
   4. Operation instructions for each system and each component.
   5. Description of actions to be taken in event of equipment failure.
   6. Valves schedule and flow diagram.
   7. Colour coding chart.

D. Maintenance Data shall include:
   1. Servicing, maintenance, operation, and trouble-shooting instructions for each item of equipment.
   2. Data to include schedule of tasks, frequency, tools required, and task time.

E. Performance Data to include:
   1. Equipment manufacturers' performance data sheets with point of operation as left after commissioning is complete.
   2. Equipment performance verification test results.
   3. Special performance data as specified elsewhere.

F. Approvals:
   1. Submit draft Operation and Maintenance Manual to ENGINEER for approval. Submission of individual data shall not be accepted unless so directed by ENGINEER.
   2. Make changes as required and re-submit as directed by ENGINEER.

G. Additional Data: Prepare and insert into operation and maintenance manual when need for same becomes apparent during demonstrations and instructions specified above.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all labour, materials, equipment, and services to complete the Works specified and shown on the Drawings.

B. Provide unions/flanges at equipment for ease of maintenance and disassembly, and removal of equipment and components. Provide as recommended by manufacturer and as indicated.

C. Space unions of flanges for servicing, disassembly, and removal of equipment and components. Provide as recommended by manufacturer and as indicated.

D. Verify that equipment is true and level. Provide shims/other methods as necessary for leveling.

E. Anchors: Provide anchors to floor or support structure as recommended by manufacturer or as otherwise indicated in specifications. For items mounted to the floor, use 316 stainless steel epoxy anchor bolts. For items mounted to steel structures, drill holes and fasten using ASTM A307 bolts as a minimum.

3.2 PROTECTION OF OPENINGS

A. Protect equipment and systems openings from dirt, dust, and other foreign materials entry as appropriate to the system.

3.3 PAINTING

A. Prime and touch up marred finished paintwork to match original.

B. Restore to new condition, finishes that have been damaged too extensively to be merely primed and touched up.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Fully coordinate all testing and commissioning activities in accordance with the requirements of the Contract Documents.

C. Unless otherwise noted in specifications for individual Sections, minimum time required for testing is 48 hours notice unless noted otherwise in other Sections.

D. Insulate or conceal work only after testing and approval.

E. Bear the costs of testing, re-testing, and making work good unless otherwise indicated.

3.5 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Clean interior and exterior of all systems including strainers and filters. Vacuum interior of ductwork and air handling units before turning system over to OWNER.

3.6 DEMONSTRATION

A. Section 01 81 0- Operations Asset Transfer Commissioning: Requirements for demonstrating installed work.

B. Provide specialized instructions by respective manufacturers to fully illustrate any particular system or component.

C. Instruct designated OWNER's personnel to ensure full comprehension of the system or component. Allow for a minimum of 3 days, 8 hours each, for each mechanical system or component. Training days to be scheduled over a 3-week period on the same day of the week (i.e., every Wednesday for 3 weeks).

3.7 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution and Closeout Requirements: Requirements for protecting installed work.

B. Protect equipment and systems openings from dirt, dust, and other foreign materials with materials appropriate to the system.

3.8 MANUFACTURER’S FIELD SERVICES

A. Provide manufacturer’s representatives to initially start up each part of the Works, as specified to check, adjust, calibrate, and balance, as applicable, components including controls, ducting, piping, and field wiring. Provide these services for such period and for as many visits as necessary to achieve complete working order in subject work.

END OF SECTION

SECTION 15060-00

COMMON WORK RESULTS FOR PROCESS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General engineering requirements.

B. General product requirements.

C. General fabrication and testing requirements.

D. General installation and commissioning requirements.

1.2 RELATED SECTIONS

A. Section 15060-01 Stainless Steel Process Piping

B. Section 15060-02 HDPE Process Piping Under 1034 kPa

1.3 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. American Society of Mechanical Engineers:
1. ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
2. ASME B18.2.1 - Square and Hex Bolts and Screws - Inch Series.

C. ASTM International:
1. ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
2. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM B32 - Standard Specifications for Solder Metal.
4. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
5. ASTM B828 - Standard Practice for Making Capillary Joints by Soldering of Copper and Copper Alloy Tube and Fittings.
6. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
7. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
8. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings.
9. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

10. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings.
11. ASTM D2661 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Schedule 40 Plastic Drain, Waste, and Vent Pipe and Fittings.
12. ASTM D2672 - Standard Specification for Joints for IPS PVC Pipe Using Solvent Cement.
13. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
14. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
15. ASTM D3138 - Standard Specification for Solvent Cements for Transition Joints Between Acrylonitrile-Butadiene-Styrene (ABS) and Poly (Vinyl Chloride) (PVC) Non-Pressure Piping Components.
16. ASTM D3139 - Standard Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.
17. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
18. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
19. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
20. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

D. American Water Works Association: AWWA C110 - Standard for Ductile-Iron and Gray Iron Fittings 76 mm Through 1219 mm.

E. American Welding Society, Inc.:
   1. AWS A5.8 - Filler Metals for Brazing and Braze Welding.
   2. AWS D1.1/D1.1M - Structural Welding Code - Steel.
   3. AWS Brazing Handbook.

F. The Copper Development Association, Inc.: CDA - Copper Tube Handbook.

G. Underwriters Laboratories (UL).

1.4 DEFINITIONS

A. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PE: Polyethylene plastic.
   4. PVC: Polyvinyl chloride plastic.

B. The following are industry abbreviations for metal materials:
   1. CLDI: Cement-lined ductile iron.
   2. CS: Carbon steel.

C. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-dieneterpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

E. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

F. Exposed Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

G. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

H. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.5 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Submit detailed catalog information on selection, identification, shop and/or Site fabrication procedure, installation, and adjusting, for the following products, including components:
   1. Pipes.
   2. Flanges.
   3. Fittings.
   4. Expansion joints, flexible hoses, and hose adapters.
   5. Mechanical sleeve seals.
   6. Supports, hangers, guides, and anchors.

C. Shop Drawings:
   1. Include descriptive information as required to fully describe the materials and procedures to be used in fabrication of the piping system. Submit all data as specified below. Partial submittals/submittals without all information as listed below in a single submittal will not be accepted by ENGINEER and will be returned Revise and Resubmit.
   2. Clearly specify pipe material and joint type selected for each pipeline, where alternatives are specified.
   3. Include Shop Drawings for fabricated components of pipe, fittings, anchors, and guides.
   4. Include a complete laying plan and section, detailing dimensions, location of each pipe section and each special length, special fittings, bends, coatings, and other pertinent information.
   5. Include double-lined to-scale drawings of each pipe support system to the scale shown on the Drawings.
   6. Locate each support and hanger, identify with type of catalog number or Shop Drawing detail number. Show anchor locations and identify them by Shop Drawing detail number.
   7. Include detailed installation drawings, catalog information, and complete component selection list for tie rods and thrust restraints systems.
   8. No change in material or joint selection will be permitted after submittal of Shop Drawings and their final review by ENGINEER.
   9. Weld procedure Specifications and Qualifications prior to start of work as required by Section 15 05 0.

D. Certificates and Reports:
   1. Certify that products meet or exceed specified requirements.
   2. Indicate results of field hydrostatic testing.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Indicate location, size, and service of piping systems.

C. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

A. Fabrication of flanged, threaded, and grooved piping shall be in accordance with ASME and AWWA standards.

1.8 QUALIFICATIONS

A. Fabricator: Company specializing in the works of this Section, and supplementary individual piping specification sections, with minimum 3 years documented experience.

B. Installer: Company specializing in performing the work of this Section, and supplementary individual piping Sections, with minimum 3 years documented experience.

C. Independent Testing Firm: Company specializing in inspection of AWWA piping material, fabrication final pressure testing, with minimum 5 years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Handle piping items strictly in accordance with manufacturer instructions, during all stages of delivery and storage.

C. Ensure no damage is done to exterior, interior, shape of pipe during activities prior to fabrication and installation.

D. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

E. Protect the products from dirt, damage, deformation, non-compatible materials, heat, cold, sunlight exposure, rain, and moisture.

F. Receive the products in factory finish condition. Inspect for damage or deterioration of product quality. Replace damaged or deteriorated quality product as required and directed by ENGINEER.

1.10 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Coordinate with work of other trades for piping fabrication, supporting, installation, insulation, connection to equipment and packages, and testing.

C. Coordinate installation of required in-line instrumentation and control/manual valves.

D. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.

E. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete and other structural components as they are constructed.

F. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

1.11 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution and Closeout Requirements: Requirements for warranties.

B. Manufacturer’s Warranty shall be as described in document BP-1-11 Rev 3– Schedule 5 – Commercial Terms and Conditions for Building Construction Services.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design the system to ASME and AWWA standards.

B. Piping Sizes and Materials: As shown on the Drawings and as per the table herein.

2.2 JOINING MATERIALS

A. Refer to individual Pipe Data Sheets and piping table herein for specific details on individual system joining methods and materials.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents:
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 3.2 mm maximum thickness unless thickness or specific material is indicated in piping data sheet.
   2. Full-face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
   3. Narrow-face Type: For raised-face, Class 250, cast-iron and steel flanges.
   4. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated in individual piping specifications.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

E. Solvent Cements for Joining Plastic Piping:
   1. ABS Piping: ASTM D2235.
   2. CPVC Piping: ASTM F493.
   3. PVC Piping: ASTM D2564. Include primer according to ASTM F656.
   4. PVC to ABS Piping Transition: ASTM D3138.

F. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

G. Stainless steel tubing: joints will be made with ferrule and nut type fittings.

2.3 PIPE, FITTINGS, JOINTS, AND EXPANSION PROVISIONS FOR EXPOSED PIPING

A. Refer to the Drawings for end-to-end piping connectivity details.

B. Refer to the Drawings for location and overall arrangement of piping systems.

C. Provide pipe anchors, expansion joints, and flexible couplings where shown on the Drawings. CONTRACTOR may install additional pipe anchors and flexible couplings to facilitate piping installation, provided that completed details describing location, pipe supports, and hydraulic thrust protection are submitted to ENGINEER for review.

D. Provide thrust ties for flexible couplings, transition couplings, and flanged coupling adapters on pressure piping as specified, including those shown on the Drawings. Thrust protection shall be adequate to sustain the force developed by 1 1/2 times the operating pressures and the test pressure specified.

E. Attach thrust ties to steel pipe with fabricated lugs, and to ductile iron pipe with cast-in-place lugs or flange lugs or socket clamps thrust tied across pipe couplings or flanges.

F. Pipe or tube connections of dissimilar metals/materials shall be made as shown on Drawings. CONTRACTOR may use the following methods for joining pipes of different materials unless specifically stated on the Drawings. All pipe connections shall be rated to 1038 kPa at 49 degrees C: Coupling of Buried Pipes with Dissimilar Materials
   1. Coupling shall be a Romac RC501 Ductile Iron Coupling or approved equivalent. Coupling shall be rated to 17.5 MPa.
   2. Joint shall be restrained using a JCM 631ESS coupling restrainer for asbestos cement pipe.
   3. All buried piping joints shall be restrained with products specifically designed and approved for the purpose of restraining the piping materials. Submit all methods and materials of joining underground piping to consultant prior to use.

G. Quick disconnect fittings shall be stainless steel camlock couplers with rated pressure of 1723 kPa:
   1. Female coupler with hose shank shall be used with movable pipes.
   2. Male coupler shall be used on fixed pipes.
   3. Quick disconnect fittings shall be Dixon "Andrews" couplers or equal.
   4. Provide caps and plugs for all quick disconnect fittings.

2.4 SLAB, FLOOR, WALL, CEILING, AND ROOF PENETRATIONS AND CLOSURES

A. Piping penetrations of slabs, floors, walls, ceilings, and roofs shall be ductile iron wall pipes or stainless steel wall pipes with thrust collars and sleeved penetrations unless otherwise noted on the Drawings.

B. Verify the size and location of all building and structure penetrations prior to pouring concrete.

C. Ductile Iron Wall Pipes:
   1. Provide ductile iron wall pipes where ductile iron piping passes through concrete walls, floors, slabs, ceilings, and roofs that are to be watertight and where shown on the Drawings.
   2. Wall pipes shall be as manufactured by American Cast Iron Pipe Company, CLOW, or approved equal.
   3. Wall pipe shall be of a thickness equal to or greater than the remainder of the piping in the line and shall comply with the requirements for fittings as detailed on the Pipe Data Sheets. Flanges set flush to the face of concrete shall be tapped for stud bolts.
   4. Provide thrust collars for wall pipes. Thrust collars shall be of ductile iron or cast iron and cast integral with the wall pipe wherever possible.
   5. Wall pipes that cannot be cast with integral thrust collars shall be fabricated by welding ductile iron thrust collar continuously around the pipe on both sides of the collar. All welds shall be done in the manufacturer's shop by qualified welders and shall be electric arc welds of ductile iron with NI-55 or FC-55, nickel-iron-carbon weld rod. The thrust collar shall be ductile iron.
   6. Thrust collars shall be rated for the thrust load developed at 250 psi and shall have a minimum safety factor of 2. Submit the pressure rating and safety factor specified.
   7. Support wall pipes by formwork to prevent contact with reinforcing steel.

2.5 PIPE SLEEVES:

A. The following types of sleeves are specified in general. Use the appropriate type as indicated on the Drawings:
   1. Galvanized Steel Sheet: 0.025-inch minimum thickness; round tube closed with welded longitudinal joint.
   2. Steel Pipe: ASTM A53/A53M, Type E, Grade B, Schedule 40, galvanized, plain ends.
   3. Cast Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
   4. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   5. Underdeck Clamp: Clamping ring with set screws.
   6. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
   7. PVC Pipe: ASTM D1785, Schedule 40.
   8. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

B. Core drilled holes drilled with a suitable rotary drill will be considered in lieu of sleeves in existing walls. Permanent sleeves are not required for holes formed by removable PE sleeves.

C. Provide a water stop center flange for all sleeves in exterior or waterbearing wall. Make the annular space between pipes and sleeves in exterior wall watertight.

D. Seal the annular space between pipes and sleeves in exterior wall by calking with rubber sealant, or by a modular annular mechanical sealing unit. The installed closure shall provide electrical isolation of the pipe from the wall sleeve.

E. When placing non-insulating type wall sleeves in concrete forms, support them by formwork to prevent contact with the reinforcing steel.

2.6 DIELECTRIC FITTINGS

A. Provide dielectric unions at interconnections between fittings of dissimilar metals.

B. Description: Combination fitting of copper alloy and ferrous materials with threaded/solder joints, plain or weld neck end connection to match piping system materials.

C. Insulating Material: Suitable for system fluid, pressure and temperature.

D. Dielectric Unions: Factory-fabricated union assembly for 1,725 kPa minimum working pressure at 82 degrees C.

E. Dielectric Flanges: Factory-fabricated companion-flange assembly for 1,305 or 2,070 kPa minimum working pressure as required to suit system pressures and flange standards as specified for piping system.

F. Dielectric Flange Kits: Companion-flange assembly for field assembly. Include flanges, full faced or ring type gasket, phenolic or polyethylene bolt sleeves, phenolic washers and steel backing washers.

G. Dielectric Couplings: Galvanized steel coupling with inert and non-corrosive, thermoplastic lining, threaded ends, and 2,070 kPa minimum working pressure at 107 degrees C.

H. Dielectric Nipples: Electroplated steel nipple with inert and non-corrosive, thermoplastic lining; plain, threaded, or grooved ends, and 2,070 kPa minimum working pressure at 107 degrees C.

2.7 GROUT

A. ASTM C1107 Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.

B. Characteristics: Post-hardening, volume-adjusting, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.

C. Design Mix: 5,000 psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.8 PIPING FABRICATION AND ERECTION

A. Join pipe and fittings according to the following requirements.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before fabrication and assembly.

D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

E. Do not use pipe sections that have cracked or open welds.

F. Piping fabrication, inspection and testing shall be in accordance with this specification, ASME and AWWA standards.

G. Erect piping with flanged and threaded connections as applicable in accordance with good engineering practice suitable for hydrocarbon processing industry. Use suitable lubricants on bolt threads.

H. The overall fabrication, supporting, and erection of piping shall be done in such a way as to impose minimum possible loading on connected equipment and valves. Wherever required, verify the alignment of the equipment and drive motor in pipe-connected and disconnected state, to verify that piping is not imposing undue load on the equipment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that surfaces and the Site conditions are ready to receive work.

3.2 INSTALLATION OF PIPING SYSTEMS - GENERAL REQUIREMENTS

A. Install piping as shown on the Drawings unless deviations to layout are approved by ENGINEER.

B. Mark each pipe and fitting on the outside to indicate the class of pipe and location number of the laying plan. Furnish and install piping in accordance with the reviewed Shop Drawings. All marking shall be coded to the Shop Drawings.

C. Provide allowance for piping to be modified around CONTRACTOR supplied equipment. Piping and piping systems may be modified up to 1.5 m in any direction after receipt of equipment Shop Drawings to suit provided equipment. All Piping shown on drawings shall be confirmed in field prior to installation.

D. Specific flange joint requirements are shown on the Drawings. Provide other break flanges/unions in accordance with general industrial practice.

E. Install building service piping in concealed locations, unless otherwise indicated and except in equipment and service areas.

F. Install piping to maximum possible extent at right angles, and club together to manage in designated piping-ways. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

H. Install piping to permit valve servicing.

I. Install piping at indicated slopes.

J. Install piping free of sags and bends.

K. Install manufactured fittings for changes in direction and branch connections. Fabricated fittings shall not be accepted where standard manufactured fittings are available.

L. Install piping to allow application of insulation where indicated.

M. Select system components with pressure rating equal to or greater than system operating pressure.

N. Valves shall be accessible from relevant level flooring, and shall be installed in accordance with manufacturers instructions.

O. Support all piping connections to dynamic equipment suitably to prevent overstressing of equipment casing beyond limits specified by the equipment manufacturers. Provide spring supports wherever necessitated due to variable loads.

P. Hard-pipe and route overflow and drain lines to appropriate drain collection points.

Q. Verify final equipment locations for roughing-in.

R. Refer to equipment specifications in other Sections of these specifications for roughing-in requirements.

S. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Coordinate sleeve sizes with the seal manufacturer for required annular space.
   1. Install steel pipe for sleeves smaller than 150 mm in diameter.
   2. Install cast-iron wall pipes for sleeves 150 mm and larger in diameter.
   3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

T. Underground Exterior Wall Pipe Penetrations:
   1. Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Coordinate sleeve sizes with the seal manufacturer for required annular space.
   2. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten

bolts against pressure plates that cause sealing elements to expand and make watertight seal.

U. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials and fire stop sealant (as minimum). All fire stop material shall be ULc listed, or as indicated on the Drawings.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and individual sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B828 or the CDA Copper Tube Handbook, using lead-free solder alloy complying with ASTM B32.

E. Brazed Joints: Construct joints according to the AWS Brazing Handbook, Pipe and Tube chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. ABS Piping: Join according to ASTM D2235 and ASTM D2661 Appendices.
   3. CPVC Piping: Join according to ASTM D2846/D2846M Appendix.
   4. PVC Pressure Piping: Join schedule number ASTM D1785 PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D2855.
   5. PVC Non-pressure Piping: Join according to ASTM D2855.
   6. PVC to ABS Non-pressure Transition Fittings: Join according to ASTM D3138 Appendix.

I. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

J. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D3212.

K. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

L. Plain-End Pipe and Fittings: Butt fusion.

M. Plain-End Pipe and Socket Fittings: Socket fusion.

N. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

O. Install couplings and restraint systems for buried piping in accordance with manufacturer’s instructions. Where required submit torque values for review after installation.

3.4 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment in accordance with Section 05500 and as shown on the Drawings.

B. Field Welding: Comply with CSA W47.1 and Section 15 05 0.

3.5 GROUTING

A. Mix and install grout for piping base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for pipe supports.

G. Place grout around anchors.

H. Cure placed grout.

3.6 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Clean piping systems by flushing with water or blowing with air with valves wide open prior to testing and before installing any primary element instrumentation on the piping systems.

C. Provide temporary restraints or isolate expansion joints which cannot sustain the reactions due to test pressure.

D. Isolate from the piping, equipment that is not to be subjected to the test pressure.

E. Piping must pass field tests.

F. No leakage will be allowed.

G. Hydrostatically test piping in accordance with Section 15 95 5.

H. Prepare a report for each test. Include in the report the following:
   1. Location or section of piping.
   2. Time and duration of test.
   3. Test pressure at start and completion.
   4. Ambient and water temperatures.

3.7 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Following assembly and testing, prior to disinfection of potable water lines, and following final acceptance, flush pipelines, except as stated below, with water at 160 gpm minimum flushing velocity until foreign matter is removed.

C. Remove accumulated debris through drains 2 inches and larger or by removing spools and valves from piping.

3.8 PIPING SCHEDULES

A. The Piping Schedule herein shall precede all other piping information within the specifications. Refer to the individual piping specifications for exact requirements/standards for materials, joint types, fittings, etc.

Service	**Detailed Piping Specification**	**Pipe Material**	**Piping Sizes**	**Class or Schedule**	**Joints and Fittings**
Wastewater Sampling (MISA Sampling System	15060-01	316 Stainless Steel Tubing	50 mm and under	316 Seamless Instrument Grade Tubing	Threaded fittings; ferrule and nut joints
Carrier Pipe for Sample Tubing	15060-02	Insulated HDPE	All Sizes	Schedule 40	Fused/Flanged Fittings
Wastewater Sampling (MISA Sampling System) - Buried	15060-03	PVDF Tubing	All Sizes	-	Threaded fittings
Carrier Pipe for Future Wastewater Discharge	15060-02	PVC, DR 35	All Sizes	-	Flanged Fittings

END OF SECTION

SECTION 15060-01

STAINLESS STEEL PROCESS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Stainless steel pipe and pipe fittings.

B. Accessories.

1.2 RELATED SECTIONS

A. Section 15060 - Common Work Results for Process Piping.

1.3 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. American National Standards Institute/American Society of Mechanical Engineers:
1. ANSI/ASME B1.20.1 - Pipe Threads, General Purpose (Inch).
2. ASME B16.5 – Flanges.
3. ASME B16.9 – Factory Made Wrought Steel Buttwelding Fittings.
4. ASME B16.11- Forged Fittings, Socket-Welding and Threaded.
5. ASME B31.1 – Power Piping.
6. ASME B36.19 – Stainless Steel Pipe.

C. ASTM International:
1. ASTM A269 – Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service
2. ASTM A312/A312M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
3. ASTM A351/A351M – Standard Specification for Castings, Austenitic, for pressure containing parts.
4. ASTM A774/A774M - Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
5. ASTM A778/A778M – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.

1.4 DEFINITIONS

A. EPDM: Ethylene propylene diene monomer.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Section 01500 - Temporary Facilities and Controls: Requirements for temporary controls.

B. If welding is performed, ensure preheat and post-weld heat treatment is completed in accordance with qualified welding procedure.

PART 2 PRODUCTS

2.1 GENERAL

A. All piping system components shall be products of the same manufacturer.

B. The piping described herein is to be a general overview. Refer to the Drawings/Section 15060 for specific requirements and methods.

2.2 STAINLESS STEEL PIPE/TUBING AND FITTINGS FOR WASTEWATER SERVICE

A. Stainless steel pressure tubing shall be seamless, bright – annealed tube for general service, manufacturer tested according to ASTM A269, using material dual certified as type TP316 and type TP316L. Tube shall be cold finished and free of scratches. Upon request, the tube supplier shall furnish mill certificates documenting compliance with this specification.

B. All bends shall be made using tubing benders, except when tubing is pulled underground through a sleeve, bend angle should be 90 degrees whenever possible. Tubing shall be routed vertical and horizontal axis of the equipment.

C. All aboveground tubing shall be fabricated using straight sticks, and anchored per code to prevent pending or excessive vibration. Suitable resilient anchors, such as Parklamp or Unitstrut Kush-A-Clamp shall be used.

D. Required tube wall thickness for water service:

Outside Dia (in)	Wall Thickness (in)	Basis
¼	0.035	Average Wall Thickness
3/8	0.035	Average Wall Thickness
½	0.035	Average Wall Thickness
1	0.083	Average Wall Thickness
1 ½	0.120	Average Wall Thickness
2	0.134	Average Wall Thickness

E. Tubing fittings shall be type 316 stainless steel, with a MAWP of not less than 2,500 psig. Acceptable products are listed below. No other products may be used without written approval from ENGINEER. All swaged fittings furnished by the CONTRACTOR shall be interchangeable products by a single manufacturer.
1. Parker “CPI”

2. Swagelok
3. Parker “Phastite”.
4. Hoke “Gyrolok”

F. All connections for tubing will be made with ferrule and nut type joints with threaded components/fittings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that surfaces are sealed, cleaned, and conditioned as required to receive work.

3.2 FABRICATION

A. Machine shape or cut pipe ends with an aluminum oxide blade. Oxygen or arc cutting are acceptable only if the cut is reasonably smooth and true and all slag is removed either by chipping or grinding.

B. Ensure surfaces are clean and free of paint, oil, rust, scale, slag, or other material.

C. Align ends to be joined within existing commercial tolerances on diameters, wall thickness, and out-of-roundness.

D. Procedure: Screwed joints with fitting threads and pipe threads accurately conforming to ASME B1.20.1. Use clean and sharp dyes to provide an accurate thread profile, free of ridges and buns. Back welding of joints to remedy joints failing pressure tests will not be permitted. Replace joints failing the pressure test with a screwed joint that passes the pressure test.

E. Testing: Test all lines at the pressures listed in the Piping Schedule and shown on the Drawings. Test procedures are specified in Section 15060, Common Work Results for Process Piping.

F. Supports and Hangers:
1. Hanger pipe contact surfaces shall have a dielectric barrier consisting of neoprene rubber wrapping or plastic-coated hangers.
2. The load rating of universal concrete inserts shall not be less than that of the hanger rods they support.

3.3 INSTALLATION

A. Install piping in accordance with manufacturer's instructions.

B. Install piping in accordance with the applicable codes and standards.

3.4 QUALITY CONTROL

A. Perform field testing as indicated in Section 15 06 0.

3.5 GROOVED END PIPING

A. Install in accordance with the manufacturer's instructions.

3.6 TOLERANCES

A. Maximum Variation from True Position: 3 mm.

B. Maximum Offset from True Alignment: 3 mm.

3.7 ADJUSTING

A. Section 01700 - Execution and Closeout Requirements: Requirements for adjusting installed work.

B. Adjust system control valves as directed by ENGINEER.

END OF SECTION

SECTION 15060-02

HDPE PVC PROCESS PIPING UNDER 1034 kPa

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HDPE pipe and pipe fittings.
   2. Buried PVC pipe and fittings.

B. Related Requirements:
   1. Section 15060 - Common Work Results for Process Piping.

1.2 REFERENCES

A. Abbreviations and Acronyms:
   1. HDPE: High density polyethylene.
   2. EPR: Ethylene propylene rubber.
   3. SDR: Standard dimension ratio.
   4. PVC: Polyvinylchloride

B. Reference Standards:
   1. ASTM International:
      a. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
      b. ASTM A194/A194M - Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
      c. ASTM D1248 - Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
      d. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
      e. ASTM F714 - Standard Specification for Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Outside Diameter.
   2. American National Standards Institute.
      a. ANSI B18.2.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Inspect each shipment of pipe and fittings and make provisions for the timely replacement of damaged material. Unload by hand or use canvas slings to avoid scratching the pipe. Do not drop, slide, or drag HDPE pipe over an abrasive surface. Remove pipe with deep scratches from the Site and replace with new pipe.

B. Stack pipe no higher than 1.5 m and provide support for the pipe barrel to prevent bending of the pipe. Cover stockpiled pipe to protect it from daylight. Provide for air circulation through the stockpile.

1.4 QUALITY ASSURANCE

A. Install piping in accordance with applicable codes, standards, and manufacturer recommendations.

1.5 AMBIENT CONDITIONS

A. Do not install pipe when the temperature is below 0 degrees C or above 32.2 degrees C.

B. Provide adequate ventilation when working with pipe joint solvent cement.

PART 2 PRODUCTS

2.1 GENERAL

A. All piping system components shall be products of the same manufacturer.

B. Warning tape/tracer wire shall be provided above all buried sections of HDPE/PVC pipe.

2.2 HDPE PIPE

A. The pipe shall be extruded from polyethylene compound and shall conform to the following requirements:
   1. Resin shall meet or exceed requirements of ASTM D3350 for material with cell classification of 335434C or better.
   2. The compound shall be protected from UV degradation by the addition of UV stabilizing elements (i.e., carbon black).
   3. Maximum allowable hoop stress shall be 5378 kPa at 22 degrees C.
   4. Pipe manufacturer shall be listed with the PPI as meeting the requirements of the resin manufacturer for the resin used to manufacture the pipe for the Project.
   5. Pipe sizes shall conform to ASTM F714.
   6. Piping shall have an SDR of 26 (or thicker) for buried carrier pipe service (water sampling).
   7. HDPE pipe shall be pre-insulated (rigid polyurethane foam, minimum insulation thickness of 2”, factory applied) with 1.27 mm polyethylene jacketing. Insulation shall have a thermal conductivity of 0.02 to 0.025 W/m.C or less.
   8. Pre-insulated HDPE pipe shall be suitable for buried service.

B. FITTINGS

C. HDPE fittings shall be fabricated by means of butt-fusion welding or electrofusion welding. All fittings shall have the same or higher pressure rating as the pipe when installed in accordance with ASTM D3350 and the latest technical specifications. Any buried insulated fittings shall be completed using polyurethane foam half shells and sealed with the application of suitable

wrap around adhesive lined heat shrink. Insulation for buried fittings will be provided by the pre-insulated HDPE pipe supplier.

D. JOINTS

E. Thermal butt-fusion joints, except where connecting to equipment, valves, and dampers that may require future disassembly and when joining to differing pipe materials. Follow manufacturer's recommended procedures for butt fusion joints.
   1. Electro-fusion welding to be used in place of thermal butt-fusion and shall conform to manufacturers recommended procedures for electro-fusion.

F. Flanges: Type 316 stainless steel backing flanges with drilling to match equipment. Flanges shall be complete with one-piece molded HDPE stub ends.
   1. Bolting to utilize Type 316 stainless steel ASTM A193/A193M Grade B8 hex head bolts and ASTM A194/A194M Grade 8 hex head nuts. Bolts shall be fabricated in accordance with ANSI B18.2 and provided with washers of the same material as the bolts.

G. Gaskets: 3 mm material as specified in Section 15060 – Common Work Results for process piping.

2.3 PVC Pipe

A. Polyvinyl Chloride (PVC) pipe in accordance with ASTM D3034 and CSA B182.2

B. DR 35

C. Joining – Bell and spigot with rubber gaskets in accordance with CSA B182.2 and ASTM F477 or as shown on Contract Drawings.

D. Approved Suppliers
   1. IPEX Inc.
   2. Royal Building Products
   3. Or equivalent

E. Fittings: As recommended by pipe manufacturer and approved by ENGINEER.

F. Joints: As recommended by pipe manufacturer and approved by ENGINEER.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces and the Site conditions are sealed, cleaned, and conditioned as required in order to be ready to receive work.

3.2 GENERAL

A. All HDPE pipe shall be cut, fabricated, and installed in strict accordance with pipe manufacturer's recommendations. Joining, laying, and pulling of HDPE pipe shall be

accomplished by personnel experienced with HDPE pipe. Pipe Supplier shall certify, in writing, that CONTRACTOR is qualified to join, lay, and pull the pipe.

3.3 JOINING PIPE SECTIONS

A. Pipes shall be joined to one another, to HDPE fittings, and to the flange connections by means of thermal butt-fusion or electro-fusion. Items to be joined shall be of the same type, pressure class, and supplied by the same raw material Supplier as certified for use in the overall system.

B. When bolting flanges to stationary equipment, provide bolts and nuts of sufficient length to allow at least three complete threads when the joint is made and torque applied to the manufacturer standard. Re-torque nuts after 4 hours.

C. Pipe connected to heavy fittings, manholes or rigid structures shall be supported in such a manner that no subsequent relative movement between the pipe at the joint and the rigid structure is possible and as specified in Section 15 06 0.

3.4 QUALITY CONTROL

A. Test the piping in accordance with the requirements of 15955.

3.5 PLACEMENT IN TRENCH

A. Exercise care to ensure pipe is not damaged, twisted, or scarred when placing pipe into trench.

B. Dig out trench with sufficient length, width, and depth to ensure clearance between prepared trench bottom and flanges, fittings, or other connections.

END OF SECTION

SECTION 15060-03

PIPE DATA SHEET – PVDF TUBING AND CARRIER PIPE

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Polyvinylidene fluoride (PVDF) Tubing for chemical feed systems.

B. Carrier pipe for PVDF tubing and chemical feed systems.

1.2 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Inspect each shipment of pipe and fittings and make provisions for the timely replacement of damaged material. Unload by hand or use canvas slings to avoid scratching the pipe. Do not drop, slide, or drag pipe over an abrasive surface. Pipe with deep scratches shall be removed from the Site and replaced with new pipe.

C. Stack pipe no higher than 5 feet and provide support for the pipe barrel to prevent bending of the pipe. Cover stockpiled pipe to protect it from daylight. Provide for air circulation through the stockpile.

1.3 CLOSEOUT

A. If specialized system or tools are used for installation, provide a complete set of required cutters, crimpers, etc., to allow for future maintenance or modification of the system to OWNER.

PART 2 - PRODUCTS

2.1 GENERAL

A. All piping system components shall be products of the same manufacturer.

2.2 PVDF TUBING

A. NSF 61 Certified, Polyvinylidene fluoride (PVDF) tubing. Size as indicated on Drawings.

B. Opaque PVDF tube, nominal OD as required for service/selected by Contractor. Nominal working pressure of up to 150 psig.

C. Temperature Range: Minus 5 degrees C to plus 65 degrees C.

D. Fittings shall be compatible with manufacturer, and with chemicals in use.

E. No fittings shall be permitted to be hidden/concealed within carrier pipe.

2.3 CARRIER PIPE

A. Refer to Section 15060-02 HDPE Process Piping Under 1034 kPa.

2.4 FITTINGS AND JOINTS

A. Connections and fittings in the carrier pipe shall be long-radius bends and use wyes in place of tees to facilitate installation of PVDF tubing by pulling through assembled pipe.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution Requirements: Verification of existing conditions before starting work.

B. Verify that surfaces and the Site conditions are sealed, cleaned, and conditioned as required in order to be ready to receive work.

3.2 GENERAL

A. All carrier pipe shall be installed and supported with general slope towards open drainage points.

B. Buried piping shall utilize minimum of joints, and shall use long-radius bends. Provide slope towards open ends of pipe in either direction.

C. Pressure test tubing in accordance with Division 15.

END OF SECTION

SECTION 15075

MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nameplates.

B. Plastic pipe markers.

C. Plastic tape pipe markers.

1.2 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification.

C. Samples: Submit two labels.

D. Manufacturer's Instructions: Indicate special procedures and installation.

1.3 FIELD SAMPLES

A. Section 01400 - Quality Requirements: Requirements for field Samples.

B. Provide field Samples of labels.

C. Locate where directed by ENGINEER.

D. Accepted Sample may remain as part of the Works.

PART 2 PRODUCTS

2.1 EQUIPMENT NAMEPLATES

A. Provide name plates in accordance with the schedule at end of Section.

B. Manufacturers standard nameplate.

C. Minimum Tag Size: 38 mm tall and 80 mm wide minimum with minimum 25 mm tall lettering.

D. Indicate at a minimum the following:
   1. Manufacturer name.

2. Model number.
3. Serial number.
4. Equipment size/capacity.

2.2 PLASTIC PIPE MARKERS

A. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering; minimum information indicating flow direction arrow and identification of fluid being conveyed.

2.3 PLASTIC TAPE PIPE MARKERS

A. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings. Minimum information indicating flow direction arrow and identification of fluid being conveyed.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

3.2 INSTALLATION

A. Plastic Markers:
   1. Install plastic pipe markers in accordance with manufacturer's instructions.
   2. Install plastic tape pipe markers complete around pipe in accordance with manufacturer's instructions.

3.3 APPLICATION

A. Apply in accordance with manufacturer's instructions.

B. Apply after painting.

3.4 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Clean excess paint and adhesive.

3.5 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution and Closeout Requirements: Requirements for protecting installed work.

B. Protect finished work using clear plastic and tape.

3.6 MECHANICAL SCHEDULE

Service	*Marking Type*	*Letter/Symbol Color*	*Color*	*Background Location*	*Required Markings*
Wastewater	Adhesive Tape	White	Green	Terminations and every 12 feet	Service, Flow Direction
Valves	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	As noted in Article 2.1
HVAC Equipment	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	As noted in Article 2.1
Pumps	Nameplate	Manufacturer Standard	Manufacturer Standard	Manufacturer Standard	As noted in Article 2.1

END OF SECTION

SECTION 15081

THERMAL PIPING AND EQUIPMENT INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wastewater Piping

1.2 REFERENCES

A. ASTM International:
   1. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   2. ASTM A240/A240M – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   3. ASTM C547 – Standard Specification for Mineral Fiber Pipe Insulation.
   4. ASTM E84 – Standard Test Method for Surface Burning Characteristics of Building Materials.

B. National Fire Protection Association:
   1. NFPA 255 – NFPA 255: Standard Method of Test of Surface Burning Characteristics of Building Materials.

C. Underwriters Laboratories of Canada:
   1. CAN/ULC S102 – Method of Test for Surface Burning Characteristics of Building Materials and Assemblies

1.3 DEFINITIONS

A. Concealed: Insulated mechanical services in suspended ceilings and non accessible chases and furred in spaces.

B. Exposed: Not concealed as defined herein.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's catalog literature and installation instructions including both procedures for installation and installation standards to be achieved.

1.5 CLOSEOUT SUBMITTALS

A. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in original factory packaging, labeled with manufacturer's name and address.

B. Protect from weather and construction traffic.

C. Protect against damage from any other source.

D. Store at temperature and moisture conditions required by manufacturer.

1.7 SEQUENCING AND SCHEDULING

A. Do not insulate untested equipment or piping systems.

B. Do not insulate welded piping systems until dye penetrant, magnetic particle, or other testing has been completed as required.

PART 2 PRODUCTS

2.1 GENERAL

A. Insulation and jacketing shall be applied to sections ductile iron (DI) piping disturbed during the installation of the new actuated wastewater control valves. All piping downstream of the sludge metering box shall be heat traced and jacketed as is currently.

B. Minimum acceptable insulation thickness is 25 mm.

C. Fire Hazard Ratings for Insulation Systems: Maximum flame spread rating of 25, fuel contributed rating of 50, and maximum smoke developed rating of 50 in accordance with NFPA 255, ASTM E84, and CAN/ULC S102 for components of insulation systems.

2.2 MATERIALS FOR INSULATION

A. Glass Fiber Molded Pipe Insulation:
   1. Glass fiber, high density, preformed sectional pipe insulation with factory applied, self sealing, all service, jacket of vinyl foil/white Kraft laminate, reinforced with open mesh glass scim fiber including jacket as indicated in schedule.
   2. K=0.035 W/(m degree C) at 24 degrees C.
   3. Glass Fiber 850 by Fiberglass Canada Inc. or Alley K APT (density 80 kg/m^3) by Manson Insulation Inc. Ltd.
   4. ASTM C547 Class 2.
   5. Valves and Fittings (65 mm Maximum): Contoured glass fiber insert with 1 piece PVC pre molded fitting cover.
   6. Valves and Fittings (65 mm or Greater): Preformed, sectional fiber, same insulation as pipe.

2.3 INSULATION SECURMENT

A. Tape: Factory installed pressure sensitive adhesive, separated by release strip, to be removed during insulation.

2.4 MATERIALS FOR JACKETING

A. General: Insulate valves, heat exchangers and appurtenances, jacketed with pre formed removable covers of same material as pipe jacketing.

B. Polyvinyl Chloride (PVC):
1. One-piece molded type with pre-formed shape as required.
2. Color: White.
3. Minimum Service Temperature: Minus 20 degrees C.
4. Maximum Service Temperature: 65 degrees C.
5. Moisture Vapor Transmission: 0.02 perm.
6. Fastenings: Pressure sensitive vinyl tape of matching color.

PART 3 EXECUTION

3.1 PREPARATION

A. Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.

B. Surfaces to be clean, dry, free from foreign material.

3.2 INSTALLATION SCHEDULE

Pipe Sizes (NPS) and Insulation Thicknesses (mm)						
		Run	NPS 1 1/4	NPS 2.5	NPS 4	NPS 8
Application	Jacketing Material	Out	to 2	to 4	to 6	and over
Wastewater (Outdoors)	PVC		25 mm	40 mm	50 mm	50 mm

3.3 GENERAL

A. Insulate full surface and entire length including elbows, tees, reducers, flanges, dampers, etc. Insulation of same thickness throughout.

B. Install all materials in accordance with manufacturers' instructions unless otherwise specified.

3.4 INSULATION

A. Clean and dry surfaces before applying insulation.

B. Install insulation with staggered joints and pack openings with loose insulation, using manufacturers recommended adhesives. For double layer construction, fill voids and cracks in first layer before second layer is installed.

C. Make provisions to allow for thermal expansion of pipe relative to insulation.

D. On cold piping and valves, seal cracks with foil tape to eliminate vapour transmission.

E. On piping with insulation and vapor barrier, install high density insulation under hanger shield. Maintain integrity of vapor barrier over full length of pipe without interruption at sleeves, fittings, or supports.

F. Install flexible metal insulation blanket neatly with wired seams concealed.

3.5 VAPOR BARRIER

A. Provide vapor barrier on cold fluid piping, and outdoor piping.

B. Do not use staples on vapor barrier lining.

C. Seal joints and protrusions in insulation with vapor barrier cement.

3.6 VALVES, FLANGES, AND APPURTENANCES

A. Insulate valves and appurtenances for freeze protection, anti sweat, heat conservation (90 to 455 degrees C) and high temperature insulation.

B. If valves and appurtenances are not insulated, and pipe insulation thickness exceeds 1 inch, bevel insulation at flanges to allow bolt access for maintenance and removal. Provide cone reducers for jacket.

C. Where valves and appurtenances are insulated, provide pre-fabricated PVC, hinged cover to allow for removal and replacement of jacketing and insulation without cutting. On hot valves, attach foil faced flexible insulation to valve cover for ease of removal.

D. Verify adequate clearance between insulation and actuators or linkages to avoid interference with moving elements.

E. Leave nameplates, code inspection plates, or stampings visible after insulation is complete. Bevel and seal insulation and jacket around exposed area.

3.7 SUPPORTS

A. Provide supports, studs, clips and angles required to hold insulation and jacket securely in position. Provide metal corner reinforcement angle to protect edges of insulation.

B. Provide welded insulation supports at 3.0 m centres on vertical piping longer than 6 m. Make support width 10 mm less than overall insulation thickness. Provide S clips at circumferential joints in jacketing.

C. Provide calcium silicon inserts or suitable saddles at pipe supports where load requirements exceed compressive strength of insulation.

D. Return hangers (on supports – displaced or blocked up during installation of insulation) to their original location and alignment after insulation work is complete.

END OF SECTION

SECTION 15201

PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.1 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. American Society of Mechanical Engineers: ASME B31.1 - Power Piping.

C. ASTM International:
   1. ASTM A123/A123M - Standard Specification for Zinc (Hot Dip Galvanized) Coatings on Iron and Steel Products.
   2. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc Iron Alloy Coated (Galvannealed) by the Hot Dip Process.

D. Building Officials and Code Administrators: BOCA Basic Building Code.

E. Ontario Building Code.

F. Manufacturers' Standardization Society:
   1. MSS SP 58 - Pipe Hangers and Supports - Materials, Design and Manufacture.
   2. MSS SP 69 - Pipe Hangers and Supports - Selection and Application.
   3. MSS SP 89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.2 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 0.3 m above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Shop Drawings:
   1. Submit seismic force level (F_p) calculations from applicable building code. Restraint selection and installation details shall be pre-approved by a professionally licensed engineer experienced in seismic restraint design.
   2. Drawings of piping support system, locating each support, brace, hanger, guide, component, and anchor. Identify support, hanger, guide, and anchor type by catalog number and Shop Drawing detail number.
   3. Revisions to support systems resulting from changes in related piping system layout or addition of flexible joints.

C. Information Submittals: Maintenance information on piping support system.

1.4 QUALIFICATIONS

A. Piping support systems shall be designed and Shop Drawings prepared and sealed by a professional engineer registered in the Province of Ontario.

1.5 DESIGN REQUIREMENTS

A. General:
   1. Seismic Load: Seismic performance category forces with seismic loads in accordance with local codes. Based on geotechnical investigations completed at the Site, a seismic site class of “C” can be assumed.
   2. Design, size, and locate piping support systems throughout facility, whether shown or not.
   3. Piping Smaller than 750 mm: Supports are shown only where specific types and locations are required; additional pipe supports shall be required.
   4. Piping 750 mm and Larger: Support systems have been designed for piping shown.
   5. Meet requirements of MSS SP 58, MSS SP 69, and MSS SP 89, or as modified by this Section.

B. Pipe Support Systems:
   1. Load: Dead loads imposed by weight of pipes filled with water, (except air and gas pipes), plus insulation.
   2. Maximum Support Spacing and Minimum Rod Size:
      a. Mild Steel or Ductile Iron Piping (Note that this spacing may require the use of higher load pipe clamps and more than a single point anchor point in concrete):

Pipe Size	**Maximum Support/Hanger Spacing**	**Minimum Rod Size Single Rod Hangers**
25 mm and smaller	1.8 m	6.25 mm
32.5 mm through 62.5 mm	2.4 m	6.25 mm
75 mm and 100 mm	3.0 m	9.5 mm
150 mm	3.6 m	9.5 mm
200 mm	3.6 m	12.5 mm
250 mm and 300 mm	4.3 m	15.9 mm
350 mm	4.8 m	19.1 mm
400 mm and 450 mm	4.8 m	22.2 mm
500 mm	5.4 m	25.4 mm
600 mm	5.4 m	31.7 mm
762 mm and larger	As shown on the Drawings	As shown on the Drawings

      b. Copper Piping:
         1) Maximum Support Spacing: 0.61 m less per size than listed for steel pipe, with 25 mm and smaller pipe supported every 1.5 m.
         2) Minimum Hanger Rod Sizing: Same as listed for steel pipe.
      c. Plastic and Fiberglass Piping:
         1) Maximum Support Spacing: As recommended by manufacturer for flow temperature in pipe.
         2) Minimum Hanger Rod Sizing: Same as listed for steel pipe.
      d. For process tubing (SS, PVDF), support as recommended by the tubing supplier.

e. Stainless Steel Piping:

SST Pipe Size	Maximum Support/Hanger Spacing	Minimum Rod Size Single Rod Hangers
25 mm through 100 mm	2.4 m	6.25 mm
150 mm	2.4 m	9.5 mm
200 mm and 250 mm	3.0 m	12.5 mm
300 mm	3.0 m	12.5 mm
350 mm and 400 mm	3.6 m	15.9 mm
450 mm and 500 mm	4.3 m	19.1 mm
600 mm	4.3 m	22.2 mm

C. Framing Support System:
1. Beams: Size such that beam stress does not exceed 172,000 kPa and maximum deflection does not exceed 1/240 of span.
2. Column Members: Size in accordance with manufacturer's recommended method.
3. Support Loads: Calculate using weight of pipes filled with Maximum Spans:
   a. Steel and Ductile Iron Pipe, 75 mm Diameter and Larger: 3 m centers, unless otherwise shown.
   b. Other Pipelines and Special Situations: May require supplementary hangers and supports.
4. Electrical Conduit Support: Include in design of framing support system.

D. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

E. Vertical Sway Bracing: 3 m maximum centers, or as shown.

F. Existing Support Systems: Use existing supports systems to support new piping only if CONTRACTOR can show that they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS

2.1 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

B. Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

C. Materials: In accordance with Tables 1 and 2, attached as supplements to this Section.

D. All support material in the station dry well / chamber shall be galvanized steel as per ASTM A653, Class G90, or hot-dip galvanized after fabrication to ASTM A123 unless otherwise noted. All support material located in the station wet well shall be 316 stainless steel meeting the requirements of ASTM A 276.

2.2 HANGERS

A. Clevis Type: MSS SP 58 and SP 69, Type 1 or 6.
   1. Anvil International; Figure 104 or 260.
   2. Cooper B Line; Figure B3198 or B3100.
   3. Approved equal.

B. Hinged Split Ring Pipe Clamp: MSS SP 58 and SP 69, Type 6 or 12.
   1. Anvil International; Figure 104.
   2. Cooper B Line; Figure B3198H.
   3. Approved equal.

C. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP 58.

D. Attachments:
   1. I Beam Clamp: Concentric loading type, MSS SP 58 and SP 69, Type 21, 28, 29, or 30, which engage both sides of flange.
   2. Concrete Insert: MSS SP 58 and SP 69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.

2.3 SADDLE SUPPORTS

A. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange.
   1. Nonadjustable Saddle: MSS SP 58 and SP 69, Type 37 with U bolt.
      a. Anvil International; Figure 259.
      b. Cooper B Line Inc.; Figure B3090.
      c. Approved equal.
   2. Adjustable Saddle: MSS SP 58 and SP 69, Type 38 without clamp.
      a. Anvil International; Figure 264.
      b. Cooper B Line Inc.; Figure B3093.
      c. Approved equal.

2.4 WALL BRACKETS

A. Welded Steel Bracket: MSS SP 58 and SP 69, Type 33 (heavy-duty):
   1. Anvil International; Figure 199.
   2. Cooper B Line Inc; Figure B3067.
   3. Approved equal.

B. Channel Type:
   1. Unistrut.
   2. Anvil International; Power Strut.
   3. Cooper B Line Inc.; Strut System.
   4. Aickinstrut Fiber Glass Framing System.

2.5 PIPE CLAMPS

A. Riser Clamp: MSS SP 58 and SP 69, Type 8.
   1. Anvil International; Figure 261.
   2. Cooper B Line Inc.; Figure B3373.

3. Approved equal.

2.6 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12 gauge, 1 5/8 inch wide minimum steel, 1 1/2 inch wide, minimum FRP.

B. Members and Connections: Design for all loads with safety factor of 5.

2.7 ACCESSORIES

A. Insulation Shields:
   1. Type: Galvanized steel or stainless steel, MSS SP 58 and SP 69, Type 40.

B. Welding Insulation Saddles:
   1. Type: MSS SP 58 and SP 69, Type 39.

2.8 INTERMEDIATE PIPE GUIDES

A. Piping 150 mm and Smaller:
   1. Type: Pipe clamp with oversized pipe sleeve to provide minimum 3.2 mm clearance.

B. Piping 200 mm and Larger:
   1. Type: Specially formed U bolts with double nuts to provide 6.4 mm minimum clearance around pipe.
   2. U Bolt Stock Size:
      a. 200 mm Pipe: 15.9 mm.
      b. 250 mm Pipe: 19.1 mm.
      c. 300 mm Through 400 mm Pipe: 22.2 mm.
      d. 450 mm Through 762 mm Pipe: 25.4 mm.

2.9 PIPE ALIGNMENT GUIDES

A. Type:
   1. Piping 200 mm and Smaller: Spider or sleeve type.
   2. Piping 250 mm and Larger: Roller type.

2.10 PIPE ANCHORS

A. Type: Anchor chair with U bolt strap.

2.11 ROOF PIPE SUPPORTS

A. Type: UV resistant rubber channel complete with through bolted connection and galvanized steel load distribution plate. Min 25 mm gap to provide free water drainage around assembly.

B. Manufacturers:
   1. Dura-Blok by B-Line (Eaton)

2. C-Port by Mifab Inc.

PART 3 EXECUTION

3.1 INSTALLATION

A. General:
1. Install support systems in accordance with MSS SP 69 and MSS SP 89, unless shown otherwise.
2. Support piping connections to equipment by pipe support and not by equipment.
3. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
4. Support no pipe from pipe above it.
5. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
6. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
7. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
8. Install lateral supports for seismic loads at all changes in direction.
9. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
10. Repair mounting surfaces to original condition after attachments are made.

B. Standard Pipe Supports:
1. Horizontal Suspended Piping:
   a. Single Pipes: Adjustable swivel ring, split ring, or clevis hangers.
   b. Grouped Pipes: Trapeze hanger systems.
   c. Furnish galvanized steel protection shield and oversized hangers for insulated pipe.
   d. Furnish precut sections of rigid insulation with vapor barrier at hangers for insulated pipe.
2. Horizontal Piping Supported From Walls:
   a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
   b. Stacked Piping:
   c. Wall mounted framing system and clips acceptable for piping smaller than 75 mm nominal diameter.
   d. Piping clamps that resist axial movement of pipe through support not acceptable.
   e. Wall mounted piping clips not acceptable for insulated piping.
3. Horizontal Piping Supported From Floors:
   a. Stanchion Type:
   b. Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
   c. Use yoked saddles for piping whose centerline elevation is 450 mm or greater above floor and for exterior installations.
   d. Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
4. Floor Mounted Channel Supports:
   a. Use for piping smaller than 75 mm nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
   b. Attach channel framing to floors with anchor bolts.
   c. Attach pipe to channel with clips or pipe clamps.

5. Concrete Cradles: Use for piping larger than 75 mm along floor and in trenches at piping elevations lower than can be accommodated using stanchion type.
6. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
7. Standard Attachments:
    a. To Concrete Ceilings: Concrete inserts.
    b. To Steel Beams: I beam clamp or welded attachments.
    c. To Wooden Beams: Lag screws and angle clips to members not less than 62.5 mm thick.
    d. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
8. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

C. Intermediate and Pipe Alignment Guides:
1. Provide pipe alignment guides (or pipe supports that provide same function) at expansion joints and loops.
2. Guide piping on each side of expansion joint or loop at 4 and 14 pipe diameters from each joint or loop.
3. Install intermediate guides on metal framing support systems not carrying pipe anchor or alignment guide.

D. Accessories:
1. Insulation Shield: Install on insulated non-steel piping. Oversize rollers and supports.
2. Welding Insulation Saddle: Install on insulated steel pipe. Oversize rollers and supports.
3. Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.
4. Dielectric Barrier:
    a. Install between carbon steel members and copper or stainless steel pipe.
    b. Install between stainless steel supports and non-stainless steel ferrous metal piping.
5. Electrical Isolation: Install 6.4 mm by 75 mm neoprene rubber wrap between submerged metal pipe and oversized clamps.

END OF SECTION

SECTION 15205

COMMON WORK RESULTS FOR PROCESS VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Common work results for process valves.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. American Society of Mechanical Engineers:
   1. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.

C. ASTM International:
   1. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
   2. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
   3. ASTM A307 – Standard Specification for Carbon Steel Bolts and Studs.
   4. ASTM A351/A351M - Standard Specification for Castings, Austenitic, Austenitic-Ferritic (Duplex), for Pressure-Containing Parts.

D. American Water Works Association:
   1. AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
   2. AWWA C508 – Swing-Check Valves for Waterworks Service, 2 In. Through 24 In.
   3. AWWA C509 – Resilient Seated Gate Valves for Water Service.
   4. AWWA C510 - Double Check Valve Backflow Prevention Assembly.
   5. AWWA C512 - Air Release, Air/Vacuum, and Combination Air Valves for Waterworks Service.
   6. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

E. Manufacturers Standardization Society:
   1. MSS SP-72 - Ball Valves with Flanged or Butt-Welded Ends for General Service.
   2. MSS SP-81 - Stainless Steel, Bonnetless, Flanged, Knife Gate Valves.
   3. MSS SP-110 - Ball Valves, Threaded, Solvent Welded, Solder Joint, Grooved and Flared Ends.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene monomer.

B. PTFE: Polytetrafluoroethylene.

1.4 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include vendor information, provide product bulletins, materials of construction, design pressure/operating pressure, and ancillary equipment details, connections, and power requirements.

C. Shop Drawings: Indicate dimensions, inlet and outlet size, overall body size, connection type, operator size.

D. Design Data: Indicate operating pressure data, and verify valve suitability for fluid service as specified.

E. Manufacturer's Instructions: Indicate installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Indicate location of valves and valve number.

C. Operation and Maintenance Data: Indicate instructions for operation, maintenance, and cleaning.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept valves on the Site in original packaging. Inspect for damage. Valves shall have end caps on both ends of valves and remain until installation.

C. Protect valves from damage.

1.7 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution and Closeout Requirements: Requirements for warranties.

B. Manufacturer’s Warranty shall be as described in document BP-1-11 Rev 3– Schedule 5 – Commercial Terms and Conditions for Building Construction Services.

C. Warranty: Include coverage for valve and operator equipment.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall include operator/actuator/handwheel/chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain wheel, wrench and accessories for a complete operational valve.

B. Valve shall be certified by the manufacturer suitable for intended service.

C. All valves to be the same size as adjoining pipe unless otherwise noted on the Drawings. Valve ends shall suit adjacent piping.

D. Size operator to operate the valve for the full range of pressures and velocities.

E. Valves shall open by turning counterclockwise.

F. Factory-mount operator, actuator, and accessories.

2.2 VALVE OPERATORS

A. General: All valves shall be equipped with operators. The valve operator types, as specified herein, describe only the general characteristics of the operator. The operator shall be compatible with the valve with which it will be used and shall be of the same manufacturer, or a product that is specified by the valve manufacturer.

B. Manual Operators:
   1. Manual handwheel operators shall be provided unless otherwise specified or indicated. Ferrous handwheels/operators shall be galvanized and painted the same colour as the valve and associated pipeline.
   2. Lever operators may be supplied on quarter turn valves 150 mm (6 inches) and smaller, if recommended by the manufacturer; however, operator force shall not exceed initial breakaway, and lever arm shall not exceed 400 mm.
   3. When the maximum force required to operate a valve under full operating head exceeds 18 kg (40 pounds), gear reduction operators shall be provided. Gear operators shall be totally enclosed and lubricated.
   4. On quarter turn valves, valve operators shall be of the self locking type to prevent the disc or plug from creeping and shall be provided with position indicators to show the position of the valve disc or plug. Operators of the worm and gear type shall have self locking worm gears, one-piece design, of bronze material, and accurately machine cut. The worm shall be hardened alloy steel, with thread ground and polished. Operators of the geared traveling nut type shall be threaded steel reach rods with an internally threaded bronze or ductile iron nut.
   5. Valves with operators located more than 1.8 m (6 feet) above finished floor shall be fitted and chain wheels and guides. Chain wheels and guides shall be galvanized or cadmium plated. Chains shall be of the size recommended by the valve manufacturer and shall extend with within 1.2 m (4 feet) of the operating floor. Where chains hang in normally traveled areas, appropriate "L" type tie back anchors shall be provided and located as approved by ENGINEER.

C. Electric Actuators:
   1. Single phase 600V power supply, dedicated feed from electrical panel, with separate conduit routed for control wiring. Install where indicated on Contract Drawings.
   2. Valve actuator shall incorporate motor, integral reversing starter, local control facilities and terminals for remote control and indication connections housed within a self-contained, sealed enclosure.
   3. Valve actuator shall comply with EN15714-2 and ISA SP96.02.
   4. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.
   5. Actuator shall be sized appropriately for selected valve. Valve shall fully close under a system pressure of 101.325 kPa (guage) at a temperature of 0-30 deg. C. The safety margin of motor power available for seating and unseating the valve must be sufficient to ensure torque switch trip at maximum valve torque with the supply voltage 10% below nominal.
   6. Actuators must be suitable for indoor and outdoor use with a standard corrosivity category, C4 medium durability as per ISO 12944. The actuator must be capable of functioning in an ambient temperature ranging from -30°C (-22°F) to +70°C (+158°F), up to 100% relative humidity. Actuators for hazardous area applications must meet the area classification, gas group and surface temperature requirements specified in the data sheet. For this application, actuators must be suitable for installation in a Class 1, Zone 2 Group D.
   7. Actuators shall be O-ring sealed, watertight to IP66/IP68 20m for 10 days, NEMA 4, 6. The motor and all other internal electrical elements of the actuator must be protected from ingress of moisture and dust when the terminal cover is removed for site cabling. The terminal compartment must maintain the same ingress protection rating with the terminal cover removed. The actuator enclosure must allow for temporary site storage without the need for electrical supply connection. All external fasteners shall be suitable for the actuator corrosivity category and installation environment indicated on the datasheet.
   8. The motor must be an integral part of the actuator, designed specifically for valve actuator applications. The motor shall be a low inertia, high torque design and class F insulated. Resulting in class B temperature rise with a time rating of 15 minutes at 40°C (104°F) at an average load of at least 33% of maximum valve torque. Temperature shall be limited by thermostat device embedded in the motor end windings and integrated into the actuator control. Electrical and mechanical disconnection of the motor shall be possible without draining the lubricant from the actuator gearcase. The actuator shall include a device to ensure that the motor runs with the correct rotation for the required direction of valve travel irrespective of the connection sequence of the power supply.
   9. Protection must be provided for the motor as follows:
      a. Stall - the motor must be de-energised within 8 seconds in the event of a stall when attempting to unseat a jammed valve.
      b. Over temperature - thermostat will cause tripping of the motor. Auto-reset on cooling
      c. Single phasing - lost phase protection.
      d. Direction – phase rotation correction.
   10. The actuator gearing must be totally enclosed in an oil-filled gearcase suitable for operation at any angle. Grease lubrication is not permissible. All drive gearing and components must be of metal construction and incorporate a lost-motion hammer blow feature. For rising spindle valves the output shaft shall be hollow to accept a rising stem, and incorporate thrust bearings of the ball or roller type at the base of the actuator. The design should be such as to permit the opening of the gearcase for inspection or disassembled without releasing the stem thrust or taking the valve out of service. For 90° operating type valves, drive gearing shall be self-locking to prevent the valve back-driving the actuator

11. A handwheel must be provided for emergency operation, engaged when the motor is declutched by a lever or similar means, the drive being restored to electrical operation automatically by starting the motor. The handwheel or selection lever must not move on restoration of motor drive. Provision shall be made for the hand/auto selection lever to be locked in both hand and auto positions. It should be possible to select hand operation while the actuator is running or start the actuator motor while the hand/auto selection lever is locked in hand without damage to the drive train.
    a. Clockwise operation of the handwheel must give closing movement of the valve unless otherwise stated in the data sheet. For linear valve types the actuator handwheel drive must be mechanically independent of the motor drive and should be such as to permit valve operation in a reasonable time with a manual force not exceeding 400N through stroke and 800N for seating/unseating of the valve.
12. The actuator shall be furnished with a drive bushing easily detachable for machining to suit the valve stem or gearbox input shaft. The drive bush shall be positioned in the base of the actuator. Thrust bearings shall be sealed for life and the base shall be capable of withstanding five times the rated thrust of the actuator.
13. The actuator must incorporate local controls for Open, Close and Stop operation and a Local/Stop/Remote mode selector switch. Mode selection must be lockable in any one of the following three positions: local control plus local stop only, stop (no electrical operation), remote control plus local stop only. It must be possible to select maintained or non-maintained local control.
    a. The local controls shall be arranged so that the direction of valve travel can be reversed without the necessity of stopping the actuator.
    b. The local controls and display shall be rotatable through increments of 90 degrees to suit valve and actuator orientation.
14. Torque and turns limitation to be adjustable as follows:
    a. Position setting range – multi-turn: 2.5 to 8,000 turns, with resolution to 7.5° of actuator output.
    b. Position setting range – direct drive part turn actuators: 90° +/-10°, with resolution to 0.1° of actuator output.
    c. Torque setting: 40% to 100% rated torque.
    d. Position measurement – Absolute position measurement should be incorporated within the actuator. The technology must be capable of reliably measuring position even in the case of a single fault. The design must be simple with the minimum amount of moving parts (no more than 5). Technologies such as LEDs or potentiometers for position measurement are considered unreliable and therefore not preferred.
    e. Measurement of torque for multi-turn actuators must be from direct measurement of force at the output of the actuator. Methods of determining torque-using data derived from the motor such as motor speed, current, flux etc. are only acceptable for part-turn actuators.
    f. A means for automatic “torque switch bypass” to inhibit torque off during valve unseating and “latching” to prevent torque switch hammer under maintained or repeated control signals shall be provided.
    g. The electrical circuit diagram of the actuator should not vary with valve type remaining identical regardless of whether the valve is to open or close on torque or position limit.
15. Four contacts must be provided which can be selected to indicate any position of the valve; Provision must be made for the selection of a normally closed or open contact form. Contacts shall maintain and update position indication during hand wheel operation when all external power to the actuator is isolated.
    a. The contacts must be rated for 5mA to 5A, 120V AC, 30V DC.
    b. As an alternative to providing valve position indication, any of the four contacts shall be selectable to signal one of the following:
        1) Valve opening, closing or moving

2) Thermostat tripped, lost phase
3) Motor tripped on torque in mid travel, motor stalled
4) Remote selected, Local selected, Stop selected
5) Actuator being operated by handwheel
6) Actuator fault

c. Provision shall be made in the design to support an additional eight contacts with the same configurable functionality.
d. A configurable monitor relay must be provided as standard, which can be used to indicate either Availability or Fault. The relay should be a spring return type with a Normally Open / Normally Closed contact pre-wired to the terminal block.
e. The Monitor (availability or fault) relay, being energized from the control transformer will de-energise under any one or more the following conditions:
f.

Available Mode	Fault Mode
• Loss of main or customer 24V DC power supply power supply	• Loss of main or customer 24V DC
• Actuator control selected to local or stop	• Motor thermostat tripped
• Motor thermostat tripped	• Actuator internal fault
• Actuator internal fault	

g. Provision shall be made in the design for the addition of a contactless transmitter to give a 4-20mA analogue signal corresponding to valve travel and / or torque for remote indication when required. The transmitter will auto range to the set limits.

16. The actuator display must include a dedicated numeric/symbol digital position indicator displaying valve position from fully open to fully close in 0.1% increments. Valve closed and open positions shall be indicated by symbols showing valve position in relation to the pipework to ensure that valve status is clearly interpreted. With mains power connected, the display must be backlit to enhance contrast at all ambient light levels and must be legible from a distance of at least 5m (16ft). A power save mode shall be available to switch off the display backlight during long periods of inactivity.
    a. Red, green, and yellow LEDs corresponding to open, closed and intermediate valve positions must be included on the actuator display when power is switched on. The yellow LED should also be fully programmable for on/off, blinker and fault indication. The digital display must be maintained and updated during handwheel operation when mains power to the actuator is isolated.
    b. The actuator display shall include a fully configurable dot-matrix display element with a minimum pixel resolution of 168 x 132 to display operational, alarm, configuration and graphical datalogger information. The text display shall be selectable between English and other languages such as: Spanish, German, French, and Italian. Provision shall be made to upload a different language without removal of any covers or using specialized tools not provided as standard with the actuator.
    c. Datalogger graphical displays and trend graphs must be available on the local LCD for the following functions:
        1) Torque versus Position
        2) Number of Starts versus Position
        3) Number of starts per hour
        4) Dwell Time
        5) Average temperature
    d. The main display must include configurable a minimum of four different home-screens that include the following information:
        1) Position and status
        2) Position and torque (analogue)
        3) Position and torque (digital)
        4) Position and demand (positioning)

e. An optional environmental cover to protect the display from high levels of UV radiation or abrasive materials must be available and shall be fitted without the need for any special tooling.
f. The local controls and display must be rotatable through increments of 90 degrees to suit valve and actuator installation orientation.

17. The reversing starter, control transformer and local controls must be integral to the valve actuator and suitably housed to prevent breathing and condensation. The starter shall be suitable for 60 starts per hour during normal service or 1,200 starts per hour under reduced load conditions and of rating appropriate to motor size. The controls supply transformer shall be fed from two of the incoming three phases and incorporate overload protection. It must have the necessary voltage tapping and be adequately rated to provide power for the following functions:
    a. Energizing of the contactor coils
    b. 24V DC or 110V AC output for remote controls (maximum 5W/VA)
    c. Supply for all the internal electrical circuits
    d. An alternative solid state motor starter is permissible for applications requiring up to 1,200 starts per hour. 24VDC remote controls should be used in combination with a solid state starter to maximise response time. The solid state starter must facilitate configurable electrical braking functionality.
    e. Speed adjustable actuators must have an integral motor controller to manage starting, speed and operation.
18. The necessary control, wiring and terminals must be contained within the actuator enclosure. Open and close external interlocks must be made available to inhibit local and remote valve opening / closing control. It must be possible to configure the interlocks to be active in remote control only.
    a. Remote control signals fed from an internal 24VDC (or 110VAC) supply and/or from an external supply between 20V and 60VDC or 40V and 120VAC, must be suitable for any one or more of the following methods of control:
        1) Open, Close and Stop control
        2) Open and Close maintained or “push to run” (inching) control
        3) Overriding Emergency Shut-Down; to close (or open) valve from a normally closed or open contact
        4) Two-wire control; energise to close (or open), de-energise to open (or close)
    b. Additionally, provision shall be made for a separate ‘drive enable’ permissive input to prevent any unwanted electrical operation.
    c. It must be possible to reverse valve travel without the necessity of stopping the actuator or moving through an intermediate stop control position. The motor starter must be protected from excessive current surges during rapid travel reversal. The internal circuits associated with the remote control and monitoring functions are to be designed to withstand simulated lightning impulses up to 2kV.
19. Facilities to indicate actuator availability and monitor operation must be included as standard.
    a. Actuator text display indication of the following status/alarms:
        1) Closed Limit, open limit, moving open, moving closed, stopped
        2) Torque trip closing, torque trip opening, motor stalled
        3) ESD active, interlock active
        4) Thermostat trip, phase lost, 24V supply lost, local control failure
        5) Configuration error, position sensor failure, torque sensor failure
        6) Battery low, battery discharged, power loss inhibit
        7) Integral datalogger to record and store the following operational data:
        8) Opening last / average torque against position
        9) Closing last / average torque against position
        10) Opening motor starts against position
        11) Closing motor starts against position
        12) Total open / closed operations

13) Maximum recorded opening and closing torque values
14) Event recorder logging operational conditions (valve, control and actuator)

b. The event log must include time and date information for each stored event.

20. Internal wiring shall be tropical grade PVC insulated stranded cable of appropriate size for the control and power. Each wire shall be clearly identified at both ends. The terminals shall be embedded in a terminal block of high tracking resistance compound.
    a. The terminal compartment must be separated from the inner electrical components of the actuator by means of a watertight seal. A minimum of four threaded cable entries with provision for an additional four extra conduit entries must be available to accommodate wiring connections.
    b. All wiring supplied as part of the actuator must be contained within the main enclosure for physical and environmental protection. External conduit connections between components are not acceptable. A durable terminal identification card showing a plan of terminals must be attached to the inside of the terminal box cover indicating:
        1) Serial number
        2) External voltage values
        3) Wiring diagram number
        4) Terminal layout
    c. The code card must be suitable for the contractor to inscribe cable core identification alongside terminal numbers.
21. Provide remote hand station for each actuator provided. Integrate remote hand station with actuator per manufacturer recommendations. Remote hand station shall be suitable for outdoor installation. Remote hand station shall be suitable in Class 1 Zone 2 Group D area. Remote hand station shall be pole mounted and shall be powered from the actuator.
22. Rotork IQ Series actuator for isolation service, unless otherwise noted.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that piping, plumbing, chambers, and pumping systems are ready to receive the work of this Section.

3.2 PREPARATION

A. Clean internal and external threads before applying sealant and assembling threaded piping.

B. Clean flange faces for proper seating of flange gasket.

3.3 INSTALLATION

A. Install and erect valves in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Provide clearance for installation of insulation and access to valves and fittings.

D. Provide access where valves and fittings are not exposed.

E. Provide support for valves where required for proper support and operation.

F. Install operator in position for convenient operation. Ensure space is available for operation of separators.

G. Install valves with stems upright or horizontal, not inverted.

H. Install unions, flanges, or couplings downstream of valves.

I. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Hydrostatic test with piping.

3.5 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Clean valves prior to painting, insulating or coating.

3.6 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution and Closeout Requirements: Requirements for protecting installed work.

B. Keep valves in closed position following installation.

3.7 VALVE SCHEDULE

Service	Function	Size	Valve Type	Specification #	Operator
Treated Sewage (MISA Sampling System)[1]	Isolation	12 mm and Greater	V-BA3	15205-01	Manual, lever
Raw Wastewater/Wastewater Sludge[2] (RAS/WAS Service	Isolation	150 mm	V-GA3	15205-2	Electric actuator with manual hand wheel

A. Refer to P-103 for associated valves and sizes.

B. Refer to P-101 and P-102 for associated valves and sizes.

END OF SECTION

SECTION 15205-01

CAST IRON PROCESS GATE VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and installation of general duty cast iron gate valves for process service.

B. Refer to Section 15205 for valve listing for specific valve types to be utilized.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. American Society of Mechanical Engineers:
1. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
2. ASME B16.5 – Pipe flanges and Flanged Fittings: Nominal Pipe Size (NPS) 1/2 inch through 24 inch – Metric/Inch Standard.
3. ASME B16.10 – Face to Face and End to End dimensions of Valves.

C. ASTM International:
1. ASTM A126 – Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.
2. ASTM A536 – Standard Specification for Ductile Iron Castings.

D. American Water Works Association:
1. AWWA C116 - Protective Fusion-Bonded Epoxy Coatings for the Interior and Exterior Surfaces of Ductile-Iron and Gray-Iron Fittings for Water Supply Service.
2. AWWA C509 – Resilient Seated Gate Valves for Water Service.
3. AWWA C550 - Protective Interior Coatings for Valves and Hydrants.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene monomer.

B. PTFE: Polytetrafluoroethylene.

C. SBR: Styrene-Butadiene Rubber.

1.4 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include vendor information, provide product bulletins, materials of construction, design pressure/operating pressure, and ancillary equipment details, connections, and power requirements.

C. Shop Drawings: Indicate dimensions, inlet and outlet size, overall body size, connection type, operator size.

D. Design Data: Indicate operating pressure data, and verify valve suitability for fluid service as specified.

E. Manufacturer's Instructions: Indicate installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Indicate location of valves and valve number.

C. Operation and Maintenance Data: Indicate instructions for operation, maintenance, and cleaning.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept valves on the Site in original packaging. Inspect for damage. Valves shall have end caps on both ends of valves and remain until installation.

C. Protect valves from damage.

1.7 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution and Closeout Requirements: Requirements for warranties.

B. Manufacturer’s Warranty shall be as described in document BP-1-11 Rev 3– Schedule 5 – Commercial Terms and Conditions for Building Construction Services.

C. Warranty: Include coverage for valve and operator equipment.

PART 2 PRODUCTS

2.1 GENERAL

A. All valves shall include operator/actuator/handwheel/chain wheel, extension stem, floor stand, worm and gear operator, operating nut, chain wheel, wrench and accessories for a complete operational valve. Refer to valve schedule in Section 15205-00 for required valve operators.

B. Valve shall be certified by the manufacturer suitable for intended service.

C. All valves to be the same size as adjoining pipe unless otherwise noted on the Drawings. Valve ends shall suit adjacent piping.

D. Size operator to operate the valve for the full range of pressures and velocities.

E. Valves shall open by turning counterclockwise.

F. Factory-mount operator, actuator, and accessories.

G. Provide valving only as specified in valve table in Section 15205, and as indicated on the Drawings.

2.2 VALVES

A. RESILIENT SEATED GATE VALVE – V-GA3
   1. Cast Iron Gate Valve, non rising stem, with bolted bonnet for valves 65 mm and larger to AWWA C509 standard.
   2. Body and bonnet to be ASTM A126 class B cast iron.
   3. Wedge is to be rubber encapsulated (SBR rubber) cast iron meeting the requirements of ASTM A126 class B.
   4. Valve to be rated for 1723 kPag maximum working pressure.
   5. Valve shall have epoxy coated interior and exterior surfaces in accordance with AWWA C550 and meet the requirements of NSF 61.
   6. End connections shall be flanged to ANSI/ASME B16.1 class 125.
   7. Provide all valves with post indicating operator unless otherwise shown on drawings.
   8. Acceptable Manufacturers
      a. Clow
      b. Mueller
      c. Crane
      d. Jenkins
      e. Approved Equal

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that piping, plumbing, chambers, and pumping systems are ready to receive the work of this Section.

3.2 PREPARATION

A. Clean internal and external threads before applying sealant and assembling threaded piping.

B. Clean flange faces for proper seating of flange gasket.

3.3 INSTALLATION

A. Install and erect valves in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Provide clearance for installation of insulation and access to valves and fittings.

D. Provide access where valves and fittings are not exposed.

E. Provide support for valves where required for proper support and operation.

F. Install operator in position for convenient operation. Ensure space is available for operation of separators.

G. Install valves with stems upright or horizontal, not inverted.

H. Install unions, flanges, or couplings downstream of valves.

I. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Hydrostatic test with piping.

3.5 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Clean valves prior to painting, insulating or coating.

3.6 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution and Closeout Requirements: Requirements for protecting installed work.

B. Keep valves in closed position following installation.

END OF SECTION

SECTION 15205-03

STAINLESS STEEL BALL VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Materials and installation of stainless steel ball valves for process duty.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. American Petroleum Institute: API 607 - Fire Test for Quarter-turn Valves and Valves Equipped with Non-metallic Seats, 6th Ed.

C. American Society of Mechanical Engineers:
1. ASME B1.20.1 – Pipe threads, general purpose, Inch.
2. ASME B16.1 – Cast Iron Pipe Flanges and Flanged Fittings.
3. ASME B16.5 – Pipe flanges and Flanged Fittings: NPS 1/2 through 24 – Metric/Inch Standard.
4. ASME B16.10 – Face to Face and End to End dimensions of Valves.

D. National Association of Corrosion Engineers: MR0175 – Petroleum and Natural Gas Industries- Materials for Use in H_2S-Containing Environments in Oil and Gas Production.

1.3 DEFINITIONS

A. EPDM: Ethylene propylene diene monomer.

B. PTFE: Polytetrafluoroethylene.

1.4 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include vendor information, provide product bulletins, materials of construction, design pressure/operating pressure, and ancillary equipment details, connections, and power requirements.

C. Shop Drawings: Indicate dimensions, inlet and outlet size, overall body size, connection type, operator size.

D. Design Data: Indicate operating pressure data, and verify valve suitability for fluid service as specified.

E. Manufacturer's Instructions: Indicate installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Project Record Documents: Indicate location of valves and valve number.

C. Operation and Maintenance Data: Indicate instructions for operation, maintenance, and cleaning.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept valves on the Site in original packaging. Inspect for damage. Valves shall have end caps on both ends of valves and remain until installation.

C. Protect valves from damage.

1.7 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution and Closeout Requirements: Requirements for warranties.

B. Manufacturer’s Warranty shall be as described in document BP-1-11 Rev 3– Schedule 5 – Commercial Terms and Conditions for Building Construction Services.

C. Warranty: Include coverage for valve and operator equipment.

PART 2 PRODUCTS

2.1 GENERAL

A. Valve shall be certified by the manufacturer suitable for intended service.

B. All valves to be the same size as adjoining pipe unless otherwise noted on Drawings. Valve ends shall suit adjacent piping.

2.2 VALVES

A. General Service Ball Valve – V-BA3.
   1. Threaded ball valve Type 316 stainless steel body, ON-OFF (2 way) service valves
   2. Minimum working pressure to be 14 MPa.

3. Threaded ends meeting the requirements of ASME B1.20.1 and ANSI B16.10.
4. Reinforced PTFE seats of memory seal type with both seats in tension or spring loaded to provide leak tight seals and high and low pressure.
5. Acceptable Manufacturers:
   a. Swagelock
   b. Approved Equal

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that piping, plumbing, chambers, and pumping systems are ready to receive the work of this Section.

3.2 PREPARATION

A. Clean internal and external threads before applying sealant and assembling threaded piping.

B. Clean flange faces for proper seating of flange gasket.

3.3 INSTALLATION

A. Install and erect valves in accordance with manufacturer's instructions.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

C. Provide clearance for installation of insulation and access to valves and fittings.

D. Provide access where valves and fittings are not exposed.

E. Provide support for valves where required for proper support and operation.

F. Install operator in position for convenient operation. Ensure space is available for operation of separators.

G. Install valves with stems upright or horizontal, not inverted.

H. Install unions, flanges, or couplings downstream of valves.

I. Install brass male adapters each side of valves in copper piped system. Sweat solder adapters to pipe.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Hydrostatic test with piping.

3.5 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Clean valves prior to painting, insulating or coating.

3.6 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution and Closeout Requirements: Requirements for protecting installed work.

B. Keep valves in closed position following installation.

END OF SECTION

SECTION 15955

PIPING LEAKAGE TESTING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. General requirements for testing piping system.

1.2 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Informational Submittals:
   1. Testing Plan: Submit prior to testing and include the following information at a minimum:
      a. Testing dates.
      b. Piping systems and section(s) to be tested.
      c. Test type.
      d. Method of isolation.
      e. Calculation of maximum allowable leakage for piping section(s) to be tested.
   2. Certifications of Calibration: Testing equipment.
   3. Certified Test Report.

PART 2 PRODUCTS (Not Used)

PART 3 EXECUTION

3.1 PREPARATION

A. Notify ENGINEER in writing, a minimum of 10 days in advance of testing. Perform testing in the presence of ENGINEER.

B. Pressure Piping:
   1. Install temporary thrust blocking or other restraint as necessary to protect adjacent piping or equipment and make taps in piping prior to testing.
   2. Prior to testing, remove or suitably isolate appurtenant instruments or devices that could be damaged by pressure testing.
   3. New Piping Connected to Existing Piping:
      a. Isolate new piping with grooved-end pipe caps, spectacle blinds, blind flanges, or as acceptable to ENGINEER.
      b. Test joints between new piping and existing piping by methods that do not place the entire existing system under test load, as approved by ENGINEER.
   4. Items that do not require testing include: Tank overflows to atmospheric vented drains and tank atmospheric vents.
   5. Test Pressure: 1.5 times maximum operating pressure with a minimum of 860 kPag.

6. Test potable water piping in accordance with OBC, hydrostatically at 1000 kPa for a minimum of 2 hours.
7. Test DWV piping and roof drains in accordance with OBC hydrostatically with 3 meters head for 15 minutes.

C. The test section may be filled with water and allowed to stand under low pressure prior to testing.

D. Gravity Piping: Perform testing after service connections completed.

3.2 HYDROSTATIC TEST FOR PRESSURE PIPING

A. Fluid: Clean water of such quality to prevent corrosion of materials in the piping system.

B. Exposed Piping:
1. Perform testing on installed piping prior to the application of insulation.
2. Maximum Filling Velocity: 0.076 m/s, applied over full area of pipe.
3. Vent piping during filling. Open vents at high points of the piping system or loosen flanges, using at least four bolts, or use equipment vents to purge air pockets.
4. Maintain the hydrostatic test pressure continuously for a minimum of 4 hours, and for such additional time as necessary to conduct examinations for leakage.
5. Examine all joints and connections for leakage.
6. Correct all visible leakage and retest as specified herein.
7. Empty the pipe of water prior to final cleaning or disinfection.
8. Correct any leakages greater than those allowable under the Contract, and retest as specified, at CONTRACTOR's expense.

3.3 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Test Report Documentation:
1. Test date.
2. Description and identification of piping tested.
3. Test fluid.
4. Test pressure.
5. Remarks, including:
   a. Leaks (type, location).
   b. Repair/replacement performed to remedy excessive leakage.
6. Signed by CONTRACTOR and ENGINEER to represent that the test has been satisfactorily completed.

END OF SECTION

SECTION 16000

ELECTRICAL AND CONTROL SYSTEM - SCOPE OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Works Organization and Intent

B. Summary of electrical, control, programming, and associated works.

1.2 EXAMINATION

A. Examine the Drawings and Specifications; visit the Site to ascertain that the Work can be carried out satisfactory without changes to the Contract Documents.

B. If anything in the Contract Documents interferes with execution of the Work and intent of the Project, or does not comply with applicable codes and regulations, inform ENGINEER immediately in writing.

1.3 WORKS INTENT

A. Upgrades include new works, demolition, modifications, and/or relocation of existing electrical and control systems in the Bruce Power Sewage Processing Plant.

B. Provision and installation of a new control panel WW-66400-CPL101 that will accommodate:
   1. Sewage Processing Plant,
   2. Existing instrumentation panel signals,
   3. MISA Sampling System,
   4. Existing Polymer Systems,
   5. Existing Alum Injection System,
   6. Sump Pumps,
   7. Existing MCC & new VFDs
   8. Existing and new instrumentation, new open channel flowmeters, motorized actuator valves and
   9. other systems currently serviced by existing OCWA OUTPOST5 Panels 1002, 1003 & 1004, which will be removed.

C. Install new MCC Sections containing VFDs for the raw sewage pumps (WW-53340-VFD1, VFD2&VFD3).

D. Install new 30A circuit breaker in section CB1G5 of WW-53340-MCC01

E. Installation of new VFD system for UV System Pumps

F. Installation of a new control panel for UV system WW-67969-PL9261. It will be provided by IRONBROOK UV.

G. Installation of new sludge wasting/return valves WW-79610-MV11, WW-79610-MV12, WW-79610-MV13 and WW-79610-MV14

H. Installation of a new marshaling panel (WW-67961-PL100).

I. Replacing existing JBs in field with new ones (WW-5354-JB100, WW-67961-JB1000 & JB1001).

J. New cabling and conduit routing for all associated signals.

K. Demolition of existing instrumentation panel, existing control panels OUTPOST5 (WW-66400-PL1002, PL1003 & PL1004) and existing UV control panel WW-67969-PL9261.

L. Decommissioning and demolition of existing Motorized Sludge Valve Local Control Panel WW-79610-PL9291 and the removal of all associated cabling.

M. Decommissioning and removal of the existing MISA sampling system in basement of existing Control Building.

N. Provide, install, and integrate new MISA sampling system in UV Building.

O. Removal of existing effluent flow measurement instrumentation. Provide, Install, and integrate new effluent flow measurement instrumentation.

1.4 PROJECT ORGANIZATION - SEQUENCING AND SCHEDULING

A. The suggested sequence of construction, as outlined in following paragraphs, generally organized by work item number is based on minimizing interferences with the operation of the Sewage Processing Plant.

B. CONTRACTOR may propose to sequence the works differently but a detailed description of the alternative sequence proposed must be submitted to BPL and ENGINEER for review and approval prior to commencing the work. For bid purposes, CONTRACTOR shall assume that the suggested sequence of construction will be followed. No claims will be considered for delays or other costs allegedly arising out of adherence to the suggested sequence of work.

C. Provide Construction Schedule. Schedule shall clearly identify all interim steps of SCADA (control system) programming works in addition to physical construction tasks. Organize and schedule works accordingly; allow time to incorporate limitations.

D. SPP shall remain operational at all times. Unless work directly impacts sections of the SPP, the CONTRACTOR shall ensure that all construction does not interfere with the current operation of the facility. CONTRACTOR to be aware that the SPP can be controlled and operated remotely from plant SCADA system. This functionality shall be maintained until equipment is switched over to the new system.

E. Coordinate construction activities with plant operations. Schedule works so that disruption to the operations of the facilities is kept to a minimum. Obtain prior authorization from the BPL before de-energizing or energizing a circuit. Plan and schedule work to minimize the interference with operations and to avoid disruptions of power.

1.5 ELECTRICAL WORKS

A. Item E100 – Identification
   1. Provide tags and identify all existing and new wiring (power, control, and network) in accordance with Specification 16075 and BPL guideline.
   2. Identify all electrical, instrumentation and control equipment with tags and labels affected by work.
   3. Tag wiring. Do not leave unidentified systems.
   4. Provide warning signs.

B. Item E110 – New raceways, junction boxes and marshalling cabinet.
   1. De-energize circuits, disconnect, and remove wiring from WW-53340-MCC01 (CB1H1 & CB1H2) to the existing MV11 & MV13 Control panel and actuators. Remove the local control panel (WW-79610-PL9291) and all cabling associated with this device. This includes all below grade field wiring and wiring in duct banks as well as all cable and conduit runs located in the basement of the control building.
   2. Install Duct Banks in the field as shown on the drawings. Core drill through the walls into the basement of the control building as shown on the drawings. Install conduits as shown on the drawings.
   3. Provide and install new raceways (conduits) including support structures and openings to accommodate new power and new control and instrumentation cables as indicated on drawings.
   4. Provide and install new marshalling cabinet including support structures and openings for terminating new cabling as shown on the Contract Drawings.
   5. Provide and install new junction box (WW-67961-JB1000) as shown on the drawings, for terminating new cabling as indicated on drawings.
   6. Provide new junction boxes for existing WW-67961-JB1001 and WW-5354-JB100. Refer to existing drawings and verify terminations on site.
   7. Connect new cabling to new junction boxes.

C. Item E120 – New feeders for motorized valves (MV11, 12, 13, 14).
   1. Provide and install new 600 VAC power feeder from WW-53340-MCC01 to the MV11, 12, 13, 14 remote actuators. Refer to Cable list for additional information on cabling.
   2. Terminate and connect new 600 VAC power wiring as shown on the drawing.
   3. Remove existing valves and install new actuated valves. Coordinate with Bruce Power SPP operations for any need to shut down process tanks or treatment trains.
   4. Install heat tracing system as indicated on the drawings.
   5. Upon completion, energize circuits and verify installation.
   6. Coordinate activities with work item C204.

D. Item E130 – Installation of new MCC Section for Raw Sewage Pump VFDs (WW-53340-VFD1, VFD2 & VFD3).
   1. This work item is identified here for work sequencing purposes only.
   2. Refer to VFDs drawings and specifications for details.
   3. Install new MCC in the location as indicated on the drawing.
   4. Field run all 600VAC and control cabling between the new MCC sections and associated devices (e.g. Control panel, Disconnect switches, etc.) Do not terminate and connect cabling at this stage.
   5. De-energize MCC and install a new 30A breaker in MCC section CB1G5. Disconnect, and remove 600 VAC power wiring from existing circuits (CB1D1, CB1D2& CB1D3) which currently feeding Raw Sewage Pumps.

6. Terminate and connect new 600 VAC power (CB1D1 30A Breaker) and control wiring to Raw Sewage Pumps WW-79610-P1 to P3 as shown on the Drawings, refer to drawing NK37-DRAW-53000-10052
7. Upon completion, energize circuits and verify installation.
8. Decommission and remove existing VFD panels. Remove all connections and remove all field cabling where safe to do so.
9. Coordinate activities with work item C204.

E. Item E140 – Installation of new panel (WW-67969-PL9275)
1. This section shall detail the replacement of the existing panel WW-67969-PL9275 with a new panel. This new panel shall be complete with New VFDs for UV pumps WW-79620-P039 & P040 and all associated hardwired controls shown on the Schematics located in the Contract Drawings.
2. Prerequisite: Installation of temporary UV system and demolition of existing panels item C150.
3. To schedule the work, coordinate with BPL and IRONBROOK.
4. Refer to drawings and specifications for details on Panel installation and VFD schematics.
5. Remove existing panel WW-67969-PL9275
6. Install new panel WW-67969-PL9275.
7. Provide and install new 600 VAC power feeder from panel WW-67969-PL9275 to UV pumps drives per the Cable list.
8. Terminate and connect existing 600 VAC power wiring from existing panel board WW-53340-PL9259.
9. Upon completion, energize circuits and verify installation.
10. Coordinate activities with work item C204.

F. Item E150 – Final demolishing and removal.
1. Upon completion of all control works, de-energize, disconnect, and remove all panels, control (signals, network) and power wiring that is no longer used.
2. Disassemble and remove all raceways (cable trays, conduits, junction and pull boxes, etc.) and associated support structures that are no longer used.
3. Return complete, decommissioned VFDs to the BPL
4. See also work items C140, C145, C148, C150.

1.6 NEW CONTROL PANEL WW-66400-CPL101

A. Item C110 – New control panel WW-66400-CPL101.
1. Overview:
   a. Works include detailed design, provision of components, manufacturing, and installation of new control panel, which will provide control and monitoring of sewage processing plant and associated systems located at the Bruce Power SPP.
   b. Control panel must be designed and build by a CSA certified panel shop. Approved panel shops:
      1) ACP Solutions,
      2) Hardie,
      3) Summa Engineering.
2. Coordinate detailed design and reviews of the new control panel with SCADA INTEGRATOR (SI). (See Work Item C200 & C202).
3. Provide detailed design and shop drawings. Shop drawings must be submitted in 2 electronic formats - PDF and AutoCAD DWG. Refer to section 13430 for more details.

4. Manufacture new control panel in accordance with other applicable standards under this contract.
5. Perform control panel FAT in accordance with standards outlined in this contract.

B. Item C112– Installation of new panel WW-66400-CPL101
   1. Overview:
      a. This task includes key works required for the installation of the control panel and putting it into operation.
      b. It shall be noted that after completion of this task, the control panel will remain live to accommodate plant operation. CONTRACTOR to isolate connections as necessary to complete other works under this specification.
      c. Systems will be switched over, added, or connected in multiple steps as outlined in the following paragraphs.
   2. Prerequisite: Successful completion of the control panel FAT accepted by BPL and ENGINEER.
   3. Install new control panel in the ELECTRICAL ROOM of SPP on the existing base as indicated on the drawings.
   4. Provide 120 VAC power from existing lighting panel as shown on the drawing.
   5. Power up control panel. Verify that are no ground faults, and that all components operate correctly.
   6. Provide and install new wire and cables. New cabling to be routed to instrumentation utilizing existing routing as much as possible or routing as indicated on the drawings. Connect control signals to the new control panel WW-66400-CPL101 as per I/O list. Including:
      a. Signals which are connected to annunciator panel / instrumentation panel.
      b. Signals from motor control center.
      c. Signals from field instruments connected to OUTPOST 5 panels and annunciator panel.
      d. Signals from Protection Relay panel.
   7. Test all I/O and connections.
   8. Provide Ethernet network connection to the new master PLC in the control panel WW-66400-CPL101 and connect it to new Ethernet switch as shown in the network architecture drawing.
   9. The SI shall:
      a. Deploy new application program, verify that new GE RX3i PLC (master PLC) is operating properly configure network address.
      b. Verify connection and presence of the new control panel in the plant network.
      c. Enable related program code in the new master PLC GE RX3i.
      d. Modify temporary interface, program code, setup of the data routing, and database to accommodate sharing of control and monitoring between new master PLC and existing OUTPOST 5.

1.7 PROGRAMMING AND SCADA INTEGRATION

A. Item C200 – SCADA Integration
   1. This work item is identified here for work sequencing purpose only.
   2. Programming and SCADA Integration will be provided by a pre-selected SI. Works will include development of new process control narrative, program code, software testing and commissioning.

B. Refer to the following paragraphs (C series work items) describing SI works required for this project and proposed sequence of construction.

C. Item C202 – Overall coordination efforts.
   1. Review and coordinate design of new control panel WW-66400-CPL101, starter panels, etc. with SI.
   2. Attend SI review meetings.
   3. Coordinate construction activities and switchovers with SI.

D. Item C204 – Start-up, testing, and commissioning (on-site / field works).
   1. For bid purposes, CONTRACTOR shall assume that:
      a. the suggested sequence of construction will be followed,
      b. each work item will require dedicated time at site to support SI start-up, testing, and commissioning efforts.
      c. more than one person may be required during switchovers to accommodate maximum process shutdown time.
      d. Sections for testing can be categorized as below:
         1) Field signals to existing level switches, flowmeters, level transmitters and other devices.
         2) Motorized valves.
         3) Testing related to signals from MCC sections related to motors and VFDs.
         4) Testing related to MISA sampling system.
         5) Testing related to UV system.
         6) Testing related to signals which are currently connected to Instrumentation Panel for alarming and recording.
         7) Testing related to Alum Injection System, Sump Pumps, Polymer Pumps.

1.8 INSTALLATION OF NEW UV SYSTEM CONTROL PANEL WW-67969-PL9261

A. Item C120 – New control panel WW-67969-PL9261will be designed and provided by IRONBROOK. Installation of this panel and all related works to UV system shall be done and coordinated by IRONBROOK, SI and BPL.
   1. Overview:
      a. This task includes key works required for the installation and commissioning of the UV control panel.
      b. It shall be noted that after completion of this task, the control panel will remain live to accommodate plant operation.
      c. Systems will be switched over, added, or connected in multiple steps as outlined in the following paragraphs.
   2. Prerequisite: Successful completion of the control panel FAT accepted by BPL and ENGINEER.
      a. Works shall be done after installation of temporary UV System and demolishing and removal of existing control panel item C150. Refer to Division 1 regarding temporary pumping and treatment requirements.
      b. Coordinate installation schedule with IRONBROOK and SI.
   3. Install new control panel in the UV building of SPP on existing base as indicated on the drawings.
   4. Provide 3 phase 4 wire 208 VAC power from existing panel source as shown on the drawing.
   5. Power up control panel. Verify that are no ground faults, and that all components operate correctly.

6. Coordinate with IRONBROOK for termination of all I/O, electrical and control signals.
7. Provide Ethernet network connection to the new GE RX3i PLC in WW-67969-PL9261 and connect it to new Ethernet switch as shown on the network architecture drawing.
8. The SI shall:
    a. Deploy new application program, SI is fully responsible for migration of existing application software from GE90-30 Series PLC to new RX3i PAC System.
    b. Verify that new GE RX3i PLC is operating properly configure network address.
    c. Verify connection and presence of the new control panel in the plant network

1.9 INITIATION OF NEW ETHERNET NETWORK AND NEW VIRTUAL SERVER

A. Item C130 - Initiation of new Ethernet network and new virtual server. This item shall be coordinated with IT and SI.
    1. Overview:
        a. Provide new Ethernet cable as per cable list.
        b. Connect new Ethernet switch as shown in network architecture drawing, for communication with new PLCs and existing SCADA system.
    2. Verify all connection on new Ethernet communication network, new server, existing SCADA node, new UV system GE RX3i PLC and the new GE RX3i master PLC.
    3. Schedule shutdown of SPP.
    4. Switchover:
        a. Disconnect network from existing OUTPOST5.
        b. The SI shall:
            1) Initiate and configure new control panel Ethernet network.
            2) Programing and SCADA:
                a) Enable program code in the new master PLC GE RX3i. Disable related program code in the existing OUTPOST5.
                b) Install temporary interface, program code, setup of the data routing, and database to accommodate sharing of data, control and monitoring between new and existing control system.
                c) Modify related SCADA database and interface graphics.
            3) Verify and test operation of:
                a) All component connected to the network,
                b) Interface between new PLC and existing control panels,
                c) SCADA operator interface.
        c. Place systems in normal operation.
            1) If modified system cannot be placed in normal operation upon end of scheduled shutdown, restore old system. Verify and test operation.
            2) Examine cause of failure to determine problem. Prepare solution. Reschedule works.
    5. Remove existing, not used, decommissioned network connections after successful period of operation (minimum 7 days).

1.10 DECOMMISSIONING OF THE OLD CONTROL SYSTEM

A. Item C140 – Final demolishing of existing annunciator/instrumentation panel.
    1. Overview:
        a. This task includes removal of this panel after connection of signals to master PLC in WW-66400-CPL101 and testing as per item C204.

b. It shall be noted that after completion of this task, all monitoring and alarm signals will be presented on SCADA.

2. Prerequisite: coordinate with OCWA and SI for confirmation and verification, to ensure all required alarm and monitoring signals are connected to new control system and work properly.
3. De-energize related control circuits, disconnect, and remove all control wiring.
4. Remove all control and power wiring to existing instrumentation on site as indicated.
5. Disassemble and remove all no longer used components, pull out power cable, controls cables and return them to BPL.
6. After removing all components in this panel, remove enclosure.

B. Item C145 – Complete removal of existing MISA control panel.
1. Overview:
a. This task includes removal of existing MISA control panel after connection of signals to master PLC in WW-66400-CPL101 and testing as per item C204.
b. It shall be noted that after completion of this task, all trending and reporting for MISA will be available on SCADA.
2. Prerequisite: coordinate with OCWA and SI for confirmation and verification, to ensure data management system for MISA sampling system on SCADA is working properly and is in compliance with API 21 requirements and complies with Ontario Reg.215/95.
3. De-energize related control circuits, disconnect, and remove all control wiring.
4. Disassemble and remove all no longer used components, pull out power cable, controls cables and return them to BPL.
5. After removing all components in this panel, remove enclosure.

C. Item C148 – De-commissioning of existing OUTPOST 5 control system (WW-66400-PL1002, PL1003 & PL1004).
1. Overview:
a. Works include decommissioning of the existing OUTPOST5 panels (WW-66400-PL1002, PL1003 & PL1004), and removal of all temporary software.
b. Coordinate the removal of the panels with OCWA to confirm removal and disconnection procedure.
2. Prerequisite: coordinate with OCWA and SI for confirmation and verification, to ensure all required alarm and monitoring signals are connected to new control system and work properly.
3. Ensure software SAT as specified under SECTION 13623 is completed prior to de-commissioning works.
4. De-energize related control circuits, disconnect, and remove control wiring connected to existing panels (WW-66400-PL1002, PL1003 & PL1004).
5. Final decommissioning of the temporary software measures:
a. The SI shall:
1) Programing and SCADA:
a) Remove all temporary program code, setup of the data routing and database accommodating sharing of data between new master PLC and existing OUTPOST 5 during construction phases,
b) Modify related SCADA database and interface graphics.
c) Verify that all systems perform properly upon shutdown of OUTPOST 5.

1.11 DEMOLISHING THE OLD UV CONTROL SYSTEM WW-67969-PL9261 AND UV VFDS

A. Item C150 – Decommissioning and removal of existing UV control system
   1. Overview:
      a. To schedule the works, to coordinated with IRONBROOK supplier of new control system for UV system and BPL.
      b. Organize works to minimize the shutdown time.
   2. Prerequisite: Installation of temporary UV system – refer to Division 1.
   3. De-energize and disconnect main feeder of panel WW-67969-PL9275 and UV Control Panel.
   4. Disconnect all control wiring connected to existing panel WW-67969-PL9275 and UV Control Panel.
   5. Disconnect and remove all components in the panel WW-67969-PL9275 and UV Control Panel. Return components to BPL.
   6. Remove enclosure and return to BPL.

1.12 ASSOCIATED WORKS

A. Provide all related equipment, labor, material, tools, supervision, and associated work as necessary to execute the Work and to realize the intent of the Project.

B. Demolition and retrofit:
   1. Protect and preserve utilities on the Site that are intended to remain in active condition. Maintain access to existing installations and systems that remain active.
   2. Remove concrete bases and restore floor surfaces to match existing conditions. Repair adjacent construction and finishes damaged during demolition and extension work.

C. Openings and supports
   1. Cutting of openings to walls, floors, foundations, footings, ceilings, roof, or other surfaces or finishes that are required for work provided under this Section shall be CONTRACTOR's responsibility.
   2. Attach supports to the building structure where allowed or as indicated. Supporting electrical equipment, wiring, conduit, etc. from ductwork, piping, equipment, etc. will not be accepted.
   3. Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of ENGINEER.
   4. Restore finishes.

D. Hangers and supports
   1. Provide supports for all cables and electrical, control, instrumentation systems and devices whether shown on the Drawings or not. Secure equipment to solid surfaces and structures.

E. Temporary installations
   1. Allow for and provide products for temporary electrical and control installations required in order to maintain facility in continuous operation.
   2. Quality of the materials shall be in accordance with the Contract Documents with exception that reused but fully functional and certified products are acceptable.

F. Restoration works
   1. Provide products for restoration works (patching materials, fire barriers and sealants, tiles, glue, sealers, paint, insulation, metal panels, roofing materials, etc.) to restore

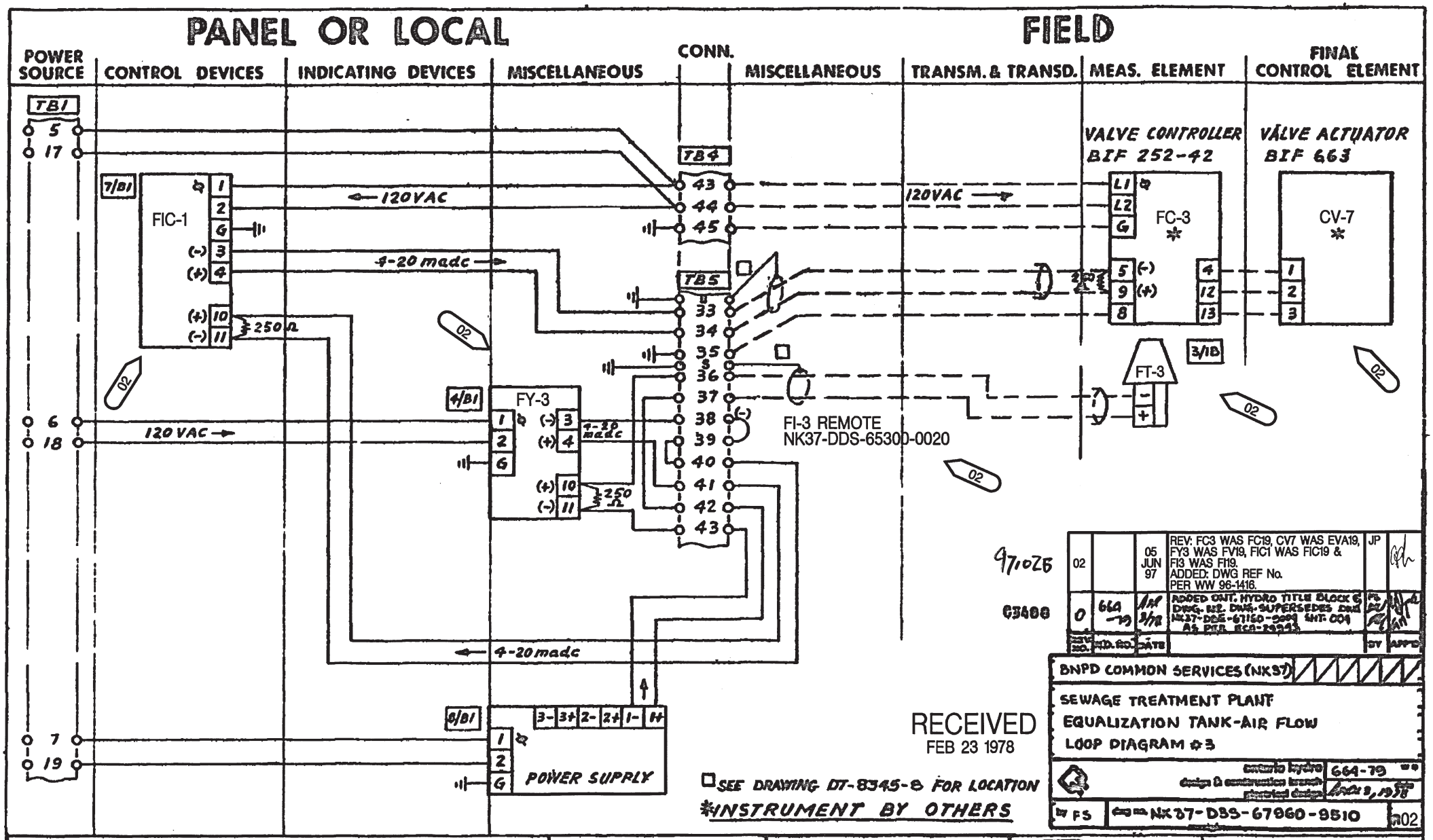
openings to walls, floors, foundations, footings, ceilings, roof or other surfaces or finishes that are affected by demolition and restoration work.

2. Allow for and provide products for electrical and control installations required for restoration/ preservation of electrical system (example: fittings to seal conduits in hazardous locations). Provide products for identification of electrical works. Quality of the materials shall be in accordance with the Contract Documents.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION


PANEL OR LOCAL
FIELD
POWER SOURCE
CONTROL DEVICES
INDICATING DEVICES
MISCELLANEOUS
CONN.
MISCELLANEOUS
TRANSM. & TRANSD.
MEAS. ELEMENT
FINAL CONTROL ELEMENT
TB1
5
17
6
18
7
19
7/B1
FIC-1
1
2
G
(-) 3
(+) 4
(+) 10
(-) 11
250 Ω
120VAC
4-20 madc
02
4/B1
FY-3
(-) 3
(+) 4
(+) 10
(-) 11
250 Ω
4-20 madc
6/B1
POWER SUPPLY
3- 3+ 2- 2+ 1- 1+
TB4
43
44
45
TB5
33
34
35
36
37
38
39
40
41
42
43
FI-3 REMOTE
NK37-DDS-65300-0020
VALVE CONTROLLER
BIF 252-42
FC-3
L1
L2
G
5 (-)
9 (+)
8
4
12
13
120VAC
VALVE ACTUATOR
BIF 663
CV-7
1
2
3
3/1B
FT-3
-
+
SEE DRAWING DT-8345-8 FOR LOCATION
*INSTRUMENT BY OTHERS
RECEIVED
FEB 23 1978
97/026
63488
02
05 JUN 97
REV: FC3 WAS FC19, CV7 WAS EVA19, FY3 WAS FV19, FIC1 WAS FIC19 & FI3 WAS FI19.
ADDED: DWG REF No. PER WW 96-1416.
JP
0
664-79
ADDED ONT. HYDRO TITLE BLOCK & DWG. NO. DWG. SUPERSEDES AND NK37-DDS-67150-9009 SHT. 004 AS PER ECA-29943
BNPD COMMON SERVICES (NK37)
SEWAGE TREATMENT PLANT
EQUALIZATION TANK-AIR FLOW
LOOP DIAGRAM #3
ontario hydro
664-79
FS
NK37-DDS-67960-9510
02
E1170
664-6159
01
SEPT 06 89
REV MEA. ELEMENT FT-19 WAS FT-13 PER WW 89-D544
RO. HP PW
JOB NAME & NUMBER
BRUCE NUCLEAR POWER DEV. SEWAGE TREATMENT PLANT
76048345
LOOP NO. 3
PANEL INSTRUMENT
APPLICATION EQUALIZATION TANK AIR FLOW
FISCHER & PORTER (CANADA) LIMITED
TORONTO ONTARIO
DRAWN
AUG. 31/76
DATE
CHK'D.
APP'D
DWG. NO.
BT-8345-10
SHT. 4 OF 10
REV 3

FOR INFORMATION ONLY

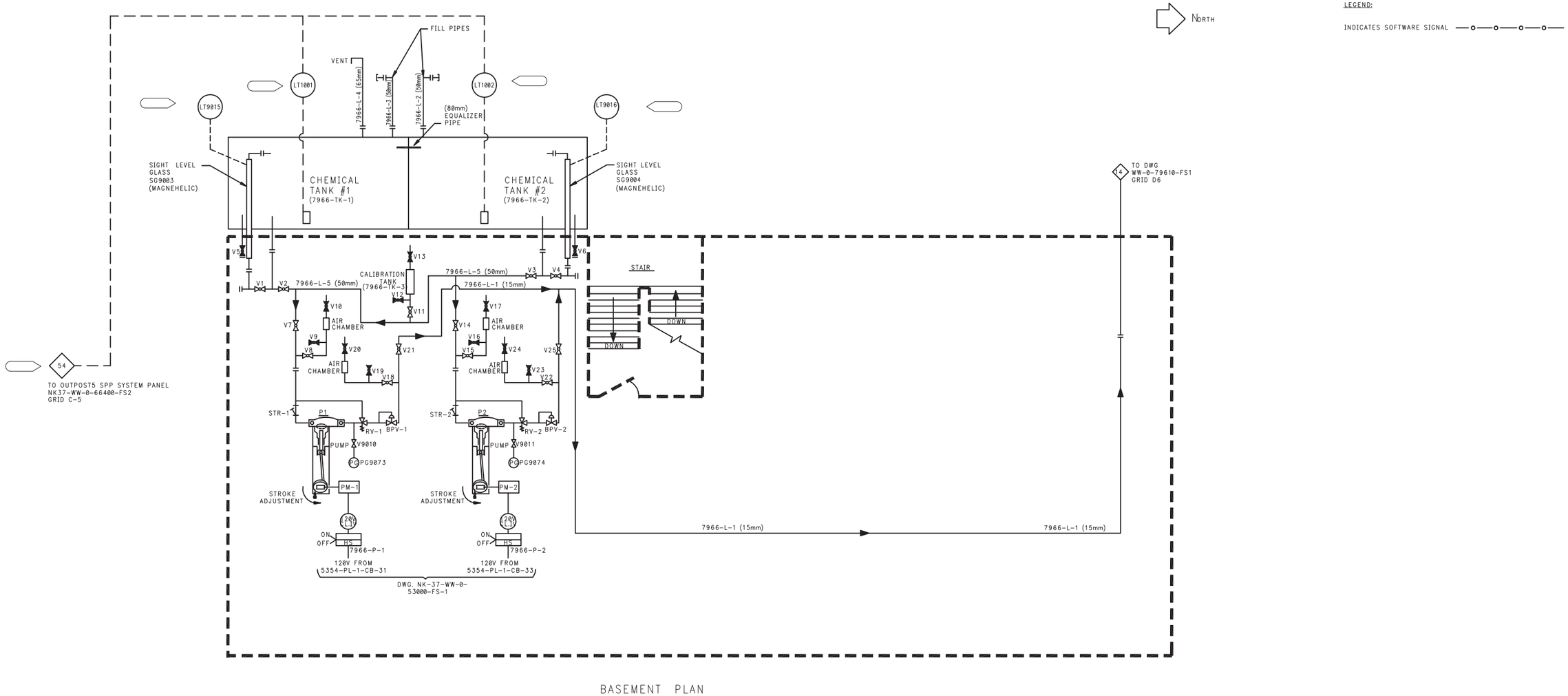
NOTES:
ASSUME PREFIX WW-79660 FOR ALL VALVES AND EQUIPMENT AND WW-67966 FOR ALL INSTRUMENTATION UNLESS OTHERWISE INDICATED.

LI9016 AND LI9015 ARE DISPLAYED ON RCU9002.

LEGEND:

INDICATES SOFTWARE SIGNAL

NORTH



BASEMENT PLAN

FOR REFERENCE PURPOSES ONLY
SEE FULL SIZE OPERATIONAL FLOWSHEET FOR CURRENT INFORMATION

rev.no.	date	particulars	by	appd
6		AS PER DCR 3775: REMOVED LI9015 & LI9016 ADDED LT1001 & LT1002 AND TIE POINT CONNECTION 54	KVS	PN
5	4 SEPT. 98	REPLACE SIGHT GLASSES WITH MAGNEHELIC REMOTE INDICATOR GLASSES. PER 2-95-01660-86.	GS	TL
4	6 MAY 97	ADD SIGHT GLASS NUMBERS. 97-5258.	GS	TL
3	92-07-13	PG9074, PG9074, V9811, V9812 ADDED PER DSR0213	R.B.	B.K.

Bruce Power
Bruce Site

SEWAGE PROCESSING PLANT - WW

B.N.P.D. SEWAGE PROCESSING PLANT, PHOSPHORUS REMOVAL SYSTEM

Drawn by	Rev Checked by	Rev Verified by
W.L. ROBINSON	D. GARLOUGH	R. THOMPSON
Date	DCN/DCR No	Rev Approved by
JULY 22, 1976	DCR 3775	P. NIESON

Dwg. No. MK37-WW-0-79660-FS1 Rev. 06

120 VAC 1Ø
60 Hz SUPPLY
FROM
WW-5354-PL1
CB34

CB1 · T1 · RE1 · CB2 · BATT. · CR5 · LOAD · FU2 2A

WW-5510-
BY 9000

OUTPUT
125 VDC
5A

125 VDC SUPPLY
TO DIST. PANEL
55100-PL5
NK37-DBS-65510-0002

125 VDC SUPPLY TO
ANNUNCIATION PANEL
TB7-1(+) & TB7-2(-)
NK37-DIS-67960-9504

BD
BLOCKING
DIODE

L1 · 0-10A · A1 · A2 · FU1 2A

S1 · TMR1 · M · V1 · CR1 · CR2 · CR3 · CR4

TROUBLE ANNUNCIATION
TO ANNUN. PANEL
TB3-50 & TB3-AP
NK37-DIS-67960-9506

LEGEND
- -TB1
- -TB4
- -TB2
- -TB3

CONTROL UNIT BT1503

12VDC · AC ON · FLOAT · EQ · CUR LIM · PL1 · PL2 · PL3 · PL4

P2
EQUAL

8VDC

P1
FLOAT

PL5 · PL6 · GFB · LVD

L.V · H.V. · PL7 · PL8 · S2 H.V. RESET · HLA

AC
FAIL · PL9

DC
BRKR
TRIP · PL10

REF. DWGS.
NK37-D1X-65510-0007 (C.W.D.)

SCANNED
REV. DD DATE 98-08-26

Rev. No.	Date	Description	By	Checked
0	89-02-14	SUPERSEDES NK37-D1X-65510-0004 R-2	RB	

Ontario Hydro
BNPD Services

SEWAGE PROCESSING PLANT

BATTERY CHARGER
WW-5510-RF 9000
ELEMENTARY WIRING DIAGRAM

Drawn by R. BULTEMA · Checked by · Date FEB 14/89
Dwg. No. NK37-D1X-65510-0006 · Rev. 0

DSR603 · E0721 · N0000636.mic

241163
10-76

dwg no

CABLE NUMBER	POWER SOURCE / SOURCE LOCATION / FROM / REMARKS	LOAD DESIGNATION / LOAD DESCRIPTION / TO / LOAD LOCATION	NO. COND / SIZE (AWG/MCM) / CABLE TYPE	CABLE L (FT) / STOCKCODE #	CONDUIT / TYPE / SIZE / LENGTH
	C A B L E R O U T E				
-1131	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	LEVEL SW 9	3c #14 600V, TECH	50	-
-1132	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	LEVEL SW 8	3c #14 600V, TECH	40	-
-1133	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	LEVEL SW 10	3c #14 600 V, TECH	40	-
-1134	5334-MCC1 CB1 H1	65330-JB42	3c #14 600 V, TECH	90	-
-1135	5334-MCC1 CB1 H2	65330-JB 42	3c #14 600 V, TECH	90	-
-1136	65330-JB 42	79610-MV11	3c #14 600 V, TECH	70	-
-1137	65330-JB 42	79610-MV13	3c #14 600 V, TECH	70	-

note : this material obtained on b/m no.

mf roll number	rev no	date	particulars	dwn / chkd	appd

BRUCE N.P.D.

SEWAGE TREATMENT PLAN
600 V SWGR.
5330-BUA
CABLE LIST CONTROL

Ontario Hydro
design & construction branch
electrical design

work order	dwn / chkd	grp leader	designed by
820-9924		A. HOLLETT	
date	chief draftsman		supv. design engineer
1983 9 8			
scale	electrical design department		approved
—			

dwg no NK37-LBE-57000-0102 SH. 2 rev 00

N0000679.MIC 04820

SCANNED
REV. 00 DATE 98-10-20

A3 (283 x 394)

0 10 50 100 150 millimetres

241163
10-76

dwg no

CABLE NUMBER	POWER SOURCE / SOURCE LOCATION / FROM / REMARKS	LOAD DESIGNATION / LOAD DESCRIPTION / TO / LOAD LOCATION	NO. COND / SIZE (AWG/MCM) / CABLE TYPE	CABLE L (FT) / STOCKCODE #	CONDUIT / TYPE / SIZE / LENGTH
	C A B L E R O U T E				
-1121	5334-MCC1 MASTER TERMINAL SECTION CB1H1	SEWAGE PLANT INSTRUMENT PANEL	10c#14 600V, TECH	15	–
-1122	5334-MCC1 MASTER TERMINAL SECTION CB1H2	SEWAGE PLANT INSTRUMENT PANEL	10c#14 600V, TECH	15	–
-1123	SEWAGE PLANT INSTRUMENT PANEL	65350-JB40	10c#14 600V, TECH	70	–
-1124	SEWAGE PLANT INSTRUMENT PANEL	65350-JB40	10c#14 600V, TECH	70	–
-1125	65350-JB40	67960-PL41 SLUDGE WASTING VALVE CONTROL PANEL	10c#14 600V, TECH	60	–
-1126	65350-JB40	67960-PL41 SLUDGE WASTING VALVE CONTROL PANEL	10c#14 600V, TECH	60	–
-1127					
-1128	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	79610-MV11	12c#14 600V LIQUID TIGHT	30	1" ST.
-1129	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	79610-MV13	12c#14 600V LIQUID TIGHT	40	1" ST
-1130	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	LEVEL SW. 7	3c#14 600V, TECH	50	–

note : this material obtained on b/m no.

mf roll number	rev no	date	particulars	dwn / chkd	appd

BRUCE N.P.D.

SEWAGE TREATMENT PLAN
600 V SWGR.
5330-BUA
CABLE LIST CONTROL

Ontario Hydro
design & construction branch
electrical design

work order	dwn / chkd	grp leader	designed by
820-9924	ZM. / PO	A HOLLETT	G.I.
date	chief draftsman		supv design engineer
1983 98			
scale	electrical design department		approved
—			

dwg no NK37-LBE-57000-0102 SH. 3 rev 00

SCANNED
REV. 00 DATE 98-10-20

A3 (283 x 394)

0 10 50 100 150 millimetres

1:4020

N0000678.mic

241163
10-76

dwg no

CABLE NUMBER	POWER SOURCE / SOURCE LOCATION / FROM / REMARKS	LOAD DESIGNATION / LOAD DESCRIPTION / TO / LOAD LOCATION	NO. COND / SIZE (AWG/MCM) / CABLE TYPE	CABLE L (FT) / STOCKCODE #	CONDUIT / TYPE / SIZE / LENGTH
	C A B L E R O U T E				
-1121	5334-MCC1 MASTER TERMINAL SECTION CB1H1	SEWAGE PLANT INSTRUMENT PANEL	10c#14 600V, TECH	15	–
-1122	5334-MCC1 MASTER TERMINAL SECTION CB1H2	SEWAGE PLANT INSTRUMENT PANEL	10c#14 600V, TECH	15	–
-1123	SEWAGE PLANT INSTRUMENT PANEL	65350-JB40	10c#14 600V, TECH	70	–
-1124	SEWAGE PLANT INSTRUMENT PANEL	65350-JB40	10c#14 600V, TECH	70	–
-1125	65350-JB40	67960-PL41 SLUDGE WASTING VALVE CONTROL PANEL	10c#14 600V, TECH	60	–
-1126	65350-JB40	67960-PL41 SLUDGE WASTING VALVE CONTROL PANEL	10c#14 600V, TECH	60	–
-1127					
-1128	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	79610-MV11	12c#14 600V LIQUID TIGHT	30	1" ST.
-1129	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	79610-MV13	12c#14 600V LIQUID TIGHT	40	1" ST
-1130	67961-PL41 SLUDGE WASTING VALVE CONTROL PANEL	LEVEL SW. 7	3c#14 600V, TECH	50	–

note : this material obtained on b/m no.

mf roll number	rev no	date	particulars	dwn / chkd	appd

BRUCE N.P.D.

SEWAGE TREATMENT PLAN
600 V SWGR.
5330-BUA
CABLE LIST CONTROL

Ontario Hydro
design & construction branch
electrical design

work order	dwn / chkd	grp leader	designed by
820-9924	ZM. / PO	A HOLLETT	G.I.
date	chief draftsman		supv design engineer
1983 98			
scale	electrical design department		approved
—			

dwg no NK37-LBE-57000-0102 SH. 3 rev 00

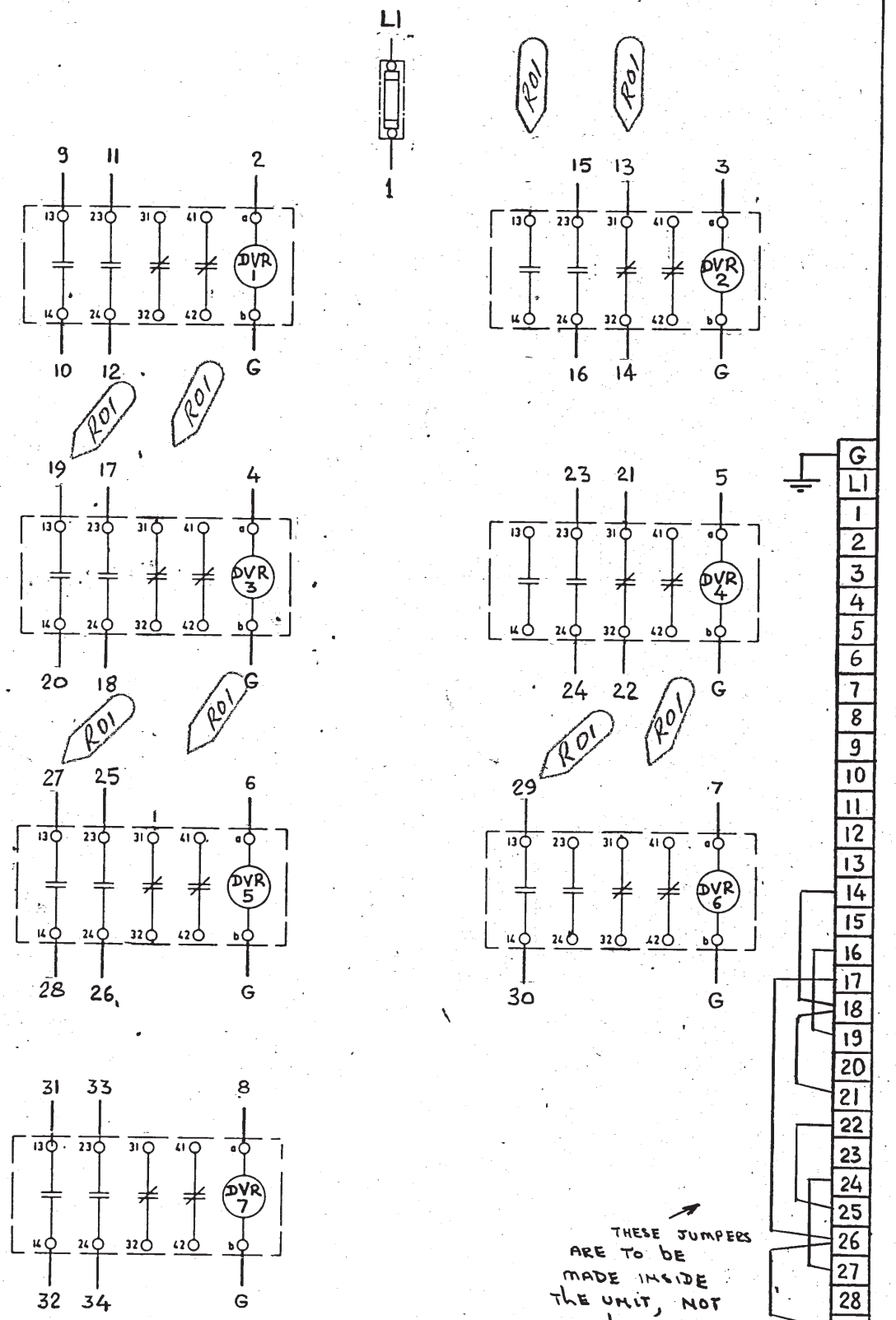
SCANNED
REV. 00 DATE 98-10-20

A3 (283 x 394)

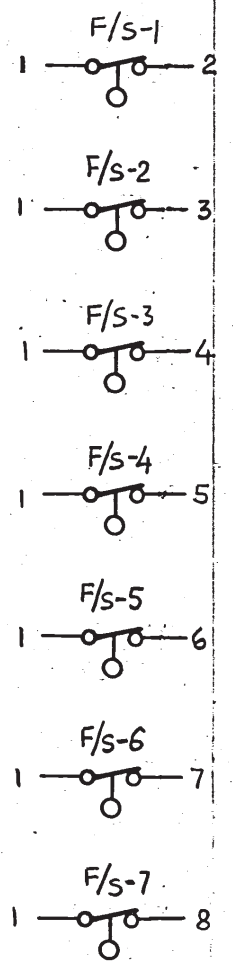
0 10 50 100 150 millimetres

1:4020

N0000678.mic



REMOTE DEVICES
COMMANDES A DISTANCE



D5011	01	OCT 12/83	ECO 1714 REVISED CONTACTS 13-14 AND 31-32 OF RELAYS DVR2, DVR3, DVR5 & DVR6	WWH AMC	
C3557	0	APR 28/78	ADDED HYDRO TITLE BLOCK & DWG. NO.	J.B. WH	
	rev. no	date	particulars	dwn / chkd	appd / mf roll number

BNPD (NK37)
SEWAGE TREATMENT PLANT
MCC SECTION 6G
ELEMENTARY WIRING DIAGRAM

ontario hydro
design & construction branch
electrical design

664-379 w o
APR 28/78 date
by J.B. dwg no. NK37-DBS-65330-9529 R01

RECEIVED
MAR 29 1978

SUBMITTER | HYDRO

HYDRO DWG. No. –

FOR SCHEMATIC DIAGRAM SEE
DWG 1-65137-04 (UNIT 6G)

QTY/QTE.	DESCRIPTION	MAT'L	NO.

REVISION
REV 1. MORE INFO. ADDED. R.C. Oct 19/76.

SCALE/ECHELLE		DATE	BY/PAR
	DRAWN DESSINE	1 SEP. 76	K.T.
TOLERANCE	CHK'D VERIFIE	"	R.C.

CONNECTION DIAGRAM
SCHEMA DE FILERIE

SIEMENS CANADA LIMITED

DRAWING NO. DESSIN 3-65137-24 REV 1

REPLACES REMPLACE
REPLACED BY REMPLACE PAR

CONNECTION DIAGRAM | SIEMENS | DWG. NO. 3-65137-24

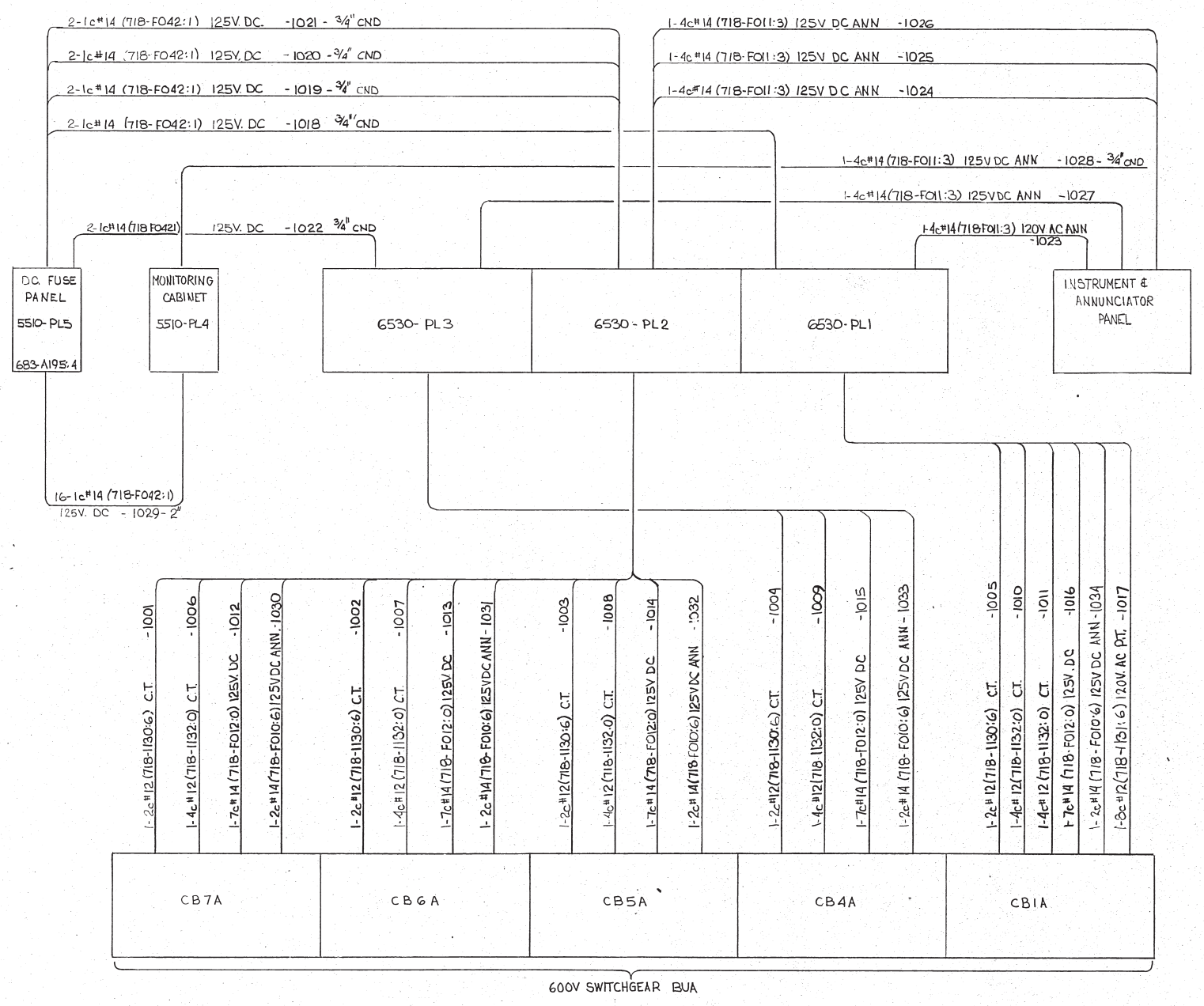
TRANSLAR 002

NOTE

ALL CABLES PREFIXED BY 6530 EXCEPT WHERE SHOWN OTHERWISE

REFERENCE DRAWINGS

ELECT. ARRGT. PROT & MET. PNL PL1 - NK37-DCS-65300-0001
ELECT. ARRGT. MCC FEEDER PROT PL2 - NK37-DCS-65300-0002
ELECT. ARRGT. MCC FEEDER PROT. PL3 - NK37-DCS-65300-0003
ELECT. ARRGT. MONITORING CAB. PL4 - NK37-DDS-55100-0001
SCHEMATIC (1-LINE) DIAGRAM - NK37-DDS-53000-0002



OBSOLETE

RECEIVED
APR 19 1977

rev. no.	date	particulars	dwn	chkd	appd
		R SUBMITTER C1852			

ONTARIO HYDRO DRAWING N° NK37-EDE-57000-0103

ONTARIO HYDRO
BRUCE NUCLEAR POWER DEV.
SEWAGE TREATMENT PLANT

600V SWITCHGEAR BUA
CABLE BLOCK DIAGRAM
ELECTRICAL ARRANGEMENT

GORE & STORRIE LIMITED
CONSULTING ENGINEERS
TORONTO ONTARIO

DATE	MARCH 1975	FILE N°	480.03-D-14612
SCALE	N/A	DRAWING N°	E-17

PROFESSIONAL ENGINEERS ASSOCIATION G.R. CRAWFORD PROVINCE OF ONTARIO

CONSULTING ENGINEER

REV. NO.	ITEM NO.	REVISION	BY	CHK'D.	APP'D.	DATE D M Y
1		AS BUILT				21 12 76

TO LIGHTING PANEL - (120VAC) CIRCUIT NO. 25

G N ⊗

TB1

1	10A	FUSE RATING	{INTERNAL LIGHT SERVICE OUTLET AND TURBIDITY METER
2	3A		
3	3A		
4	1A	MLS1-10	
5	1A	TB4-43	
6	1A	FV-19	L1
7	1A	{4-20 mADC FRP POWER SUPPLY	
8	1A	FQ9024	
9	1A	FV-20	
10	1A	(202) PS9027	
11	1A	FV-21	
12	1A	(203) PS9007	
13		{INTERNAL LIGHT SERVICE OUTLET	
14			
15			
16		MLS1-10	
17		TB4-44	
18		FV-19	L2
19		PS9027	
20		PS9007	
21		FV-20	
22		FQ9024	
23		FV-21	
24		SPARE	
25		G	
26		G	
27		G	
28		G	
29		G	AS REQ'D.
30		G	
31		G	
32		G	

TO LIGHTING PANEL - (120VAC) CIRCUIT NO. 26

N ⊗

TB2

1	1A	FUSE RATING.	SPARE
2	1A		TB4-37
3	1A		67960-FT1000L
4	1A		SPARE
5	1A		53540-JB100 TB1-1 (PH1001 HTR)
6	6A		53540-JB100 TB1-3, TB1-4 (D0X1001, D0X1003) L1
7	1A		TO TB4 34 (SPARE)
8	1A		SPARE
9	1A		SPARE
10	1A	(226)	TB4-49
11	1A	(227)	TB4-47
12	1A		SPARE
13			MLS1-11
14			TB4-38
15			67961-FT1000N
16			TB4-48,50
17			53540-JB100 TB1-N
18			SPARE L2
19			TO TB4 35(SPARE)
20			SPARE
21			SPARE
22			SPARE
23			"
24			"
25			G
26			G
27			G
28			G
29			G AS REQ'D.
30			G
31			G
32			G

125 VDC (-) (+)

TB7 ANNUNCIATOR

1 (+)	TBA1-H
2 (-)	TBA1-N
3	PS9034(+)
4	PS9034(-)

PS9034

TB7-3 (+) — 125VDC
TB7-4 (-) — 24VDC (+) TB11-2, (-) TB11-19

PS9007

TB1-12 (203) L1
TB1-20 N
(204) + TB11-1
(205) - TB11-20

PS9027

TB1-10 (202) L
TB1-19 (12) N
12V DC POWER SUPPLY
(200) + , (201) - } WW-66000-ANN9001, NK37-D3S-66000-0001

TB11

NK37-D3S-67960-9509-001	(204) 1	(204) PS9007(+)
NK37-D2X-67960-0001 RTU9000(+)	(204) 2	(204) PS9034(+)
NK37-D2X-67960-0001 TB1(+)	(204) 3	
NK37-D3S-67960-9508 LT-1	(206) 4	
	5	
	6	
	7	
	8	
	9	
	10	
NK37-D3S-67960-9509-001	(205) 11	
NK37-D2X-67960-0001 RTU9000(-)	(205) 12	
NK37-D2X-67960-0001 BD#1-TBB8	(205) 13	
NK37-D3S-67960-9508 LT-1	(205) 14	
	15	
	16	
	17	
	18	
	19	PS9034(-)
	20	(205) PS9007(-)

	07	04 DEC 2019	PER EC 57258 (CIC): REVISED: PL1 TB2-1, TB2-3 TO TB2-6, TB2-8, TB2-14, TB2-15, TB2-21	CS JP	DS AP SW	AS
0307234	06	06/10 1998	REVISED AS PER WP# 2-98-3636. ADDED POWER SUPPLY PS9034.	JP/SW	ANT. AW	
98061B	05	20/03 1998	DELETED: CONNECTIONS AT TB1-2, 3, 14 & 15. PER AS BUILT WW 97-1509.	JP		
96032B	04	04 JUN 97	ADDED: TB11, PS9007 & PS9027. REV: CONNECTIONS AT TB1-10, 12, 19, TB2-4, 10, 11, 12 & 14 PER WW 95-1416.	JP	TL	
96032B	03	22 DEC 95	ADDED: CONNECTIONS AT TERMINALS TB1-8,-12,-208-22. REVISED: CONNECTIONS AT TERMINALS 8 & 18. PER WW 94-1082 & WW 95-1148.	JB JP	TL	
0983 #	02	27 JAN 95	PER FIELD PACKAGE NW-87-023736 BUILT: TB2 TERM. 10,11 IS WIRE & PARE	T.C.		
rev. no.		date	particulars	drawn	appvd	ext refd number/year

BNPD COMMON SERVICES (NK37)
SEWAGE TREATMENT PLANT
INSTRUMENT PANEL POWER DISTRIBUTION
CONNECTION WIRING DIAGRAM

Bruce Power — Engineering Electrical — 664-79 — drawing no. NK37-DIS-67960-9504 — 07

SUB-TYPE	SIZE
CWD	1

RECEIVED
FEB 23 1978

AS BUILT
JAN 2 1978

ONTARIO HYDRO

ACCEPTED ..... ☒
NOT ACCEPTED ..... ☐
ACCEPTED AS NOTED ☐
Date 5 MAR 96
Signed T. LITTLE

ACCEPTANCE OF THIS DOCUMENT DOES NOT RELIEVE THE CONTRACTOR OF RESPONSIBILITY FOR ANY ERRORS OR OMISSIONS.

DO NOT SCALE

DWG. TOLERANCES (UNLESS OTHERWISE NOTED)
FRACTIONAL 0" - 36" ± 1/32"
3' & OVER ± 1/16"
DECIMAL 3 PLACES ± 0.01"
3 PLACES ± 0.005"
ANGULAR MEASURE ± 1/2°
PAINT SPEC. NO.

APPROXIMATE SCALE — REF DWG.

FISCHER & PORTER (CANADA) LIMITED
TORONTO ONTARIO

DWG STATUS	BY	DATE D	M	Y
DRAWN		1	9	76
CHECKED		9	9	76
APPROVED		9	9	76

CUSTOMER & JOB NUMBER: SUTHERLAND & SCHULTZ
REF NO. 6048343

title: BRUCE NUCLEAR POWER DEV. SEWAGE TREATMENT PLANT INSTRUMENT PANEL POWER DISTRIBUTION

DWG. NO. DT-8345-9 — SHT. 3 of 3 — REV. 1

NK37-DIS-67960-9504

LM-34 BRUNING 40-334 MLX. 571

NK37-DIS-67960-9505

REV NO	ITEM NO	REVISION	BY	CHK'D.	APP'D.	DATE D	M	Y
1		REVISED AS PER CUST'S. MARKED UP PRINT DATED 18 OCT. 76.	H.E.	H.C.	DA	9	11	76

INSTRUMENT PANEL

FIELD ALARM CONTACTS	FIELD TERMINATIONS TB3	ANNUNCIATOR CABINET TBA1
NO.1	1	1
RAW SEWAGE PUMP 0129-DIS-60100-0506	2	2
	3	3
AIR BLOWER 0129-DIS-60100-0506	4	4
	5	5
	6	6
COMMINUTOR 0129-DIS-60100-0506	7	7
	8	8
EFFLUENT WATER PUMP 0129-DIS-60100-0506	9	9
	10	10
SUMP PUMP 0129-DIS-60100-0506	11	11
	12	12
SETTLING TANK COLLECTORS 0129-DIS-60100-0506	13	13
	14	14
CR2 CYLINDERS LOW LEVEL	15	15
	16	16
	65	AP
	66	AP

R.I.S. INTERCONNECTION CABLES

RELAY PANEL RP1	FIELD TERMINATIONS TB6	REMOTE ANNUNCIATION
1	1	RAW SEWAGE PUMPS
2	2	
4	3	
5	4	
7	5	
8	6	
10	7	AIR BLOWERS
11	8	
13	9	
14	10	
16	11	
17	12	
19	13	COMMINUTORS
20	14	
22	15	
23	16	
25	17	EFFLUENT WATER PUMPS
26	18	
28	19	
29	20	
31	21	SUMP PUMPS.
32	22	
34	23	
35	24	
37	25	SETTLING TANK COLLECTORS
38	26	
40	27	
41	28	
43	29	CR2 CYLINDER NO.1
44	30	
46	31	CR2 CYLINDER NO.2
47	32	

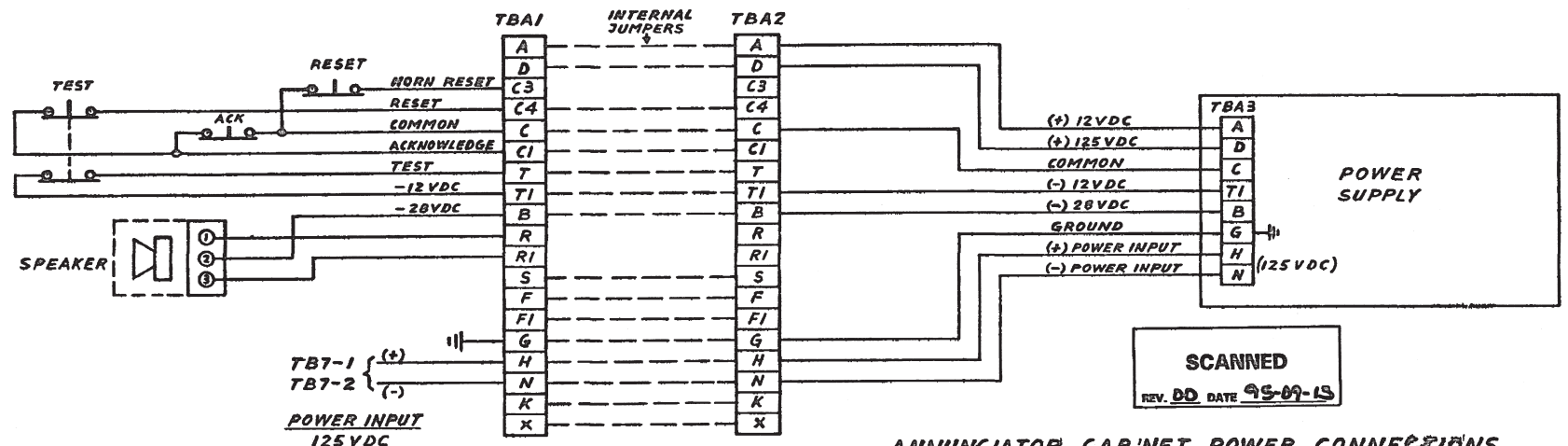
INSTRUMENT PANEL

FIELD ALARM CONTACTS	FIELD TERMINATIONS TB3	ANNUNCIATOR CABINET TBA1
BLDG. SUMP HIGH LEVEL	17	17
COMMINUTOR INTAKE HIGH LEVEL 0129-DIS-60100-0506	18	18
EQUALIZATION TANK HIGH LEVEL 0129-DIS-60100-0506	19	19
CHEMICAL PUMP FLOW	20	20
CHLORINE GAS LEAK NK37-DBH-67967-9003	21	21
BOOSTER PUMP P9026 FAILURE NK37-DDS-65330-9508	22	22
CHLOR-1 NO FLOW NK37-D3S-67970-0001	23	23
CHLOR-2 NO FLOW NK37-D3S-67970-0001	24	24
SEWAGE PUMPING STATION TROUBLE NK37-DDS-65300-0020	R1K1 25	25
MISA SAMPLE POT LOW	26	26
PLANT CONTROL COMPUTER FAILURE NK37-D2X-67960-0001	R2K4 1209 27	27
SPARE POSITIONS	28	28
	29	29
	30	30
	31	31
	32	32
	67	AP
	68	AP

R.I.S. INTERCONNECTION CABLES

RELAY PANEL RP2	FIELD TERMINATIONS TB6	REMOTE ANNUNCIATION
17	33	BUILDING SUMP PUMP
2	34	
18 4	35	COMMINUTOR INTAKE
5	36	
19 7	37	EQUALIZATION TANK
8	38	
20 10	39	CHEMICAL PUMP
11	40	
21 13	41	CHLORINE GAS LEAK
14	42	
22 16	43	SPARE
17	44	
23 19	45	CHLOR-1 NO FLOW
20	46	
24 22	47	CHLOR-2 NO FLOW
23	48	
25 25	49	SPARE
26	50	
26 28	51	MISA SAMPLE POT LOW
29	52	
27 31	53	SPARE
32	54	
28 34	55	"
35	56	
29 37	57	"
38	58	
30 40	59	"
41	60	
31 43	61	"
44	62	
32 46	63	"
47	64	"

* - FOR REMOTE ANNUNCIATION REFER TO DWG. NK37-DDS-65300-0020



ANNUNCIATOR CABINET POWER CONNECTIONS

SCANNED
REV. DD DATE 95-09-15

NOTE:
ALL WIRING TO BE 14 AWG. (BLUE) STRANDED.

RECEIVED
FEB 23 1978

AS BUILT
JAN 23 1978

02	04 JUN 97	ADDED: REF DWG No's, R1K1 & R2K4, REV: TB3-65 THRU 68 WAS TB3-AP, AND CONNECTIONS AT TB3-23, 24, TB6-43 THRU 48. PER WW 96-1416 & WW 96-1336.	JP		
01	22 DEC 95	REVISED: TERMINATIONS AT TERMINAL TB3-25,-26,TB6-51, &-52. PER WW 94-1062.	JB	TL	
0	APR 3/78	ADDED REF DWG. NR. ADDED ONT. HYDRO TITLE BLOCK & DWG. NR. DWG. SUPERSEDES DWG. NR NK37-DDE-67160-9003 ENT. 601. PER ECO-29943	JP FS		

BNPD COMMON SERVICES(NK37)
SEWAGE TREATMENT PLANT
INSTRUMENT PANEL ANNUNCIATION
CONNECTION WIRING DIAGRAMS

ontario hydro 664-79
design & construction branch
electrical design

by FS dwg no. NK37-DIS-67960-9505 02

DO NOT SCALE
DWG. TOLERANCES (UNLESS OTHERWISE NOTED)
FRACTIONAL 0"-24" ± 1/32"
24" & OVER ± 1/16"
DECIMAL 2 PLACES ± 0.01"
3 PLACES ± 0.005"
ANGULAR MEASURES ± 1/2°
PAINT SPEC. NO.
APPROXIMATE SCALE
REF DWG

FISCHER & PORTER (CANADA) LIMITED
TORONTO ONTARIO

DWG STATUS	BY	DATE D	M	Y
DRAWN	H.E.	3	9	76
CHECKED	H.C.	9	9	76
APPROVED	D.A.	9	9	76

WTR3 BRUCE NUCLEAR POWER DEV.
SEWAGE TREATMENT PLANT
INSTRUMENT PANEL
ANNUNCIATOR SCHEMATIC

CUSTOMER'S JOB NUMBER
SUTHERLAND & SCHULTZ
F&P No. 76048345

DWG NO DT-8345-11 SH. 1 OF 2 REV 1

REV NO	TEMP REV	DESCRIPTION	BY	CHK'D	APP'D	DATE
1		REVISED AS PER CUST'S. MARKED UP PRINT DATED 18 OCT. 76				9 11 76

INSTRUMENT PANEL

FIELD ALARM CONTACTS	FIELD TERMINATIONS TB3	ANNUNCIATOR CABINET TBA2	RELAY PANEL RP3	FIELD TERMINATIONS TB6	REMOTE ANNUNCIATION
5330-CB1A NK37-DDS-65300-0020	33	1	1	65	5330-CB1A
				66	
5330-CB4A NK37-DDS-65300-0020	34	2	2	67	5330-CB4A
			4	68	
5330-CB5A NK37-DDS-65300-0020	35	3	3	69	5330-CB5A
			7	70	
5330-CB6A NK37-DDS-65300-0020	36	4	4	71	5330-CB6A
			10	72	
5330-CB7A NK37-DDS-65300-0020	37	5	5	73	5330-CB7A
			13	74	
SPARE	38	6	6	75	SPARE
			16	76	
SPARE	39	7	7	77	SPARE
			19	78	
SPARE	40	8	8	79	SPARE
			22	80	
TANK 7 HI LEVEL NK37-DXX-67961-0004	41	9	9	81	TANK 7 HI LEVEL
			25	82	
TANK 8 HI LEVEL NK37-DXX-67961-0003	42	10	10	83	TANK 8 HI LEVEL
			28	84	
67961-MV11 FAILURE NK37-DXX-67961-0003	43	11	11	85	67961-MV11 FAILURE
			31	86	
67961-MV13 FAILURE NK37-DXX-67961-0004	44	12	12	87	67961-MV13 FAILURE
			34	88	
SPARE	45	13	13	89	SPARE
			37	90	
SPARE	46	14	14	91	SPARE
			40	92	
SPARE	47	15	15	93	SPARE
			43	94	
SPARE	48	16	16	95	SPARE
			46	96	
	69	AP	47		
	70	AP			

R.I.S. INTERCONNECTION CABLES

INSTRUMENT PANEL

FIELD ALARM CONTACTS	FIELD TERMINATIONS TB3	ANNUNCIATOR CABINET TBA2	RELAY PANEL RP4	FIELD TERMINATIONS TB6	REMOTE ANNUNCIATION
53140-T1 HIGH TEMPERATURE NK37-DDS-65300-0020	49	17	1	97	53140-T1 HIGH TEMPERATURE
			2	98	
BATTERY CHARGER LAB NK37-D1X-65510-0006	50	18	4	99	BATTERY CHARGER CAB.
			5	100	
5330-BUA-BKR TRIP SUPPLY FAIL NK37-DDS-65300-0020	51	19	7	101	5330-BUA BKR. TRIP SUPPLY FAIL
			8	102	
SPARE	52	20	10	103	SPARE
			11	104	
MCC-5334 MCC1 UNDER VOLTAGE NK37-D1S-60100-0506	53	21	13	105	MCC-5334 MCC1 UNDER VOLTAGE
			14	106	
SPARE	54	22	16	107	SPARE
			17	108	
SPARE	55	23	19	109	SPARE
			20	110	
SPARE	56	24	22	111	SPARE
			23	112	
SPARE	57	25	25	113	SPARE
			26	114	
SPARE	58	26	28	115	SPARE
			29	116	
SPARE	59	27	31	117	SPARE
			32	118	
SPARE	60	28	34	119	SPARE
			35	120	
SPARE	61	29	37	121	SPARE
			38	122	
SPARE	62	30	40	123	SPARE
			41	124	
SPARE	63	31	43	125	SPARE
			44	126	
SPARE	64	32	46	127	SPARE
			47	128	
	71	AP			
	72	AP			
	73				

R.I.S. INTERCONNECTION CABLES

* – FOR REMOTE ANNUNCIATION REFER TO DWG. NK37-65300-0020

REV	DATE	DESCRIPTION	BY	CHK'D	APP'D
02	04/08/1997	ADDED DWG REF Nos. REV. TB3-38, 39, 40, 45, 46, 47, 48, 57, 59, TB6-75 THRU 80, 89 THRU 96, 113, 114, 117 & 118 MADE SPARE. PER WW 96-1416.	JP		
1	MAY 5/82	820-9924ECO B41360 (81-01-14) TANK 7,8 HI LEVEL & 67961-MV11,67961-MV13 FAILURE ALARMS ADDED FIELD REF NW60-1023	JP		
0	APR 1/78	ADDED REF. DWG. NO. & ADDED DWT-HYDRO TITLE BLOCK & DWG NO. DWG. SUPERSEDES DWG. NK37-DDE-67160-9003, SHT 002 AS PER ECO-79042	PS		

SUB-TYPE	SIZE
CWD	1

mf roll number	rev no	date	particulars	dwn chkd	design appd
	03	08 Jun 2017	EC 59982 (CIC): THIS REVISION ORIGINAL DESIGN BY SNC-LAVALIN. REV: DESCRIPTION FOR TB3-49 & TB6-97/98.	DS JP	

BRUCE SITE W W

SEWAGE TREATMENT PLANT
INSTRUMENT PANEL ANNUNCIATION
CONNECTION WIRING DIAGRAM

Bruce Power — Engineering Electrical — 669-79 WO — Approved 2 1978

dwg no. NK37-D1S-67960-9506 R03

RECEIVED
FEB 23 1978

AS BUILT
JAN 29 1979

DO NOT SCALE

DWG TOLERANCES (UNLESS OTHERWISE NOTED)
FRACTIONAL 0" TO 36" ± 1/32"
3' & OVER ± 1/16"
DECIMAL 2 PLACES ± 0.01
3 PLACES ± 0.005"
ANGULAR MEASURE ± 1/2°

PAINT SPEC NO.

APPROXIMATE SF/LB | SF/M

FISCHER & PORTER (CANADA) LIMITED
TORONTO ONTARIO

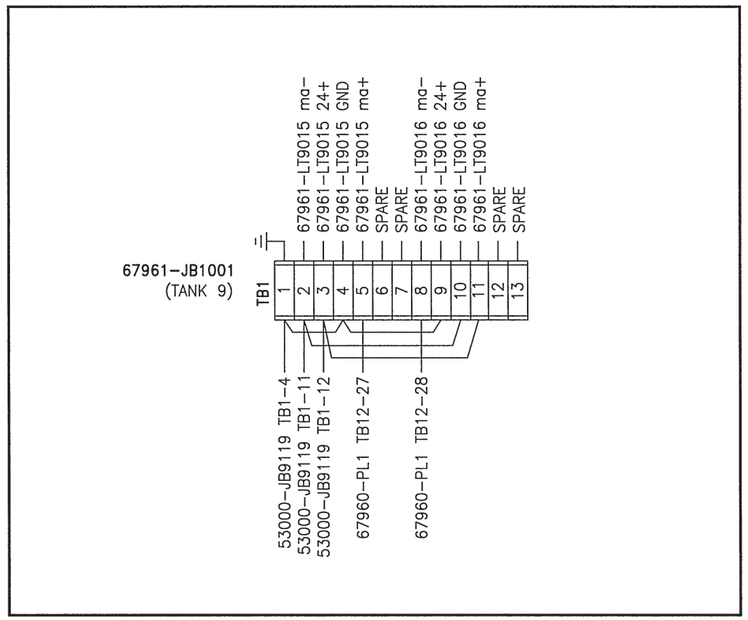
DWG STATUS	BY	DATE D	M	Y
DRAWN		3	9	76
CHECKED		9	9	76
APPROVED		9	9	76

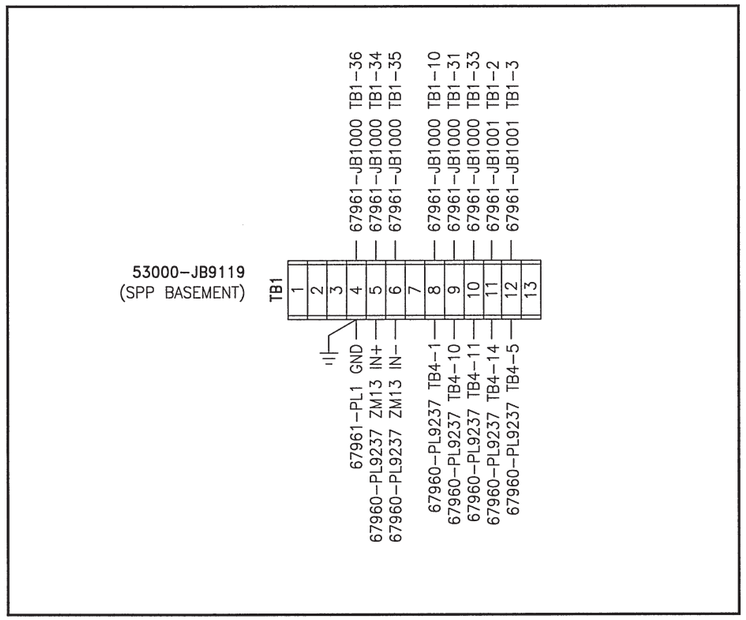
CUSTOMER & JOB NUMBER: SUTHERLAND & SCHULTZ
F&P NO. 7604B8345

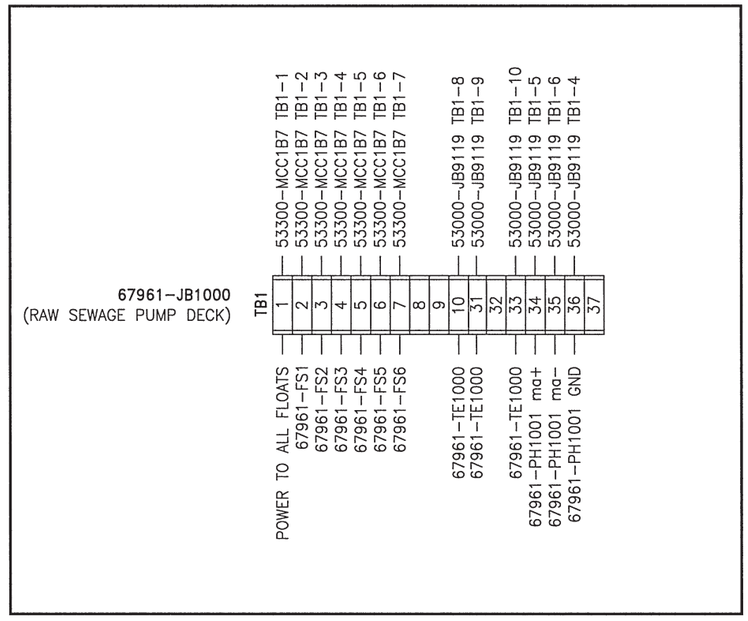
TITLE: BRUCE NUCLEAR POWER DEV. SEWAGE TREATMENT PLANT INSTRUMENT PANEL ANNUNCIATOR, SCHEMATIC

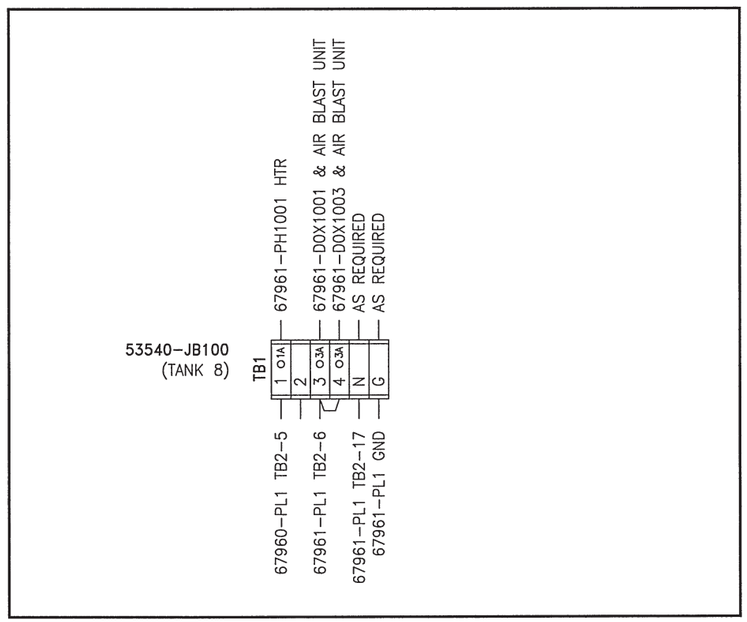
DWG NO: DT-8345-11 SHT 2 REV 1

Q:\ENG\Complete\NK37-6\NK37-D1S-67960-9506-R03.dwg, 10/05/2017 1:39:16 PM, silvertd, PLOTTER B (Q1425).pc3









NOTES:

1. ALL JUNCTION BOXES PREFIXED WITH WW

REFERENCES:

SEWAGE TREATMENT PLANT
INSTRUMENT PANEL POWER DISTRIBUTION
CWD.....NK37-D1S-67960-9504

mf roll number	rev no	date	particulars	dwn chkd	dsgn appd
			BRUCE SITE	W W	

WASTE WATER AND
SEWAGE PROCESSING PLANT
JUNCTION BOXES
CONNECTION WIRING DIAGRAM

Bruce Power — Engineering — Electrical

EC# EC57258 (CIC)	dwn C. Sheehan	chkd J. Potter	designed by A. Bruce
date of issue 04 DEC 2014	FLM drafting R. Kent		verified by J. Chapin
scale N.T.S.			approved by S. Willems
size 2	sub-type CWD	For original signatures see revision 00	micrographic stamp no.
dwg no. NK37-DRAW-67961-10001			rev 00

PANEL OR LOCAL — FIELD

POWER SOURCE	CONTROL DEVICES	INDICATING DEVICES	MISCELLANEOUS	CONN. TB-5	MISCELLANEOUS	TRANSM. & TRANSD.	MEAS. ELEMENT	FINAL CONT. ELEMENT

TB-2 · 11 (F) · (227) · TB-4 · 47 · 48 · (227) · 05 · 05 · 05 · 05

TB-5 · 63 · 64 · JB (1, 2) · WEST SIDE (+, −) · LEVEL TRANSMITTER 9001

(205) · IN (-) 1 (+) 2 · (220) · LM 9001 (10, 11, G) · (227) · OUT (-) 5 (+) 6 · (222) · 48

EAST SIDE (+, −) · LEVEL TRANSMITTER 9000 · 05

59 — SEE SHT. 2 FR9001-11

(224) · 60 — SEE SHT. 2 FR9000-11

(223) · 61 — SEE SHT. 2 TB 5-17

(225) · 62 — SEE SHT. 2 TB 5-19

OUT (-) 5 (+) 6 · LM 9000 (10, 11, G) · IN (-) 1 (+) 2 · (205)

TB-4 · 10 (F) · 1G · (226) · 49 · 50

(219) · (221) · 65 · 66 · JB (1, 2)

TB-11 · 1 · 11 · (205) · 57 · (205) · (205) · 58 · (204) · 59 (F) · (218) · 60 (F) · (219)

NOTES:
1. TB2 & TB11 ON DRAWING NK37-D1S-67960-9504

05

mf roll number	rev no	date	particulars	dwn / chkd	appd
971028	05	05 JUN 97	ADDED: NOTE 1 & WIRE No's. REV: TB11 & LT9000 WAS 9001. PER WW 96-1416.	JP	
96032B	04	12 JAN 96	DEL: LT9000 & LT9001. ADDED: TB11, TB4-57 THRU TB4-60 & TB5-63 THRU TB5-66 PER WW95-1192	JP	TL

Reneo A W.O. 664-6159 — AT TB-5 DEL JUMPERS AT TERM 48/59/60; CONN "SEE SHT 2 FZ-1 TERM -11" AT TERM 48. REV AT TERM 61/62 TB 5-17 WAS FZ-1 TERM +9; TB 5-19 WAS FZ-1 TERM +10. ADDED CONN TO TERM 59/60. PER WW 90-0669 — JF, HE, PW

E217 4 · 3 · 05 MAR 91

883 6 · 05 · 87 OCT 22 — PER FIELD PACKAGE WW-87-0299 AS BUILT REVISED & REDRAWN — T.S

mf roll number · rev no · date · particulars · dwn / chkd · appd

BNPD COM. SERV. (NK37)

SEWAGE TREATMENT PLANT EFFLUENT FLOW NO. 1 & NO. 2 LOOP DIAGRAM NO. 2

Ontario Hydro
design & construction branch
electrical design

664-79	T.S		
APR. 5, 1978			
NONE			

NK37-D3S-67960-9509-001 — 05

AS (203 x 294) · millimetres · 0 · 50 · 100 · 150

PANEL OR LOCAL

POWER SOURCE	CONTROL DEVICES	INDICATING DEVICES	MISCELLANEOUS	CONN.	MISCELLANEOUS

FIELD

TRANSM. & TRANSD.	MEAS. ELEMENT	FINAL CONTROL ELEMENT

WW-67960
RTU9000
A/I 1A (208)
2-1 1B (205)
NK37-D2X-67960-0001

TB10
24
23
NK37-DDS-65300-0020

6/B2
67961-LI-1
(-) 11 (208)
(+) 10 (207)

TB11
24V+ (204) 4
NK37-D1S-67960-9504

TB4
31 (F) (1/4A)

TB5
5 (206)
6 (207)
7 (205)
8

4-20MADC

(205)

TB11
24V- (205) 14
NK37-D1S-67960-9504

LEVEL TRANSMITTER
MILLTRONICS PROBE 86211010

67961-LT1
*
\+ 24V+
\+ MA+
24V-
MA-

03	04 JUN 97	ADDED: TB11, TB4 & DWG REF No's. REV: CONNECTIONS AT LT1. PER WW 96-1416.	JP	EL	
02	22 DEC 95	ADDED: RTU9000 & TB10. DELETED: TB2 & TB4. PER WW 94-1062.	JB JP	TL	
01	SEPT 06 89	Reneo WO 664-6159 AT TB5-7/8 DEL REMOTE JUMPER, ADDED DWG REF No. REV 67961-LT-1 WAS LT-15, 67961-LI-1 WAS LI-15 PER WW 89-0514	P.O. HE PW		
0	APR 3/78	ADDED ONT. HYDRO TITLE BLOCK & DWG. No., DWG. SUPERSEDES DWG. NK37-DDE-67160-9004 SHT 002. PER ECO-25933			
rev. no.	date	particulars	drawn	appd	mf roll number

97/02B
96032B
E1170
C34880

BNPD COMMON SERVICES (NK37)

SEWAGE TREATMENT PLANT
EQUALIZATION TANK - LEVEL
LOOP DIAGRAM #1

ontario hydro
design & construction branch
electrical design

664-79 W O
APRIL 3, 1978 DATE

by FS | dwg no. NK37-D3S-67960-9508 | rev 03

RECEIVED
FEB 23 1978

* *INSTRUMENT BY OTHERS*
☐ SEE DRAWING DT-8345-8 FOR LOCATION

EDS-4-01-01-B

REV	DESCRIPTION	BY	DATE	CHK'D	APP'D

JOB NAME & NUMBER
BRUCE NUCLEAR POWER DEV.
SEWAGE TREATMENT PLANT
76048345

LOOP NO *1*
PANEL *INSTRUMENT*
APPLICATION *EQUALIZATION TANK - LEVEL*

FISCHER & PORTER (CANADA) LIMITED
TORONTO ONTARIO

DRAWN	DATE	CHK'D	APP'D	DWG NO	SHT	REV
	AUG. 31/76			BT-8345-10	2 OF 10	3

NK37-D1S-60100-0004

WW-5334-MCC1 MASTER TERMINAL BOARD (CONTROL TERMINALS)

NK37-DDS-65330-9509

UNIT-G2: 1 — TB3-53; 17 — TB3-AP } NK37-D1S-67960-9506

UNIT-G3: 1, 2, 3 } NK37-DDS-65330-9506

UNIT-G4: 1, 2, 3 } NK37-DDS-65330-9506

UNIT-G5: 1, 2, 3 } NK37-DDS-65330-9506

UNIT-G6: 1, 2, 3 } NK37-DDS-65330-9506

UNIT-F1: BW/BR R — X2; 1, 4, 5, BW/R G — 6, 7, 10, BW/R BR — 13 — TB3-4; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 10 } NK37-DDS-65330-9506

UNIT-F2: BW/R S — X2; 1, 4, 5, BW/S R — 6, 7, 10, BW/B BK — 13 — TB3-5; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 10 } NK37-DDS-65330-9506

UNIT-F3: BW/O BK — X2; 1, 4, 5, BW/BK B — 6, 7, 10, BW/BK O — 13 — TB3-6; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 10 } NK37-DDS-65330-9506

UNIT-H1: 1 — TB8-1; 2 — TB8-2; 3 — TB8-3; 4 — TB8-4; 5 — TB8-5; 6 — TB8-6; 7, 8, 9, 10 } NK37-DDS-65300-0020

UNIT-H2: 1 — TB8-9; 2 — TB8-10; 3 — TB8-11; 4 — TB8-12; 5 — TB8-13; 6 — TB8-14; 7, 8, 9, 10 } NK37-DDS-65300-0020

50PR#18 TIE BACK SPARES

6030/1007

TO BBSSCC 0129-D1S-60100-0501

NK37-DDS-65330-9509

UNIT-E1: 2, 3, 4 } NK37-DDS-65330-9506

UNIT-E2: BW/BK G — X2; 4, 5, BW/G BK — 6, 9, 10, BW/BR BK — 11, 13 — TB3-11; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 9 } NK37-DDS-65330-9506

UNIT-E3: BW/S BK — X2; 4, 5, BW/BK BR — 6, 9, 10, BW/BK S — 11, 13 — TB3-12; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 9 } NK37-DDS-65330-9506

UNIT-E4: 2 — (1209); 3 — (1210) } NK37-DDS-65300-0020; 4, 5, 6 } NK37-DDS-65330-9506

UNIT-E5: BW/W B — X2; 1, 4, 5, BW/B W — 6, 7, 9, BW/O W — 13 — TB3-13; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 9 } NK37-DDS-65330-9506

UNIT-E6: BW/G W — X2; 1, 4, 5, BW/W O — 6, 7, 9, BW/W G — 13 — TB3-14; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 9 } NK37-DDS-65330-9506

NK37-DDS-65330-9509

UNIT-D1: BW/W BR — X2; 1, 4, 5, BW/BR W — 6, 7, 13 — TB3-1; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 13, 14, 16, 18, 19, 20, 21 } NK37-D1S-65330-0001

UNIT-D2: BW/BR R — X2; 1, 4, 5, BW/W S — 6, 7, 13 — TB3-2; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 13, 14, 16, 18, 19, 20, 21 } NK37-D1S-65330-0001

UNIT-D3: BW/R O — X2; 1, 4, 5, BW/O R — 6, 7, 13 — TB3-3; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 13, 14, 16, 18, 19, 20, 21 } NK37-D1S-65330-0001

UNIT-D4: BW/Y B — X2; 1, 4, 5, BW/O Y — 6, 7, 13 — TB3-7; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 13, 14 } NK37-DDS-65330-9507

UNIT-D5: BW/G Y — X2; 1, 4, 5, BW/Y G — 6, 7, 13 — TB3-8; 14 — TB3-AP } NK37-D1S-67960-9505; 1, 4, 5, 6, 7, 13, 14 } NK37-DDS-65330-9507

G, BK, B, BK, O, BK, Y, BK, BR, BK, R, BK

14PR

67961/9041

NK37-DDS-65300-0020

NK37-DDS-65330-9509

UNIT-C1: 4, 5, 9 } FIELD JUMPERED; 10, 13, 14 } NK37-DDS-65330-9507

UNIT-C2: 3, 4 } NK37-DDS-65330-9507

UNIT-C4: X2, 2, 3, 5 } NK37-DDS-65330-9507

UNIT-C5: X2, 3, 4, 6 } NK37-DDS-65330-9507

UNIT-B1: 3, 4 } NK37-DDS-65330-9508

UNIT-B2: 3, 4 } NK37-DDS-65330-9508

UNIT-B3: 3, 4, 5, 6, 7 } NK37-DDS-65330-9508

UNIT-B4: X2, 3, 4, 5 } NK37-DDS-65330-9508

UNIT-B5: X2, 3, 4, 5 } NK37-DDS-65330-9508

UNIT-B6: 3, 4, 5 } NK37-DDS-65330-9508

NK37-DDS-65330-9509

UNIT-B7: L1, G, 1, 2, 3, 4, 5, 6, 7, 8 } NK37-DDS-65330-9508; 9 — TB3-19; 10 — TB3-AP } NK37-D1S-67960-9505; 11, 12 } NK37-DDS-65330-9508; 31 — TB3-18; 32 — TB3-AP } NK37-D1S-67960-9505; 33, 34 } NK37-DDS-65330-9508

UNIT-A1: X2, 1, 3, 4, 5 } NK37-DDS-65330-9508

UNIT-A2: X2, 1, 4, 5, 6, 7, 10 } NK37-DDS-65330-9508; 13 — TB3-9; 14 — TB3-AP } NK37-D1S-67960-9505

UNIT-A3: X2, 1, 4, 5, 6, 7, 10 } NK37-DDS-65330-9508; 13 — TB3-10; 14 — TB3-AP } NK37-D1S-67960-9505

UNIT-A4: 1, 2, 3 } NK37-DDS-65330-9508

UNIT-A5: 2 — (1205); 3 — (1206) } NK37-DDS-65300-0020; 4, 5, 6 } NK37-DDS-65330-9508

SUPERSEDES DRAWING 0129-D1S-60100-0506 REV02.
ADDED: UNIT H1 & H2 TERMINALS WITH CONNECTIONS & REF DWG No'S.
REV: UNIT G2, G3, G4, G5, G6, F1, F2, F3, E1, E2, E3, E4, E5, E6, D1, D2, D3, D4, D5, C1, C2, C4, C5, B1, B2, B3, B4, B5, B6, B7, A1, A2, A3, A4 & A5 WERE 1B, 1C, 1D, 1E, 1F, 2A, 2B, 2C, 3A, 3B, 3C, 3D, 3F, 3G, 4A, 4B, 4C, 4D, 4E, 5A, 5B, 5D, 5E, 6A, 6B, 6C, 6D, 6E, 6F, 6G, 7A, 7B, 7C, 7D & 7E RESPECTIVELY.
PER WW 96-1416.

mf roll number	rev no	date	particulars	dwn / chkd	appd

Ontario Hydro
BNPD – NWESD
WASTE MANAGEMENT – DESIGN

SEWAGE PROCESSING PLANT-WW

SEWAGE PROCESSING PLANT
MCC1
MASTER CONTROL SECTION
CONNECTION WIRING DIAGRAM

work order	drawn by	designed by
WW96-1416	JP	
date of issue	checked by	approved by
97-06-11	JP	DB for W. Little
scale	drafting supervisor	superintendent design
N.T.S.		
mf roll no	for original signatures see revision 00	
97/028		

dwg no. NK37-D1S-60100-0004 rev 00

A1 (22.28 X 31.54)

0 10 50 100 200 250 300 millimetres

NK37DDS-65330-9508

L1
L2
L3

INCOMING COMP'T

CT-1
X1 TO WATTFORMER - 1
X2 TO WATTFORMER GROUND
TO UNIT G1
CT-2
X1 TO WATTFORMER - 5
X2 TO WATTFORMER GROUND

550V/3PH/60Hz
4 WIRE SUPPLY

03

UNIT MASTER TERMINAL SELECTION

UNIT - H1
DISCONNECT
3P DEVICE
O/L
MV11
TRANSF
FUSE
SEE DWG NK37-DXX-67961-0003

UNIT - H2
DISCONNECT
3P DEVICE
O/L
MV13
TRANSF
FUSE
SEE DWG NK37-DXX-67961-0004

UNIT - H3
DISCONNECT
3P DEVICE
MISA UNIT

UNIT - H4
DISCONNECT
3P DEVICE
M
O/L
P9026
TRANSF
FUSE
95 O/L 96
M AUX
21 START 22
STOP
1A
A1 M A2
M AUX
1 43 44 5 X1 X2
97 O/L 98
TB3-22 TB3-AP

03

	03	03/06 1997	ADDED: H1, H2, H3H4, CABLE 9042 & REF DWG NUMBER. PER WW 96-1416 & WW 96-1329.	JP		97109 B
05011	02	OCT 12/83	ECO 1314 CONTACT BVK2-13,14 WAS N.O. CONTACTS BVK5 27,28 AND BVKL-28,30 WERE N.C.	WM AMC		
01684	1	MAY 6/82	820-9924ECOB41360 (81-01-14) UNITS 7A-B-C-D-E-F 6A-B-C-D E-F-G REVISED TO A1-2-3-4-5-6, B1-2-3-4 -5-6 FIELD REF WWBD-1053	JK		
C3557	0	APR 28/78	ADDED HYDRO TITLE BLOCK & DWG. NO.	J.B.		
	rev. no	date	particulars	dwn/chkd	appd	mf roll number

BNPD (NK37)
SEWAGE TREATMENT PLANT
MCC SECTIONS 6, 7 & 8A
ELEMENTARY WIRING DIAGRAM
ontario hydro design & construction branch electrical design
w o 664-379
date APR 28/78
by J.B.
dwg no. NK37-DDS-65330-9508 R03

SECTION - 8

UNIT-A1
3P DISCONN DEVICE
DISPOSITIF SECTIONNEUR A 3P
M
O/L
MOTOR MOTEUR
SAMPLING PUMP 1HP
TRANSF
FUSE
STOP
RUN
OFF ON
MOYNO MONITOR

UNIT-A2
FOAM CONT. WATER PUMP # 1 5HP
RESET
P&B TYPE KULHA
TRR
2kΩ 12W
3700Ω
TAS
LO STOP
OVERLOAD TRIP
(A.B. BUL. 700 TYPE NT)
R27
TB3-9 TB3-AP
NK37-DIS-65330-9509

UNIT-A3
FOAM CONT. WATER PUMP # 2 5HP
CONTROL CIRCUIT SAME AS IN UNIT - A2 WITH EXCEPTIONS SHOWED HERE
TB3-10 TB3-AP
NK37-DIS-65330-9509

UNIT-A4
3kW HEATER
COMMUNITOR ROOM
HM
OA
AUTO
TH

UNIT-A5
UNWATERING & SLUDGE LOADING PUMP # 4 5HP
CONTROL CIRCUIT SAME AS IN UNIT - E4
NK37-DDS-65330-9506

UNIT-A6
IL1
IL2
IL3

03

SECTION - 7

UNIT-B1
EXHAUST FAN WASH ROOM 1/4HP (EF-2)
CONTROL CIRCUIT SAME AS IN UNIT - B1

UNIT-B2
EXHAUST FAN OFFICE 1/4 HP (EF-3)
CONTROL CIRCUIT SAME AS IN UNIT - B1

UNIT-B3
EXHAUST FAN BLOWER ROOM 1HP (EF-4)
DM-5
TO DM6

UNIT-B4
EXHAUST FAN CHLORINE ROOM 1/4 HP (EF-5)
TRANSF 100VA 120/26V
2T1 2T2 3T1 3T2
DAMPER MOTOR #1
DAMPER MOTOR #2

UNIT-B5
EXHAUST FAN CHLORINE ROOM 1/4 HP (EF-6)
CONTROL CIRCUIT SAME AS IN UNIT - B4

UNIT-B6
EXHAUST FAN ELECT. EQUIP ROOM 1/4 HP (EF-8)
DM-8

UNIT-B7
RAW SEWAGE PUMP CONTROL
FROM 120V SUPPLY IN L.P. - CCT #35
F1 2A
EL 615.75 F/S-1
EL 614 F/S-2
EL 613.5 F/S-3
EL 613 F/S-4
EL 612.5 F/S-5
EL 612 F/S-6
F/S-7
DVR-1 DVR-2 DVR-3 DVR-4 DVR-5 DVR-6 DVR-7
TB3-19 TB3-AP NK37-DIS-65330-9509
TB6-123 TB6-124
B BK
BR BK
R BK
O BK
Y BK
G BK
14PR 67961 9042
NK37-D2X-67960-0001
TB3-18 TB3-AP NK37-DIS-65330-9509
TB6-121 TB6-122

03

SECTION - 6

NOTE:
1. ALL UNITS ARE PROVIDED WITH TEMPERATURE SWITCH WIRING CONNECTIONS. TEMPERATURE SWITCHES ARE NOT USED IN ALL CASES.

* REMOTE DEVICES COMMANDES A DISTANCE

SECTION - 6

QTY/QTE.	DESCRIPTION	MAT'L	NO.
REVISION	2 - AS PER CUSTOMER REQUEST 1 SEP. 1976 - K.T REVU ALL RELAYS 'Z' CHANGE TO NO. I.K. AUG 13/76		

SCALE/ECHELLE		DATE	BY/PAR
	DRAWN DESSINE	6 JULY 76	K.T.
TOLERANCE	CHKD VERIFIE	"	R.C.

SCHEMATIC DIAGRAM

SIEMENS CANADA LIMITED

DRAWING NO. DESSIN 1-65137-04 REVISION 2

REPLACES REMPLACE | REPLACED BY REMPLACE PAR

NK37-DDS-65330-9508

TRANSLAR 003

MASTER TERMINAL BOARD (POWER TERM'S)

UNIT-A1 UNIT-A2 UNIT-A3 — T1 T2 T3
UNIT-A4 UNIT-A5 — H1 H2 H3 / T1 T2 T3

UNIT-A1 — X2, 1, 2, 3, 5 — T1 T2 T3
* THESE WIRES TO GO DIRECTLY TO OVER LOAD.

UNIT-A2 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-A3 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-A4 — 1, 3 — H1 H2 H3
* THESE WIRES TO GO DIRECTLY TO CONTACTOR

UNIT-A5 — X2, 2, 5, 6, 7, 8, 9–B7, 10–B7, 11–(1203) TB12-3, 12–(1204) TB12-4, 27, 28, 29, 30, 31, 32, 33, 34 — T1 T2 T3
SAME AS UNIT A1

SECTION #A

MASTER TERMINAL BOARD (POWER TERM'S)

UNIT-B1 UNIT-B2 UNIT-B3 — T1 T2 T3
UNIT-B4 UNIT-B5 UNIT-B6 — T1 T2 T3

UNIT-B1 — X2, 2, 3, 4 — T1 T2 T3
SAME AS UNIT A1

UNIT-B2 — X2, 2, 3, 4 — T1 T2 T3
SAME AS UNIT A1

UNIT-B3 — X2, 2, 3, 4, 5, 6, 7 — T1 T2 T3
SAME AS UNIT A1

UNIT-B4 — X2, 2, 3, 4, 5 — T1 T2 T3
SAME AS UNIT A1

UNIT-B5 — X2, 2, 3, 4, 5 — T1 T2 T3
SAME AS UNIT A1

UNIT-B6 — X2, 2, 3, 5 — T1 T2 T3
SAME AS UNIT A1

UNIT-B7 — G, L1, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30, 31, 32, 33, 34

SECTION #B

MASTER TERMINAL BOARD (POWER TERM'S)

UNIT-C1 UNIT-C2 — T1 T2 T3
UNIT-C4 UNIT-C5 — T1 T2 T3

UNIT-C1 — X2, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-C2 — X2, 2, 3, 4, 5 — T1 T2 T3
SAME AS UNIT A1

UNIT-C4 — X2, 2, 3, 4, 5, 6, 7 — T1 T2 T3
SAME AS UNIT A1

UNIT-C5 — X2, 2, 3, 4, 5, 6 — T1 T2 T3
SECTION #C SAME AS UNIT A1

MASTER TERMINAL BOARD POWER TERMINALS

UNIT H1	UNIT H2	UNIT H3	UNIT H4
T1 T2 T3	T1 T2 T3	T1 T2 T3	T1 T2 T3

LIGHTS (LOCAL)

UNIT H1 — 8, 7, 6–(012), 5–(011), 4–(004), 3–(003), 2–(002), 1–(001)
SAME AS UNIT A1 — OL/T1, OL/T2, OL/T3

LIGHTS (LOCAL)

UNIT H2 — 8, 7, 6–(033), 5–(032), 4–(022), 3–(031), 2–(021), 1–(020)
SAME AS UNIT A1 — OL/T1, OL/T2, OL/T3

TO OVERLOADS — T1 T2 T3

1, 1A, 3, 5 — CONTROL LIGHTS (LOCAL)

SAME AS UNIT A1 — OL/T1, OL/T2, OL/T3

SECTION #H

MASTER TERMINAL BOARD (POWER TERM'S)

UNIT-D1 UNIT-D2 UNIT-D3 — T1 T2 T3
UNIT-D4 UNIT-D5 — T1 T2 T3

UNIT-D1 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21
TB1 — T1, T2, T3, L1, L2, L3, OL1, OL2, OL3

UNIT-D2 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 16, 17, 18, 19, 20, 21
TB1 — T1, T2, T3, L1, L2, L3, OL1, OL2, OL3

UNIT-D3 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14, 16, 17, 18, 19, 20, 21
TB1 — T1, T2, T3, L1, L2, L3, OL1, OL2, OL3

UNIT-D5 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-D4 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, 14 — T1 T2 T3
SAME AS UNIT A1

SECTION #D

MASTER TERMINAL BOARD (POWER TERM'S)

UNIT-E1 UNIT-E2 UNIT-E3 — H1 H2 H3 / T1 T2 T3
UNIT-E4 UNIT-E6 UNIT-E7 — T1 T2 T3

UNIT-E1 — 2, 4 — H1 H2 H3
SAME AS UNIT A4

UNIT-E2 — X2, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-E3 — X2, 1, 2, 3, 4, 5, 6, 8, 9, 10, 11, 12, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-E4 — X2, 2, 5, 6, 7, 8, 9–B7, 10–B7, 11–(1007) TB12-7, 12–(1008) TB12-8 — T1 T2 T3
SAME AS UNIT A1

UNIT-E5 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-E6 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, 14 — T1 T2 T3
SAME AS UNIT A9

SECTION #E

MASTER TERMINAL BOARD (POWER TERM'S)

UNIT-F1 UNIT-F2 — T1 T2 T3
UNIT-F3 — T1 T2 T3

UNIT-F1 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-F2 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 13, 14 — T1 T2 T3
SAME AS UNIT A1

UNIT-F3 — X2, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 14 — T1 T2 T3
SAME AS UNIT A1

SECTION #F

MASTER TERMINAL BOARD (POWER TERM'S)

UNIT-G3 UNIT-G4 — H1 H2 H3
UNIT-G5 UNIT-G6 — H1 H2 H3

TO UNIT-8A — CT1-X2, CT2-X2, CT3-X2, CT-X1

UNIT-G1 — 1L1, 1L2, 1L3, L1, L2, L3
WATTFORMER ① ⑤ G

UNIT-G2 — 1, 10, 12, 13, 16, 17, L1, L2, L3

UNIT-G3 — 1, 3 — H1 H2 H3
SAME AS UNIT A4

UNIT-G4 — 1, 3 — H1 H2 H3
SAME AS UNIT A4

UNIT-G5 — 1, 3 — H1 H2 H3
SAME AS UNIT A4

UNIT-G6 — 1, 3 — H1 H2 H3
SAME AS UNIT A4

SECTION #G

INCOMING AND CT'S COMPT

UNIT-8A

TO WATTFORMER (UNIT-1A) G 1G1 — X1 X2 — CT-1
TO WATTFORMER (UNIT-1A) G 5G1 — X1 X3 — CT-2

N L1 L2 L3
SUPPLY LINE

MASTER TERMINAL BOARD (CONTROL TERM.)

UNIT-G2 — 1, 17
UNIT-G3 — 1, 2, 3
UNIT-G4 — 1, 2, 3
UNIT-G5 — 1, 2, 3
UNIT-G6 — 1, 2, 3

UNIT-F1 — X2, 1, 4, 5, 6, 7, 10, 13, 14
UNIT-F2 — X2, 1, 4, 5, 6, 7, 10, 13, 14
UNIT-F3 — X2, 1, 4, 5, 6, 7, 10, 13, 14
UNIT-H1 — 1, 2, 3, 4, 5, 6, 7, 8, 9, 10
UNIT-H2 — 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

NK37-DIS-60100-0004

UNIT-E1 — 2, 3, 4
UNIT-E2 — X2, 4, 5, 6, 9, 10, 11, 13, 14
UNIT-E3 — X2, 4, 5, 6, 9, 10, 11, 13, 14
UNIT-E4 — 2, 3, 4, 5, 6
UNIT-E5 — X2, 1, 4, 5, 6, 7, 9, 13, 14
UNIT-E6 — X2, 1, 4, 5, 6, 7, 9, 13, 14

NK37-DIS-60100-0004

UNIT-D1 — X2, 1, 4, 5, 6, 7, 13, 14, 16, 18, 19, 20, 21
UNIT-D2 — X2, 1, 4, 5, 6, 7, 13, 14, 16, 18, 19, 20, 21
UNIT-D3 — X2, 1, 4, 5, 6, 7, 13, 14, 16, 18, 19, 20, 21
UNIT-D4 — X2, 1, 4, 5, 6, 7, 13, 14
UNIT-D5 — X2, 1, 4, 5, 6, 7, 13, 14

NK37-DIS-60100-0004

UNIT-C1 — 4, 5, 9, 10, 13, 14
UNIT-C2 — 3, 4
UNIT-C4 — X2, 2, 3, 5
UNIT-C5 — X2, 3, 4, 6
UNIT-B1 — 3, 4
UNIT-B2 — 3, 4
UNIT-B3 — 3, 4, 5, 6, 7
UNIT-B4 — X2, 3, 4, 5
UNIT-B5 — X2, 3, 4, 5
UNIT-B6 — 3, 4, 5

NK37-DIS-60100-0004

UNIT-B7 — L1, G, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 31, 32, 33, 34
UNIT-A1 — X2, 1, 3, 4, 5
UNIT-A2 — X2, 1, 4, 5, 6, 7, 10, 13, 14
UNIT-A3 — X2, 1, 4, 5, 6, 7, 10, 13, 14
UNIT-A4 — 1, 2, 3
UNIT-A5 — 2, 3, 4, 5, 6

NK37-DIS-60100-0004

SECTION #8

rev. no	date	particulars	dwn / chkd	appd	mf roll number
02	11/06 1997	ADDED: TB1 AT D1, D2 &D3, TERMS AT A5 & E4 & REF DWG NO. REV: E5 WAS E6, E6 WAS E7, CONNECTIONS AT SECTION H. DELETED: EXTERNAL CONNECTIONS AT SECTION 8 - G2, F1, F2, F3, H1, H2, E2, E3, E5, E6, D1, D2, D3, D4, D5, B7, A2 & A3. PER WW 96-1416 & WW 96-1329.	JP		97128
1	MAY 5/97	820-9924 ECO B41360(81-01-14) SECTION H ADDED FIELD REF WWRO-1053.	JK		
0	APR 28/78	ADDED HYDRO TITLE BLK & DWG. NO.	J.B.	MT	

RECEIVED
MAR 20 1978

BNPD (NK37)
SEWAGE TREATMENT PLANT
MCC SECTION A,B,C,D,E,F,G,H
CONNECTION WIRING DIAGRAM

ontario hydro design & construction branch electrical design
669-379 w.o.
APR 28/78 date
by J.B. dwg no. NK37-DDS-65330-9509 R02

QTY/QTE	DESCRIPTION	MAT'L	NO.
	Correction made - Sept 22/76 R.C.		

SCALE/ECHELLE
TOLERANCE
DRAWN/DESSINE 1 SEP 76 K.T.
CHKD/VERIFIE

MASTER TERMINAL BOARD AND INTERLOCKING DIAGRAM

SIEMENS CANADA LIMITED

DRAWING NO./DESSIN 1-65137-27

REPLACES/REMPLACE — REPLACED BY/REMPLACE PAR

TRANSLAN 002

EQUALIZATION TANK

EQUALIZATION TANK

WEST SETTLING TANK 4438 TK2

WEST CONTACT STABILIZATION TANK TK4 4438

WEST RE-AERATION TANK 4438 TK6

WEST AEROBIC DIGESTER STAGE 11 TK10

WEST AEROBIC DIGESTER STAGE I TK8 4438

RE-AERATION TANK 4438 TK6

EAST AEROBIC DIGESTER STAGE 11 TK9

EAST AEROBIC DIGESTER STAGE I TK7 4438

RE-AERATION TANK 4438 TK5

EAST SETTLING TANK NO. 2 4438 TK1

EAST CONTACT STABILIZATION TANK TK3 4438

EAST RE-AERATION TANK 4438 TK5

RAW SEWAGE PUMPING STATION 67961-PH1001

CONTROL BUILDING

WALKWAY

EL. 617.50

HEAT TRACING

DUCT BANK N°3

CONDUITS GROUTED INTO BASEMENT WALL TO FORM A WATERTIGHT SEAL.

EXPANSION JOINTS INSTALLED WITH GROUNDING STRAP & CLAMP

PLACE CONDUIT TO SUIT EQUIPMENT PROVIDED

FLYGT SWITCH N°7 INLET CHAMBER HIGH LEVEL G18.5

JUNCTION BOX

2 N°12-3/4"C. TO M.C.C.1-B7 (1101)

DISCONNECT SWITCHES CEMA 4 STAINLESS STEEL ENCLOSURES

8 N°12-3/4"C. FROM E.S.P.P. TO M.C.C.1-C81 01

8 N°12-3/4"C. FROM RAW SEWAGE PUMP #2 TO M.C.C.1-D2 (1103)

8 N°12-3/4"C. FROM RAW SEWAGE PUMP #3 TO M.C.C.1-D3 (1104)

67961-TE1000 4438

FLYGT SWITCHES #1 TO 6

JUNCTION BOX c/w TERMINAL STRIP 67961-JB1000 4438

7 N°12-3/4"C. TO M.C.C.1-B7

JUNCTION BOX 1-4/C BELDEN CABLE IN 1" C TO INST. PANEL TB4-8,9,10,11,12,13,16 & 15 (1118)

LONGITUDINAL COLLECTOR DRIVE #1

L.O.S.

8 N°12-3/4"C. TO M.C.C.1-E6 (1106)

67961-DOX1003 4438

(EVA-2) SLUDGE FLOW CONTROL VALVE #1

6 N°12-3/4"C. TO INST. PANEL TB4-1,2,3,4 & 5 (1117)

67961-LT9014

67961-LS-9

79610-MV11

79610-MV13

4233

67961-LS10

67961-LT9013

3 N°10-3/4"C. TO L.P. CCT. N°32 (1108)

8 N°12-3/4"C TO MCC1-E7 (1107)

67961-DOX1001 4438

JUNCTION BOX 1 N°6C BELDEN CABLE N°8787 (EMC CABLE) IN 1" C TO INST PANEL TB 4-23,24,25,26,27,28,29 & 30 (1120)

LONGITUDINAL COLLECTOR DRIVE #2

79610-PL9291

67960-PL41

PLANT EFFLUENT FLOW TRANSMITTER LT9001 4438

3 N°16 SHIELDED (4-20 MA) -3/4"C TO INST. PANEL TB5-17 & 18 (1109)

67961-LT9016 4438

PLANT EFFLUENT FLOW TRANSMITTER LT9000 4438

3 N°16 SHIELDED (4-20 MA) -3/4"C TO INST. PANEL TB5-20 & 21 (1111)

67961-LT9015 4438

5354-JB100 4438

65330-JB42

65330-JB40

18-3/4"C & 2-1"C ENCASED IN CONCRETE FROM EQUIPMENT LOCATED ON TANK TO EQUIPMENT LOCATED IN CONTROL BLDG.

EQUALIZATION TANK LEVEL TRANSMITTER (LT-15)

4438

4233

4238

KEY PLAN

NOTE
FOR LEGEND OF SYMBOLS AND ABBREVIATION SEE DWG. E1

POLE MOUNTED HPS 250W LIGHTING FIXTURE CAT. No. PR25C125A COOPER LIGHTING

4" DIA.

10'-0"

HANDRAIL

WALKWAY

6" DIA.

JUNCTION BOX 2 N°12-3/4"C.

TYPICAL MOUNTING DETAILS OF TYPE 'C' LIGHTS

mf roll number	rev no	date	particulars	dwn chkd	appd
960328	04	DEC 22 95	DELETED: POWER SUPPLY TO INSTR. PANEL. REVISED LIGHT FIXTURE CAT. No. PER WW24-1062, 25-1151.	JB JP	TL
E1170 664-6159	03	SEPT 06 89	Renco A REV. MCC1 FEEDS & TRANSMITTER IDENTS PER WW89-0544	RO HE PW	
050608B	05	06 JUNE 2005	PER DCR 4438: REVISED LABELS FOR TANK'S, FOR LT9000, LT9001, JB1000, DOX1003, & DWG TITLE. ADDED DWG SUB-TYPE, LT9013, 9014, 9015 & 9016, JB100, JB1001, PH1001 & TE1000. DELETED SLT-9.	AJJ	RD
			WP 2-98-4233 DELETED: LS7 & LS9. ADDED: 79610-PL9291.	JP	JC

DRAWING N° NK37-DDE-53000-0103 REV. 05

Bruce Power

ENGINEERING

ELECTRICAL

UNIT: WW

SEWAGE TREATMENT PLANT
POWER & LIGHTING
TANKS

GORE & STORRIE LIMITED
CONSULTING ENGINEERS
TORONTO ONTARIO

SUB-TYPE	SIZE
ELC	1

DATE MARCH 1975 | FILE N° 480.03-D-14599

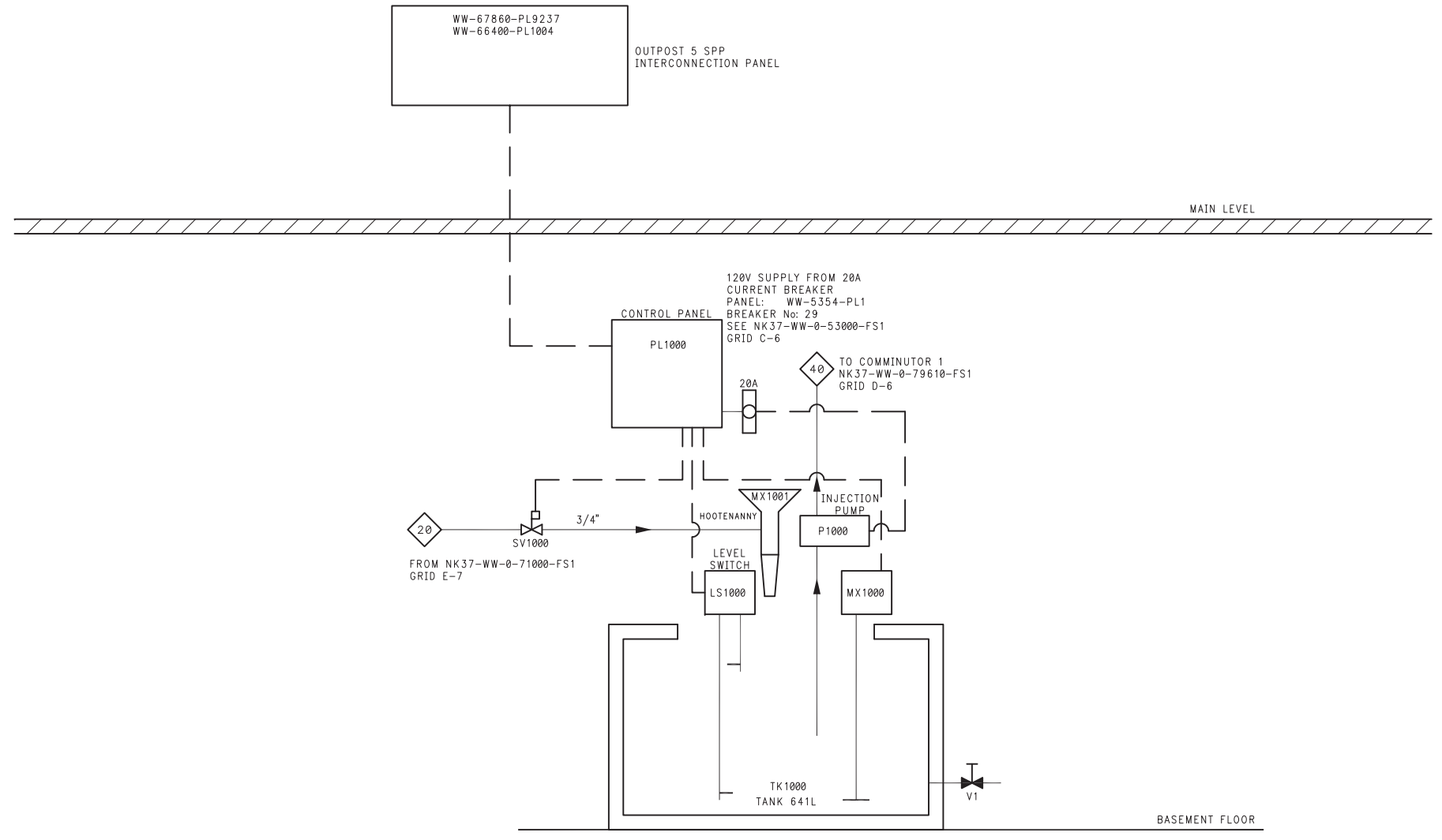
SCALE 1/4" = 1'-0" | DRAWING N° E-4

Q:\ENG\Complete\NK37-5\NK37-DDE-53000-0103-R05.dwg, 05/20/05 11:18:34 AM, POTTERJ, PLOTTER B (Q1425).pc3

FOR INFORMATION ONLY

NOTES:

ALL EQUIPMENT AND DEVICES PREFIXED WITH WW-79650-SPP UNLESS OTHERWISE NOTED.



FOR REFERENCE PURPOSES ONLY

SEE FULL SIZE OPERATIONAL FLOWSHEET FOR CURRENT INFORMATION

rev.no.	date	particulars	dwn / chkd	verif / appd
		TIE POINTS CHECKED ON 27-JAN-2011		

Bruce Power
Bruce Site

SEWAGE PROCESSING PLANT-WW

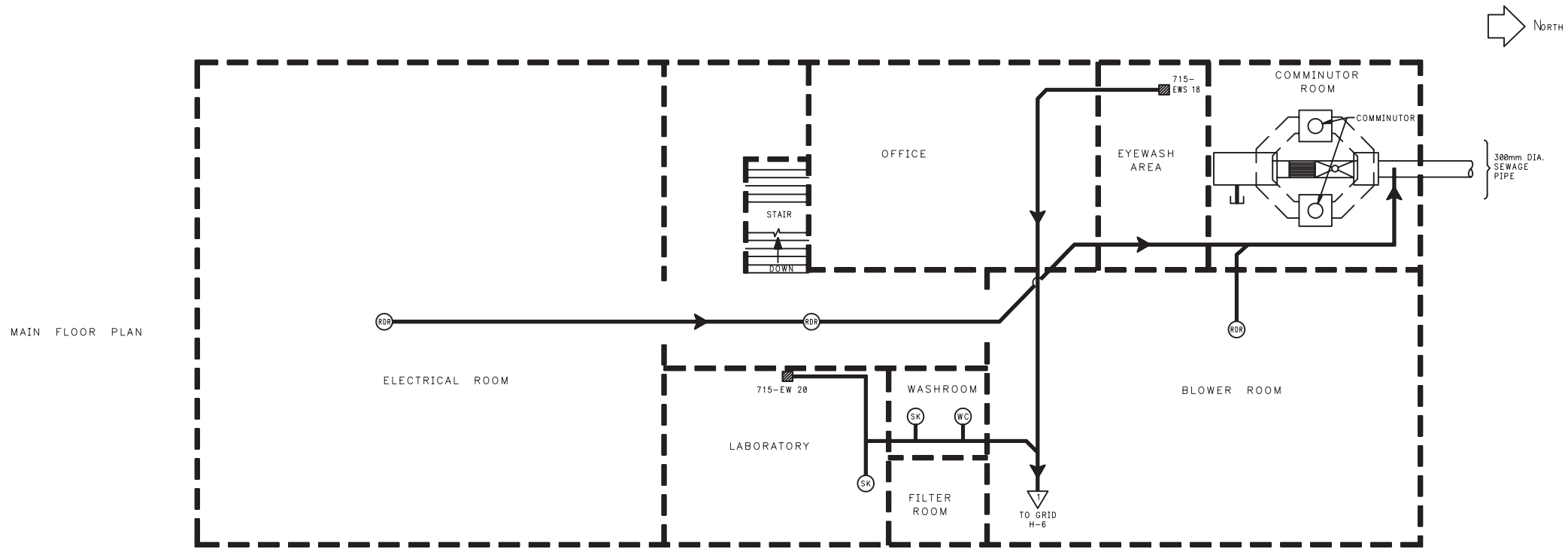
SPP POLYMER INJECTION SYSTEM

Drawn by	Checked by	Verified by
PLC/KVS	ARP	J. Dykeman
Date	AR No	Approved by
	28234537	G. Lee

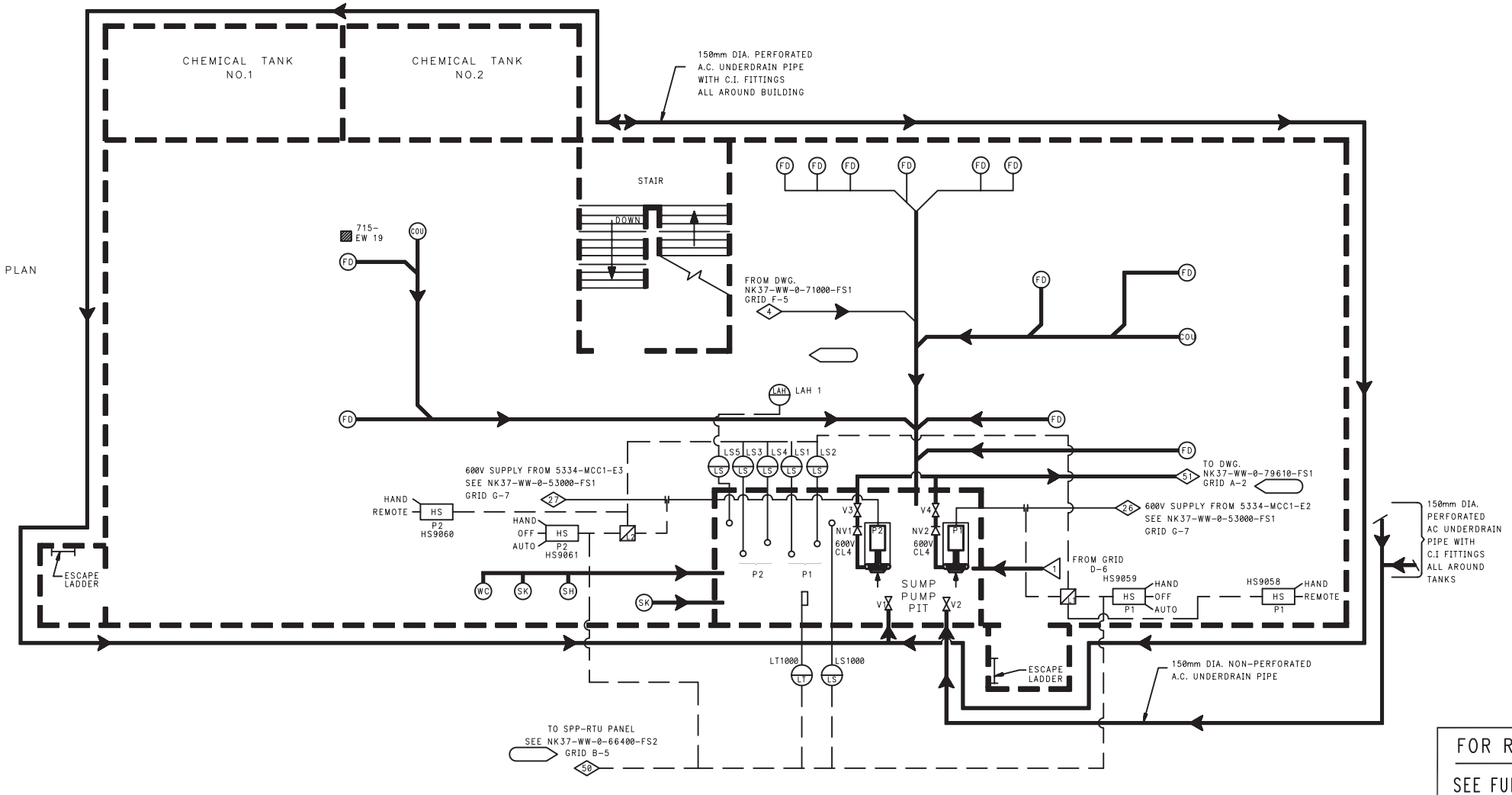
Dwg. No.	Rev.
NK37-WW-0-79650-FS1	00

FOR INFORMATION ONLY

MAIN FLOOR PLAN



BASEMENT PLAN



LOGIC L1

1) P1 LS1 + P1 LS2 + HS9058 IN 'REMOTE' + HS9059 IN 'AUTO' + MOTOR THERMOSTAT FOR P1 + O/L = P1 MOTOR ENERGIZED
2) HS9058 IN 'HAND' + MOTOR THERMOSTAT FOR P1 + O/L = P1 MOTOR ENERGIZED
3) HS9059 IN 'HAND' + MOTOR THERMOSTAT FOR P1 + O/L = P1 MOTOR ENERGIZED

LOGIC L2

1) P2 LS3 + P2 LS4 + HS9060 IN 'REMOTE' + HS9061 IN 'AUTO' + MOTOR THERMOSTAT FOR P2 + O/L = P2 MOTOR ENERGIZED
2) HS9060 IN 'HAND' + MOTOR THERMOSTAT FOR P2 + O/L = P2 MOTOR ENERGIZED
3) HS9061 IN 'HAND' + MOTOR THERMOSTAT FOR P2 + O/L = P2 MOTOR ENERGIZED

BASEMENT SUMP ALARMS
HMI SCREEN ALARMS
PUMP 1 FAULT
PUMP 2 FAULT
HIGH LEVEL SETPOINT
HIGH HIGH LEVEL FLOAT

NOTES
1. PREFIX ALL EQUIPMENT WW-71700 AND ALL INSTRUMENTATION WW-67170 UNLESS OTHERWISE INDICATED.
2. BASEMENT SUMP HAS PROVISIONS FOR OUTPOST 5 CONTROL
3. OUTPOST5 WILL ONLY CONTROL PUMPS WITH HAND SWITCHES IN AUTO POSITION.

OUTPOST5 CONTROL

WATERPILOT:
WW-67170-LT1000
OUTPOST5 WILL START AND STOP THE PUMPS ACCORDING TO PROGRAMMED START AND STOP SETPOINTS. OUTPOST5 WILL ALTERNATE THE PUMPS STARTS.

HIGH HIGH LEVEL FLOAT:
WW-67170-LS1000
OUTPOST5 WILL START BOTH PUMPS WHEN THE HIGH HIGH LEVEL FLOAT CLOSES. THE PUMPS WILL STOP SIXTY SECONDS AFTER THE HIGH HIGH LEVEL FLOAT OPENS.

LEGEND
EW – EYEWASH STATION
EWS – EYEWASH SHOWER STATION

rev.no.	date	particulars	dwn	verif appd
07		AR 28251534: DELETED LAH 1A @ GRID F-5 AND NOTE 2. REVISED TIE POINT 51 GRID REFERENCE @ G-7 AND BASEMENT SUMP ALARMS CHART @ GRID C-9. RE-NUMBERED NOTES. ADDED GRID REF TO TIE POINT 50 @ GRID H-4.	CR ARP	
06	14 JAN 2008	AS PER DCR 6766: ADDED SK & WC @ GRID H-4.	PCL	CW LRK
05	25 MAR 2004	AS PER DCN 4633 CLOSEOUT: SHOWER DRAIN ADDED IN BASEMENT	KVS	DG
		AS PER DCR 2945: RELABELLED OFFICE & LABORATORY. ADDED NOTE 3, 4, LT1000, LS1000, TIE POINT CONNECTIONS 50 & 51. REMOVED TIE POINT CONNECTION 2 AND CAPPED LINE.	PCL	ARP
04	2 APR. 98	REVISE P1 & P2 & CHG. LOGIC AT TK1	GS	TL
03	92-10-20	DWG. CONVERTED TO CAD DSR 50284	R.B.	B.K.
02	83-07-04	ADD EWS20 PER WW83-10448 V21, V22	SL	
01	81-03-26	ADDED EWS & EWSS	D.G.	
00	79-01-11	AS BUILT	D.G.	
		TIE POINTS CHECKED ON 15-JUN-2011		

Bruce Power
Bruce Site

SEWAGE PROCESSING PLANT – WW

SEWAGE PROCESSING PLANT
SEWAGE & DRAINAGE
SYSTEM

Drawn by	Rev Checked by	Rev Verified by
W.L. Robinson	DG	R. Thompson
Date	DCN/DCR No	Rev Approved by
AUG. 25 1976	DCR 2945	P. Nixon
Dwg. No. NK37-WW-0-71700-FS1		Rev. 07

FOR REFERENCE PURPOSES ONLY
SEE FULL SIZE OPERATIONAL FLOWSHEET FOR CURRENT INFORMATION

SECTION 16010

ELECTRICAL GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Items common to electrical works provided under Divisions 13 and 16, and electrical equipment and components provided under other Divisions.

1.2 ALTERNATIVES

A. Whenever an alternate is proposed, pending ENGINEER and OWNER approval, guarantee that such proposed alternative will not result in any additional expense to be incurred by OWNER because of the use of the alternate product, particularly in connection with any required changes in the work that may affect other trades. If approved, coordinate any changes required by the use of an alternate with the work of other Divisions.

1.3 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Canadian Standards Association:
   1. CSA C22.1 - Canadian Electrical Code, Part I – Safety Standard for Electrical Installations.
   2. CSA C22.1 - Canadian Electrical Code, Part II – Safety Standard for Electrical Equipment.

C. Electrical and Electronic Manufacturers' Association of Canada (EEMAC).

D. International Electrotechnical Commission (IEC).

E. National Electrical Manufacturer's Association (NEMA).

F. Ontario Electrical Safety Code (OESC) and Bulletins.

G. Ontario Regulations made under Electricity Act, 1998:
   1. O. Reg. 88/89 - Electrical Safety Authority.
   2. O. Reg. 438/07 - Product Safety.
   3. O. Reg. 570/05 - Licensing of Electrical Contractors and Master Electricians.

1.4 DEFINITIONS

A. ESA: Electrical Safety Authority (ESA) is administrative authority with regulatory power under the Electricity Act 1998, responsible for public electrical safety in Ontario, as designated by O. Reg. 89/99, and product safety as designated by O. Reg. 438/07.

1.5 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Shop Drawings:
   1. Include detailed control panel layouts, wiring schematics, diagrams, etc. presenting electrical system and components.
   2. Include arrangement drawings showing overall dimensions, clearance requirements, size and location of connections, layouts, etc.
   3. All electrical and control drawings will be done in electronic file format and submitted to ENGINEER and OWNER in printed and electronic format.

C. Product Data:
   1. Electrical characteristics: service type, voltage, continuous current, power ratings, short circuit and interrupting ratings, electrical properties, conductor sizes, grounding, arrangements. Include data sheets showing capacities and rating methods.
   2. Mechanical Characteristics: layout, enclosure type, assembly or structure, mounting arrangements, clearance requirements, entry provisions, size and location of connections, finishes, etc.
   3. Bill of materials. Include complete catalog numbers. List all options and accessories furnished.
   4. ENGINEER reserves right to request detailed product design/data sheets or manuals for review to evaluate submittal.

D. Samples: Submit where listed or required for evaluation.

E. Test Reports: Factory acceptance reports. Site acceptance reports.

F. Certificates: Certify that products meet ESA/CSA requirements.

G. Manufacturer's Instructions: Installation details.

H. Manufacturer's Field Reports: Commissioning report on field tests, including all test forms and confirming proper installation prior to energization.

1.6 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents:
   1. As-built drawings including any field modifications as listed under progress submittals.
   2. As-built drawings to be submitted in printed and electronic Adobe Acrobat PDF and editable (AutoCAD DWG) format on CD.

C. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.
   1. As-built product data including any field modifications as listed under progress submittals.
   2. Bill of materials. Include complete catalog numbers. List all options and accessories furnished.
   3. Operating manuals, manufacturer's instructions or control descriptions for each device type. Recommended renewal parts list and service schedules.
   4. Copies of factory test and field test reports.
   5. ESA certificate of final inspection.

6. Operation and maintenance data to be submitted in printed and electronic Adobe Acrobat PDF format on CD. Upon OWNER approval, large manuals may be provided only in electronic Adobe Acrobat PDF format.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.7 QUALIFICATIONS

A. Electrical Contractor: Company specializing in performing the work of this Division with 5 years documented experience and licensed in Ontario by ECRA/ESA, as designated by O. Reg. 570/05.

B. Do not employ an unfit person or anyone not skilled in the assigned work. Employ only licensed, fully qualified and experienced electricians for work involving any high voltage equipment installations (over 750 VAC).

1.8 REGULATORY REQUIREMENTS

A. Electrical system must comply with the requirements of current edition of applicable electrical safety regulations of the Electrical Safety Authority. Complete installation in accordance with the Ontario Electrical Safety Code and Safety Bulletins, latest revisions.

B. Apply to the Electrical Safety Authority for an Inspection Work Permit prior to commencement of work. Supply the necessary number of Drawings and Specifications for examination and approval. Pay associated fees. Notify ENGINEER of changes required by the Electrical Safety Authority prior to making changes.

C. Equipment and material to be CSA, ULC or cUL certified. Refer to www.esasafe.com electrical product safety for complete list of recognized certification marks. Where there is no alternative to supplying equipment that is not certified, obtain special approval in accordance with applicable regulation of Electrical Safety Authority.

D. Conform to Ontario Building Code applicable regulations.

E. Should any instance occur in the Specifications or on the Drawings, in which the materials or construction methods called are less then the minimum requirements of the applicable regulatory requirements and codes, the requirements of the codes take precedence. Provide materials and perform the work as called for to the minimum requirements of the codes, however in no instance the Project requirements established by the Specifications and Drawings to be reduced by any of the above codes unless approved by ENGINEER.

F. Conform to applicable safety regulations in regards to safety of workers and personnel at the Site.

1.9 CERTIFICATIONS

A. Furnish Certificate of Acceptance from the Electrical Safety Authority on completion of work to OWNER.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Protect equipment and components from mechanical damage, moisture, dust and metal debris during construction. Store equipment indoor in boxes, or completely wrapped in covering of heavy-duty plastic or similar material, to prevent damage to materials.

C. Maintain minimum temperature of 10 degrees C to prevent condensation and moisture penetration. Provide heating.

D. Store the equipment in secure location.

E. Protect equipment which may be installed by others, but which requires connection to the electrical or control system, from physical or electrical hazard. Do not remove from the Site materials supplied by others and to be installed under this Section without OWNER or ENGINEER written permission.

1.11 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Coordinate the installation of motors, equipment, and mechanical work with electrical work. Schedule works accordingly; allow time and incorporate limitations.

C. Co-operate with other trades on the Project to satisfactorily install all equipment and with no delay to any other trade. Sequence and coordinate work with other trades. Notify other trades in advance of openings, anchors, hangers, or other provisions necessary for electrical installation.

D. Schedule the electrical work so that disruption to the operations of the facilities is kept to a minimum. Obtain prior authorization from OWNER before de-energizing or energizing a circuit. Plan and schedule works to minimize the interference with operations and to avoid disruptions of power.

1.12 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution and Closeout Requirements: Requirements for warranties.

B. Fill out original warranty forms in OWNER's name and register with manufacturer.

1.13 SYSTEM STARTUP AND COMMISSIONING

A. Section 01810 –Operations Asset Transfer Commissioning: Requirements for commissioning.

B. Perform equipment functional tests.

C. Provide startup and commissioning.

D. Measure and record equipment voltage and full load current to verify proper operation.

E. Refer to other Sections for specific requirements.

1.14 SPARE PARTS AND MAINTENANCE MATERIALS

A. Section 01700 – Execution and Closeout Requirements: Requirements for spare parts and maintenance materials.

B. Provide spare parts and maintenance materials, as specified in manufacturers' shipping containers. Attach labels providing applicable information (including specification) for the spare parts in the package.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Products must meet applicable EEMAC standards. Permanently attached certification marks to be attached to each assembly and all equipment supplied. Manufacturers and approval labels must be visible and legible after equipment is installed.

B. Use new materials and equipment unless otherwise specified. Provide material and equipment of minimum specified design and quality, conforming to published ratings and for which replacement parts are readily available. Use products of one manufacturer for equipment or material of same type or classification. Refurbished materials are not considered new.

C. All materials and equipment used shall be approved for the area classification and location in which it is being installed.

D. Equipment ratings have shown what is expected. Ratings are for guidance only and do not limit the equipment size. When the equipment or motors furnished under this Contract differ from the expected ratings indicated, make necessary adjustments to the electrical system to accommodate size installed. Size controllers in accordance with EEMAC (NEMA) ratings. IEC ratings are not considered equal.

E. Materials and equipment of the specified manufacturer have been incorporated on the Drawings with space and areas required for the respective manufacturer's equipment. Where manufacturer's equipment is listed in these Specifications, the Drawings and Specifications have been prepared on the basis of the manufacturer listed. Where the equipment supplied under this Contract is not by the manufacturer as listed, adjust layouts, surface penetrations, housekeeping pads and all other affected items to suit the requirements of this equipment. Coordinate these changes with the work of other Divisions.

F. All breakers and switches rated above 48 volts shall have a provision for padlocking in the off position.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Review contract documents to identify electrical, instrumentation and control components listed under other Divisions.

C. Verify that surfaces, mechanical works, and the Site conditions are ready to receive work.

D. Verify field equipment locations and raceways routing. Take actual measurements in the field.

3.2 INSTALLATION AND CONSTRUCTION

A. Electrical works to be carried out under supervision of Master Electrician, as designated by O. Reg. 70/05.

B. Install electrical and control/instrumentation components in accordance with manufacturer's instructions, code requirements, and consistent with requirements of these Specifications. Maintain adequate clearance between electrical and mechanical equipment.

C. Use installation and wiring methods approved for the area classification (Hazardous Locations) and environmental conditions in which equipment is installed.

D. Do not install electrical power, control wiring, instrumentation or data cables in the same raceway, unless otherwise shown or specified. Use dedicated raceways.

E. Guard exposed live or energized electrical or control equipment during construction for personal safety of all workers on the Site. Provide temporary barriers, locks, etc. to suit Site conditions.

F. Provide equipment grounding and bonding as required regardless of whether it has been shown on the Drawings or called for in this specification. Bond together individual building structural steel members and building structures, each metallic raceway or open wireway, pipe, duct, steel tank and other metal object.

G. Electrical Systems Identification:
   1. Identify all electrical, instrumentation and control equipment with nameplates and labels. Labels shall conform to the equipment tags for each piece of equipment as noted on the Drawings
   2. Provide cable and raceways schedule. Tag and identify all wiring including spare wires and terminal blocks.
   3. Provide warning signs to meet code and OWNER's safety requirements.

H. CONTRACTOR is responsible for all electrical wiring and terminations to ensure a complete and functioning installation.

3.3 INTERFACE WITH OTHER WORK

A. Do not install electrical, instrumentation, and control equipment at locations where other equipment is to be installed, walkways are obstructed or access is difficult.

B. Provide cutting of openings to walls, floors, foundations, footings, ceilings, roofs or any other surfaces or finishes that are required for Works provided under this Division. Under no circumstances shall any cutting of the structural parts of the building be undertaken without the written authority of ENGINEER.

C. Provide restoration, patching, painting and making good of walls, floors, ceiling, partitions and roofs or any other surfaces or finishes that are required for work provided under this Division. Employ qualified tradesmen specializing in that particular trade.

D. Provide proper sealing for all openings, where conduits and cables pass through outside or rated walls and floors (fire, explosion proof, noise control, etc.).

3.4 TOLERANCES

A. Equipment locations are approximate unless dimensioned. Locations may change based on actually provided equipment and installation methods utilized by other Divisions. Allow for changes without extra cost.

B. In addition, ENGINEER reserves right to change location of any equipment, panel, box, outlet, raceway, wiring, etc. within a 5.0 m radius of the shown location. Provide changes without extra cost when modifications requested before installation.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Provide good workmanship in regard to durability, quality, efficiency, and attention to details. Conform to the best practices applicable to this type of work. Completed work must present a neat and clean appearance. Replace unsatisfactory workmanship at no extra cost.

C. ENGINEER will periodically observe and inspect work in progress and prepare deficiency lists for action by CONTRACTOR, during and on completion of the Project. Expeditiously attend to these deficiencies, to the satisfaction of ENGINEER.

3.6 ADJUSTING

A. Section 01700 - Execution and Closeout Requirements: Requirements for adjusting installed work.

B. Perform adjustments of electrical protective devices as required to place the equipment in final operating condition. Adjust trip settings to coordinate overcurrent protection devices in circuit.

3.7 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Control of Debris: At all times keep the premises free from all accumulations of debris resulting from the electrical work.

C. Control of Dust: Keep electrical and control rooms free from dust accumulations resulting from construction activities.

D. Clean electrical and control rooms such that it is free of any dust and debris that may become airborne during ventilation system operation and/or equipment operation. Include cleaning of all floor surfaces, wall surfaces, structural members, and equipment or any other surfaces to remove dust, debris, and construction waste. Use chemical powdered floor cleaner.

E. Clean the interiors and exteriors of electrical equipment assemblies (power panels, control panels, field panels, junction boxes, MCCs including floor sections and compartments, etc.) prior to the operation of any of the systems. Include all panel surfaces, electrical components, and devices. Remove marks from oil, grease, and tape, dust, debris, and construction waste. Use strong magnets to remove wire strings to prevent electrical arcing. De-energize and lockout electrical equipment prior to cleaning.

F. Touch up minor damage to factory finished equipment, to match original finish. Replace items suffering major damage to factory finish.

G. Clean, prime, and paint exposed non-galvanized hangers, supports, and fastenings to prevent corrosion.

3.8 DEMONSTRATION

A. Section 01810 - Operations Asset Transfer Commissioning: Requirements for demonstrating installed work.

B. Demonstrate electrical, control, and instrumentation systems and equipment operation.

C. Provide training.

3.9 PROTECTION OF FINISHED WORK

A. Section 01700 - Execution and Closeout Requirements: Requirements for protecting installed work.

B. Protect finished work after installation.

END OF SECTION

SECTION 16013

ARC FLASH HAZARD ASSESSMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Arc flash hazard assessment.

B. Arc flash and electrical hazard identification.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Canadian Standards Association: CSA Z462-15 - Workplace Electrical Safety.

C. Institute of Electrical and Electronics Engineers: IEEE 1584-2002 - Guide for Performing Arc-Flash Hazard Calculations.

D. Ontario Electrical Safety Authority (ESA).

E. Ontario Electrical Safety Code (OESC).

F. Ontario Health and Safety Act (OHSA).

1.3 OBJECTIVES

A. Intent of the studies is to establish arc flash hazard for electrical equipment, and to comply with the requirements of the OESC and OHSA.

B. Preparation and installation of detailed warning labels for all electrical systems including bill of materials, incorporating findings of the arc flash hazard assessment that meet Project requirements.

C. Preparations of regulatory submittals in accordance with the OESC and utility requirements.

1.4 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Provide submittals in printed and electronic format.

C. Product Data: Submit computer software package details.

D. Preliminary Findings Report: Upon completion of preliminary calculations, submit a brief summary report (one or two pages tech memo) with comments on results of arc flash calculations identifying possible safety issues, unexpectedly high energy levels, and examples of labels.

E. Preliminary Study Report: Submit arc flash hazard assessment study, detailed labels, including executive summary. See PART 3 for report content requirements.

F. Final Study Report: Submit final arc flash hazard assessment study, detailed labels, including executive summary. Study shall be sealed (stamped and signed) by a professional engineer licensed in the Province of Ontario. See PART 3 for report content requirements.

G. Inspection Report: Submit report upon completion of the Site inspection. Stipulate if labels are properly installed; include any additional requirements, and findings if required to meet safety requirements.

H. Qualifications Statements: Submit qualifications of individual(s) who will perform work for approval prior to commencement of work.

1.5 QUALITY ASSURANCE

A. Qualifications: The electrical study shall be prepared by qualified engineers, registered as a professional electrical engineer, licensed in the Province of Ontario, with minimum 10 years experience and specializing in performing electrical power system assessments.

B. Perform studies using the industry recognized computer software package, and/or manual calculations when software does not have a features required to complete study.

C. Review and respond to ENGINEER's comments; modify to meet Site conditions and constructability requirements.

D. Study report and design based on unrealistic data, wrong assumptions, constructability issues over what is outlined under this specification or agreed during this assignment will be rejected.

1.6 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Review related Project data and documentation.

C. Complete arc flash hazard assessment after electrical equipment data, ratings, and installation details, become available, and before commissioning of the electrical system.

D. Schedule Site visit to familiarize with electrical installation.

E. Submit preliminary findings report. Include proposed solutions/options to meet Site conditions and to address constructability issues.

F. Conduct preliminary findings report review meeting (workshop) (approximately 2 hours) to determine the design directions.

G. Re-calculate and incorporate changes required to meet Site conditions and to address constructability issues based on review meeting (workshop) comments in the preliminary study report. Allow for number of iterations.

H. Submit preliminary report.

I. Incorporate ENGINEER's comments and submit final report.

J. Respond to ESA comments.

K. Arc flash hazard assessment study will be incorporated into Pre-Start Health and Safety Report.

L. Complete Site inspection after installation of the arc flash hazard warning system. Submit inspection report.

PART 2 PRODUCTS

2.1 ARC FLASH WARNING LABELS

A. Category specific, detailed, machine printed (with no field markings), colour, electrical hazard warning labels, minimum 89 mm by 127 mm in size, vinyl with self-adhesive back.

B. include the following information on arc flash hazard labels:
   1. Warning or Danger header, black on orange or red.
   2. Description: "Arc Flash & Electric Shock Hazard. Appropriate Electrical PPE Required."
   3. Arc flash hazard boundary in cm.
   4. Incident energy in cal/cm^2.
   5. Hazard risk category.
   6. Voltage level or range.
   7. Working distance (limited, restricted, prohibited) in cm.
   8. Minimum PPE requirements.

C. Electrical Hazard Warning Labels:
   1. Description: "No Arc Flash Hazard, Electric Shock Hazard," or equal.

PART 3 EXECUTION

3.1 DATA COLLECTION

A. Obtain and provide data required for preparation of the arc flash hazard assessment. Retrieve relevant data from the short circuit and protective device coordination studies.

B. Include all portions of the electrical distribution system in the study. Adequately cover normal system connections and those which result in maximum arc flash hazard conditions in the study.

C. Incorporate Site specifics, existing and proposed installations, and systems accessibility into data collection and calculations.

3.2 ARC FLASH HAZARD ANALYSIS

A. Perform the arc flash hazard analysis according to CSA Z462 and IEEE 1584.

B. Calculate utilizing industry recognized computer software package:
   1. Arcing fault magnitude.
   2. Protective device clearing time.
   3. Duration of arc.
   4. Arc flash boundary.
   5. Working distance.
   6. Incident energy.
   7. Hazard Risk Category.
   8. Recommendations for arc flash energy reduction.

C. Calculate flash protection boundary and the incident energy at all significant locations in the electrical distribution system operating above 347 V, including:
   1. Substations.
   2. Switchgear.
   3. Generators and automatic transfer switches.
   4. Switchboards.
   5. Panelboards.
   6. Splitters.
   7. Motor control centers.
   8. Enclosed controllers.
   9. Disconnect switches.
   10. Control panels.
   11. Any other equipment that is likely to require examination, adjustment, servicing, or maintenance while energized.

D. Include in the arc flash hazard analysis all significant locations in 347 V, 240 V, and 208 V systems fed from transformers equal to or greater than 125 kVA where work could be performed on energized parts.

E. Assessment and Calculations:
   1. Use short circuit fault level and the clearing times of the overcurrent protective devices from the related studies for each equipment location and not assumed data.
   2. Base safe working distances on the calculated arc flash boundary considering incident energy of 1.2 cal/cm^2.
   3. Base arc flash calculations on actual overcurrent protective device clearing time.
      a. Maximum Clearing Time: 2 seconds. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, use a maximum clearing time based on the specific location.
   4. Perform calculations to represent the maximum contributions of fault current magnitude for multiple system scenarios (e.g., normal and emergency operating conditions).
   5. Incident energy calculations shall consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources (fault contribution from motors and generators).
   6. Ground fault protection should not be taken into consideration when determining the clearing time in incident energy calculations.
   7. Evaluate incident energy and flash protection boundary for both the line and load side of disconnecting devices.

3.3 REPORT

A. Summarize the results of the arc flash hazard assessment in a final report.

B. Include the following sections in the report:
   1. Executive Summary: Objective, results, comments.
   2. Brief overview of regulatory requirements, explanation of arc flash hazard, terminology (limits of approach, protection boundary, incident energy), how to read hazard label, and PPE requirements.
   3. Detailed list and calculations for each evaluated electrical system and equipment.
   4. Detailed list of electrical systems and equipment not evaluated.
   5. Conclusion, comments, and recommendations.
   6. Appendices:
      a. Labels details (one per equipment; typical are not acceptable).
      b. Detailed calculations and printouts.

3.4 INSTALLATION

A. Provide and install detailed arc flash hazard labels for each electrical system, equipment, or component analyzed, and that are likely to require examination, adjustment, servicing, or maintenance while energized.

B. Provide and install electrical hazard warning that are likely to require examination, adjustment, servicing, or maintenance while energized, but not evaluated under arc flash assessment, including:
   1. Control panels (e.g., processor, I/O, operator interface, network, communication).
   2. 600/347 and 208/120 V panelboards.
   3. Junction, pull, or terminal boxes.
   4. Other electrical equipment operating at 50 V or more.

C. Locate the marking to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of equipment.

3.5 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. ENGINEER will inspect identification in accordance with final report.

END OF SECTION

SECTION 16060

GROUNDING AND BONDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical equipment grounding.

B. Grounding electrodes and conductors.

C. Equipment bonding.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Canadian Standards Association:
   1. CSA C22.1 - Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.
   2. CSA C22.2 No. 0.4 - Bonding and Grounding of Electrical Equipment (Protective Grounding).
   3. CSA C22.2 No. 41 - Grounding and Bonding Equipment.

C. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Grounding and bonding connectors.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Accurately record actual locations of grounding and bonding connections.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of the Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Burndy.

B. Crouse-Hinds.

C. Erico.

D. Hubbell Power Systems.

E. Thomas & Betts.

2.2 WIRE

A. Bare Grounding Conductors: Class B stranded soft copper conductor, size as indicated, or in accordance with CSA C22.1.

B. Conductors for Metal Structures, Transformers, Panelboards, Ground Ties: Class B, stranded, bare, soft copper conductor, No. 2/0 AWG, or as indicated.

C. Conductors for Grounding Cable Sheaths, Raceways, Pipe Work, Screen Guards, Switchboards, PTs: Class B, stranded, bare, soft copper conductor, No. 4 AWG, or as indicated.

D. Conductors for Grounding Meter and Protection Relay Cases: Green color, PVC insulated, stranded soft annealed copper wire No. 14 AWG, or as indicated.

E. Insulated Grounding Conductors: Green, size as indicated.

2.3 MECHANICAL CONNECTORS

A. Grounding and Bonding Connectors: Non-corroding, necessary for complete grounding system, type, and material type as indicated, including but not necessarily limited to:
   1. Grounding and bonding bushings.
   2. Mechanical and compression type connectors.
   3. Protective type clamps.
   4. Bonding jumpers, straps, pressure wire connectors.

2.4 ACCESSORIES

A. Grounding and Bonding Hardware and Accessories: Non-corroding, type to suite, size material as indicated including, but not necessarily limited to:
   1. Cable sheath isolating sleeves.
   2. Fasteners and connectors.

PART 3 EXECUTION

3.1 GENERAL

A. Install complete permanent, continuous grounding and bonding system. Provide all equipment grounding as required regardless of whether it has been shown on the Drawings or called for in this Specification. Provide bonding in accordance with Ontario Electrical Safety Code.

B. Install grounding connections to typical equipment included in, but not necessarily limited to following list:
   1. Service equipment.
   2. Transformers.
   3. Duct systems.
   4. Frames of motors.
   5. Motor control centers.
   6. Starters.
   7. Control panels.
   8. Building steel work.
   9. Distribution panels.

   Bond together individual building structural steel members and building structures, each metallic raceway or open wireway, pipe, duct, steel tank and other metal object.

C. Connect to grounding system.

D. Use compression connectors for all underground grid connections.

E. Soldered joints are not permitted.

3.2 INSTALLATION

A. Install conductors, connectors and accessories in accordance with manufacturer's instructions.

B. Use mechanical connectors for grounding connections to equipment provided with lugs, where required.

C. Protect exposed grounding conductors from mechanical injury. Provide protection and grounding wires support if required.

D. Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

E. Ground hinged doors to frame of electrical equipment enclosure with flexible jumper. Install flexible ground straps for any joints, where such bonding is not inherently provided with equipment.

F. Bond single conductor, metallic sheathed cables together at one end only. Break sheath continuity by inserting insulating sleeves in cables. Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath. Connect bonded cables to ground with No. 2/0 AWG copper conductor.

G. Bond armoured cables to cabinet at supply end. Do not use bare copper conductors near un-jacketed lead sheath cables.

H. Install grounding connections for telephone, fire alarm, and communication systems.

I. Protect all joints, connections and other bare points with Glyptol or other approved corrosion inhibitor.

3.3 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Inspect grounding and bonding system conductors and connections for tightness and proper installation.

C. Verify grounding and bonding continuity.

END OF SECTION

SECTION 16070

HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Raceways and equipment hangers and supports.

B. Anchors and fasteners.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. ASTM International:
1. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
2. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
3. ASTM A325M - Standard Specification for High-Strength Bolts for Structural Steel Joints Metric.

C. Canadian Standards Association:
1. CAN/CSA G164-M - Hot Dip Galvanizing of Irregularly Shaped Articles.
2. CSA W48 - Filter Metals and Allied Materials for Metal Arc Welding.
3. CSA W59 - Welded Steel Construction (Metal Arc Welding).

D. Canadian General Standards Board:
1. CAN/CGSB 1.181 - Ready-Mixed Organic Zinc-Rich Coating.
2. CAN/CGSB 1.40 - Anticorrosive Structural Stell Alkyd Primer.

E. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Shop Drawings: Include drawings for custom and engineered supports.

1.4 REGULATORY REQUIREMENTS

A. Conform to the requirements of the Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown on Drawings.

PART 2 PRODUCTS

2.1 PRODUCT REQUIREMENTS

A. Provide materials, sizes, and types of anchors, fasteners, and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.

B. Manufacturers (in alphabetic order):
   1. B-Line Systems, by Eaton.
   2. Thomas & Betts: Kindorf, Superstrut, and Steel City brands.
   3. Tyco, Power-Strut.
   4. Unistrut.

2.2 STRUT SUPPORT AND MODULAR METAL FRAMING SYSTEMS

A. Channel: Prefabricated, U shape, size 41 by 41 mm, 2.5 mm thick.
   1. Slotted or with elongated holes for normal loads.
   2. Combination (two channels welded back to back) for heavy duty service or heavy loads.
   3. Material: Hot-dip galvanized steel or Type 316 stainless steel.

B. Provide Manufacturer's Standard:
   1. Fittings: Rods, threaded rods, hanging rods, joints, U-splice/Z/U brackets, angles, combos, flats, angle braces, plates, beam clamps, etc.
   2. Accessories: Pipe and cable clamps, supports, anchors, hangers, etc.
   3. Hardware: Nuts, bolts, washers, spring channel clamping nuts, etc.

2.3 WELDED SUPPORT AND FRAMING SUPPORTS

A. Materials:
   1. Steel Sections and Plates: CAN/CSA G40.21, Grade 350W.
   2. Steel Pipe: ASTM A53/A53M Schedule 40.
   3. Welding Materials: CSA W59.
   4. Welding Electrodes: CSA W48 Series.
   5. Bolts and Anchor Bolts: ASTM A307 or ASTM A325M.

B. Finishes:
   1. Galvanizing: Hot-dipped with zinc coating 600 g/m^2 CAN/CSA G164-M.
   2. Shop Coat Primer: CAN/CGSB 1.40.
   3. Zinc Primer: Zinc-rich, ready mix, in accordance with CAN/CGSB 1.181.

2.4 ANCHORS AND FASTENERS

A. Concrete Structural Elements: Precast insert system, expansion anchors, powder actuated anchors.

B. Steel Structural Elements: Beam clamps, spring steel clips, steel ramset fasteners, and welded fasteners.

C. Concrete Surfaces: Expansion anchors.

D. Hollow Masonry, Plaster, and Gypsum Board Partitions: Toggle bolts, hollow wall fasteners.

E. Solid Masonry Walls: Expansion anchors and preset inserts.

F. Sheet Metal: Sheet metal screws.

G. Wood Elements: Wood screws.

PART 3 EXECUTION

3.1 CONSTRUCTION

A. Provide and install complete support systems for all electrical, control and instrumentation equipment regardless of whether it has been shown on the Drawings or called for in this Specification.

3.2 APPLICATION

A. Stainless steel strut support and modular metal framing systems for installation in wet and corrosive areas.

B. Hot-dip galvanized steel for installation in other process areas and outdoors.

C. Welded support and framing systems may be used only after ENGINEER approval in case where use of modular system is not practical.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions. Field verify all locations and supported loads.

B. Attach supports to the building structure where allowed or as indicated. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

C. Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of ENGINEER.

D. Supports for outdoor electrical equipment shall be suitably anchored in concrete so as not to lean or weaken. All metal supports used outdoors are to be primed and painted appropriately.

E. Obtain permission from ENGINEER before drilling or cutting structural members.

F. Provide surface openings and patching for support systems.

G. Install pre-manufactured fastening/support systems:
   1. Fabricate supports from structural steel or steel channel. Rigidly connect members to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts. Support equipment, conduit, cables etc. using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

2. Remove sharp burrs or projections to prevent damage to cables, equipment or injury to personnel. Restore metal finishes after cutting.

H. Suspended Support Systems:
   1. Support individual cable or conduit runs with 9 mm diameter threaded rods and spring clips.
   2. Support two or more cables or conduits on channels supported by 9 mm diameter threaded rod hangers where direct fastening to building construction is impractical.

I. Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields. Secure equipment to poured concrete with expandable inserts. Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

J. Fasten exposed conduit or cables to building construction or support system using straps.
   1. Use one-hole steel straps to secure surface conduits and cables 50 mm and smaller and two-hole steel straps for conduits and cables larger than 50 mm.
   2. Beam clamps to secure conduit to exposed steel work.

K. For surface mounting of two or more conduits use channels at 1,000 mm o.c. spacing.

L. Provide metal brackets, frames, hangers, clamps, and related types of support structures where indicated, or as required to support conduit and cable runs.

M. Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

N. Install fastenings and supports as required for each type of equipment cables and raceways. Do not use wire lashing or perforated strap to support or secure raceways or cables.

O. Install surface-mounted cabinets and panelboards with minimum of four anchors. In wet and damp locations use steel channel supports to stand cabinets and panelboards 25 mm off wall.

P. Use sheet metal channel to bridge studs above and below cabinets and panelboards recessed in hollow partitions.

Q. Manufacture and install welded structures (where indicated):
   1. Fabricate work square, true, straight, and accurate to required size, with joints closely fitted and properly secured.
   2. Use self-tapping shake-headed screws on items requiring assembly by screws or as indicated.
   3. Where possible, fit and shop assemble work, ready for erection.
   4. Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.
   5. Isolate metals from dissimilar metals, concrete, mortar and masonry, by means of bituminous paint.
   6. Clean, prepare surfaces and prime steel.
   7. Paint all supports, columns and beams after fabrication and prime painting. The film thickness to be 4 mils minimum (primer plus two top coats).

R. Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Clean and prime exposed non-galvanized hangers, racks, and fastenings to prevent rusting.

S. Bond individual support structures.

END OF SECTION

SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Identification methods for electrical, control, instrumentation devices, and related components.

B. Nameplates and labels.

C. Wire and cable markers.

1.2 REFERENCES

A. Section 01600 – Product Requirements: Requirements for references.

B. Canadian Standards Association: CSA C22.1, Canadian Electrical Code, Part I – Safety Standard for Electrical Installations.

C. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data:
   1. Include catalog data for nameplates, labels, and markers.
   2. Provide raceway, conduit, cable, wire and wiring list and schedules prior to the commencement of the works. Identify origin and destination, type, installation, etc.
   3. Submit product samples.
   4. Submit reference documents listing suitability of the product, when requested.

C. Submit complete list of device and instrumentation tags for review and approval prior.

1.4 REGULATORY REQUIREMENTS

A. Conform to the requirements of the Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Weidmüller.

B. Phoenix Contact.

C. Brady.

D. Panduit.

E. 3M.

2.2 NAMEPLATES AND LABELS

A. Nameplates: Engraved 3-layer laminated plastic, black letters on white background.

B. Locations: Panelboards, MCCs, circuit breakers, transformers, control panels, control equipment enclosures, control stations, boxes, and major equipment.

C. Letter Size:
   1. Minimum 6.4 mm letters for identifying disconnect switches, control panels, operator control devices, etc.
   2. Minimum 13 mm letters for identifying panelboards, MCCs, circuit breaker, power transformers and major equipment.

D. Labels: Embossed adhesive tape, with 5 mm white letters on black background. Use only for identification of individual wall switches and receptacles, control device stations.

2.3 IDENTIFICATION TAGS

A. Instrumentation tags made of stainless steel, minimum 3 mm thick with 12.5 mm high lettering, drilled or punched hole, smooth edges for each instrument, instrument sensor or field control device.

B. Instrument tags to match tags shown on the Drawings.

2.4 WARNING AND DANGER SIGNS

A. Warning and danger signs to meet the requirements of Electrical Safety Authority.

B. Install signs on panelboard, generator, transfer switch, electrical room, circuit breaker, MCCs, and as indicated.

2.5 RACEWAYS, CABLE, AND WIRE IDENTIFICATION

A. Cables and Raceways (conduits): Wieland Uni-Labels, 12.5 mm rigid PVC slotted channel with manufactured single lettering, white with black lettering. Cables and raceways to be tagged as they enter equipment and device enclosures. Any added cables or raceways will use available tags following the cable and conduit schedule tagging convention. An updated cable and conduit schedule shall be maintained on Site and provided with as-recorded field notes upon Project completion.

B. Control, Instrumentation and Signal Wiring, Power Wiring (acceptable systems):
   1. Heat-shrink Sleeves: Printed, heat-shrink polyolefin white sleeves, black lettering, width as required, (Brady PermaSleve).
   2. Adhesive Wrap Around: Printed durable vinyl cloth white wrap-around black lettering, width as required.
   3. Self-Laminating: Printed labels with non-printed clear area, which wraps around white and laminates over the printed text; width as required.

2.6 TERMINAL BLOCKS IDENTIFICATION

A. Terminal blocks identification system: terminal blocks manufacturer's or compatible system, suitable for use with provided terminal blocks, white with black lettering.

2.7 UNDERGROUND WARNING TAPE

A. Description: 100 mm wide plastic tape, detectable type, coloured red, with suitable warning legend describing buried electrical lines.

2.8 ACCESSORIES

A. Mechanical fastening system for labels (self-tapping screws).

B. Adhesive fastening system for labels (where allowed).

C. Stainless steel chain and fasteners for instrumentation tags.

D. Temporary labels and write-on tags. Permanent markers.

E. Safety identification: danger signs, lockout-tags, warning tape, etc.

PART 3 EXECUTION

3.1 APPLICATION

A. Provide and install complete identification system for all electrical, control and instrumentation equipment regardless of whether it has been shown on the Drawings or called for in this Specification.

B. Electrical or control work without proper identifications will be considered as "work not completed".

C. Provide detailed raceway, conduit, cable, wiring scheduled. Raceway identification scheme shall be alphanumeric and preferably follow raceway origin or destination.

D. Tag all wiring. Install wire tags as construction proceed. Do not leave wiring unidentified.

E. CONTRACTOR shall provide an operational portable handheld labeler(s) available at the Site at all times for miscellaneous identification work.

3.2 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.3 INSTALLATION - IDENTIFICATION LABELS AND TAGS

A. Manufacturer's nameplates and labels to be visible and legible after equipment is installed.

B. Identify all electrical and control equipment with nameplates, labels and tags. Lettering must describe the function of the labeled equipment as indicated. Wording on nameplates and labels to be approved by ENGINEER prior to manufacture. Include name and process tag. Allow for re-labeling of existing electrical equipment.

C. Provide and install identification tags and labels on all instruments. In general instrument labeling shall consist of stainless steel tag mounted on the sensor with chain and Lamicoid label attached to the transmitter. The tag shall list instrument process tag, where label shall list process tag and function. Provide tags for all listed instruments, even if the instrument is indication type without electrical or control signals.

D. Mechanically attach labels. Tape or adhesive fixings are acceptable only if mechanical attachments are not suitable as defined by ENGINEER.

3.4 INSTALLATION - WARNING AND DANGER SIGNS

A. Manufacturer's warning and danger signs shall be visible and legible after equipment is installed.

B. Install warning signs as specified and to meet requirements of Electrical Safety Authority and ENGINEER.

3.5 INSTALLATION – RACEWAYS AND WIRING IDENTIFICATION

A. Identify all raceways, conduits, cables on both ends and before entering/leaving any electrical enclosure (e.g., control panel, junction box, MCC, marshalling panel) with Uni-Labels. Secure with holding strips. Face labels toward the front of the enclosure for easy cable identification.

B. Identify, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring. Maintain phase sequence and colour coding throughout. Colour code in accordance with CSA C22.1.

C. Mark junction and outlet boxes inside using permanent marker.

D. Identify all circuits powered from lighting/distribution panels.

E. Identify all terminal blocks.

F. Identify all new control wiring with unique tags on both ends and before entering/leaving any electrical enclosure (e.g., control panel, junction box, MCC, marshalling panel).

G. Identify all existing control wiring, when modified, relocated or affected by the Works with new tags on both ends and before entering/leaving any electrical enclosure (e.g., control panel, junction box, MCC, marshalling panel).

3.6 INSTALLATION – TEMPORARY IDENTIFICATION

A. Identify work in progress and pulled wiring with temporary write-on tags.

B. Identify, date, and sign lockout tags.

C. Do not use duct tape for marking on the finished surfaces, as it may leave permanent marks. Cleaning of plastic surfaces with solvents is not acceptable.

3.7 INSTALLATION – UNDERGROUND WARNING TAPE

A. Identify underground conduits using underground warning tape. Install one tape per trench at 150 mm below finished grade or as shown on the Drawings.

END OF SECTION

SECTION 16123

BUILDING WIRE AND CABLE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Wire and cable.

B. Armored cable.

C. Wiring connectors and connections.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Canadian Standards Association:
1. CSA C22.1 - Canadian Electrical Code, Part I – Safety Standard for Electrical Installations.
2. CSA C22.2 No. 03 – Test Methods for Electrical Wires and Cables.
3. CSA C22.2 No. 38 - Thermoset-Insulated Wires and Cables.
4. CSA C22.2 No. 51-09 – Armoured Cables.
5. CSA C22.2 No. 65-13 - Wire Connectors.
6. CSA C22.2 No. 75-08 – Thermoplastic-Insulated Wires and Cables.
7. CSA C22.2 No. 123 - Metal Sheathed Cables.
8. CSA C22.2 No. 131 – Type Teck 90 Cable.
9. CSA C22.2 No. 239-09 – Control and Instrumentation Cables.

C. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include for each cable assembly type and each wire type.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency.

1.4 REGULATORY REQUIREMENTS

A. Conform to the requirements of the Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.5 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Provide products of exact manufacturer, if explicitly shown and described in the other Sections of Contract Documents for specific application.

B. Manufacturers/Suppliers (in alphabetic order):
   1. Anixter.
   2. Belden.
   3. BICC Cable.
   4. General Cable.
   5. Nexans (Alcatel/Canada Wire).
   6. Olflex Cable.
   7. Phillips Cables.
   8. Prysmian.
   9. Shawflex.

2.2 WIRE AND CABLE

A. Description: Stranded, soft copper, single conductors, size as indicated.

B. Insulation Voltage Rating:
   1. 600 V insulation for all circuits up to 347 VAC.
   2. 1,000 V insulation for all 600 VAC circuits as indicated.

C. Insulation: CSA Type RW90 XLPE. RWU90 XLPE for 600 VAC power feeders suitable for submersion in water and installation in underground duct based on minimum 30 years lifetime.

D. Insulation Temperature Rating: 90 degrees C.

E. Minimum Conductor Size:
   1. AWG 12 for motors, heaters, etc.
   2. AWG 14 for lights, receptacles.

2.3 TECK 90 POWER CABLE

A. Teck 90 cable as manufactured by General Cable. Other acceptable manufacturers:
   1. Anixter.
   2. Approved equal.

B. Conductor: Three Class B stranded soft copper conductors with uninsulated Class B stranded soft copper ground conductor.

C. Insulation Voltage Rating: 1,000 V.

D. Insulation: XLPE.

E. Insulation Temperature Rating: 90 degrees C.

F. Colour Coding: Red (Phase A), black (Phase B), blue (Phase C).

G. Materials of Construction:
   1. Inner Jacket: Polyvinyl chloride (PVC) material.
   2. Outer Jacket: Thermoplastic PVC heat, flame and moisture resistant jacket, black.
   3. Armour: Interlocking aluminum.
   4. Filler and Binder Tape: As required.
   5. UV resistant jacket for cables exposed to direct sunlight.
   6. Marked Hazardous Locations (HL) and rated to CSA C22.2 No. 174 when installed in such a location.
   7. Flammability Ratings: FT4.

2.4 TECK 90 CONTROL CABLE

A. Teck 90 cable as manufactured by General Cable. Other acceptable manufacturers:
   1. Anixter.
   2. Approved equal.

B. Conductor: Class B stranded soft copper conductor, RW90, AWG 14 minimum with stranded copper ground conductor.

C. Insulation Voltage Rating: 600 V.

D. Insulation: XLPE.

E. Colour Coding: Manufacturer's standard.

F. Materials of Construction:
   1. Inner Jacket: Polyvinylchloride (PVC) material.
   2. Outer Jacket: Thermoplastic polyvinyl chloride (PVC), heat, flame and moisture resistant jacket, black.
   3. Armour: Interlocking aluminum.
   4. Filler and Binder Tape: As required.
   5. UV resistant jacket for cables exposed to direct sunlight.

2.5 VFD TYPE, ARMOURED POWER CABLE

A. Drive cable specifically designed for use with variable frequency drives to eliminate cable failure due to voltage reflection and voltage spikes as manufactured by Alcatel ("DriveRx"), Shawflex ("VFD Cable").

B. Class B stranded soft copper signal conductor, number and size as indicated, minimum No. 12 AWG with three, symetrically located, bare, stranded soft copper conductors, with continuous copper tape shield.

C. Cable Assembly: XLPE (cross link polyethylene) insulation, 1000 VAC voltage rating, fillers and binder tape as required, PVC material inner jacket, interlocking aluminum armour, thermoplastic PVC heat, flame, and moisture resistant outer jacket. UV resistant for outdoor locations.

D. Temperature Ratings:
   1. Temperature: Minus 40 degrees C to 90 degrees C.
   2. Flammability Ratings: FT4. Marked Hazardous Locations (HL) and rated to CSA C22.2 No. 174 when installed in such a location.

E. Colour Coding: Standard colour coding to OESC.

2.6 INSTRUMENT CABLE

A. Manufactured by General Cable. Other acceptable manufacturers:
   1. Belden.
   2. Approved equal.

B. Instrumentation:
   1. Class B stranded soft copper, number of twisted shielded pairs (analog signals) or triads (RTD signals), AWG 18 (minimum).
   2. Insulation Resistance: 300 V.
   3. Insulation: PVC.
   4. Insulation Temperature Rating: Minus 40 degrees C to 105 degrees C.
   5. Colour Coding:
      a. Pairs: Black, white, and number code.
      b. Triads: Black, white, red, and number code.

C. Materials of Construction:
   1. Inner Jacket: Polyvinyl chloride (PVC) material.
   2. Outer Jacket: Thermoplastic PVC heat, flame and moisture resistant jacket, black.
   3. Armour: Interlocking aluminum, if required.
   4. Filler and Binder Tape: As required.
   5. Special Construction: Overall shield with individual pair or triad shield.
   6. UV resistant jacket for cables exposed to direct sunlight.

2.7 INDUSTRIAL ETHERNET DATA CABLES

A. Industrial Ethernet Cable: 100 Base TX, Category 6a.

B. Cable Assembly: No. 24 AWG four bonded-pairs solid copper conductors, polyolefin insulation, polyvinyl chloride (PVC) material inner jacket, rip cord, industrial grade sunlight and oil-resistant blue PVC outer jacket, RJ-45 compatible.

C. Ratings:
   1. Temperature Rating: Minus 40 degrees C to 75 degrees C.
   2. Flammability Rating: FT4.

D. Colour Coding: White/blue stripe and blue, white/orange stripe and orange, white/green stripe and green, white/brown stripe and brown.

E. Manufacturer: Belden.

2.8 SPECIAL SENSOR WIRES AND CABLES

A. As provided and in accordance with manufacturer's specifications.

2.9 ACCESSORIES

A. Ethernet Data Cables Connectors: Category 6a RJ-45 clear connectors, eight positions shielded, 50 micro gold, one-piece design (no bars or liners) for use with solid network wiring, compatible with Category 6a standards (EIA/TIA-568), complete with cable boot/clip protector.

2.10 BARE COPPER

A. Stranded Bare Copper: Class B, stranded soft copper conductor, size as indicated or in accordance with CSA C22.1.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Wire and cable routing is approximate unless dimensioned; route as required to meet field conditions. Where wire and cable (raceway) routing is not shown, and destination only is shown on the Drawings, determine exact routing and lengths required. Field verify all locations.

C. Verify all field routing and locations. Verify that field measurements are as shown on the Drawings.

D. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

A. Review documentation for building systems, equipment, components, auxiliary systems provided under the Works. Become familiar with the manufacturer's installation guidelines and particulars of packaged systems, and other equipment. Cross-reference documentation.

B. Do not proceed with installation work without complete knowledge of any component. Replace any item that has been damaged as a result of misunderstanding and wrong connections.

3.3 WIRING METHODS

A. Process equipment power and control system wiring for this Project is based on installation of wires.

B. Colour Code: Power and branch circuit wiring in accordance with the OESC.

3.4 INSTALLATION

A. Install products in accordance with manufacturer's instructions.
   1. Use conductor not smaller than 12 AWG for power (motors, heaters, etc.).
   2. Use conductor not smaller than 14 AWG for lighting and receptacle circuits.

B. Maintain spacing and proper bending radius. Install pull boxes.

C. Clean raceways. Pull multiple cables in duct simultaneously. Use approved lubricants of type compatible with cable jacket to reduce pulling tension.

D. Protect exposed cable from damage.

E. Group cables wherever possible in raceways.

F. Provide support structures and proper cables fastening.

G. Make connections as indicated. Ground cables shield.

H. Use proper tools for communication cables, cable and wire terminations. Provide terminals blocks for all wiring including interconnections in terminal/junction boxes. Twist-on connectors are not acceptable.

I. Maintain colour coding of wires in instrumentation and control cables throughout the system. In general:
   1. AC Three-Phase Power Wiring: In accordance with Ontario Electrical Safety Code.
   2. AC/DC Line and Load Power (Hot/Live): Black.
   3. Current Carrying Grounded Conductor (Neutral): White.
   4. AC Control and I/O Circuits: Red.
   5. DC Control and I/O Circuits: Blue.
   6. Analog Pair (+, Feed): Black.
   7. Analog Pair (-, Return signal to PLC): White.
   8. Circuits Energized from External Source (24 VDC and 120 VAC) (wiring that enters the Control Panel and is energized from a source other than the Control Panel): Yellow.
   9. Intrinsically Safe Wiring: Blue with white stripe.
   10. DC Signal Ground: Green with yellow tracer.
   11. Electrical/Panel Ground: Green.

J. Use suitable cable fittings and connectors. Use proper tools for cable and wire terminations. Clean conductor surfaces before installing lugs and connectors.

K. Identify all cables, wires, and conductors.

L. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

3.5 ANALOG SIGNALS WIRING

A. Use always four terminal blocks (to accommodate two-wire and four-wire transmitters) per analog signal to terminate field wiring. Use knife type terminal block disconnects for system troubleshooting. Use fused terminal block for loop power. Use standard terminal block for shield drain wiring connections. Refer to the Drawings for details.
   1. Connect signals per Field Device Requirements: Two-wire or four-wire connections.

B. Maintain shield isolation through raceways by the use of insulating sleeves or dedicated terminal block assignments. Terminate shield drain wiring only at control panels. Insulate shield and do not terminate at field devices.

C. Terminate analog signals to uniquely numbered terminal blocks within control panels. Separate analog signals from any other 24 VDC and 120 VAC wiring. Use separate DIN rails or group together, and use terminal barriers with minimum of 25 mm gap from other wiring. Field device wiring shall not be directly connected to PLC I/O modules.

3.6 DISCRETE (DIGITAL) SIGNALS WIRING

A. Use always terminal blocks to terminate field wiring. Use fused terminal block to supply power to groups of signals. Use standard terminal block for other wiring connections. Refer to the Drawings for details. Connect signals in accordance with field device requirements.

B. Use shielded pairs for discrete signals in noisy (signal interference) environments. Use interposing relays with "dry contact" to isolate outputs from solid state devices, and for connections between controllers.

C. Terminate discrete signals to uniquely numbered terminal blocks within control panels. Separate 24 VDC and 120 VAC wiring. Group wiring by function (I/O points, field control power, etc.) and use terminal block barriers. Provide minimum of 25 mm gap between 24 VDC and 120 VAC wiring. Field device wiring shall not be directly connected to PLC I/O modules.

3.7 FIELD QUALITY CONTROL

A. Section 01600 - Product Requirements

B. Inspect wire and cable for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor.

E. Test Insulation:
   1. Use a 500 V megger for wire, cable and equipment rated 350 V and less. Use a 1,000 V megger for the remaining equipment.
   2. Test the following equipment:
      a. Cables and wiring sized No. 6 AWG and greater. Measure insulation resistance between each conductor and ground and between each pair of conductors in a circuit.
      b. Check resistance to ground before meggering.

3. Replace any cable or wire circuit having an insulation resistance of less than 0.5 megohm phase-to-ground or 1.0 megohm phase-to-phase.
4. Advise ENGINEER immediately, if motor insulations resistance is less than 0.5 megohm.

END OF SECTION

SECTION 16131

CONDUIT

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Nonmetallic conduit.

B. Electrical nonmetallic tubing.

C. Fittings and conduit bodies.

D. Accessories.

1.2 REFERENCES

A. Section 01600 – Product Requirements: Requirements for references.

B. Canadian Standards Association:
1. CSA C22.1 - Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.
2. CSA C22.2 No. 211.1, Rigid Types EB1 and DB2/ES2 PVC Conduit.
3. CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.
4. CSA C22.2 No. 45 - Rigid Metal Conduit.

C. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include for metallic conduit, flexible metal conduit, liquidtight flexible metal conduit, metallic tubing, nonmetallic conduit, flexible nonmetallic conduit, nonmetallic tubing, fittings, and conduit bodies.

C. Conduit and Wiring Schedule: As a minimum, list following information: raceway type (conduit, cable, etc.), identification (ID tag, number, etc.), raceway (type, conduit material, size, etc.), locations (from/to), cable or wire type and quantity.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.

C. Record Documents:
   1. Accurately record actual routing of conduits larger than 50 mm.
   2. Provide complete "as-recorded" conduit and cable schedule.

1.5 REGULATORY REQUIREMENTS

A. Conform to the requirements of the Ontario Electrical Safety Code.

B. Furnish Products listed and classified by CSA as suitable for purpose specified and shown on Drawings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept conduit on the Site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

D. Protect PVC conduit from sunlight.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Conduit Size: Minimum size to be the larger of that indicated or that required by the Ontario Electrical Safety Code.

B. All Products shall be of such construction as to be approved for use in the environment or area classification or in which they are located.

2.2 RIGID PVC CONDUIT AND FITTINGS

A. Construction: PVC, Schedule 40 (unless indicated otherwise), minimum size 27 mm.

B. Type DB2 shall be used for direct buried or concrete encased applications.

C. Fittings and Conduit Bodies: PVC, couplings, adapters, 30 degrees/45 degrees/90 degrees elbows, clamps and spacers, expansion joints, access fittings, offsets, sealing rings, covers, etc. manufactured for use with conduit specified.

D. Manufacturers:
   1. Carlon.
   2. IPEX.

2.3 ELECTRICAL NONMETALLIC TUBING (ENT) AND FITTINGS

A. Construction: Nonmetallic, corrugated, flexible tubing, minimum size of 27 mm.

B. Fittings and Conduit Bodies: PVC, couplings, adapters, clamps and spacers, expansion joints, access fittings, offsets, sealing rings, covers, etc. manufactured for use with conduit specified.

C. Manufacturer:
   1. IPEX Cor-Line/Kwikon line, or approved equal.

2.4 ACCESSORIES

A. Polypropylene fish cord.

B. Weatherproof, watertight expansion fittings, material to match conduit, with integral bonding jumper, suitable for linear expansion and deflection in all directions.

C. Where a process area is classified as hazardous as indicated on the drawings, install explosion proof conduit seals, unions and fittings as manufactured by Crouse-Hinds.

D. Sealing compound made by the manufacturer of the sealing fittings.

2.5 RESTORATION PRODUCTS

A. Products for restoration works. Include patching materials, tiles, glue, sealers, paint, insulation, metal panels, roofing materials, fire barriers and fire stops, etc. to restore any openings to walls, floors, foundations, footings, ceilings, roof or any other surfaces or finishes that are affected by the Works.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Conduit routing is shown on the Drawings in approximate locations unless dimensioned. Route as required to complete wiring system. Verify that field measurements are as shown on the Drawings.

C. Verify routing and termination locations of conduit prior to rough-in.

3.2 APPLICATION

A. Minimum Size: 21 mm unless otherwise specified.

B. Rigid Metal Conduit (RMC) in corrosive environment and hazardous areas. Refer to the Drawings for the area classifications.

C. EMT for building services (lighting, receptacles, etc.) installations in the electrical room.

D. Rigid PVC conduit for subsurface installations.

E. Liquid tight flexible metal conduit for connection to:
   1. Motors on all equipment where TECK cable is not used.
   2. Vibrating equipment.
   3. Electric and solenoid valves.
   4. All electrical control devices, sensors and instruments.
   5. HVAC equipment.

3.3 INSTALLATION

A. Install nonmetallic conduit in accordance with manufacturer's instructions.

B. In accordance with Sections of Division 16:
   1. Support conduits independently of fittings, boxes and enclosures, process piping and equipment; protect from mechanical damage.
   2. Ground, bond and clean conduits.
   3. Restore openings, install seals for fire stopping and noise reduction.
   4. Install electrical identification (in accordance with conduit schedule list).

C. Install conduits to cause minimum interference in spaces through which they pass. Maintain clearances.
   1. Do not run conduits through structural members. Run conduits in flanged portion of structural steel. Arrange conduit to maintain headroom and present neat appearance.
   2. Do not place conduit in concrete slabs in which slab thickness is less than four times conduit diameter. Place conduits larger than this size under floor. Route conduit in and under slab from point to point. Organize conduit in slabs to minimize cross-over. Obtain approval and minimum concrete cover (minimum 25 mm) required from ENGINEER prior to installing conduits in slabs.
   3. Provide wall and surface openings for conduit. Install sleeves where conduits pass through slab or wall.
   4. Maintain adequate clearance between conduit and piping. Do not locate conduits less than 150 mm parallel to steam or hot water lines with minimum of 100 mm at crossovers. Where possible run conduit above pipes carrying liquids. In no case shall conduit be run parallel directly below cold water lines.
   5. Do not locate conduits in front of heating appliances (minimum 1.5 m clearance).
   6. Route exposed conduit parallel and perpendicular to walls.
   7. All conduits below vehicle traffic shall be in a reinforced concrete envelope.

D. Group conduits wherever possible on suspended or surface channels. Arrange supports to prevent misalignment during wiring installation. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers. Fasten conduit supports to building structure and surfaces. Do not support conduit with wire or perforated pipe straps.

E. Provide suitable fittings to accommodate expansion and deflection where conduit crosses seismic, control, and expansion joints.

F. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

G. Cut conduit square using saw or pipecutter; deburr cut ends. Remove sharp burrs to prevent damage to cables or injury to personnel. Bring conduit to shoulder of fittings; fasten securely.

H. Join nonmetallic conduit using cement recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes minimum.

I. Install no more than equivalent of three 90 degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 50 mm size.

J. Maximum length of flexible liquid-tight conduit shall not exceed 1 m.

K. Field bends are permitted only if the pre-manufactured combination of fittings, elbows, etc. is not available for particular installation. Use only manufacturer recommended methods for field bends of PVC conduit. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

L. Use suitable caps to protect installed conduit against entrance of dirt and moisture. Dry and clean conduits before installing wire.

M. Avoid moisture traps where possible; where unavoidable, provide junction box with draining fitting at conduit low point.

N. Remove and replace blocked conduit sections. Do not use corrosive liquids to clean out conduits.

O. Remove temporary conduit supports.

P. Provide suitable pull string (fish cord) in each empty conduit except sleeves and nipples.

3.4 INTERFACE WITH OTHER WORK

A. Install conduit and transit systems to preserve ratings (fire, explosion proof, noise control, etc.) of partitions and other elements. Use proper materials and methods and provide proper sealing for all openings. Provide fire barriers for all conduits in accordance with applicable building code regulations.

B. Restore openings to walls, floors, foundations, footings, ceilings, roof or any other surfaces or finishes that are affected by the Works. Provide patching, painting and making good of walls, floors, ceiling, partitions and roof. Restore finishes. Employ qualified tradesmen specializing in that particular trade.

END OF SECTION

SECTION 16132

DUCT BANK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Duct.

B. Pull boxes.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Canadian Standards Association:
   1. CSA C22.2 No. 18 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
   2. CSA C22.2 No. 211 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
   3. CSA C22.2 No. 227 - Fittings for ABS and PVC Plastic Utilities Duct for Underground Installation.

C. Ontario Electrical Safety Code (OESC).

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Shop Drawings: Indicate dimensions, reinforcement, size and locations of openings, and accessory locations for precast pull boxes.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Accurately record actual locations of exact routing of duct bank, and actual locations of each pull box.

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept conduit on the Site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

PART 2 PRODUCTS

2.1 CONDUIT

A. Conduit type as listed on the Drawings and as conforming to Section 16131.

2.2 ACCESSORIES

A. Underground Warning Tape: 100 mm wide plastic tape, detectable type, colored red with suitable warning legend describing buried electrical lines.

2.3 CONCRETE

A. Refer to the Contract Drawings for details.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that excavation, base material installation, and compaction is completed.

C. Verify that field measurements are as shown on the Drawings.

D. Verify routing and termination locations of duct bank prior to excavation for rough-in.

E. Verify locations of pull boxes prior to excavating for installation.

F. Duct bank routing is shown on the Drawings in approximate locations unless dimensions are indicated. Route as required to complete duct system.

G. Locate pull boxes as required to complete duct bank system.

3.2 PREPARATION

A. Prepare excavation in accordance with manhole manufacturer's instructions.

3.3 DUCT BANK INSTALLATION

A. Install duct in accordance with manufacturer's instructions.

B. Install duct to locate top of duct bank at depths as shown on the Drawings.

C. Install duct with minimum slope of 100 mm per 30 m. Slope duct away from switchgear entrances.

D. Cut duct square using saw or pipe cutter; deburr cut ends.

E. Insert duct to shoulder of fittings; fasten securely.

F. Join nonmetallic duct using adhesive as recommended by manufacturer.

G. Wipe nonmetallic duct dry and clean before joining. Apply full even coat of adhesive to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.

H. Install no more than equivalent of three 90 degree bends between pull points.

I. Provide suitable fittings to accommodate expansion and deflection where required.

J. Provide suitable pull string in each empty duct except sleeves and nipples.

K. Swab duct. Use suitable caps to protect installed duct against entrance of dirt and moisture.

L. Pour concrete encasement.

M. Backfill trenches.

N. Interface installation of underground warning tape with backfilling. Install tape half way between top of duct bank and finished grade.

END OF SECTION

SECTION 16133

CABLE TRAY

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cable trays.

B. Accessories.

1.2 REFERENCES

A. Section 16070 - Hangers and Supports

B. Section 16060 – Grounding and Bonding

C. Canadian Standards Association:
   1. CSA C22.2 No. 26- Construction and Test of Wireways, Auxiliary Gutters, and Associated Fittings.
   2. CSA C22.2 No. 126.1- Metal Cable Tray Systems.
   3. CSA CAN/CSA G164, Hot Dip Galvanizing of Irregular Shaped Articles.

D. Electrical and Electronic Manufacturer's Association of Canada: EEMAC F5-1- Cabletrough Systems and Accessories.

E. Ontario Electrical Safety Code (OESC).

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Performance criteria, compliance with appropriate reference standard, characteristics, limitations, and production transportation, storage, handling and installation requirements.

C. Cable tray load calculations.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Accurately record actual routing, elevations, sections and details of cable trays.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Calculate cable tray loading based upon required cable runs. Select cable tray classification and design cable tray supports based upon loading calculations. Cable tray load class shall be CSA C1 minimum.

B. Side Rails: Minimum 150 mm high. Cable tray size as shown on the Drawings. No reduction without ENGINEERS acceptance.

2.2 MANUFACTURERS

A. Cooper B-Line Systems.

B. Thomas & Betts.

C. Approved equal.

2.3 MATERIALS

A. Cable Tray: Various components of wireway fully interchangeable, readily and easily assembled in field. Ladder type with 225 mm rung spacing, aluminum, with cover for vertical application.

B. Straight Sections, Fittings, Elbows, Risers, Tees, Covers, Expansion Joints and Similar Items: As recommended by cable tray manufacturer.

C. Cable Tray Supports, Hardware and Accessories: Stainless steel.

D. Bonding Jumper: Braided tinned copper to Ontario Electrical Safety Code. Length to suit cable tray dimensions.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install cable tray in accordance with manufacturer's instructions. Field verify all locations.

B. Install cable tray in locations shown on the Drawings. Level, straight and parallel to the existing cable trays or structure, with minimum of directional changes. Minor deviations in routing to avoid interferences allowed subject to acceptance of ENGINEER.

C. Support trays in accordance with Section 16070. Provide supports at each connection point, at the end of each run and at other points based upon cable tray classifications. Maximum spacing no greater than 2,000 mm. Supports shall be of cantilever or L-shaped design to facilitate access from one side of the tray.

D. Do not walk or climb on tray.

E. Provide continuity between tray components.

F. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.

G. Ground and bond cable tray under provisions of Section 16060. Where expansion joints/connectors are used, bonding jumpers shall be installed to ensure continuity.

H. Support cables in vertical cable tray with cushion clamps. Install woven stainless steel wire cable grips at upper extremity of each cable.

I. Provide covers on vertical cable tray sections which are under 2,000 mm above floor level.

J. Install straight and vertical bend barriers for separation of medium voltage power cables and low voltage control and signal cables.

K. Install barriers when different voltage systems are in the same cable tray.

END OF SECTION

SECTION 16135

BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Outlet boxes.

B. Pull and junction boxes.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Canadian Standards Association:
   1. CSA C22.1 - Canadian Electrical Code, Part I – Safety Standard for Electrical Installations.
   2. CSA C22.1 - Canadian Electrical Code, Part II – Safety Standard for Electrical Equipment.

C. Electrical Equipment Manufacturers of Canada (EEMAC).

D. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include data sheets and catalog numbers.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution and Closeout Requirements: Requirements for closeout submittals.

B. Record Documents: Record actual locations and mounting heights of outlet, and pull and junction boxes.

1.5 REGULATORY REQUIREMENTS

A. Conform to the requirements of the Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 OUTLET BOXES

A. Nonmetallic Boxes: For use as small junction boxes, for mounting wiring devices, etc. that are surface/recessed mounting, prefabricated one piece with conduit openings and mounting feet, PVC, impact resistant polycarbonate, or thermoplastic molding compound, indoor or weatherproof type boxes single or multi gang type with grounding provisions. Blank cover plates for boxes without wiring devices.

B. Size Requirements:
   1. Octagonal Type: 102 mm by 38 mm minimum.
   2. Square: 102 mm square, 54 mm deep minimum.
   3. Device, Masonry: 76 by 50 by 50 mm minimum.

2.2 JUNCTION AND PULL BOXES

A. Fiberglass Boxes: Molded fiberglass polyester material, smooth finish, no holes or knockouts, hinged door, stainless steel clamps, oil resistant gasket, external provisions for mounting, light gray polyester powder finish, back panel for junction type boxes, minimum size 152 by 152 by 102 mm (W x H x D). Covers with 25 mm minimum extension all around, for flush-mounted boxes.

B. Cast Metal Boxes: boxes for use outdoor, EEMAC Type 4X or 6, flat flanged, surface mounted, cast aluminum, neoprene gasket, and stainless steel cover screws.

C. Cast Metal Boxes: boxes for use in hazardous locations, EEMAC Type 7 or 9 explosion proof, rated for area classification, surface mounted.
   1. Junction boxes with threaded covers: ferroalloy cast body, aluminum cover.
   2. Square boxes: cast aluminum body and hinged cover, neoprene gasket, stainless steel cover bolts.

D. Slab Boxes: Boxes for use as pull boxes in concealed locations that are in concrete slabs, block, masonry, etc. Recessed, prefabricated one-piece PVC assembly with molded conduit connectors, single or multi gang type with grounding provisions. Cover plates for boxes.

2.3 ACCESSORIES

A. Accessories: Extensions, covers, brackets, hardware. Knockout fillers to prevent entry of debris.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that surface or mounting is suitable for boxes installation. Verify locations of floor boxes and outlets in offices, and work areas prior to rough-in.

C. Verify that field measurements are as shown on the Shop Drawings.

3.2 APPLICATION

A. Provide electrical boxes as required for splices, taps, wire pulling, equipment connections, and code compliance. Size and install boxes to meet code and project requirements. Generally install pull boxes so as not to exceed 20 m of conduit run between pull boxes. Use suitable boxes matching raceway type. Size boxes in accordance with CSA C22.1.

B. Only main boxes are indicated. In general, exact location of the boxes shall not be furnished, but drawings showing the location of all major devices. Locations shown are approximate unless dimensioned. Field to verify all locations.
   1. Nonmetallic boxes for power and lighting circuits and concealed locations (concrete slabs, masonry walls, etc.), all process areas.
   2. Fiberglass boxes for all control and instrumentation wiring (including terminal blocks), all process areas.
   3. Large Pull Boxes: Use hinged enclosure, surface-mounted in dry areas, standoff 25 mm in wet locations.

3.3 INSTALLATION

A. Install in locations as shown on the Drawings, and as required for splices, taps, wire pulling, equipment connections. All products shall be of such construction as to be approved for use in the environment or area classification or in which they are located.

B. Install in accordance with manufacturer's instructions. Install pull boxes in inconspicuous but accessible locations. Coordinate mounting heights and locations. Maintain spacing and clearances.

C. In accordance with Sections of Division 16:
   1. Support cabinets and boxes independently of connecting raceways.
   2. Install wiring ducts, terminal blocks and control devices.
   3. Ground, bond and clean boxes.
   4. Install electrical identification.

D. Set wall-mounted boxes at elevations to accommodate mounting heights shown on the Drawings.

E. Electrical boxes are shown on the Drawings in approximate locations unless dimensioned. Adjust box location up to 3 m if required to accommodate intended purpose.

F. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes. Orient boxes to accommodate wiring devices. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices.

G. Maintain headroom and present neat mechanical appearance.

H. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

I. Install boxes to preserve fire resistance rating of partitions and other elements. Provide fire stops where required.

J. Locate outlet boxes to allow luminaires positioned as shown on reflected ceiling plan.

K. Use flush mounting outlet box in finished areas.

L. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

M. Do not install flush mounting box back to back in walls; provide minimum 150 mm separation. Provide minimum 600 mm separation in acoustic rated walls.

N. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

O. Use stamped steel bridges to fasten flush mounting outlet box between studs.

P. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

Q. Use adjustable steel channel fasteners for hung ceiling outlet box.

R. Do not fasten boxes to ceiling support wires.

S. Support boxes independently of conduit.

T. Use gang box where more than one device is mounted together. Do not use sectional box. Install barriers where outlets for more than one system are grouped.

U. Use gang box with plaster ring for single device outlets.

V. Provide correct size of openings for raceways and connections. Install proper fittings. Reducing washers are not allowed. Remove sharp burrs in openings to prevent damage to cables or injury to personnel.

W. Install blank cover plates for boxes without wiring devices.

X. For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening. Do not install back-to-back.

Y. Protect finishes. Touch up surfaces of shop-painted equipment scratched or marred to match original paint.

3.4 INTERFACE WITH OTHER WORK

A. Coordinate installation of outlet box for equipment connected under Section 16150.

3.5 ADJUSTING

A. Section 01700 - Execution and Closeout Requirements: Requirements for adjusting installed work.

B. Adjust flush mounting outlets to make front flush with finished wall material.

C. Install knockout closures in unused box openings.

3.6 CLEANING

A. Section 01700 - Execution and Closeout Requirements: Requirements for cleaning installed work.

B. Clean interior of boxes to remove dust, debris, and other material.

C. Clean exposed surfaces and restore finish.

END OF SECTION

SECTION 16150

WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrical connections to equipment specified under other Sections.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 REGULATORY REQUIREMENTS

A. Conform to the requirements of the Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.5 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Obtain and review Shop Drawings, product data, and manufacturer's instructions for equipment provided under other Sections.

C. Determine connection locations and requirements.

D. Sequence rough-in of electrical connections to coordinate with installation schedule for equipment.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. 3M.

B. Allen-Bradley.

C. Belden.

D. Burndy.

E. Marr.

F. Panduit.

G. Thomas & Betts.

2.2 WIRING CONNECTORS 0 TO 1,000 V

A. Pressure/Mechanical Type Wire Lug Connectors: Copper current carrying parts, copper alloy, sized to fit copper conductors as required.

B. Power blocks, as manufactured by Allen-Bradley, Bulletin 1492, or approved equal.

C. Twist-on connectors (Marrettes®), nylon colour cap, copper current carrying parts, to be used for only copper conductors of size No. 10 AWG or less.

D. Set-screw wire connectors, threaded brass vibration resistant insert connection, nylon insulating shells.

E. Crimp sleeve wire connectors, one piece nylon self-insulated.

2.3 ACCESSORIES

A. Electrical tape, colour coded for 0 to 1,000 V circuits, rating, thickness, material, and designation as required for termination and splicing purposes.

B. Heat shrink insulating tubing, covers, and boots as required.

C. Nylon/vinyl heat shrinkable locking fork terminals, splices, disconnect terminals for control/instrumentation connections as required.

D. Electrical joint compounds. Insulation compounds, resins and sealing materials.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution and Closeout Requirements: Verification of existing conditions before starting work.

B. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 INSTALLATION - WIRING CONNECTORS 0 TO 1,000 V

A. Install strictly in accordance with manufacturer's instructions.

B. Remove insulation carefully, so the conductor strands are intact and size (connection) is not affected.

C. Apply joint compound to conductors prior to installation of connectors.

D. Install pressure type connectors with appropriate compression/die tool recommended by manufacturer.

E. Install mechanical type connectors, tighten screws with appropriate tool recommended by manufacturer.

F. Install power blocks on all process equipment power wiring (120 VAC and 600 VAC) to split/distribute power.

G. Maintain clearances and terminations spacing.

H. Use twist-on (Marrettes®) connectors only on general purpose receptacle and lighting circuits. Twist-on connectors are not acceptable on any process related power or control wiring.

I. Use set-screw or crimp sleeve wire connectors on any vibrating 0 to 300 V circuits.

END OF SECTION

SECTION 16160

CABINETS AND ENCLOSURES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Hinged cover enclosures.

B. Cabinets.

C. Splitters

D. Thermal management.

E. Accessories.

1.2 REFERENCES

A. Section 01600 – Product Requirements: Requirements for references.

B. Electrical Equipment Manufacturers of Canada (EEMAC).

C. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 PROGRESS SUBMITTALS

A. Section 01330 – Submittal Procedures: Requirements for progress submittals.

B. Product Data: Include manufacturer's standard data for enclosures and cabinets.

C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.4 REGULATORY REQUIREMENTS

A. Conform to the requirements of the Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 RATINGS

A. Indoor:
   1. Dry, Low Dust/Debris: NEMA 12.
   2. Dry, Dust/Debris Present: NEMA 12.
   3. Damp/Moist, Corrosive: NEMA 4 (polycarbonate).
   4. Damp/Moist, Not Subject to Spray: NEMA 4.
   5. Wet/Damp, Subject to Liquid Spray: NEMA 4X.
   6. Hazardous Location: NEMA 7.

B. Outdoor:
   1. Rain/Snow, Non-Hazardous: NEMA 4X, stainless steel.
   2. Rain/Snow, Hazardous: NEMA 7.

2.2 METALLIC WALL-MOUNT ENCLOSURES

A. Enclosures for use in Indoor Dry, Wet, or Outdoor Locations.

B. Construction: Single door, No. 16 or 14 gauge steel, seams continuously welded, smooth finish, no holes or knockouts, body flange, door and body stiffeners, hidden hinges, door gasket, quarterturn or three-point latch system with padlock handle, grounding stud on the door, white inside panel, mounting kit, gray polyester powder finish surface. Panels with door clamps are not considered equal.

C. Standard of Acceptance: Hoffman CONCEPT series.

D. Manufacturers:
   1. Hoffman.
   2. Rittal.
   3. Hammond.
   4. Approved equal.

2.3 NONMETALLIC WALL-MOUNT ENCLOSURES

A. Enclosures for use in Corrosive, Indoor Wet, or Outdoor Locations.

B. Construction: Single door, sealed seams, smooth finish, no holes or knockouts, door and body stiffeners, corrosion resistant hinges with no exposed metal parts, door gasket, quick release latch kit or quarterturn or three-point latch system with padlock handle on larger panels, grounding stud, white inside panel, thermoplastic data pocket, mounting foot kit, gray colour.

C. Standard of Acceptance: Hoffman ULTRX series.

D. Manufacturers:
   1. Hoffman.
   2. Hammond.
   3. Rittal.
   4. Approved equal.

2.4 FLOORMOUNTED ENCLOSURE

A. Enclosures for use in Corrosive, Indoor Wet, or Outdoor Locations.

B. Construction: Two door floor mounted, formed 12 gauge 304 Stainless Steel, seams continuously welded, smooth finish, no holes or knockouts, body flange, door and body stiffeners , heavy gauge continuous hinges, 3 point padlocking, grounding stud provided in the enclosure, welded on floor stands

C. Standard of Acceptance: Hammond HN4 FM SS series.

D. Manufacturers:
   1. Hoffman.
   2. Hammond.
   3. Rittal.
   4. Approved equal.

2.5 CONTROL PANEL ENCLOSURES

A. Refer to Specification Section 13430 Subsection 2.3

2.6 CABINETS - GENERAL

A. Cabinet Boxes: Galvanized steel with removable end walls, 450 mm wide, 600 mm high, 150 mm deep or larger.

B. Cabinet Fronts: Steel, flash or surface type with concealed hinge and flush lock, finished in gray baked enamel.

2.7 SPLITTERS

A. Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in the closed position.

B. Main and branch lugs shall match the required size and number of incoming and outgoing conductors as indicated in the Drawings.

C. Provide a minimum of three spare terminals on each set of lugs in splitters less than 400 A.

2.8 THERMAL MANAGEMENT

A. Louvers and vents including filters changeable from outside.

B. Cooling fans (forced air cooling) including filters changeable from outside.

C. Heaters and thermostats.

D. Breathers and Drains: Standard (drain for water, breather with cap for air) or universal (drain/breather for water/air) design with labyrinth design, stainless steel, 1/2 inch size. Appleton ECDB type, or approved equal.

E. Enclosure high temperature switches.

2.9 ACCESSORIES

A. Electrical or mechanical safety door interlocks preventing access to the power cabinets (power panels only) with power on.

B. LED light with door mounted or stand alone switch in all free standing enclosures.

C. Data pockets.

D. Wiring Management Products:
   1. Panel Wiring Duct: PVC rigid vinyl, slotted type including cover. Door mounted devices: spiral flexible wraps.
   2. Accessories: Separators, retainers, inserts, corner and joining strips, duct mounting clips, rivets, etc.

E. Accessories: Fasteners, seals and mounting hardware.

F. Touch-up Paint: Spray. Provide two spare cans.

PART 3 EXECUTION

3.1 PREPARATION

A. Provide enclosures and as required for control devices, equipment installations, and code compliance. Size and install enclosures and cabinets to meet code and Project requirements. Do not use enclosures smaller then 300 by 300 by 150 mm (WxHxD).

B. Only major enclosures are indicated. Locations shown are approximate unless dimensioned. Field verify all locations. Indicate exact locations on record drawings. Size cabinets and enclosures to accommodate housed devices and equipment.

C. Prior to cabinets and enclosures sizing review documentation for building systems, equipment, components, auxiliary systems provided under these works. Become familiar with the manufacturer's installation guidelines and particulars of packaged systems, and other equipment. Cross-reference documentation. Allow for minimum 15 percent spare backpanel surface space inside panels.

3.2 APPLICATION

A. Listed enclosures types shall be used unless specified otherwise.

B. Nonmetallic enclosures shall be used in chemical and process areas (unless indicated otherwise) where corrosion is major factor and stainless steel is not suitable.

C. Hazardous location enclosures shall be used in all classified areas.

D. Thermal Management:
   1. Provide thermal management if temperature inside the enclosure during normal operation will exceed 40 degrees C (at 25 degrees C ambient).
   2. Install louvers and vents with filters changeable from outside in enclosures with electronic operator interfaces, transformers or power supplies over 250 W, and where convection cooling is sufficient.
   3. Provide forced air-cooled fans with filters changeable from outside in enclosures with drive(s), transformer over 750 W, power equipment, etc. sized appropriately to maintain no more then 40 degrees C inside enclosure (at 25 degrees C ambient). Install and wire panel high temperature alarm.
   4. Install panel heaters and thermostats in all outdoor enclosures, and wet locations where required to maintain moisture control. Assume minus 30 degrees C ambient for outdoor locations.
   5. Install drains and breathers in all outdoor enclosures (other than Type 4X).

E. Accessories:
   1. Provide and install data pockets in all panels.
   2. Provide and install LED light with door mounted or stand alone switch in all free-standing enclosures.
   3. Provide and install folding shelf inside control panels with any type of programmable logic controller.
   4. Provide and install electrical or mechanical safety door interlocks preventing access to the power cabinets where required or voltages exceeding 347 VAC may be present.

F. Electronic Rack Cabinets: Provide and install mounting hardware as required and accessories as specified under other Sections.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install enclosures and boxes plumb. Coordinate mounting heights and locations. Maintain spacing and clearances. Anchor securely to wall as applicable and structural supports at each corner.

C. Install splitters and mount plumb, true and square to the building lines.

D. Extend splitters for the full length of the equipment arrangement except where indicated otherwise in the drawings.

E. In accordance with Sections of Division 16:
   1. Support enclosure and cabinets independently of connecting raceways.
   2. Install control devices, equipment, terminal blocks, wiring ducts.
   3. Ground, bond and clean.
   4. Install electrical identification.

F. Provide correct size of openings for raceways and connections. Install proper fittings. Reducing washers are not allowed. Remove sharp burrs in openings to prevent damage to cables or injury to personnel.

G. Protect finishes. Touch up surfaces of shop-painted equipment scratched or marred to match original paint.

H. No top entry into enclosures permitted in Corrosive, Wet, or Outside Locations.

END OF SECTION

SECTION 16445

MOTOR CONTROL CENTRE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Controllers and component details, fabrication, supply and field services for the Motor Control Centre as described under this Section and shown on the Drawings.

1.2 REFERENCES

A. Section 01000 - General Requirements.

B. Canadian Standards Association:
   1. CSA C22.1 - Canadian Electrical Code, Part I - Safety Standard for Electrical Installations.
   2. CSA C22.2 No. 4 - Enclosed Switches.
   3. CSA C22.2 No. 5.1 - Moulded Case Circuit Breakers.
   4. CSA C22.2 No. 14 - Industrial Control Equipment.
   5. CSA C22.2 No. 47 – Air Cooled Transformers (Dry-Type).

C. Electrical and Electronic Manufacturers' Association of Canada (EEMAC).

D. Ontario Electrical Safety Code (OESC) and Bulletins.

1.3 DEFINITIONS

A. MCC: Motor Control Centre.

B. VFD: Variable Frequency Drive.

1.4 PROGRESS SUBMITTALS

A. Section 01000 - General Requirements.

B. Shop Drawings:
   1. Summary tables showing bills of material. Include catalog numbers for circuit breakers, disconnects, motor starters, contactors, solid state controllers, drives, transformers, pilot devices, and other devices as required. List all options and accessories furnished.
   2. Wiring diagrams and control schematics. Unit's connection/layout diagram. Nameplate legends.
   3. Front view elevation, floor plan, top view, configuration of compartments and layouts with dimensions, and weights. Shipping split details, floor anchoring method and dimensioned foundation template.

4. All electrical and control drawings shall be prepared in electronic file format and submitted to ENGINEER and OWNER in printed and electronic editable format.

C. Product Data:
1. MCC Electrical Characteristics: Include service type, voltage, current, vertical and horizontal power bus size, neutral and ground bus size and arrangements, short circuit rating, bracing and device withstand ratings. Main feeder entry provisions.
2. MCC Mechanical Characteristics: Include enclosure type/NEMA rating, outline and support point dimensions, mounting arrangements, clearance requirements, feeder entry provisions, cable terminal sizes, size and location of connections, finishes, etc.
3. Controllers and Components Data: Include data sheets and catalog numbers for fuses, circuit breakers, magnetic, combination and solid state starters, contactors, drives, control transformer, operator devices, and other miscellaneous items. List all options, trip adjustments, and accessories furnished for each MCC.
4. Provide detailed product data sheets or manuals for review when required to evaluate submittal, requested by ENGINEER.

D. Test Reports: Factory test shall be witnessed by ENGINEER. Contractor shall submit factory tests report complete with ENGINEER’s sign off.

E. Certificates: CSA certificates.

F. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Manufacturer's Field Reports: Commissioning report on field tests, including all test forms and confirming proper installation.

1.5 CLOSEOUT SUBMITTALS

A. Section 01000 - General Requirements.

B. Record Documents:
1. As-built drawings including any field modifications.
2. As-built drawings to be submitted in printed and electronic Adobe Acrobat PDF and editable (AutoCAD DWG) format on CD, USB or electronic file.

C. Operation and Maintenance Data: Indicate and submit maintenance data for incorporation into Operations and Maintenance Manuals.
1. As-built product data including any field modifications.
2. Include complete bill of material with catalog numbers. Provide operating manuals, manufacturer's instructions or control descriptions for each device type. Recommended renewal parts list and service schedules.
3. Copies of factory test and field test reports.
4. ESA certificate of final inspection.
5. Operation and Maintenance Data shall be submitted in printed and electronic Adobe Acrobat PDF format on CD. Upon approval, large manuals may be provided only in electronic Adobe Acrobat PDF format.

1.6 QUALITY ASSURANCE

A. Conform to CSA C22.2 No. 14 service conditions during and after installation of MCC.

B. Factory test shall be witnessed by ENGINEER. Contractor shall carry all costs for ENGINEER representatives' airfare, hotel, and car rental. Costs shall also be carried for any additional travel required for additional testing due to deficiencies observed during factory test.

1.7 REGULATORY REQUIREMENTS

A. Conform to Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01000 - General Requirements.

B. Divide assembly for shipment to the Site, complete with hardware and instructions for re-assembly. Deliver in 1,524 mm maximum width shipping splits, individually wrapped for protection, and mounted on shipping skids. Provide instructions for lifting.

C. Perform external inspection before product is removed from the carrier's transport vehicle to identify shipping damage or rough handling in transit.

D. Off-load and rig equipment in accordance with manufacturer's handling instructions. Use only approved lifting methods. Protect equipment from shock, falling and mechanical damage during rigging. Sensitive components are mounted within equipment assembly.

E. Protect equipment and all components from mechanical damage, moisture, dust and metal debris during construction. Store equipment indoor on shipping skids completely wrapped in covering of heavy-duty plastic or similar material, to prevent entry of dirt and dust. Maintain minimum temperature of 10 degrees C to prevent condensation and moisture penetration. Provide heating. Store the equipment in secure location.

1.9 SEQUENCING AND SCHEDULING

A. Section 01000 - General Requirements.

B. Schedule manufacturing. The MCC ratings shown are for estimating purposes only and the equipment is not approved for manufacturing (or procurement of components) until short circuit and coordination studies are completed, and progress submittals approved.

1.10 MANUFACTURER'S WARRANTY

A. Section 01700: Execution Requirements: Requirements for warranties.

B. Fill out original warranty forms in OWNER's name and register with manufacturer.

1.11 SPARE PARTS

A. Section 01000 - General Requirements.

B. Furnish ten of each size of cover bolts, cage nuts, and door fasteners.

C. Furnish one can of aerosol touchup paint.

D. Furnish four control transformer primary fuses of each size and type installed.

E. Furnish six control transformer secondary fuses of each size and type installed.

F. Furnish three replacement LED lamps.

G. Furnish three replacement lens caps for each colour of pilot light.

H. Furnish four replacement auxiliary control relays used within MCC assembly.

1.12 SYSTEM STARTUP AND COMMISSIONING

A. Section 01000 - General Requirements.

B. Verify settings. Ensure circuit over current protective devices such as breakers, protective relays, fuses, etc. are installed and set to required values based on installed equipment.

C. Verify the safety and readiness of the cables, phasing and connections prior to energization. Obtain ESA approval.

D. Energize MCC. Verify operation.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design complete MCC. Provide suitable controllers and devices that will perform specified functions for all electrical motors and equipment. Adjust layout; modify control schematics, component type and all other affected items to suit equipment requirements.

B. Supply MCC capable of continuous full load operation under the following conditions:
   1. Location: Indoor, enclosed, ventilated area.
   2. Ambient Temperature: 5 to 40 degrees C.
   3. Relative Humidity: 20 to 95 percent.

C. Ratings: 600 VAC, 60 Hz, three-phase, three-wire solidly grounded power system.

D. Bus:
   1. Horizontal: 600 A Tin-plated copper, polyester barrier.
   2. Vertical: 300 A minimum or as required, tin-plated copper.
   3. Neutral: Distributed to utility metering compartment.
   4. Ground: Minimum 300 A, 1/4 inch by 1 inch bare copper, top mounted.

5. Bracing: 42,000 A RMS symmetrical.
   a. Enclosure: EEMAC Type 1, with gaskets.
   b. Interrupting Capacity: 25 kAIC.

E. EEMAC Classification: Class II control center, Type B wiring.

F. All external connections to the drive shall be terminated in suitably rated and clearly identified terminals/terminal blocks. All control wiring shall be identified with slip-on type wire number.

G. Controls: Standard, hardwired control for operation in manual mode and provisions for operation in automatic mode including interlocks and other provisions per schematics.

H. Control schematics are shown in generic form to identify equipment functionality and minimum control requirements; as components and implementation varies between manufacturers, modify as required to suit required functionalities. Some of the units may require additional auxiliary relays to meet control requirements.

I. In addition to the typical control devices provided by the MCC manufacturer, there will be provisions for installation, wiring, control relays, operator interface devices, etc. and unit space reserved for protection devices (special monitors and relays) provided by others as shown on the Drawings.

J. All MCC components shall be standard stock items with 7 day parts or unit replacement available in Canada. Any special delivery units shall be listed as exception.

K. Equipment and motor ratings shown are what is expected. Ratings are for guidance only and do not limit the equipment size. When the equipment or motors furnished under the Contract differ from the expected ratings indicated, make necessary adjustments to the electrical system to accommodate size installed.

L. Design shall consider and allow safe local normal operation of MCC electrical components controls by Plant Operation staff requiring no PPE for protection from the potential hazards (arc flash, shock, etc.) from electrical component being operated; allowance for protective devices and / or remote control panel(s) if required shall be provided as part of MCC equipment. Short circuit study and protective device coordination study and arc flash hazard assessment shall identify this condition is satisfied.

2.2 MANUFACTURERS

A. Eaton Electrical, Freedom 2100 MCC.

B. No Substitutions will be considered acceptable.

2.3 STRUCTURE

A. Main horizontal and branch vertical, three-phase high conductivity tin-plated copper bus bars in separate compartment, self-cooled, extending entire width and height of motor control center, supported on insulators. Bottom mounted grounding bus, entire width of the structure.

B. Floor mounted, front access only, free standing, enclosed dead front structure:
   1. Standard Section Depth: 533 mm.
   2. Standard Section Width: 615 mm.

3. Overall Height: 2,286 mm, 1,830 mm of control equipment vertical unit space.

C. Compartmentalized vertical sections with common power bus bars, completely enclosed assembly. Each unit to have complete top and bottom steel plate for isolation between units. Provide guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses are energized. Automatic shutters.

D. Horizontal wireways, equipped with cable supports, across top and bottom, extending full width of MCC, isolated from bus bars by steel barriers.

E. Vertical wireways including doors for load and control conductors extending full height of vertical sections, equipped with cable tie supports. Installation wiring to units accessible with doors open and units in place.

F. Hinge unit doors on same side. Pushbuttons and indicating lights mounted on door front.

G. Provision for future extension of one end of MCC including busbars without need for further drilling, cutting or preparation in field.

H. Finish: Manufacturer's standard gray enamel.

2.4 UNIT INTERLOCKS

A. Operating mechanism mounted on the primary disconnecting means of each starter unit shall be mechanically interlocked with the unit door to prevent access unless the disconnecting device is in the OFF position and to prevent inadvertent closing of the disconnecting device with the door open. Include mechanical defeater to bypass this interlock.

B. Mechanical interlock to prevent removal or re-insertion of the unit while in the ON position.

C. Padlocking facilities for disconnecting means to positively lock the disconnecting device in the OFF position with one to three padlocks with the door open or closed.

2.5 ADJUSTABLE SPEED DRIVES

A. Manufacturers:
   1. Eaton DG1 Series
   2. No other manufacturers shall be considered acceptable

B. Variable frequency drive, solid state, pump or blower application, variable torque; convert 3-phase, 60 Hz input power to adjustable frequency and voltage for controlling the speed of squirrel cage induction motor. The solid state starter shall bring motor up to speed in current limiting mode, then automatically switch to full voltage operation.
   1. Pulse width modulated (PWM) inverter system to minimize audible motor noise and increase overall performance; rated 575 VAC plus or minus 10 percent, 3-phase, 60 Hz; efficiency 95 percent.
   2. Power Factor: 0.97.
   3. Input Reactor: Minimum 3 percent.
   4. Speed compensated motor overload and solid state drive/motor protection (undervoltage, over temperature, ground fault).

5. 120 VAC maximum control circuit.
6. Electronic drive operator interface with display for drive programming/control/monitoring and fully functional keypad. The system shall be designed to operate a motor that is connected to the controller with conductors (in conduit or raceway) or TECK cable up to 100 m long.
7. Programmable parameters to include motor data, minimum and maximum frequency limits, acceleration and deceleration times, overload and torque limits.

C. Adjustable speed controller units: main circuit breaker with "semiconductor" type fuses, input reactor, variable frequency drive sized as indicated to accommodate motor actually installed, dV/dt filter, control transformer or power supply for the drive circuitry, cooling fans and louvres with filters.
1. Circuit Breakers: 25 kA (minimum) RMS at 600 VAC interrupting capacity rating, thermal magnetic, with integral thermal and instantaneous magnetic trip in each pole.
2. Fused Disconnects: Allowed only if specifically indicated, or in lieu of the breaker if mandatory for protection of solid state equipment, or to obtain required short circuit interrupting rating if such a breaker is not available
3. Fuses: Fast acting, "semiconductor" type to protect variable frequency drive.
4. dV/dt Transient Filter: Motor guarding/reflective wave trap filter installed on the drive load side; type and size to match motor and drive.

D. Operator interface and control devices for manual and auto operation. Control inputs and status outputs as indicated.

2.6 CONTROL SYSTEM COMPONENTS

A. Control Circuitry: 120 VAC, 1 phase, 60 Hz.

B. Control Relays: Types, number of poles, contact ratings and coil voltage as indicated.

C. Minimum Contacts Ratings for Control Devices: 5 A at 120 VAC, 3 A at 24 VDC. Control relays shall have silver alloy contacts SPDT, electrically held, coil rated continuous duty.

D. Timers: Timing function and time adjustment as required, Form C contacts, coil rated for continuous duty, solid state device, dial type, equal to Allen-Bradley Bulletin 700, Type HR.

E. Operator Control Devices: Round 30.5 mm, function as indicated, contacts as required.

F. Pilot Lights: Round 30.5 mm, transformer type with LED type bulb, lens color as indicated. All operator control devices will be readily accessible for all control functions and settings.

G. Control Power Transformers: Single phase, dry type, copper wound, 600:120 VAC, minimum size 50 VA, primary and secondary fusing, bond un-fused leg of secondary to enclosure wiring. Voltage, ratio, and power rating as required in each motor starter, unless specified otherwise.

H. Terminal Blocks: Pull apart, screw type, minimum 5 A rating, 15 terminal blocks with manufacturer's standard numbering system in each starter.
1. Mounting Hardware: Manufacturer's standard.

I. Control Wire and Wire Management Products and Accessories: Manufacturer's standard.

2.7 IDENTIFICATION

A. MCC Main Nameplate: Standard electrical data, manufacturing date and Supplier reference number.

B. Compartment Nameplates: White lamicoid with black lettering 8 mm high. Lettering must describe the labeled equipment as indicated.

C. Bucket Control Wiring: Standard numbering system, permanent indelible identifying markings on both ends of circuit wiring.

D. A copy of printed control schematics shall be located inside each MCC bucket.

E. Nameplate on each column: Vertical and horizontal bus rating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01000 - General Requirements.

B. Verify that surface is suitable for MCC installation.

C. Verify that field measurements are as shown on the Drawings.

3.2 PREPARATION

A. Provide housekeeping pads.

3.3 INSTALLATION

A. Assemble and install MCCs in accordance with manufacturer's instructions. Assemble MCCs as shown on the Drawings into complete system. Provide feeder connections.

B. Verify that equipment is true and level. Verify door operation. Provide shims as necessary for leveling. Align and secure motor control centre structure by using anchor bolts or brackets. Secure structure to the concrete bases. Remove shipping brackets.

C. Tighten accessible bus connections and mechanical fasteners after placing MCC. Use manufacturer's sealants and torque wrench with scale for bus connections.

D. Install fuses in fusible switches. Adjust trip setting of circuit breakers.

E. Select and install heater elements in motor starters to match installed motor characteristics.

F. Make all internal wiring connections in accordance with manufacturer's instructions and the Drawings.

G. Motor Data: Provide neatly typed label inside each motor starter door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing Inspect and test MCC and each controller in accordance with CSA C22.2 No. 14.

B. Inspect each motor controller visually. Check electrical, mechanical or control interlocks.

C. Perform several ON-OFF operations on each motor controller.

D. Verify circuit continuity on each pole in closed position.

E. Include description of testing and results in test report.

3.5 MANUFACTURER'S FIELD SERVICES

A. Section 01000 - General Requirements.

B. Provide support services to assist CONTRACTOR in installation and commissioning of the MCC. Manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general assembly of the equipment, connections and adjustments.

C. Supply testing equipment and qualified factory-trained manufacturer's technical representatives at the Site to verify MCC assembly, installation and operational tests, units' setup (overload relays, solid state devices, etc.), program variable frequency drives and operational tests prior to the system commissioning. Provide written report confirming proper installation. Include:
   1. Installation Assistance, Drives Setup and Certification: 2 days.
   2. Testing and Training: 1 day.
   3. Minimum Number of Trips: Two.

3.6 ADJUSTING

A. Section 01000 - General Requirements.

B. Perform field adjustments of all protective devices as required to place the equipment in final operating condition. Adjust trip settings so that circuit breakers coordinate with other overcurrent protection devices in circuit. Adjust trip settings to provide adequate protection from overcurrent and fault currents. Settings will be in accordance with the approved protective device coordination study.

C. Determine the exact motor current and set overloads in accordance with manufacturer's specifications.

D. Adjust time delay for reversing, multi-speed, auto transformer starters, and ramp up and ramp down speed and complete other programming of electronic solid state starters.

3.7 CLEANING

A. Section 01000 - General Requirements.

B. Prior to the energization of MCC, clean the inside of bucket units and compartments such that it is free of any dust and debris that may become airborne during equipment operation, cause corrosion, or arc (wire strings).

3.8 PROTECTION OF FINISHED WORK

A. Section 01000 - General Requirements.

B. Do not permit unauthorized personnel access to the MCC during construction, tests, and energization. Provide barriers and limit access.

END OF SECTION

SECTION 16460

DUPLEX PUMP CONTROL PANEL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Duplex pump control panel.

1.2 REFERENCES

A. Section 01400 - Quality Requirements: Requirements for references.

B. National Electrical Manufacturer's Association (NEMA).

C. Canadian Standards Association (CSA).

D. Ontario Electrical Safety Code and all Electrical Safety Authority Bulletins.

1.3 SYSTEM DESCRIPTION

A. UV Pumping Station:
   1. Pumping system control panel shall be factory assembled. Principle items of equipment include level control device, electrical wiring, control panel with circuit breakers, and variable frequency drives.
   2. Equipment and installation shall include the following:
      a. Supply and installation of control panel in accordance with manufacturer's instructions.
      b. Interconnection between control panel and existing UV pumps.
      c. Area Classification: Unclassified.

1.4 PROGRESS SUBMITTALS

A. Section 01300 - Administrative Requirements: Requirements for progress submittals.

B. Shop Drawings: Provide detailed layout drawings, general assembly, components, dimensions, wiring schematics, weights, clearances, and methods of assembly including all accessories as specified.

C. Product Data: Include detailed component specifications and catalog cuts as required.

D. Manufacturer's Certificates: Certify that products meet or exceed specified requirements of this Section.

E. Manufacturer's Instructions:
   1. Indicate installation, operation, and maintenance requirements.
   2. Indicate product transportation, storage, handling, and installation requirements.

1.5 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Requirements for closeout submittals.

B. Record Documents: Indicate location of control panel. Provide detailed inner panel layout drawings, general assembly, door layout, components, dimensions, and wiring schematics of pump control panel.

C. Operation and Maintenance Data: Include manufacturer's literature, wiring schematics, cleaning procedures, replacement parts lists, and repair data for pumps.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

A. Perform work of this Section in accordance with applicable provincial and federal standards.

1.7 REGULATORY REQUIREMENTS

A. Comply with authorities having jurisdiction. Include for changes or alterations by authorities having jurisdiction.

B. Where materials require special inspection and approval by local authorities, obtain such approval.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Protect materials and equipment from weather by storage in a dry or heated place.

1.9 SEQUENCING AND SCHEDULING

A. Section 01300 - Administrative Requirements: Requirements for coordination.

B. Sequence and schedule activities with other works..

1.10 MANUFACTURER'S WARRANTY

A. Section 01700: Execution Requirements: Requirements for warranties.

B. Fill out original warranty forms in OWNER's name and register with manufacturer.

1.11 EQUIPMENT TESTING

A. Section 01800 – Facility Operation: Requirements for commissioning.

B. Section 13623 – Control System Testing and Commissioning.

PART 2 PRODUCTS

2.1 ADJUSTABLE SPEED DRIVES (VFDs)

A. Drives shall adhere to Specification 16445 Section 2.5

2.2 UV PUMPS VFD CONTROL SYSTEM

A. Provide a duplex pump control system for the operation of the UV pumps utilizing variable frequency drives and level control. The plant PLC will monitor and control pump operation. The system shall operate in a duty-standby capacity such that the failure of one pump to start will result in the starting of the second pump, and shall include additional control as listed herein.

B. The UV Pump Control System shall include the following Alarms:
1. Float Low Level Alarm
2. VFD1 Run Status
3. VFD2 Run Status
4. VFD 1 Fault
5. VFD 2 Fault
6. VFD 1 in Local/Remote Mode
7. VFD 2 in Local/Remote Mode
8. Motor 1 High Temperature/ Seal Leak
9. Motor 2 High Temperature/ Seal Leak

C. The UV Pump Control System shall include the following Analog and Remote Control Capabilities:
1. VFD 1 Remote Start from the PLC
2. VFD 2 Remote Start from the PLC
3. VFD 1 4-20mA Speed Control
4. VFD 2 4-20mA Speed Control
5. VFD 1 4-20mA Speed Feedback
6. VFD 1 4-20mA Speed Feedback

D. Provide the following independently adjustable control levels:
1. Pump start level.
2. Pump off level.
3. Pump operation shall alternate on time basis.
4. Pump speed shall vary proportionally such that at start level pump speed is 100 percent and at 0.2 metres above off level pump speed is minimum. Pump speed shall be

modulated from a 4-20mA input based off measurements from an existing transmitter that is connected to the PLC. Should the levels drop below the off level, the duty pump shall shut down.

5. Should the water levels drop below low low level as indicated by the floats, pumps shall be locked out. Lock out shall clear once water levels raise to a point that will cause the start float to tip. All other Alarm and Control components that have been listed on the Contract Drawings shall be included for this VFD.

2.3 UV PUMPS CONTROL PANEL AND WIRING

A. All components shall be CSA approved.

B. Panel Enclosure: Type 4X Free Standing Enclosure. Enclosure shall be provided with a lockable front cover. All indicating lights, Hand-Off-Auto selector switches, pushbuttons, VFD keypad, and alarm buzzer shall be mounted on the enclosure front cover door.

C. Power Supply: 575 VAC, 3 phase, 60 Hz. Other voltages required by control system to be provided by control transformers mounted in panel enclosure.

D. Furnish control panel complete with required components including but not limited to:
   1. Main feeder fuse protection and suitable current rating for station load.
   2. Circuitry for level controls.
   3. Variable frequency drives as specified in Section 16445, Article 2.5.
   4. Alarm buzzer with silence switch.
   5. Indicator lights to be LED type, push to test.

E. Ground connection lug.

F. Mount schematic wiring diagram inside control panel door.

G. Connectors: Copper.

H. All Control Wiring and Components shall conform to Section 13430. Control components shall be accessible from a separate compartment.

I. Power Wire: Section 16123.

J. Wire:
   1. Numbered with printed permanent indelible identifying plastic tapes to correspond to schematic diagram.
   2. Terminated for external control connections by tubular screw type terminal blocks with barrier and labels.
   3. Equipped with grommet and shields for mechanical protection.
   4. Adequately supported and installed to approval of ENGINEER.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01700 - Execution Requirements: Verification of existing conditions before starting work.

B. Verify that the Site conditions are ready to receive work.

C. Verify that field measurements are as shown on the Drawings.

D. Verify that walls and floor finishes are prepared and ready for installation of equipment.

E. Beginning of installation means installer accepts existing conditions.

3.2 EQUIPMENT INSTALLATION

A. Install level control devices, control panel, conduit, and related components in accordance with manufacturer's instructions.

B. Install power and control wiring from devices to control panel as per manufacturer's instructions and the Ontario Electrical Safety Code.

3.3 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection and testing.

B. Inspect and test each controller in accordance with CSA C22.2 No. 14.

C. Inspect each motor controller visually. Check electrical, mechanical or control interlocks.

D. Perform several ON-OFF operations on each motor controller.

E. Verify circuit continuity on each pole in closed position.

F. Include description of testing and results in test report.

3.4 MANUFACTURER'S FIELD SERVICES

A. Section 01000 - General Requirements.

B. Provide support services to assist CONTRACTOR in installation and commissioning of the Control System. Manufacturer's representative shall provide technical direction and assistance to CONTRACTOR in general assembly of the equipment, connections and adjustments.

C. Supply testing equipment and qualified factory-trained manufacturer's technical representatives at the Site to verify Control panel assembly, installation and operational tests, units' setup (protection feeders, solid state devices, etc.), program variable frequency drives

and operational tests prior to the system commissioning. Provide written report confirming proper installation. Include:

1. Installation Assistance, Drives Setup and Certification: 2 days.
2. Testing and Training: 1 day.
3. Minimum Number of Trips: Two.

3.5 ADJUSTING

A. Section 01700 - Execution Requirements: Requirements for adjusting installed work.

B. Section 13623 – Control System Testing and Commissioning.

3.6 DEMONSTRATION

A. Section 01800 - Facility Operation: Requirements for demonstrating installed work.

B. Section 13623 – Control System Testing and Commissioning.

C. Perform startup in the presence of manufacturer's representative and ENGINEER.

3.7 PERFORMANCE TESTING

A. Performance testing will occur at such time as CONTRACTOR's work is complete and the system is available for operation.

B. During performance testing, manufacturer and CONTRACTOR, with the assistance of OWNER's trained personnel, shall startup and operate the system. The performance tests shall be run to determine the actual system operating conditions and verify that the systems meet the requirements of this Section.

C. Proposed test procedures shall be developed by manufacturer and CONTRACTOR and approved by ENGINEER. A qualified representative of both manufacturer and CONTRACTOR shall supervise equipment operation during the test.

D. Equipment found to be defective shall be replaced at the expense of CONTRACTOR and re-tested.

E. If, in the opinion of ENGINEER, the performance test is successful and meets the requirements specified herein, ENGINEER will recommend to OWNER, in writing, acceptance of the control panel.

END OF SECTION

SECTION 16857

HEAT TRACING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heat tracing

1.2 REFERENCES

A. Section 01000 - General Requirements.

B. Canadian Standards Association (CSA): C22.2 No. 130 - Requirements for Electrical Resistance Heating Cables and Heating Device Sets.

C. Ontario Electrical Safety Code.

1.3 PROGRESS SUBMITTALS

A. Section 01000 - General Requirements.

B. Shop Drawings: Include drawings with layout of heat tracing components including dimensions, electrical characteristics including voltage, unit summary tables showing bill of materials and nameplate legends and components for ENGINEER'S review.

C. Product Data: Include heat loss and cable selection calculations, amount and type of heating cable required, heating cable power output at the maintain temperature, minimum and maximum maintain temperature vs. minimum and maximum ambient temperature, GFEP circuit breaker and circuit sizing.

D. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Include spare parts data listing, source and current prices of replacement parts and supplies, and recommended maintenance procedures and intervals for startup.

B. Fill out original warranty forms in OWNER's name and register with manufacturer.

1.5 QUALITY ASSURANCE

A. Perform work of this Section in accordance with CSA C22.2 No. 130.

1.6 REGULATORY REQUIREMENTS

A. Conform to Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01000 - General Requirements.

B. Deliver units individually wrapped for protection.

C. Store in a clean, dry space. Maintain factory wrapping or provide additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

D. Handle carefully to avoid damage to components.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Thermon

B. Chromalox

C. Approved equivalent

2.2 DESIGN REQUIREMENTS

A. Supply and installation of complete pipe freeze protection heat tracing system for process piping systems exposed to outdoor temperatures as shown on the Drawings and indicated in the Schedule.

B. Ductile Iron Piping Design Data:
   1. Maximum Pipe Temperature: 50 degrees C.
   2. Design Ambient Temperature: Minus 30 degrees C to plus 40 degrees C.
   3. Targeted Maintained Temperature: 5 degrees C.
   4. Location: Outside
   5. Pipe Diameter: 150mm (6”)
   6. Insulation : Glass fibre, 25 mm (1 inch) minimum.

C. Self-regulating Heating Cables:
   1. Metallic Piping:
      a. Description: Self-regulating heating cable changing its power output relative to the temperature of the surface, designed for a minimum of 20 years of continuous operation.
      b. Assembly: Bus wires, two No. 14 AWG or larger stranded copper bus wires, embedded in a self-regulating polymeric core that controls power output, primary jacket, tinned copper braid, fluoropolymer overjacket for chemical and mechanical

protection so that the cable can be used directly on plastic or metallic pipes. The cable shall be designed such that it can be crossed over itself and cut to length in the field.

c. Approvals: Must be rated for Class 1 Zone 2 Group IIA areas
d. Sludge Wasting Valves:
    1) Chromalox HSRM Series self-regulating cable or approved equal
    2) Power: Single phase, 120 VAC, 60 Hz.
    3) Minimum 10 W/ft or as otherwise indicated by manufacturer of system based on design parameters.

2. Control:
    a. Chromalox DTS-HAZ-DC or approved equal
    b. Heat Trace digital, pipe mounted, and programmable thermostat with a 30A Solid State Relay (SSR) complete with a RTD PT100 type sensor.
    c. Power Input: 120 to 208V, single phase, 60Hz
    d. Enclosure to be NEMA 4X rated and capable of accepting heating cables, AC power, and sensor connections as specified on the Drawings
    e. Approvals: Must be rated for Class 1 Zone 2 Group IIA areas
    f. Operating temperature: -30°C to 50°C
    g. Solid State Alarm for remote indication of alarm status. Must be able to provide the following 120VAC fail-safe alarm outputs:
        1) DO1: Device fault

D. Accessories:
1. End Seal Kit:
    a. Chromalox UESL End Seal Signal Kit 394257 or Approved Equal
    b. NEMA 4X rated end seal with water resistant cable entry complete with 120 LED indicator Light.
    c. Approvals: Must be rated for Class 1 Zone 2 Group IIA areas
2. Terminations and connectors:
    a. Chromalox UMC Multiple Entry Connection Box 393561 or Approved Equal
    b. NEMA 4X rated, water resistant cable entry junction boxes designed to connect multiple heat trace cables to customer supplied power wiring
    c. Connection components, power connectors, splices, tees, end connectors, etc. shall be approved for the heat tracing system with the specific type of heating cable in use.
    d. Approvals: Must be rated for Class 1 Zone 2 Group IIA areas
3. Accessories: Cable straps, heat transfer tape, ties, fiberglass tape, warning labels, etc.
    a. NOTE: All heat tracing cables installed on Ductile Iron piping shall use fibreglass tape with a suitable adhesive to mitigate the risk of stress corrosion cracking of the piped
    b. Heat Trace warning labels to be mounted on exterior cladding at visible locations every.
4. Mounting equipment: Provide mounting hardware as required to suitably mount equipment permanently in desired locations. Controllers to be wall-mounted, end-seals and other accessories may be pipe-mounted.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Field verify all locations and lengths.

C. Verify that surfaces and the Site conditions are ready to receive work.

D. Remove sharp burrs or projections to prevent damage to cables, equipment or injury to personnel. Restore metal finishes after cutting.

E. Apply the heating cable linearly on the pipe after piping has been fully commissioned. Secure cable to pipe at 18-inch intervals with the suitable fibreglass banding tape. Vinyl tape, tie wire, zip ties and banding are not acceptable. Install capillary-type sensor under pipe insulation and in contact with pipe and in accordance with manufacturer's instructions.

F. Ground and bond in accordance with Section 16060 and as required by the Ontario Electrical Safety Code and local requirements.

G. Install heat trace warning labels type HT-1 at 6m intervals along route of heat tracing as per the Ontario Electrical Safety Code. Labels must be placed in visible positions throughout the lines.

3.2 QUALITY CONTROL

A. Use 500 V megger to test cables for continuity and insulation value, record values and include in report.

B. Perform tests to ensure proper heating and operation at maintain temperature set point.

C. Include description of testing and results in test report.

3.3 SCHEDULE

	Location/Description	Process	Diameter	Est. Linear Length	Notes
1	West Sludge Wasting Line/ 150- DICL-WWW	Sludge Waste	150 mm Ductile Iron	15m	One Tee connection Two Butterfly Valves Two elbows
2	East Sludge Wasting Line / 150-DICL-WWE	Sludge Waste	150 mm Ductile Iron	15 m	One Tee connection Two Butterfly Valves Two elbows

END OF SECTION