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END OF SECTION

SECTION 01000

SUMMARY OF WORK

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Description of the Project.

B. Location.

C. Access to the Site.

D. Scope of work.

E. Sequence of work.

F. Contract Times and Milestones.

G. Drawings.

H. Appendices

I. CONTRACTOR use of the Site.

J. OWNER occupancy.

K. Sub-Contractors

1.2 DESCRIPTION OF PROJECT

A. Treatment of domestic sewage (wastewater) at the Bruce Power LP site (Site) is facilitated by the Sewage Processing Plant (SPP). The SPP was constructed in the late 1970s. Due to increasing Site population associated with the Major Component Replacement (MCR) project being implemented by Bruce Power, a third treatment train is required for the SPP to ensure that Site wastewater flows can be fully managed should one of the existing treatment trains need to be taken offline for maintenance/inspection. Several upgrades to the existing SPP treatment trains (i.e. East, West Trains) will also be executed as part of this project.

B. Upgrades to the SPP Controls systems includes (but are not limited to) construction of a third treatment train (North Train) as well as modifications to the existing SPP treatment trains (i.e. East, West Trains).

1.3 LOCATION

A. The Sewage Process Plant (SPP) is 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 North Train 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.
3. Construction administration/Health and Safety Activities – all in accordance with Bruce Power LP requirements.
4. Execution of utility locates as noted in C Series drawings.
5. Execution of geotechnical testing/investigation as required/noted in C series and S series drawings and specifications.
6. Materials testing associated with engineered fill, cast in place concrete, etc. shall be the responsibility of the Contractor. Materials testing reports shall be provided to the Engineer for Review.
7. Execution of rebar scanning prior to modification of any existing concrete structures is the responsibility of the Contractor.
8. Implementation of Site preparation works including the implementation of sediment erosion controls associated with the Proposed Works.
9. Implementation of civil piping (buried services) as detailed in Civil (C Series) drawings.
10. Modification of SPP access road as shown in C Series drawings.
11. Surface modifications/restoration as shown in C Series Drawings.
12. Grading modifications, retaining wall construction, surface piping modifications as per C Series drawings.
13. Excavation and soil management associated with construction of the North Train and modification to the existing East/West trains as shown in Civil and Structural Drawings.
14. Modification to the existing SPP treatment train final settling tank sludge hoppers as shown in Structural (S Series) drawings.
15. Construction of the new North Treatment Train (concrete tanks and associated metal works) as shown in S Series.
16. Construction of metal structures/elements as shown in the S Series drawings.
17. Implementation of mechanical removals as shown in the Mechanical (M Series) drawings.
18. Construction of process-mechanical piping (wastewater, sludge, low pressure air) works as detailed in the M Series Drawings.
19. Procure, install, commissioning fine bubble aeration system in North Train aeration tanks as noted in M Series Drawings.
20. Procure, install, commissioning coarse bubble aeration system in North Train digester tanks as noted in M Series Drawings.
21. Procure, install, commissioning North Train final settling tank sludge collector mechanism (including scum trough system)as noted/shown in M Series Drawings.
22. Procure, install, commissioning SPP process pumps as noted/shown in M Series Drawings.
23. Procure, install, commissioning North Train air blowers as noted/shown in M Series Drawings.
24. Procure, install, commissioning hoist/davit equipment as shown in M and S series drawings.
25. Provide new motor control center (MCC) as detailed in the Electrical (E Series) drawings.
26. Provide new lighting panel as shown in E Series drawings.
27. Implementation of electrical (power) and control wiring as required for all new systems and equipment as shown in E Series Drawings.

28. Provision of North Train area lighting as shown in E Series drawings.
29. Procure and install heat tracing as shown in E Series Drawings.
30. Procure, install, commission instrumentation as shown throughout Instrumentation and Control (I&C Series) Drawings.
31. Execution of commissioning activities as detailed in Project Specifications.
32. Project Closeout and 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 SPP will entail multiple project components executed in parallel. CONTRACTOR shall coordinate schedule and resources as required.

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 North Train Construction Sequence

Item No.	Description
6.	Scanning and daylighting for full confirmation of buried utilities and other pre-construction site investigations

Item No.	Description
7.	Installation of temporary facilities and controls
8.	Required utility relocations
9.	Civil and Structural Works Associated with North Train
10.	Mechanical Works associated with North Train
11.	Electrical and I&C Works associated with North Train
12.	North Treatment Train Commissioning
13.	Structural Modifications to East/West Treatment Trains
14.	Mechanical Modifications to East/West Treatment Trains
15.	Recommissioning of East/West Treatment Trains

I. General Project Finalization Work

Item No.	Description
1.	Substantial Performance and project closeout documentation
2.	Demobilization
3.	Warranty Period

J. Mandatory scheduling constraints include the following:
   1. SPP North Train Constraints:
      a. 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 and approved in writing by the Owner/Engineer.
      b. The Bruce Power Sewage Process Plant (SPP) must have two treatment trains available for processing of sewage at all times. The North Train (third train) must be fully constructed and commissioned before work commences on the existing East/West treatment trains.
      c. 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. In the event of any conflict between construction activities and facility operations, the facility operations shall have priority.
      d. Request for shutdown and/or operator assistance for any SPP systems shall be made in writing a minimum of 4 weeks prior to the planned event as coordination with the Ministry of Environment, Conservation, and Parks (MECP) may be required.

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 requirements 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 ENGINEERThe 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.

J. 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. Survey requirements.

B. Survey reference points and markers.

C. Records.

D. GIS deliverables.

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 or which require further clarification or definition.

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 America
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 Commission
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. Specification language.

B. Mobilization and startup.

C. Coordination.

D. Pre-construction meeting.

E. Progress meetings.

F. 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 ENGINEER/OWNER.

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 ENGINEER/OWNER. 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 ENGINEER/OWNER'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 3 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 ENGINEER/OWNER 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. ENGINEER/OWNER 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. ENGINEER/OWNER will make arrangements for meeting, prepare agenda with copies for participants, and preside at meeting. Provide data required to ENGINEER/OWNER 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. ENGINEER/OWNER will record minutes and distribute copies to participants and those affected by decisions made. Identify errors in the minutes, if any, to ENGINEER/OWNER in writing within 3 days of receipt.

1.6 PROGRESS MEETINGS

A. ENGINEER/OWNER 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. ENGINEER/OWNER will make arrangements for meetings, prepare agenda with copies for participants, and preside at meetings. Provide data required to ENGINEER/OWNER 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. Meetins will be chaired by the CONTRACTOR. ENGINEER/OWNER 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 ENGINEER/OWNER 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 ENGINEER/OWNER, 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. ENGINEER/OWNER will record minutes and distribute copies to participants and those affected by decisions made.

F. Identify errors in the minutes, if any, to ENGINEER/OWNER 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. References.

B. Quality assurance.

C. Format.

D. Schedules.

E. Submittals.

F. Review and evaluation.

G. Updating schedules.

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

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

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

D. Submit with letter transmittal form as specified in Section 01330.

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. Submittal procedures.

B. Progress schedules.

C. Monthly progress reports.

D. Construction quality control reports.

E. Submittals and shop drawings.

F. Product data.

G. Samples.

H. Manufacturer installation instructions.

I. Manufacturer certificates.

J. Pre-construction and construction progress photographs.

K. Project organization.

L. Submittals for progress meetings.

M. Site layout.

N. Lead paint management plan.

O. 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, 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 without action.

G. Except as specified otherwise, for each submittal for review by OWNER, OWNER 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 and OWNER.

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

J. Make corrections to each submittal required by OWNER. 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. For each and every resubmitted submittal for review by OWNER, OWNER 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 without action.

N. Adjustments made on CONTRACTOR's drawings by OWNER 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 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 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 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 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's written approval for the revised schedule has been obtained. The schedule will be acceptable to OWNER 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 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 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 one digital copy of CONTRACTOR's drawings on USB memory stick or electronic file transfer compatible for use with Windows 7 and AutoCad 2010 or later edition.

G. After OWNER 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 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 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'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's "Reviewed" or "Reviewed as Noted" notation. OWNER'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.

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.

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'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's office identified in PART 1, SUBMITTAL PROCEDURES unless otherwise authorized by OWNER. One Sample shall be delivered to OWNER's field office.

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

G. OWNER's approval of Samples shall not relieve CONTRACTOR of responsibility for any deviation from the requirements of the Contract Documents. OWNER'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. 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'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.

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.

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 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.

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.

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. Quality Control.

B. Tolerances.

C. Requirements for References.

D. Inspection and Testing Services.

E. 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. References

B. General

C. Dewatering in excess of 50,000 L/day

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

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

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

G. Temporary Barriers and Enclosures:
1. Exterior enclosures.
2. Fencing
3. Security.

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

I. Removal of temporary facilities and controls.

1.2 REFERENCES

A. Occupational Health and Safety Act (OHSA).

B. Ontario Electrical Safety Code.

C. O. Reg. 213-07 – Fire Code.

1.3 GENERAL

A. Conform to the requirements of BP-PROC-00927 Setup and Manage Construction Island Site and Form-13931 R003 Construction Island Checklist.

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.
   6. The CONTRACTOR shall obtain all permits necessary to facilitate dewatering in excess of 50,000 L/day including those associated with the Ministry of Environment, Conservation, and Parks (MECP).

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 VEHICULAR ACCESS AND PARKING

A. Access Roads:
1. Existing Roads: Reasonable use of existing on-Site roads for construction traffic is permitted subject to the following conditions:
a. Do not interrupt or interfere with traffic on roads at any time.
b. Improve existing roads as CONTRACTOR may require to perform the Works.
c. Comply with weight and load size restrictions where applicable.
d. Tracked vehicles are not allowed on paved areas.
2. Maintenance and Use:
a. Maintain existing and permanent gravel and paved areas used for construction; promptly remove standing water and repair breaks, potholes, low areas, and other deficiencies, to maintain paving and drainage in original or specified condition.
b. Remove mud from vehicle wheels before entering public roads.
3. Removal and Repair: Repair existing and permanent facilities damaged by use to specified condition.

B. Parking:
1. Provide temporary gravel surface parking areas to accommodate use of construction personnel.

2. When Site space is not adequate, provide additional off-Site parking.
3. Locate parking areas as directed by ENGINEER or OWNER.
4. Do not allow tracked vehicles on pavement.
5. Designate two parking spaces for OWNER and one space for ENGINEER.
6. Maintain separate parking area for construction equipment.

C. Traffic Regulation: Provide trained and equipped flagpersons to regulate traffic when construction operations or traffic encroach on traffic lanes.

1.9 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.

1.10 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.

1.11 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. Basic product requirements.

B. Product substitutions.

C. Product delivery and handling requirements.

D. 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. References

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. Adjusting.

M. Protection.

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

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.

1.6 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.

1.7 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.

1.8 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.

1.9 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.

1.10 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.

1.11 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.

1.12 ADJUSTING

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

1.13 PROTECTION

A. Protect installed work and provide special protection where specified in individual Sections.

B. Provide temporary and removable protection for installed products. Control activity in the immediate work area to prevent damage.

C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.

D. Protect finished floors, stairs, and other surfaces from wear, damage, or movement of heavy objects.

E. Prohibit traffic on landscaped areas unless otherwise noted.

F. Maintenance of Flow: Maintain the flow of wastewater in the system and in existing sewers, drains, and watercourses.

G. Flotation: Take necessary precautions against the flotation of any structures during construction. Make good any damage caused by flotation.

1.14 CLOSEOUT PROCEDURES

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 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.

1.16 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.

1.17 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.

1.18 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.

1.19 EQUIPMENT IDENTIFICATION

A. All equipment shall be identified by nameplates in accordance with Bruce Power's standards. Labels shall include details consistent with contract documents including drawings as well as any changes that may occur through execution of the Contract.

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. References.

B. Definitions

C. Testing and Commissioning description.

D. Meetings.

E. Reports.

F. Sequencing.

G. Scheduling.

H. Progress submittals.

I. Closeout submittals.

J. Qualifications.

K. Testing and Commissioning responsibilities.

L. Examination.

M. Deficiencies.

N. Demonstration.

O. Training.

1.2 DEFINITIONS

A. CT: Commissioning Team.

B. FAT: Factory Acceptance Testing

C. SAT: Site Acceptance Testing

1.3 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 Contract works, 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.

1.4 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).

1.5 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.

1.6 SEQUENCING

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

1.7 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.

1.8 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 and completed calibration certificates.
   7. Documentation of all equipment settings and setpoint values.
   8. 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

1.9 CLOSEOUT SUBMITTALS

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

B. Operation and maintenance data.

C. Final SAT Report.

1.10 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. 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.

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

C. 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 five 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 02100

CLEARING AND GRUBBING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. CONTRACTOR shall furnish all labor, materials, equipment and incidentals required to perform all clearing and grubbing as shown, specified, and otherwise required to complete the Works.

B. Coordination: Coordinate the work under this Section with applicable work outlined in other Sections of the Specifications.

1.2 RELATED SECTIONS

A. Section 02300 – Excavation and Backfill.

B. Section 02480 – Landscaping and Restoration.

C. Section 02120 – Off-Site Transportation and Disposal.

1.3 REGULATORY REQUIREMENTS

A. Codes and Standards: Provincial and local laws and code requirements shall govern the hauling and disposal of grass, trees, shrubs, stumps, roots, rubbish, debris, and other matter.

B. Contractor shall comply with the requirements of O.Reg. 406/19: On-Site and Excess Soil Management.

1.4 JOB CONDITIONS

A. Protection:
   1. Laneways, roads, adjacent property, and other works and structures shall be protected throughout the entire Project. CONTRACTOR shall return to original or better condition, satisfactory to ENGINEER, damaged facilities caused by CONTRACTOR’s operations.
   2. Trees, shrubs, and grassed areas which are to remain shall be protected by fences, barricades, wrapping, or other methods as shown, specified, or approved by ENGINEER. Trees shall not be removed without approval of ENGINEER unless shown or specified.

1.5 GUARANTEE

A. CONTRACTOR shall guarantee that work performed under this Section will not permanently damage trees, shrubs, turf, or plants designated to remain, or other adjacent work or facilities. If damage resulting from CONTRACTOR's operations appears during the period up to

12 months after completion of the Project, CONTRACTOR shall replace damaged items at no additional cost to OWNER.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 CLEARING AND GRUBBING

A. Prior to execution of the work under this Section, CONTRACTOR and ENGINEER will examine the Site and agree upon the extent of clearing and grubbing required.
   1. In areas requiring extensive clearing and grubbing, agreement shall be on limits of the Works. These limits shall be the minimum required for construction. Damage outside these limits caused by CONTRACTOR’s operations shall be corrected at CONTRACTOR’s expense.

B. Except as noted below, CONTRACTOR shall remove from the Site and satisfactorily dispose of all turf, trees, shrubs, stumps, roots, brush, masonry, rubbish, scrap, debris, pavement, curbs, fences, and miscellaneous other structures not covered under other Sections as shown, specified, or otherwise required to permit construction of the new work.
   1. Trees, stumps, and other cleared and grubbed material shall be disposed off Site. No cleared or grubbed material may be used in backfills or structural embankments.
   2. Burning on Site shall not be permitted.
   3. Trees and shrubs shall be trimmed, where required, to avoid removal or damage to them. Trimmed or damaged trees shall be treated and repaired by ISA Certified Arborists who are approved by ENGINEER. Trees and shrubs intended to remain which are damaged beyond repair or removed, shall be replaced by CONTRACTOR at CONTRACTOR's expense.
   4. Control air pollution caused by dust and dirt, and comply with governing regulations.
   5. No clearing or grubbing will be permitted without the formal completion of a bird sweep. The bird sweep, when required, shall be completed prior to construction as to not create delays.

3.2 TOPSOIL REMOVAL

A. Topsoil is defined as friable clay loam surface soil found in a depth of not less than 100 mm. Topsoil shall be substantially free of subsoil, clay lumps, stones, and other objects over 50 mm in diameter, and without weeds, roots, and other objectionable material.

B. Strip topsoil which is satisfactory to whatever depths are encountered, and in such manner as to prevent intermingling with the underlying subsoil or other objectionable material. Remove heavy growths of grass from areas before stripping.
   1. Where trees are shown or directed to be left standing, stop topsoil stripping a sufficient distance from such trees to prevent damage to the main root system.

C. Stockpile topsoil in storage piles in areas available within the limit of construction, or where otherwise approved by ENGINEER. Construct storage piles to freely drain surface water.

Cover storage piles if required to prevent windblown dust. Topsoil in excess of quantity required shall remain property of OWNER.

D. Excess topsoil shall be tested, transported, and disposed off-site in full compliance with the requirements of O.Reg. 406/19: On-Site and Excess Soil Management.

3.3 TRANSPORTATION AND DISPOSAL

A. Refer to Section 02120 for additional requirements.

END OF SECTION

SECTION 02120

OFF-SITE 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 materials that cannot be recycled from the Site to approved off-Site disposal or storage facilities including, but not limited to:
   1. Asbestos
   2. Refrigerants containing ODS.
   3. Light ballasts containing PCBs.
   4. Fluorescent, high intensity discharge and emergency lamps.
   5. Mercury thermostats and other mercury devices.
   6. Batteries.
   7. Non-hazardous liquid or solid waste.

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

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

I. Preparing characterization profiles and obtaining acceptance documents from disposal facilities.

1.2 REFERENCES

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

B. Canadian Environmental Protection Act (CEPA).

C. Ontario Regulation:
   1. Revised Regulations of Ontario (R.R.O.) 1990, Reg. 261 - Dangerous Goods Transportation Act.
   2. O. Reg. 347 (as amended) - General - Waste Management.
   3. O. Reg. 278/05 - Designated Substance - Asbestos On Construction Projects and in Buildings and Repair Operations.
   4. O.Reg. 490/09 - Designated Substances.
   5. O.Reg. 406/19 – On-Site and Excess Soil Management.

D. Ontario Guideline: Ontario Ministry of Labour (MOL): A Guide to the Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations (May 2011).

E. Transportation of Dangerous Goods Regulations (TDGR).

F. Ontario Provincial Standard Specifications Municipal (OPSS.MUNI).

G. Bruce Power L.P. requirements and procedures.

1.3 PROGRESS SUBMITTALS

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

B. Transportation and Disposal Plan: Submit for review and approval a proposal for transportation and disposal of materials 14 days prior to transportation and disposal of materials from the Site. Include relevant transporter information, methods of transportation and disposal, show transportation route, or alternate routes, which will be used to transport materials, contingency plans for spills during transportation, and schedule for transportation and disposal.

C. Letters of Commitment:
   1. CONTRACTOR shall include a copy of the letter of commitment from each proposed disposal facility prior to shipping material to the facility. These letters of commitment shall meet or exceed OPSS.MUNI 180 requirements and O.Reg. 406/19 – On-Site and Excess Soil Management. 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.

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 10 days prior to entry to the Site.

E. Disposal Facility Requirements:
   1. For each disposal facility accepted by OWNER or specified by OWNER, CONTRACTOR shall provide the disposal facility requirements to OWNER 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.

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.

1.4 QUALITY ASSURANCE

A. Do not remove any waste materials from the Site without prior authorization by ENGINEER.

B. Comply with CEPA, Reg. 261, and TDGR.

1.5 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. Clean up any and all spills or leaks in transit.

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 requirements of O.Reg. 406/19 - On-Site and Excess Soil Management and OPSS.MUNI 180.

B. Contractor shall provide all labour, containers, packing materials, labels required for the execution of the works.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Notify ENGINEER a minimum of 10 working days in advance of its intention to commence activities at the Site that require attendance by ENGINEER as provided herein.

C. Activities requiring attendance by OWNER or 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 OWNER or ENGINEER's inspection.

3.2 WASTE PROFILING

A. Conduct waste profile sampling and analysis as required.

B. OWNER or ENGINEER may perform its own sampling and/or analysis in addition to the Contractor’s scope to preform waste profile sampling and analysis. Such sampling and/or analysis or failure to perform such sampling and/or analysis by OWNER shall not release or reduce CONTRACTOR's obligation to perform the Works in accordance with the requirements of Contract Documents. Do not remove materials from the Site which have been sampled by OWNER or ENGINEER and are awaiting analytical results. OWNER will receive analytical results within 15 days of OWNER or ENGINEER's sample collection. OWNER will provide copies of analytical results to CONTRACTOR upon request.

C. Transported material which is delivered to, and rejected by, a facility shall be returned to the Site.

3.3 SELECTION OF DISPOSAL FACILITIES

A. Provide submittals to OWNER identifying proposed disposal facilities for disposal of non-hazardous waste. OWNER will accept disposal facilities identified by CONTRACTOR or request alternate disposal facilities.

B. Provide submittals to OWNER identifying proposed disposal facilities for disposal of hazardous waste. OWNER will accept disposal facilities identified by CONTRACTOR or request alternate disposal facilities.

3.4 SEGREGATION OF MATERIALS

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

3.5 PREPARATION AND SECUREMENT OF TRANSPORT VEHICLES/CONTAINERS

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

B. Comply with Laws and 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 1 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 in accordance with 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. OWNER will waive the lining requirements where CONTRACTOR can demonstrate, to the satisfaction of OWNER, 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.

3.6 CLEANING

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

B. Clean transport vehicles and containers at point of loading, after loading, and prior to leaving the Site. Remove material on the tires and axles of trucks and material on the vehicle resulting from loading operations and stage for subsequent loading onto following haulage vehicle.

3.7 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.

3.8 TRANSPORTATION

A. 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.

B. Where required, mark and placard shipments in accordance with 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 waste stream being transported.

3.9 DISPOSAL

A. Make all arrangements with the disposal facility for the receipt and acceptance of materials removed from the Site, ensuring requirements under OPSS 180 are met or exceeded.

B. 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. Dispose of materials at the disposal facilities approved by OWNER, 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 OWNER to verify proper delivery of materials which have been removed from the Site and for payment purposes.

3.10 NON-HAZARDOUS LIQUID AND SOLID WASTES

A. Dispose of non-hazardous liquid and solid wastes at CONTRACTOR proposed disposal facility approved by OWNER.

B. The facility shall be appropriately licensed to receive liquid solid wastes, other than hazardous wastes.

END OF SECTION

SECTION 02200

SITE PREPARATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Removal and disposal of surface debris.

B. Clearing and grubbing.

C. Tree protection.

D. Location and confirmation of underground utilities

1.2 RELATED SECTIONS

A. Section 02100 – Clearing and Grubbing

B. Section 02120 – Off-Site Transportation and Disposal

C. Section 01500 – Temporary Facilities and Controls

1.3 REFERENCES

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

B. Ontario Provincial Standard Specifications Municipal (OPSS.MUNI).

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

D. O.Reg. 406/19 - On-Site and Excess Soil Management.

1.4 DEFINITIONS

A. Clearing: Felling, trimming, and cutting of trees into sections and the satisfactory disposal of trees and other vegetation designated for removal, including down timber, snags, brush, and rubbish occurring in the areas to be cleared.

B. Grubbing: Removal and disposal of turf, stumps, roots larger than 75 mm in diameter, and matted roots from the designated grubbing areas.

C. SMDD: Standard Maximum Dry Density and in the context of this Contract means the maximum dry unit weight determined in accordance with ASTM D698.

1.5 REGULATORY REQUIREMENTS

A. Coordinate locating and clearing work with utility companies and Bruce Power LP.

B. Conform to applicable code for disposal of debris.

1.6 ENVIRONMENTAL REQUIREMENTS

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

B. Control the amount of dust resulting from operations to avoid creation of a nuisance in the surrounding area.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify that existing plant life or other surface features designated to remain are tagged or identified.

C. Information regarding any existing services and/or utilities shown on the drawings are furnished as per the best available information. The CONTRACTOR shall interpret this information as he sees fit with the understanding that the OWNER and ENGINEER disclaim all responsibility for its accuracy and/or sufficiency. It shall be the CONTRACTOR'S responsibility to confirm existing utility source, location, alignment, elevation, material and diameter where required.

3.2 PREPARATION

A. Protect turf, trees, plant growth, utilities, and surface features designated to remain from damage incident to clearing, grubbing, and construction operations.

B. Delineate Contract boundaries shown on the Drawings.

C. Field locate, expose and survey any and all existing buried utilities and/or infrastructure prior to removal activities using electronic locating services, hand-digging, or non-destructive day-lighting.

D. Prepare the site to receive permanent works and temporary works as noted in Section 01500.

3.3 CLEARING AND GRUBBING

A. Clearing and grubbing to be completed in accordance with Section 02100.

3.4 NOT USED.

3.5 TREE PROTECTION

A. ENGINEER will identify all areas and significant trees to remain prior to tree removal.

3.6 UNDERGROUND UTILITY LOCATION

A. Layout of underground utilities are approximate based on limited Subsurface Utility Engineering survey and approximate based on-site measurements taken from as-built drawings supplied by the OWNER.

B. Prior to commencement of construction, all existing underground utilities within the limit of construction shall be located, marked, and protected by the CONTRACTOR. Any utilities, not identified for relocation, that are damaged or disturbed during construction shall be repaired or replaced to the satisfaction of the OWNER at the Contractor's expense.

C. CONTRACTOR to confirm source provider and ownership of all existing utilities to be relocated.

D. Once source is identified, CONTRACTOR must coordinate with and make all necessary arrangements with source provider to confirm materials and length of utility splice, prior to completing the required location, extension and reconnection of underground utilities as shown on the Contract Drawings.

E. CONTRACTOR shall be responsible for the utility relocations.

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 in the Contract Documents.

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. Section 02120 – Off-Site Transportation and Disposal.

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

D. 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.

E. Operating Licenses and Permits:
1. Include copies of valid operating licenses and permits for each proposed disposal facility 10 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 10 days prior to entry to the Site.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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

5. O.Reg. 406/19 - On-Site and Excess Soil Management

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 they 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 15 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 02120 – Off-Site 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 1.6.

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.

J. Provide all labour, material, and equipment to safely store salvage items in accordance with the manufacturers recommendations and industry best practices until OWNER is ready to receive the salvage items.

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 of Specifications includes all Work and items necessary to perform, for the purpose of constructing structures, conduits, pipelines, roads, grading, and other facilities required to complete the Work of this Contract, 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.

1.2 RELATED SECTIONS

A. Section 02480 - Landscaping and Restoration.

B. Section 02500 - Paving and Surfacing.

C. Section 02120 – Off-Site Transportation and Disposal

1.3 REFERENCES

A. AST International (ASTM):
   1. A36/A36M - Standard Specifications for Carbon Structural Steel.
   2. A328/A328M - Standard Specification for Steel Sheet Piling.
   3. C117 - Standard Test Method for Materials Finer than No. 200 Sieve in Mineral Aggregates by Washing.
   4. C136 - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   5. D422 - Standard Test Method for Particle-Size Analysis of Soils.
   6. D1556/D6938 - Density of Soil in Place by the Sand-Cone Method, or Nuclear Method.
   7. D1557 - M Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort.

B. Canadian Institute of Steel Construction (CISC).

C. Ontario Provincial Standard Specifications Municipal (OPSS.MUNI).

D. O.Reg. 406/19 – On Site and Excess Soil Management.

E. Geotechnical Investigation Third Train Upgrade Bruce Power LP Sewage Processing Plant.

1.4 QUALITY ASSURANCE

A. The services of a qualified third party sampling, inspection, field testing, and testing laboratory firm shall be engaged by the CONTRACTOR to make tests and determine acceptability of the imported fill or material as listed below and the installed works. Select Backfill Samples: CONTRACTOR'S attention is directed to Part 2.1.

1.5 SUBMITTALS

A. CONTRACTOR shall submit information regarding the following applicable items:
   1. Sheeting, shoring and bracing.
   2. Protection methods anticipated.

B. 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 the ENGINEER of the Work involved. CONTRACTOR shall be wholly responsible for designing, installing and operating whatever system is necessary to accomplish satisfactory sheeting, bracing, protection, underpinning and dewatering.

C. Test Reports - Subgrade, 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 D6938.
   3. Optimum Moisture - Maximum Density Curve: ASTM D1557 modified.
   4. Proctor Test: ASTM D698
   5. Material source.

1.6 REGULATORY REQUIREMENTS

A. Permits and Regulations:
   1. Permits and Regulations: Perform excavation work in compliance with applicable requirements of the Occupational Health and Safety Act.
   2. MOECC: Obtain and pay for all costs including required studies and reports to complete a EASR registration for Water Taking.
   3. CONTRACTOR shall perform excavation Work in compliance with applicable requirements of governing authorities having jurisdiction.
   4. The CONTRACTOR shall, in addition to items outlined above, obtain all additional permits, provide insurance, bonds and guarantees, and all else required by the governing authorities at his own expense. The CONTRACTOR'S responsibility under this paragraph may include, but is not limited to the following:
      a. Constructing and removing temporary facilities and structures.
      b. Provide details of construction methods.
      c. Reimbursing the applicable authority for any and all expenses incurred by them in connection with the Work.
      d. Coordination of scheduling with the authority.
      e. Necessary cleanup and restoration.
   5. Comply with the requirements of O.Reg. 406/19 – On-Site and Excess Soil Management.

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.

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 2 material as in accordance with OPSS.MUNI 1010, Table 2

C. General Backfill and Fill Materials:
   1. The term general backfill and fill materials used herein these Specifications shall mean "Granular “B” Type 2 backfill material".
   2. General backfill and fill materials shall be imported material.
   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

B. Flowable Fill: Excavatable type.

PART 3 EXECUTION

3.1 JOB CONDITIONS

A. The CONTRACTOR may examine the Geotechnical Report. Such data, is offered in good faith solely for the purpose of placing the CONTRACTOR in receipt of all information available and in no event is to be considered a part of the Contract Document. The boring logs and other subsurface information will not be interpreted by the OWNER or the ENGINEER, or the boring CONTRACTOR. The CONTRACTOR must interpret such data according to his own judgement, and acknowledges that he is not relying upon the same as accurately describing the subsurface conditions which may be found to exist. CONTRACTOR may make additional test borings and other exploratory operations at no cost to OWNER.

B. Existing Structures: Shown on the Contract Drawings are certain surface and underground structures adjacent to the Work. This information has been obtained from existing records. It is not guaranteed to be correct or complete and is shown for the convenience of the CONTRACTOR. CONTRACTOR shall complete field verification of all existing buried infrastructure including day-lighting in advance of the required excavations. They shall be supported and protected from injury by the CONTRACTOR. If they are destroyed or damaged, they shall be restored immediately by the CONTRACTOR at its own expense.

C. Existing Utilities: Locate existing underground utilities in the areas of Work. If utilities are to remain in place, provide all labour, materials, and equipment to adequately protect the utilities and all works.
   1. Should uncharted piping or other utilities be encountered during excavation, consult the ENGINEER immediately for directions as to procedure. Cooperate with OWNER and utility companies in keeping respective services and facilities in operation. Repair damaged utilities to satisfaction of utility owner.
   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 site existing underground utilities indicated to be removed. Coordinate with utility companies for shut-off of services if mains are active.
   4. Protect, support, and maintain all gas, water and sewer mains, laterals, telephone ducts, electrical/control utilities and utility poles and towers during the course of the Work. Should any services or laterals be damaged, they shall be repaired or replaced in a manner satisfactory to the ENGINEER and the OWNER. All costs of repair or replacement shall be the responsibility of the CONTRACTOR.
   5. Utility service connections to buildings such as gas, water, sewer, electricity and telephone may not be shown on the Contract 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 the OWNER in order to complete the Work under this project.

3.2 INSPECTION

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

3.3 SITE PREPARATION

A. All areas to be occupied by permanent construction or embankments shall be cleared of all trees, brush, roots, stumps, logs, wood and other materials and debris. Subgrades for fills and embankments shall be cleaned and stripped of vegetation, sod, topsoil and organic matter. All waste materials shall be removed from 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 the ENGINEER.

3.4 EXCAVATION

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

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 Drawings submitted under Part 1.5 above, and according to Part 3.8 of this Section. At a minimum, trench protection shall be provided using a trench box or trench shield. All sheeting, shoring, and bracing shall conform to the requirements of the Ontario Health and Safety Act. Contractor shall provide all labour, materials, and equipment required to provide and maintain a safe excavation that is compliant with the Ontario Health and Safety Act.

2. Where the structure or pipeline is to be placed below the ground water table, well points, cofferdams or other acceptable methods shall be used to permit construction of said structure or pipeline under dry conditions. Dry conditions shall prevail until fresh concrete has reached sufficient strength to withstand earth and hydrostatic loads and until the pipelines are properly jointed, tested and backfilled.
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 subgrade.
4. The elevation of the bottom of footings or structures shown shall be considered as approximate only and the 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 the ENGINEER, or where required due to the actions of the CONTRACTOR, they shall be backfilled with backfill material or concrete as directed by the ENGINEER at the expense of the 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 backfill material meeting the requirements of Part 2.1 of this Section of the Specification. The finished elevation of stabilized subgrades shall not be above subgrade elevations shown or required.
7. Stability of Excavations: Slope sides of excavations to comply with codes and ordinances of agencies having jurisdiction. 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. Pipe Trench Preparation:
    a. No more than 30 meters of trench may be opened in advance of pipe laying.
    b. Trench width shall be minimized to greatest extent practical but shall conform to the following:
        1) Sufficient to provide room for installing, jointing and inspecting piping, but in no case wider at top of pipe than pipe barrel OD plus 600 mm.
        2) Enlargements at pipe joints may be made if required and approved by ENGINEER.
        3) Sufficient for sheeting, bracing, sloping, and dewatering, where required.
        4) Sufficient to allow thorough compaction of backfill adjacent to bottom half of pipe.
        5) Do not use excavating equipment that requires the trench to be excavated to excessive width.
    c. Depth of trench shall be as shown on the Contract Drawings. If required and approved by ENGINEER depths may be revised. Trench walls shall be vertical from the bottom of the trench to at least 300 mm above the top of pipe.
9. 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.

10. Where the existing material beneath the bedding material or subbase material is considered unsuitable by the ENGINEER as a result of the third part inspection and testing provided by the CONTRACTOR, CONTRACTOR shall remove and replace it with Granular 'B' Type 2 fill compacted a minimum of 98% of Standard Proctor Maximum Dry Density (SPMDD), or approved by the ENGINEER at no additional cost to the OWNER.

3.5 UNAUTHORIZED EXCAVATION

A. All excavation outside the lines and grades shown on the plans and which is not approved by the ENGINEER, together with the removal and disposal of the associated material shall be at the CONTRACTOR'S expense. The unauthorized excavation shall be filled and compacted with Granular 'B' Type 2 backfill by the CONTRACTOR at its own expense.

3.6 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. Maintain the ground water level below the bottom of the excavation to provide a stable surface for construction operations, and a stable subgrade for the permanent work, and to prevent damage to the Work during all stages of construction.

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

E. Dewatering system shall continue in operation until the permanent construction provides sufficient dead load to withstand the hydrostatic uplift of the normal groundwater including maximum anticipated storm levels.

F. As a minimum dewatering system shall include pumps, flow meter, filter bag, settling tanks and splash pad.

G. Obtain ENGINEER'S approval before shutting down dewatering system for any reason.

H. Obtain required permits by local, provincial and federal agencies of jurisdiction, for any water being discharged into river, streams, or watercourses.

I. Standby Requirements for Dewatering: Provide standby equipment to ensure continuity of dewatering operations.

J. 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 Work under construction or completed.
   2. Dispose of water in such a manner as to cause no inconvenience to the 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.

K. Dewatering in excess of 50,000 L/day:
   1. CONTRACTOR shall monitor and record daily water takings.
   2. In the event that dewatering exceeds 50,000 L/day, CONTRACTOR shall notify the ENGINEER and OWNER and shall apply and comply with the requirements for EASR registration for Water Taking.
   3. The CONTRACTOR shall install a dewatering system; including though not limited to installing well points around the outside of the excavation and necessary pumps or well points within the excavation and all other required appurtenances.
   4. Discharge water quality and erosion control requirements shall be provided by the CONTRACTOR and shall be monitored and maintained throughout the dewatering duration.
   5. 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.
   6. 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
      f. permit requirements
   7. The CONTRACTOR shall submit detailed shop drawings of the entire dewatering system for review and approval prior to the system's installation or implementation.
   8. The CONTRACTOR shall submit all reporting requirements as required by the permits listed above.

3.7 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 100 meters of sheeting installations shall be subject to a pre-construction survey to identify and record existing structural conditions. These inspections shall be carried out by a pre-inspection firm experienced in this line of Work.
   2. During the actual construction process, the CONTRACTOR shall provide for monitoring and recording of the actual vibrations generated. A baseline of ambient vibration levels shall be established prior to driving sheet pilling, where required.
   3. The particle acceleration during the driving of the sheet pilling shall not exceed 0.6 m/s.
   4. The CONTRACTOR will be required to change the construction methods if the Work is resulting in unacceptable vibration levels.

B. All local, provincial and federal ordinances, codes, regulations and laws shall be observed. The CONTRACTOR shall provide all sheeting, shoring and bracing which conform to Ontario’s Labor Relations Laws and all applicable Sections of Ontario’s OHS (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 CISC (Canadian Institute of Steel Construction) except that field welding will be permitted.

E. Steel sheet piling shall be manufactured from steel conforming to ASTM A328. Steel for soldier piles, wales and braces shall be new or used and shall conform to ASTM A36.

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. Provide permanent steel sheet piling wherever subsequent removal of sheet piling might permit lateral movement of soil under adjacent structures.

I. The clearances and types of the temporary structures, insofar as they affect the character of the finished Work, and the design of sheeting to be left in place, will be subject to the approval of the ENGINEER; but the CONTRACTOR shall be responsible for the adequacy of all sheeting, shoring, bracing, etc.

J. Safe and satisfactory sheeting shall be the entire responsibility of the CONTRACTOR.

K. Removal of Sheeting and Bracing:
   1. Remove sheeting and bracing from excavation unless otherwise ordered in writing by the ENGINEER. Removal shall be done so as not to cause injury to the Work. Removal shall be equal on both sides of excavation to ensure no unequal loads on pipe or structure.
   2. Defer removal of sheeting and bracing, where removal may cause soil to come into contact with concrete until the following conditions are satisfied:
      a. Concrete has cured a minimum of 7 days.
      b. Wall and floor framing up to and including grade level floors are in place.

3.8 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 the CONTRACTOR. All materials used for filling and backfilling shall be subject to the approval of the ENGINEER and shall conform to specifications outlined under Part 2.1 and meet the requirements outlined under Section 02316.

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.
   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 Under and Around Pipe: (Pipe Bedding and Encasement):
   1. All trenches from the bottom of the trench to the limits shown on the Contract Drawings shall be backfilled by hand or by machine with pipe bedding material, placed in 150 mm layers and thoroughly compacted by tamping. The backfilling material shall be deposited

in the trench for its full width on each side of the pipe simultaneously and consolidated against the pipe wall to form a good support.
2. Materials shall be compacted to 98% standard proctor density.
3. In cases where tamping is done by mechanical means, the tamping machine shall be of a satisfactory and approved type. Hand tamping shall be done as directed with suitable tools of approved weight and there shall be at least two tampers for each man shoveling.
4. Material used for pipe bedding and encasement shall conform to Part 2.1 of this Section of Specifications.

E. Backfilling Over Pipe to Grade:
1. From the top of the pipe bedding and/or encasement material above the pipe to the grade shown on the Drawings or specified, the trench shall be backfilled by approved mechanical methods.
2. Trench backfill shall conform to the requirements under OPSS.MUNI 401 and the materials list in Part 2.1 of this Section.
3. In paved, traveled ways, or under sidewalks, curbs, gutters and driveways, the trench shall be backfilled from the top of the above described pipe bedding and encasement to the underside of the existing pavement base, to the subbase for driveways, or to the ground surface with the material as specified and placed in 150 mm layers and tamped.
4. Backfill material in locations such as grass areas shall be approved fill materials. The backfill material shall be tamped or compacted with an approved roller from the above point to the surface in 150 mm layers to accomplish minimum settlement level to the adjacent ground surfaces within a tolerance of 50 mm.
5. In grass areas, all topsoil shall be removed, kept separate from the other excavated material and replaced to a depth equal to the existing topsoil thickness. Refer to Section 02480 for requirements of topsoil and final landscaping.
6. Backfill shall proceed after pipe construction as promptly as the Work will permit and as the ENGINEER may approve. Not more than 15 meters of pipe shall remain uncovered before backfilling is done. If the CONTRACTOR does not promptly and properly install backfill, the ENGINEER may stop other Work on the job until this is done.
7. Where pipe is laid in rock excavation, 150 mm minimum of pipe bedding material shall be carefully placed and tamped over the rock before the pipe is laid. After laying pipe, the balance of the backfill shall be placed as described herein.
8. The water content of fill material shall be controlled during placement within the range necessary to obtain the compaction specified. In general, the moisture content of the fill shall be within 3 percent of the optimum moisture content for compaction as determined by laboratory tests. CONTRACTOR shall perform all necessary Work to adjust the water content of the material to within the range necessary to permit the compaction specified. No fill material shall be placed when free water is standing on the surface of the area where the fill is to be placed. No compaction of fill will be permitted with free water on any portion of the fill to be compacted.
9. No fill shall be placed or compacted in a frozen condition or on top of frozen material. Fill containing organic materials or other unacceptable material shall be removed and replaced with approved fill material.
10. Compaction of fill shall be performed with equipment suitable for the type of material placed and which is capable of providing the densities required for the specific conditions encountered. CONTRACTOR shall select compaction equipment and submit it and his proposed procedure to the ENGINEER for approval.
11. Fill shall be compacted by at least two coverages of all portions of the surface of each lift by compaction equipment or as required to attain specified degree of compaction. One coverage is defined as the condition obtained when all portions of the surface of the fill material have been subjected to the direct contact of the compactor.
12. The maximum density for backfill materials shall be as follows:
    a. General Backfill Material: 98% Standard Proctor Density.

b. Backfill Base Course Materials under Driveways/Parking Lots: 100% Standard Proctor Density.
c. Backfill Sub-Base Course Materials under Driveways/Parking Lots: 98% Standard Proctor Density.

13. If the specified densities are not obtained because of improper control of placement or compaction procedures, or because of inadequate or improperly functioning compaction equipment, the CONTRACTOR shall perform whatever work is required to provide the required densities. CONTRACTOR shall repair, at his own expense, all settlement that occurs. He shall make all repairs and replacements necessary within 30 days after notice from the ENGINEER or OWNER.

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

G. Backfill and Restoration of Gravel Roadways:
1. Preparation and compaction of the pipe trench to be restored shall be completed for the full length and width of the trench prior to installation of the final top Granular materials.
2. Sub-base course material shall be Granular “B” Type 1 material as specified under OPSS.MUNI 1010, compacted to 98% Standard Proctor Maximum Dry Density. Thickness of material shall be as identified on the Contract Drawings.
3. Base course material shall be Granular “A” material as specified under OPSS.MUNI 1010, compacted to 100% Standard Proctor Maximum Dry Density. Thickness of material shall be as identified on the Contract Drawings.

3.9 BACKFILL MATERIAL

A. Backfill material shall be provided that meet the requirement under Section 02316.

B. Backfill necessary to replace subgrade materials disturbed and softened as a result of the CONTRACTOR'S operations or to backfill unauthorized excavation shall be provided, placed and compacted at the CONTRACTOR'S expense.

3.10 GRADING

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

B. Grading Requirements:
1. Turfed Areas: Finish areas to receive topsoil to within not more than 1 inch above or below the required subgrade elevations.

2. Walks: Shape surface of areas under walks to line, grade and cross-section, with finish surface not more than 25 mm above or below the required subgrade elevation.
3. Pavements: 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 subgrade elevation.
4. 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.

3.11 DISPOSAL OF EXCAVATED MATERIALS

A. Material removed from the excavations shall be quantified by the CONTRACTOR, for inclusion within an Environmental Impact Worksheet (EIW) document supplied by the OWNER, before being hauled away from the project site by the CONTRACTOR and disposed of in compliance with local, provincial, federal rule, regulation and/or requirements or stockpiled for later use on the project on site at a location to be determined by the OWNER.

B. Conform to the requirements of Section 02120 – Off-Site Transportation and Disposal and O.Reg. 406/19 – On-Site and Excess Soil Management.

3.12 TEMPORARY PAVEMENT REPLACEMENT

A. CONTRACTOR shall place 50 mm of temporary bituminous pavement immediately after backfilling trenches in paved roadways, shoulders, driveways and parking lots which are to be retained for permanent use. CONTRACTOR shall maintain in good and safe condition during progress of the entire Work, the surface of the paved area over the trench, and promptly fill all depressions over and adjacent to the trench caused by settlement of backfilling until the permanent pavement has been installed. Permanent pavement replacement shall be as specified in Section 02500.

3.13 NOT USED

3.14 FIELD QUALITY CONTROL

A. Quality Control Testing During Construction: Testing services shall be performed by an independent testing company provided by the CONTRACTOR. Field density tests shall be conducted in accordance with ASTM D6938. Testing of subgrades and fill layers shall be taken as follows:
   1. Paved Areas: Make at least one field density test of subgrade for every 190 square meters of paved area, but in no case less than 3 tests.
   2. Pipe Trench Backfill: In each compacted 2-fill layer, conduct one field density test for every 50 meters of pipe trench.
   3. Subgrade material: In each excavation test subgrade material for suitability as a min proof role and complete T-Probe tests. One test for every 20 square meters of excavated areas and one test for every 10 meters of trench.
   4. If, based on reports of testing service and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional expense to OWNER.

B. Refer to Section 02316 for additional testing requirements.

END OF SECTION

SECTION 02311

ROUGH GRADING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grading, rough contouring, and compacting.

1.2 ENVIRONMENTAL REQUIREMENTS

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

B. Comply with Section 02316 and 02300.

1.3 SEQUENCING AND SCHEDULING

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

B. Sequence and schedule rough grading activities with work of other Sections.

C. Grade areas shown on the Drawings in an approved sequence. Submit proposed sequencing changes to ENGINEER in writing. Such changes, if approved, will be authorized by ENGINEER in writing.

D. Do not allow or cause any of the work performed or installed to be covered up or enclosed prior to required inspections, tests, or approvals.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify that survey bench marks and intended elevations for the Works are as shown on the Drawings.

C. Obtain ENGINEER's approval of graded surfaces or previously placed material prior to placing materials on them.

3.2 PREPARATION

A. Field verify expose, stake, flag and protect existing of utilities and subsurface infrastructure to remain.

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

C. Locate, identify, and protect utilities that remain from damage.

D. Protect plant life, lawns, and other features remaining as a portion of final landscaping.

E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from grading equipment and vehicular traffic.

F. Maintain and protect from damage wells, utilities, and structures encountered. In the event of disturbance of or damage to any well, utility, or structure, immediately notify ENGINEER. Repair or replace, as directed by ENGINEER, any well, utility, or structure damaged by CONTRACTOR operations unless specified for removal.

G. Protect surface features which may be affected while work is in progress.

H. Protect existing structures where temporary unbalanced earth pressures are liable to develop on walls or other structures utilizing bracing, shoring, or other approved methods to counteract unbalance.

I. Protect monitoring wells and other structures and pipelines from uplift and displacement or disturbance during grading operations.

J. Employ procedures for grading such that disturbance of wells, utilities, structures, and their foundations is avoided.

K. Protect graded areas from contamination.

L. Obtain direction from ENGINEER before moving or otherwise disturbing wells, utilities, or structures.

M. Unless otherwise specified, advise ENGINEER a minimum of 10 days in advance of grading operations to enable ENGINEER to take pre-grading cross-sections.

N. Where fill shall be placed on existing ground, scarify top 150 mm of underlying subgrade and compact in accordance with Section 02316.

O. When placing and compacting fill, do not disturb satisfactorily placed material.

P. Keep surfaces crowned or sloped to grades shown on the Drawings so that surfaces will drain freely to the proposed subdrain.

Q. Immediately prior to temporary suspension of operations, leave surfaces under construction to specified grades so as to leave surface free of ruts, depressions, or areas that will pond or collect water.

3.3 GRADING

A. Grade subsoil from areas to be further regraded.

B. Do not grade wet subsoil.

C. Temporary stockpile graded material in area designated on the Site to height not exceeding 3 m and protect from erosion.

D. Benching Slopes: Horizontally bench existing slopes steeper than 4H:1V to key placed fill material to slope to provide firm bearing.

E. Stability: Replace damaged or displaced subsoil to same requirements as for specified fill.

F. Strip or otherwise remove unsuitable material within the area upon which fill is to be placed before fill placement is started.

3.4 PROOF ROLLING

A. Perform proof rolling where earth shall be cut, or fill shall be placed and compacted.

B. Perform proof rolling in accordance with Sections 02316 and 02300.

3.5 FILLING

A. Fill areas to contours and elevations with unfrozen graded materials.

B. Place graded material in continuous 150 mm compacted thickness layers and compact in accordance with Sections 02316 and 02300.

C. Make grade changes gradual. Blend slope into level areas.

3.6 TOLERANCES

A. Top Surface of Subgrade: Plus or minus 25 mm from required elevation.

B. Conform to the requirements of Section 02316 and 02300.

3.7 FIELD QUALITY CONTROL

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

B. Perform compaction testing in accordance with Sections 02316 and 02300.

END OF SECTION

SECTION 02316

FILL MATERIAL

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Grading and proof rolling of subgrade

B. Supply and place low permeability soil and topsoil.

C. Compaction as scheduled.

1.2 REFERENCES

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

B. American Society for Testing and Materials (ASTM):
1. D422 - Standard Test Method for Particle-Size Analysis of Soils.
2. D698 - Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
3. D1557 - Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).
4. D2216 - Standard Test Method for Laboratory Determination of Water (Moisture) Content of Soil and Rock.
5. D2487 - Standard Classification of Soils For Engineering Purposes (Unified Soil Classification System).
6. D2974 - Standard Test Method for Moisture, Ash and Organic Matter of Peat and Other Organic Soils.
7. D4318 - Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
8. D4972 - Standard Test Methods For pH of Soils.
9. D5084 - Standard Test Method for Measurement of Hydraulic Conductivity of Saturated Porous Materials Using a Flexible Wall Permeameter.

C. Ontario Provincial Standard Specifications Municipal (OPSS.MUNI).

D. Ontario Provincial Standard Specifications Provincial (OPSS.PROV).

1.3 DEFINITIONS

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

B. OPSS.MUNI: Ontario Provincial Standard Specifications Municipal.

C. OPSS.PROV: Ontario Provincial Standard Specifications Provincial.

1.4 PROGRESS SUBMITTALS

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

B. Materials Sources: Submit name of proposed imported soil materials sources at least 7 days prior to commencing transport of materials to the Site.

C. Independent Geotechnical and Analytical Testing Firm: At least 15 days prior to commencing transport of soil materials to the Site, submit the name and qualifications of the independent testing firms proposed by the CONTRACTOR to provide testing services for work of this Section. The testing by the CONTRACTOR's testing firm shall be completed by a Qualified Person (as described under Section 5 of Ontario Regulation 153/04).

D. Geotechnical and Chemical Data: At least 10 days prior to commencing transport of materials to the Site, submit laboratory test results to confirm geotechnical and chemical acceptability of imported fill materials.

E. Suppliers' Certificates: Submit certificate indicating that each type of soil materials meets or exceeds specified requirements.

1.5 QUALITY ASSURANCE

A. Perform work of this Section in accordance with OPSS.

1.6 ENVIRONMENTAL REQUIREMENTS

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

B. Suspend operations whenever climatic conditions, are unsatisfactory for placing fill to the requirements of this Section.

C. After occurrence of heavy rains, do not operate equipment on previously placed material or on approved surfaces until the material has dried sufficiently to prevent occurrence of excessive rutting.

D. Do not place fill in a frozen state or against frozen surfaces or frozen previously placed material. Do not place fill on snow, ice, water, or other objectionable material or on improperly prepared surfaces or previously placed material.

E. Where surfaces or previously placed material have been softened or eroded, remove soft and yielding material or otherwise objectionable or damaged areas and replace with compacted fill as specified by ENGINEER.

PART 2 PRODUCTS

2.1 MATERIALS – GRANULAR

A. Comply with the requirements of OPSS.MUNI 401, Granular "A" material as in accordance with OPSS.MUNI 1010, Table 2.

B. Comply with the requirements of OPSS.MUNI 401, Granular “B” shall be Type 2 material as in accordance with OPSS.MUNI 1010, Table 2.

2.2 MATERIALS – 50MM CLEAR STONE

A. Comply with the requirements of OPSS.PROV 1004 – Meeting Table 2 Gradation.

2.3 MATERIALS – INSULATION FOR BURIED PIPING

A. Comply with the requirements of OPSS.MUNI 1605 – Extruded Expanded Polystyrene Pavement Insulation

2.4 MATERIALS – UNSHRINKABLE FILL

A. Comply with the requirements of OPSS.MUNI 1359 – Unshrinkable Fill

2.5 NOT USED.

2.6 TOPSOIL

A. Friable loam neither heavy clay nor of very light sandy nature.

B. Reasonably free of roots, rocks, or lumps larger than 12.7 mm, weeds, vegetation, and seeds of noxious weeds.

C. Acidity Range (pH): 5.5 to 7.5.

D. Containing minimum 5 percent and maximum 25 percent organic matter determined in accordance with ASTM D2974.

2.7 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements: Requirements for source testing and analysis of soil material.

B. Testing and Analysis of Topsoil:
   1. Grain Size, ASTM D422: 1 sample per 500 m^3, or portion thereof, of topsoil required.
   2. pH, ASTM D4972: 1 sample per 500 m^3, or portion thereof, of topsoil required.
   3. Organic Matter, ASTM D2974: 1 sample per 500 m^3, or portion thereof, of topsoil required.
   4. Phosphorus, potassium, calcium, and magnesium, in accordance with province-accredited method: 1 sample per 500 m^3, or portion thereof, of topsoil required.

C. If tests indicate materials do not meet specified requirements, change material or material source and retest.

D. Provide materials of each type from the same source throughout the Works.

E. In the event of changes to approved sources of materials during the performance of the Works, immediately advise ENGINEER of revised locations and obtain approval of such locations and materials prior to use in the Works.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, measurements, tests, or approvals.

C. Obtain approval from ENGINEER for completed excavations and previously placed material prior to placement of successive lifts.

D. Ensure areas to be backfilled are free from debris, snow, ice, water, soft soils, organic materials, or frozen ground.

3.2 PREPARATION

A. Remove debris, snow, ice, water, soft soils, organic materials, or frozen ground from areas to be backfilled.

B. Grade and Proofroll subgrade (waste and/or daily/interim cover) prior to placement of low permeability soil.

3.3 FILLING

A. Fill areas to grades and elevations shown on the Drawings and as directed by ENGINEER.

B. Granular Fill: Place and compact material in equal continuous layers not exceeding 150 mm compacted depth.

C. Employ a placement method that does not disturb or damage other work.

D. Maintain optimum moisture content of backfill materials to attain required compaction density. For low permeability soil, maintain moisture and density within zone of acceptable compaction defined in Article 3.5.

E. Backfill around installations as follows:
   1. Do not dump directly against installation.
   2. Place layers simultaneously on both sides of installed work to equalize loading and minimize movement.
   3. Where temporary unbalanced earth pressures are liable to develop on walls or other structures:
      a. If approved by ENGINEER, erect bracing or shoring to counteract unbalance, and leave in place until removal is approved by the ENGINEER.

b. Place material by hand under, around, and over installations until 600mm of cover is provided.

F. Filling shall be completed such that grading directs stormwater runoff towards the proposed drainage swale. Make gradual grade changes. Blend slope into level areas.

G. Compact each layer to density specified in Article 3.5 before placing succeeding layers.

3.4 PLACING TOPSOIL

A. Spread topsoil to minimum settled depth of 150 mm over area to be seeded.

B. Place topsoil during dry weather and on dry unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low, or soft areas, and to ensure positive drainage.

E. Rake until smooth, and then roll lightly.

3.5 COMPACTION

A. Common Imported Fill: Compact to a minimum of 98 percent SMDD.

B. Apply uncontaminated water as necessary during compaction to obtain specified density. If material to be compacted is excessively moist, aerate with suitable equipment and methods until the moisture content is corrected. In areas not accessible to rolling equipment, compact material to specified density with mechanical tampers.

C. Do not direct jets of water at fill with such force that finer materials will be washed out.

D. Compaction Equipment: The type, size, and efficiency of compaction equipment shall be capable of achieving specified degree of compaction. Compact with sheepsfoot roller with feet length at least 2/3 thickness of lift. When operating equipment adjacent to and immediately above structures, exercise care so as not to cause damage or displacement of the structure.

3.6 TOLERANCES

A. Top Surface of Backfilling: Plus or minus 50 mm from required elevations.

3.7 FIELD QUALITY CONTROL

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

B. CONTRACTOR shall retain the services of a qualified third party testing firm to complete the testing as described in this section.

C. Testing of fill shall include analysis for presence of grain size, moisture content, and maximum dry density. Testing for compacted backfill shall include moisture content, maximum dry density and situ density.

D. Submit copies of all test reports to ENGINEER.

E. Required Testing:
   1. Maximum dry density and optimum moisture content will be determined in the laboratory in accordance with ASTM D698.
   2. Moisture content in the laboratory will be determined in accordance with ASTM D2216.
   3. Bulk wet density will be determined in the field in accordance with ASTM D2922.
   4. Moisture content will be determined in the field in accordance with ASTM D3017.
   5. Confirmatory bulk wet density will be determined in the field at a frequency of 10 percent of ASTM D2922.
   6. Confirmation moisture content will be determined in the field at a frequency of 10 percent of ASTM D3017 using ASTM D2216.
   7. Particle size analysis will be performed in accordance with ASTM D422 or ASTM C117 and ASTM C136, whichever is appropriate to material being tested.
   8. Refer to Section 02300 for additional testing requirements.

F. Failure to Meet Specified Requirements: If tests indicate that material specifications have not been achieved or cannot be obtained with equipment in use, procedure being followed, or material being incorporated, remove and replace work and modify operations so that the equipment, procedures, and materials will produce the required results. Additional testing required by ENGINEER will be to CONTRACTOR's account.

3.8 ADJUSTING

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

B. Finish compacted surfaces to within 25 mm of established grades shown on the Drawings but not uniformly high or low. Correct surface irregularities by loosening and adding or removing material until the surface is within specified grade.

C. Leave work areas in a properly graded condition sloped as required to permit proper drainage and free of depressions that will pond or collect water or debris that will restrict flow.

D. Refer to Section 02300 for additional requirements.

3.9 CLEANING

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

B. Clean and reinstate work areas and areas affected by equipment outside work areas to specified restoration condition.

C. Upon completion of backfilling, remove excess material and debris from work areas and travel routes.

3.10 PROTECTION OF FINISHED WORK

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

B. Reshape and recompact fills subjected to vehicular traffic.

END OF SECTION

SECTION 02480

LANDSCAPING AND RESTORATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Landscaping and restoration services including, but not limited to, the following:
   1. Rough and final grading.
   2. Topsoil stockpiled for reuse.
   3. Lawn areas.
   4. Retaining Wall
   5. Maintenance work as specified until completion of the Contract.
   6. Miscellaneous landscape materials.

1.2 RELATED SECTIONS

A. Section 02300 - Excavation and Backfill.

B. Section 02316 – Fill Material.

C. Section 02500 - Paving and Surfacing.

D. Section 02923 - Hydroseeding

1.3 REFERENCES

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

B. ASTM International (ASTM): D2487 - Classification of Soils for Engineering.

C. Seed Act of Canada, Canadian Food Inspection Agency.

D. Fertilizers Act and Regulations, Ministry of Agriculture and Lands.

E. Geotechnical Investigation Third Train Upgrade Bruce Power LP Sewage Processing Plant

1.4 QUALITY ASSURANCE

A. General: Ship landscape materials with certificates of inspection as required by governmental authorities. Comply with governing regulations applicable to landscape materials.

B. Topsoil Stockpiled for Reuse: Submit to ENGINEER test results of representative soil samples to be tested for physical properties, hydrogen-ion value, organic matter, and available phosphoric acid and potassium. Obtain 40 kg samples and make tests at no additional cost to OWNER. If deficiencies in the topsoil are found as a result of this analysis, they shall be

corrected at no additional cost to OWNER. CONTRACTOR shall retain a third party testing firm to complete sampling and testing.

C. Topsoil From off-Site Sources: Topsoil from off-Site sources may be provided for use on this Project. All topsoil furnished from off-Site sources shall be subject to ENGINEER's approval.

1.5 PROGRESS SUBMITTALS

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

B. Shop Drawings: Submit for approval the following:
   1. Manufacturer's specifications and installation instructions for all landscape materials.
   2. Retaining Wall Shop drawings designed for this project, bearing stamp and signature of a Professional Engineer registered in the Province of Ontario, with at least 5 years experience for Retaining Wall Systems.
   3. Retaining Wall detailed design calculations, completed and sealed by an Engineer in accordance with the design requirements outlined by the manufacturer.
   4. Retaining Wall Materials Submittal – Manufacturer's certifications, stating that the retaining wall units and imported aggregates, imported fill and soils met the requirements of the Engineer's design.
   5. Retaining Wall Installer Qualifications – demonstrating that field construction supervisor has the necessary experience for the project by providing documentation showing that they have successfully completed projects of similar scope and size.

C. Certificates: Submit for approval the following:
   1. Certificates of inspection as may be required by governmental authorities to accompany shipments, and manufacturer's or vendor's certified analysis for retaining wall, soil amendments and fertilizer materials. For standard products submit other data substantiating that materials comply with specified requirements.
   2. Certificates from seed vendors certified statement for each seed mixture required, stating botanical and common name, percentage by weight and percentages of purity, germination, and weed seed for each species.
   3. Certificate guaranteeing work through the specified maintenance period.

1.6 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution Requirements: Requirements for warranties

B. Guarantee lawns and landscape through the specified maintenance period, and until final acceptance of the Works.

PART 2 PRODUCTS

2.1 MATERIALS

A. Topsoil: Topsoil will be stockpiled for re-use in landscape work.

B. In the event that topsoil excavated on Site is not sufficient to meet the requirements of the Project:
   1. Topsoil: Fertile, agricultural soil, typical for locality, capable of sustaining vigorous plant growth, free of subsoil, clay or impurities, plants, weeds, and roots.

C. Soil Amendments:
   1. Compost: Derived from well-composted green organic waste matter.
      a. All compost material shall meet the Ontario Ministry of the Environment's "Interim Guidelines for the Production and Use of Aerobic Compost in Ontario" definition for Type A compost and shall be supplied from composting sites certified to meet the requirements of the Ontario Ministry of the Environment's compost Regulation 101.
   2. Peat moss shall be added in the field and mowed with cultivation equipment. Supply shredded material, free from toxic materials, live plants, lumps, roots, stones and other extraneous foreign matter, in a pulverized condition, capable of passing through 50 mm screen, which can easily be incorporated with the topsoil.
   3. Commercial Fertilizer:
      a. Conforming to Canada “Fertilizers Act” and “Fertilizers Regulations”.
      b. Supplied in original bags bearing the manufacturer's original label indicating the mass and analysis.
      c. Complete synthetic, in granular form, dry, free flowing and free from lumps, slow release with 35 percent of nitrogen content in water insoluble form.
      d. Starter fertilizer shall be high in phosphorus and low in nitrogen and applied at a rate of 2.5 kg per 100 m^2.

D. Grass Seed Material:
   1. Grass Seed Mixture: "Canada pedigreed grade" in accordance with the Seeds Act, R.S.C. 1985, c. S-8 and Seeds Regulations, C.R.C., C. 1400. Provide seed of the grass species as specified below:
      The "Schedule of Grass Seed Requirements" is as follows:

By Dry Weight	*Name of Grass*
5%	Agricultural Seed Oats
10%	Canada Wild Rye
15%	Mustang Tall Fescue
20%	Sheep’s Fescue
20%	Victory Chewing’s Fescue
5%	Native Red Fescue
5%	Switch Grass
5%	Little Bluestem
5%	Indian Grass
4%	Showy Tick-Trefoil
2%	Hoary Vervain
4%	American Purple Vetch

   2. Legume mixture: "Certified", "Specialty Seed", "Canada No. 1 " in accordance with the Seeds Act and Seeds Regulations.

E. Retaining Wall shall be a mechanically stabilized earth (MSE) wall system, designed by Atlantic Industries Limited or approved equivalent.

PART 3 EXECUTION

3.1 JOB CONDITIONS

A. Environmental Requirements:
   1. Proceed with and complete the Works as rapidly as portions of the Site become available, working within the seasonal limitations for each kind of landscape work required.
   2. Do not plant when drought, or excessive moisture, or other unsatisfactory conditions prevail.

B. Scheduling: Plant or install materials only during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance until occupancy by OWNER.

3.2 INSPECTION

A. CONTRACTOR and his installer must examine the subgrade, verify the elevations, observe the conditions under which Work is to be performed, and notify ENGINEER of unsatisfactory conditions. Do not proceed with the Works until unsatisfactory conditions have been corrected in a manner acceptable to ENGINEER.

3.3 PREPARATION

A. Turfbed Preparation (lawn areas):
   1. Loosen subgrade of turfbed areas to a minimum depth of 25 mm. Remove stones over 50 mm in any dimension and sticks, roots, rubbish and other extraneous matter. Limit preparation to areas that will be planted promptly after preparation.
   2. Spread topsoil to depth matching existing topsoil conditions after natural settlement and light rolling.
      a. Do not spread topsoil while in a frozen or muddy condition.
   3. Apply starter fertilizers in the following quantities:
      a. For grass apply starter fertilizer (high in phosphorus and low in nitrogen) at a rate of 2.5 kg per 100 m^2, for example bone meal. If hydroseeding, a (8-38-15) fertilizer shall be applied at 2.5 kg per 100 m^2.
   4. Apply starter fertilizers within 10 days of seeding.
   5. Grade turfbed areas to smooth, even surface with loose, uniformly fine texture. Remove all stones and extraneous foreign material in excess of 50 mm in diameter. Roll and rake and remove ridges and fill depressions, as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
   6. Moisten prepared turfbed areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting. Do not create a muddy soil condition.
   7. Restore turfbed areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

B. Bed Preparation (field areas):
   1. York rake areas to be seeded.
   2. All stones or other undesirable materials over 50 mm or greater in diameter shall be removed and disposed of as approved.
   3. Swale areas to drain ditches.
   4. Fertilize area and lightly rake.

3.4 INSTALLATION

A. Hydroseeding:
   1. Refer to Section 02923 – Hydroseeding.

B. Fertilizing Program: Approximately 6 weeks after germination, apply suggested organic supplementary fertilizer 27-14-0 at a rate determined by topsoil analysis.

C. Reconditioning Existing Turf:
   1. Recondition existing turf areas damaged by CONTRACTOR's operations including storage of materials and equipment and movement of vehicles. Also recondition existing turf areas where minor regrading is required.
   2. Provide fertilizer, seed or sod and soil amendments as specified for new turf and as required to provide a satisfactorily reconditioned turf. Provide topsoil as required to fill low spots and meet new finish grades.
   3. Cultivate bare and compacted areas thoroughly to provide a satisfactory planting bed.
   4. Remove diseased and unsatisfactory turf areas; do not bury into soil. Remove topsoil containing foreign materials resulting from CONTRACTOR's operations including oil drippings, stone, gravel and other loose building materials.
   5. In areas approved by ENGINEER, where substantial turf remains (but is thin), mow, rake, aerate if compacted, fill low spots, remove humps and cultivate soil, fertilize, and seed. Remove weeds before seeding or if extensive, apply selective chemical weed killers as required. Apply a seedbed mulch, if required, to maintain moist condition.
   6. Water newly planted areas and keep moist until new turf is established.

3.5 MAINTENANCE

A. Begin maintenance immediately after planting.

B. Maintain turf for a period as required to establish an acceptable stand, as determined by ENGINEER, this shall be a minimum of 60 days.

C. Maintain lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas.

D. Repair and re-seed dead or bare spots to allow establishment of seed prior to acceptance.

E. Eliminate weeds by mechanical or chemical means.

3.6 CLEANUP AND PROTECTION

A. During landscape work, store materials and equipment where directed. Keep pavements clean and Work area in an orderly condition.

B. Protect landscape work and materials from damage due to landscape operations, operations by Other Contractors and trades and trespassers. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged landscape work as directed.

C. Remove all rubbish, equipment and rejected materials from the Site.

D. Protection includes all temporary fences, barriers, and signs and other work incidental to proper maintenance.

3.7 INSPECTION AND ACCEPTANCE

A. When the landscape work is completed, including maintenance, ENGINEER will make an inspection to determine acceptability.

B. Where inspected landscape work does not comply with the requirements, replace rejected work and continue specified maintenance until re-inspected by ENGINEER and found to be acceptable. Remove rejected plants and materials promptly from the Site.

3.8 RETAINING WALL

A. Review the site soil and geometric conditions as noted in the enclosed Geotechnical Report to ensure the designed wall is compatible with the site prior to construction.

B. Inspect the site conditions, materials incorporated into the retaining wall, and the construction practices used during the construction.

C. The walls shall be designed to suit the soil conditions, geometric dimensions and CL-625 loading conditions. Excavation to the lines and grades required, including disposal of all surplus excavated materials. If after excavating to the required elevation, the material encountered should be unacceptable to the Design Engineer as a foundation, the contractor shall perform additional excavation and fill to the satisfaction of the ENGINEER.

D. The Contractor shall check the level of the wall with each lift of imported backfill to ensure that no gaps are formed between successive lifts. Care shall be taken to ensure that the wall units and geotextile are not broken or damaged during handling and placement. The units shall be installed as shown on the Contractor’s Drawings in accordance with the Design Engineer’s stamped design.

END OF SECTION

SECTION 02500

PAVING AND SURFACING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. This Section includes the requirements of paving and surfacing including, but not limited to, the following:
   1. Hot-mix hot-laid bituminous pavements.
   2. Concrete road bases.
   3. Shoulder replacement and restoration.
   4. Testing as specified.

1.2 RELATED SECTIONS

A. Section 02300 - Excavation and Backfill.

B. Section 02480 - Landscaping and Restoration.

1.3 REFERENCES

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

B. Ontario Provincial Standard Specifications Municipal (OPSS.MUNI):
   1. 301 - Construction Specification for Restoring Unpaved Roadway Surfaces.
   2. 310 - Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving and Hot Mix Patching.
   3. 904 - Construction Specification for Concrete Structures.
   4. 1150 - Material Specification for Hot Mixed, Hot Laid Asphaltic Concrete.

C. Asphalt Institute (AI): MS-2 - Mix Design Methods for Asphalt Concrete and Other Hot Mix Types.

D. ASTM International (ASTM):
   1. C88 – Standard Test Methods for Soundness of Aggregates by Use of Sodium Sulfate.
   2. C127 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregates.
   3. C128 – Standard Test Method for Density, Relative Density (Specific Gravity) and Absorption of Fine Aggregates.
   4. D3203 – Standard Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.
   5. D4125 – Standard Test Method for Asphalt Content of Bituminous Mixtures by Nuclear Methods.

1.4 QUALITY ASSURANCE

A. General: Testing of materials and of compaction requirements for compliance with technical requirements of the Specifications shall be the duty of a testing laboratory provided by CONTRACTOR.

B. Responsibilities and Duties of CONTRACTOR: The use of testing service shall in no way relieve CONTRACTOR of his responsibility to furnish materials and construction in full compliance with the Contract Documents. To facilitate testing service, CONTRACTOR shall:
   1. Secure and deliver to the testing laboratory representative samples of the materials he proposes to use and are required to be tested.
   2. Furnish such casual labor as is necessary to obtain and handle samples at the Site or at other sources of material.
   3. Advise the testing laboratory and ENGINEER sufficiently in advance of operations to allow for completion of quality tests and for the assignment of personnel.

1.5 PROGRESS SUBMITTALS

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

B. Product Data: Submit manufacturer's Product data indicating:
   1. Performance criteria, characteristics, and limitations.
   2. Product storage preparation, handling, and installation requirements, techniques, and criteria.

C. Certifications:
   1. Minimum 14 days prior to placement of asphalt, submit to ENGINEER manufacturer's test data and certification by a qualified independent inspection and testing laboratory that the following materials will meet the specified requirements:
      a. Asphalt concrete.
      b. Tack coat.
      c. Admixtures.
      d. Aggregates.
      e. Curing compound.

D. Mix Design:
   1. Minimum 14 days prior to placement of each type of asphalt, submit mix designs to ENGINEER for trial mix testing and written approval.
   2. Do not place asphalt before written approval of mix is received.
   3. Do not vary the approved mix without written approval.
   4. Submit mix design for patching material to ENGINEER for written approval.

E. Records:
   1. Before unloading asphalt at the Site, provide ENGINEER a delivery ticket (with each batch of asphalt) on which is printed, stamped or written the following information:
      a. Name and location of batch plant.
      b. Date and serial number of ticket.
      c. Name of Contractor.
      d. Specific designation of job (name and location).
      e. Approved mix code.
      f. Amount of asphalt in tonnes.
      g. Truck number, cumulative total, and/or load number.
      h. Time truck was loaded.

2. Provide space for the following information, which shall be registered by producer's representative on at least 2 copies of the delivery ticket, after discharge has been completed:
   a. Time that load arrived on the Site.
   b. Time load was discharged.
3. Maintain accurate records of asphalt placements. Records shall have the following information:
   a. Date that asphalt was placed.
   b. Location of asphalt placement.
   c. Air temperature when asphalt was placed.
   d. Test samples taken and results of test samples.

1.6 ENVIRONMENTAL REQUIREMENTS

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

B. Comply with weather and ground surface conditions in the OPSS standards.

C. Do not place on wet ground, wet pavement, or in standing water.

D. Do not place during rain or snow.

E. Do not install the work of this Section outside of the following environmental ranges without ENGINEER's and Product manufacturer's written acceptance:
   1. Ambient Air and Surface Temperature: 5 to 50 degrees C.
   2. Precipitation: None allowed within 24 hours prior to placement.

F. Provide temporary protection and facilities to maintain environmental requirements for 24 hours before, during, and after installation.

PART 2 PRODUCTS

2.1 MATERIALS

A. Excavation and Backfill: Section 02300

B. Asphalt: HL3 and HL8 in accordance with OPSS.MUNI 1150.

2.2 EXAMINATION

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

B. Verify that compacted stabilized soil is dry.

C. Verify gradients and elevations of base are correct.

PART 3 EXECUTION

3.1 MIXING PLANT

A. Mixing plants shall be operated in accordance with the manufacturer's recommendations and shall be calibrated prior to commencing production of the specified mix. Provide ENGINEER with a certification of calibration for the plant prior to starting production of the mix.

B. Plant shall be capable of consistently meeting or exceeding all the requirements of these specifications.

C. Plant shall have facilities necessary for sampling asphalt cement and aggregates, as well as temperature indicators for testing the aggregates, asphalt cement and mixtures.

3.2 GENERAL

A. All pavements, driveways, parking areas, and shoulders that are removed, damaged, or disturbed during construction work under the Contract shall be replaced or restored at the discretion of ENGINEER.

B. At a minimum, all replacement pavement sections shall match existing thickness of disturbed areas or thickness required within the Contract Drawings, whichever is greater.

C. The minimum thickness of asphalt concrete pavement installed under the Contract shall be as shown on the Contract Drawings.

3.3 TRANSPORTING THE ASPHALT MIX

A. The mix shall be transported in accordance with the Standard OPSS Specifications for asphalting.

B. Truck boxes shall be clean, free from accumulations of asphalt mix and foreign material. Excess truck box lubricants such as light oil, detergents or lime solutions shall not be allowed to contaminate the mix, and shall be disposed of in an environmentally acceptable manner. Petroleum based truck box lubricants shall not be used.

C. During transport, the mix shall be completely covered to protect it from precipitation and excessive heat loss using waterproof tarpaulins, unless otherwise approved.

D. Schedule delivery of material for placing in daylight hours, unless otherwise approved by ENGINEER. Deliver material to paver at a uniform rate and in an amount within capacity of paving and compacting equipment.

E. Deliver loads continuously and immediately spread and compact. Deliver and place mixes at a temperature not less than 120 degrees C or more than 140 degrees C.

3.4 NOT USED

3.5 PLACING THE MIX

A. Heavy Duty Design Pavement Layer:
   1. Asphalt Concrete HL3 Compacted to 92% Marshall Density, 40mm Thickness
   2. Asphalt Concrete HL8 Compacted to 92% Marshall Density, 60mm Thickness

B. Spreading Mixture:
   1. The mix shall be placed at a temperature not less than 120 degrees C or more than 140 degrees C. The subbase and road surface shall be dry prior to placement.
   2. Mixture shall be spread by means of a mechanical self-propelled paver or approved mechanical spreader capable of setting true lines, grades and pavement crowns. Unless operating on fixed side forms, the paver shall employ mechanical devices such as equalizing runners, straight-edge runners, evener arms, or other approved compensation devices to adjust the depth and confine the edges of the placed mixture. The paver shall be suitable of spreading the mix without segregation to the depths shown and specified and to adjustable widths.
   3. Pavers shall be equipped with an adjustable strike-off screed with built-in tamping bars for compaction during spreading. Paver shall carry an approved straightedge for checking finished surface profile.
   4. Immediately after screening and prior to compaction, the surface shall be checked and any irregularities corrected and adjusted. Irregularities in alignment and grade along the outside pavement edge shall be corrected by the addition or removal of materials before the edge is rolled.
   5. Where the surface course is to be placed in 2 lifts, the first lift shall be placed, finished and compacted prior to commencing the second lift. When placing the second lift, the second course mixture shall be spread and laid in such a manner so that longitudinal joints in each layer do not coincide.
   6. Hauling over new pavements shall not be permitted until the mixture has been compacted and cooled to atmospheric temperature.

C. Prime and Tack Coat:
   1. Apply Prime Coat at a rate of 1.5 L/m^2. Paint contact surfaces of curbs, gutters, manholes, catch basins, and similar structures with a thin uniform coat of asphalt prime materials prior to installation of the pavement mixture.
   2. Where the asphalt surface course is placed in 2 lifts, the surface of the first lift shall be thoroughly cleaned of dirt by sweeping with a power broom and hand brooming and scraping where necessary. A tack coat shall then be applied prior to installation of the second course. Tack coat shall be applied by means of an approved pressure distributor.

D. Thickness of Lifts:
   1. Unless otherwise shown or directed by ENGINEER, the asphalt mix shall be placed in the following lift thickness:
      a. A single lift when the design compacted thickness is 70 mm or less.
      b. In 2 or more lifts when the design compacted total thickness is greater than 70 mm. The lift thickness selection shall be determined by CONTRACTOR except that:
         1) The maximum thickness of any lift shall be 70 mm.
         2) The minimum of the top or final lift shall be 50 mm.
         3) When a total ACP thickness of 80 mm is specified, the thickness of the first lift shall be 30 mm and the final lift 50 mm.
         4) When a total ACP thickness of 90 mm or more is specified, the thickness of all lifts except the top lift shall be 40 mm or greater.

E. Compaction:
   1. After the mixture has been spread to the thickness required, it shall be compacted to a minimum of 92 percent Marshall Density. Selection of the equipment shall be by CONTRACTOR to attain specified densities. ENGINEER will approve the means and methods for compaction.
   2. CONTRACTOR shall furnish rollers, tampers, and other approved compaction equipment to provide the specified compaction in restricted areas.
   3. At pavement installations adjacent to curbs, manholes, valve boxes, and other structures not accessible to rollers, CONTRACTOR shall compact thoroughly by means of hot tampers. The joint between these structures and the placed paving materials shall be effectively sealed.

3.6 JOINTS

A. Longitudinal and traverse joints shall be vertical butt type, well bonded and sealed, and finished to provide a continuous, smooth profile across the joints.

B. All longitudinal joints shall be straight and uniform with no lateral waviness. Any mat contact that is not straight or uniform shall be trimmed by saw cutting or other approved method.

C. Any mat with a contact edge that has deteriorated, cracked, or slumped due to improper rolling or vehicle traffic shall be trimmed by saw cutting prior to placing the adjacent mat.

D. Traverse joints shall be made by cutting back on the previously spread and rolled course in order to expose its full depth. When spreading of the course is resumed, the exposed edge of the joint shall be painted with an approved bituminous material and freshly laid mixture shall be raked against the joint, tamped with hot tampers, and rolled.

E. The mixture shall be laid so that all longitudinal joints are made while the asphalt mat which was laid first is still hot.

F. A narrow strip along the edge of a mat which is to be jointed with another asphalt mat shall be left without rolling until the adjoining mat has been placed against it. The joint, which is formed, shall be rolled immediately after the adjacent mat has been placed to ensure bonding of the material while the asphalt is still hot.

G. When paving is discontinued in any lane or in any lift, the mat shall be tapered to a slope of 10 horizontal to 1 vertical.

H. Traverse joints from one lift to the next shall be separated by at least 0.6 m.

I. Longitudinal joints shall be offset a minimum of 0.2 m from one lift to the next.

3.7 SAWCUTTING

A. Prior to placing any permanent pavement, CONTRACTOR shall sawcut any exposed edges of existing pavements to straight and even lines parallel to the centerline of the trench.

B. Sawcuts will be approved by ENGINEER prior to placing any permanent pavement.

C. Sawcuts shall be made by a machine suitable for use and shall be capable of making straight, even and fine cuts completely through the existing pavement in one pass.

D. Where existing pavement has been undermined, CONTRACTOR shall cut back the pavement to a location where solid subbase is available.

3.8 TOLERANCES

A. Smoothness: The maximum variation under a 3 m straight edge shall be as follows:
   1. Longitudinal in Direction of Travel: 3 mm.
   2. Transverse to Direction of Travel: 6 mm.

B. Grade: Plus or minus 6 mm maximum variation from designated grade elevations.

C. Texture: The finished surfaces shall have a tightly knit texture free of visible signs of poor workmanship such as, but not limited to:
   1. Areas of excess or insufficient depth of asphalt.
   2. Segregation.
   3. Improper matching of longitudinal or traverse joints.
   4. Roller marks, cracking, tearing, bump or waves.
   5. If surface grade and tolerances are exceeded, or if surface texture is not met, grind down and resurface defective area as directed by ENGINEER.

3.9 THICKNESS TOLERANCES

A. At ENGINEER's direction, the quality assurance laboratory will take cores from the asphalt pavement areas suspected to be deficient in total thickness, each comprising of 3 cores whose average thickness represents not more than 1,000 m^2 of asphalt pavement.

B. If average core thickness is deficient, that area of asphalt pavement will be assessed a pay factor as determined by ENGINEER, to be applied to the pro-rated price of the top 50 mm of asphalt surface.

C. Asphalt pavement with excess thickness may be accepted with no extra payment, if surface and grade tolerances and texture are met.

3.10 DENSITY TOLERANCE

A. At ENGINEER's direction, the quality assurance laboratory will take a single core representing the quantity of hot-mix in not more than 1,000 m^2 of mat, with a minimum of 1 core taken from a day's production. If the initial core density is below specified, that initial density is discarded and 3 new cores will be taken from the same area. The average density of the 3 new cores will represent that area.

B. Pavement compaction will be accepted on the basis of the ratio (in percent of core density to the density of Marshall specimen). If cores were drilled from the mat where no Marshall specimens were taken, acceptance will be based on the ratio of core density to the average density of all Marshall specimens taken to date.

C. If the average core density is below specified, the represented area of mat may be accepted subject to a pay factor as determined by ENGINEER, to be applied to the pro-rated price of the quantity of hot-mix in that mat area.

3.11 TRAFFIC CONTROL

A. Traffic shall not be permitted to run on final pavement until it has been compacted and cooled to atmospheric temperature. CONTRACTOR shall be responsible for all traffic control necessary during construction to protect work zones and pavement in progress.

3.12 ADJUSTMENT OF MANHOLES, STRUCTURES, AND FACILITIES

A. CONTRACTOR is responsible to locate all manholes, catch basins, valve boxed, and other facilities and structures which will interfere with the paving operations. Prior to placing any paving, CONTRACTOR shall adjust these facilities to the finished pavement surface elevations as directed by ENGINEER. All costs associated with adjustment of manholes, structures, and facilities shall be included for payment in the various paving items of the Contract.

3.13 CLEANUP

A. The entire Project including the construction areas, work sites and yards, shall be cleaned up and left in a neat and orderly condition. All construction refuse shall be removed from the Site to the satisfaction of ENGINEER.

3.14 NOT USED

3.15 SAMPLING AND TESTING

A. During the progress of the Works, tests will be carried out on materials and workmanship to ensure compliance with the requirements of the Specifications.

B. ENGINEER’s approval of any materials or mixture shall in no way relieve CONTRACTOR from its obligation to furnish materials and workmanship in accordance with the Specifications.

C. ENGINEER will have access to the Works at all times for taking samples. CONTRACTOR shall provide any assistance necessary for taking samples. Compensation for providing assistance with sampling and equipment for sampling shall be included in the various bid items covering this work.

D. CONTRACTOR shall retain a qualified third party testing firm to complete all quality testing.

E. Base course asphalt (HL8) and surface course asphalt (HL3) shall be tested to ensure quality assurance with respect to, and following all OPSS.MUNI 310 requirements.

F. Field samples are to be taken with plate and chain.

G. Asphalt Extraction sampling shall be completed as per ASTM D2172.

H. Field Density tests by nuclear methods as per ASTM D2950. Technicians shall sample the asphalt and record temperatures.

I. The Engineer's approval of any materials or mixture shall in no way relieve the Contractor from its obligation to furnish materials and workmanship in accordance with the Specifications.

END OF SECTION

SECTION 02501

BURIED UTILITIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Excavate, expose, and remove or relocate existing electrical lines and/or conduits, water supply line and yard hydrant, chemical feed lines and any associated structures as indicated on the Drawings.

B. Excavate trenches for new alignment of proposed effluent discharge line to connect to UV sump, with auxiliary connection to existing UV effluent line from disinfection building, sludge pipe connection to existing lagoon pipe, wastewater supply to aeration tank and decant/sludge transfer sump to existing equalization tank.

C. Reconnect, supply and install underground electrical utilities around the proposed third train structure for the sewage processing plant.

D. Reconnect, supply and install water supply piping and yard hydrant to the north side of the proposed third train structure.

E. Install effluent discharge line to UV disinfection building sump, with auxiliary connection to existing UV effluent line, sludge pipe connection to existing lagoon pipe, wastewater supply line to aeration tank and decant/sludge transfer line to equalization tank.

F. Provide all material, labour, and equipment required to install all buried infrastructure required for the works as noted in the Contract Documents.

1.2 REFERENCES

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

B. American Society for Testing and Materials (ASTM): B88 - Standard Specification for Seamless Copper Water Tube.

C. American Water Works Association (AWWA): C901 – Polyethylene (PE) Pressure Pipe, Tubing, and Fittings, 1/2 Inch through 3 Inch, for Water.

D. Canadian Standards Association (CSA):
1. B137.3 – Standard for Polyvinyl Chloride (PVC) Pipe.
2. C22.2 No. 45 - Rigid Metal Conduit.
3. C22.2 No. 211.2 - Rigid PVC Conduit.
4. C22.2 No. 211.3 - Rigid Reinforced Thermoset (RE) Conduit and Associated Fittings.
5. D3350 - Specification for Polyethylene Plastics Pipe and Fittings Materials.

E. Ontario Provincial Standard Specifications Municipal (OPSS.MUNI):
1. 407 - Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation.
2. 410 - Pipe Sewer Installation in Open Cut.

3. 412 – Sewage Forcemain Installation in Open Cut.
4. 441 – Watermain Installation in Open Cut.
5. 501 – Compacting.
6. 491 – Preservation, Protection and Reconstruction of Existing Facilities.
7. 401 – Trenching, Backfilling, Compaction.
8. 518 – Control of Water.
9. 402 – Excavation and Backfilling for Maintenance Holes.
10. MUNI. 1004 – Aggregates – Miscellaneous.
11. MUNI. 1010 – Material Specification for Aggregates – Granular A, B, M, and Select Subgrade Material.
12. 1842 - Material Specification for Pressure Polyethylene Pipe Products.

F. Latest edition of the Ontario Building Code 2012 as amended.

G. Ontario Electrical Safety Code.

H. Section 02300 – Excavation and Backfilling

I. Section 02316 – Fill Materials

J. Section 02222 – Demolition and Removals

1.3 DEFINITIONS

A. PEX: Cross-linked polyethylene pipe manufactured using extrusion method

B. HDPE: High Density Polyethylene

1.4 PROGRESS SUBMITTALS

A. Product Data: Submit detailed catalog information on selection, identification, shop and/or Site fabrication procedure, installation, and adjusting, for the following proposed products, for the ENGINEER'S approval, that shall include, but not be limited to the following components:
   1. Pipes.
   2. Flanges/Flange Adaptors.
   3. Yard Hydrant.
   4. Gate and Ball Valves.
   5. Capped Cleanouts.
   6. Fittings/Bends/Reducers.
   7. Restraints.

B. 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 yard hydrant, pipe, insert stiffeners, fittings, bends, restraints, reducers, etc.

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 detailed installation drawings and complete component selection list for tie rods and thrust restraints systems, where required.
6. No change in material or joint selection will be permitted after submittal of Shop Drawings and their final review by ENGINEER.

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

D. Record Documents: Indicate actual locations of piping and conduit, connections, and invert elevations; identify and describe unexpected variations to subsoil conditions.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver, handle, and transport soil or aggregate materials in a manner and with equipment that will prevent intermixing of soil or aggregate types, segregation, or contamination.

C. Minimize stockpiling requirements. Transport material from source directly to final position where possible.

D. Stockpile fill materials on the Site in locations approved by ENGINEER.

E. Handle pipe in accordance with applicable requirements of specified references, manufacturer's instructions, and as specified herein.

F. Use every precaution to prevent damage to pipe. Do not permit metal tools or heavy objects to unnecessarily come in contact with pipe. Repair damage to pipe from any cause during excavation, removal, and reinstallation as directed by ENGINEER.

1.6 SEQUENCING AND SCHEDULING

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

B. Coordinate with OWNER to schedule piping/utility stoppage times to facilitate connecting proposed into existing systems. Requests for shutdowns shall be submitted in writing a minimum of 15 days prior to the works and shall be approved in writing by the OWNER prior to start the works.

C. Schedule work to minimize time during which trenches and excavations remain open.

PART 2 PRODUCTS

2.1 WATER SERVICE PIPING

A. Pipe: PEX, SDR9 Service Tubing, 1,100 kPa (160 psi at 23 Degree Celsius) pressure rating.

B. Fittings (ie. Gate Valve/Couplings): As recommended by pipe manufacturer and shall be fully restrained.

C. Joints: As recommended by pipe manufacturer and shall be fully restrained.

2.2 PROCESS PIPE – Effluent Discharge to UV Disinfection Building – Gravity Piping

A. Pipe: OPSS.MUNI 1842, PE 4710, DR17, HDPE.

B. Fittings: Complete with insert stiffener, where required and formed to suit pipe size, material, pressure rating and configuration required.

C. Joints: HDPE Pipe Fusion, and/or HDPE flanged (flange adaptor coated with Denso System), restrained joint when connecting to ductile iron fitting as required on Contract Drawings.

D. HDPE Pipe Fusion
1. Butt fusion shall be used to make end-to-end joints between “butt” or plain end pipes and fittings that have the same outside diameter and like wall thickness.
2. Butt fusion methodology shall be in accordance with HDPE pipe manufacturer’s recommendations.
3. For the standard practice for underground installation of thermoplastic pressure pipe refer to ASTM D2774.

E. Pipe Insert Stiffeners shall be installed within HDPE pipe that are inserted through wall penetrations or mechanical fittings/restraints.

2.3 PROCESS PIPE – Sludge Pipe Connection

A. Pipe: OPSS.MUNI 1842, PE 4710, DR17, HDPE.

B. Fittings: Complete with insert stiffener, where required and formed to suit pipe size, material, pressure rating and configuration required.

C. Joints: HDPE Pipe Fusion and/or HDPE flanged (flange adaptor coated with Denso System), restrained joint when connecting to ductile iron fitting as required on Contract Drawings.

D. HDPE Pipe Fusion
1. Butt fusion shall be used to make end-to-end joints between “butt” or plain end pipes and fittings that have the same outside diameter and like wall thickness.
2. Butt fusion methodology shall be in accordance with HDPE pipe manufacturer’s recommendations.
3. For the standard practice for underground installation of thermoplastic pressure pipe refer to ASTM D2774.

E. Pipe Insert Stiffeners shall be installed within HDPE pipe that are inserted through wall penetrations or mechanical fittings/restraints.

2.4 PROCESS PIPE – RAW Wastewater Supply to Aeration Tank, refer to Specification Section 15060-18 HDPE Piping

A. Pipe: OPSS.MUNI 1842, PE 4710, DR17, HDPE.

B. Fittings: Complete with insert stiffener, where required and formed to suit pipe size, material, pressure rating and configuration required.

C. Joints: HDPE Pipe Fusion, and/or HDPE flanged (flange adaptor coated with Denso System), restrained joint when connecting to ductile iron fitting as required on Contract Drawings.

D. HDPE Pipe Fusion
   1. Butt fusion shall be used to make end-to-end joints between “butt” or plain end pipes and fittings that have the same outside diameter and like wall thickness.
   2. Butt fusion methodology shall be in accordance with HDPE pipe manufacturer’s recommendations.
   3. For the standard practice for underground installation of thermoplastic pressure pipe refer to ASTM D2774.

E. Pipe Insert Stiffeners shall be installed within HDPE pipe that are inserted through wall penetrations or mechanical fittings/restraints.

F. Insulation over proposed pipe shall be 150mm insulation thickness of Styrofoam Highload 100 extruded polystyrene, to be installed in accordance with OPSD 1109.030.

G. Pipe supports shall be in accordance with Detail 2 found on Contract Drawing M-004, to match the required grade of 0.5% and be spaced at 1.0m spacing.

2.5 PROCESS PIPE – Decant/Sump to Existing Equalization Tank, refer to Specification Section 15060-18 HDPE Piping

A. Pipe: OPSS.MUNI 1842, PE 4710, DR17, HDPE.

B. Fittings: Complete with insert stiffener, where required and formed to suit pipe size, material, pressure rating and configuration required.

C. Joints: HDPE Pipe Fusion, and/or HDPE flanged (flange adapter coated with Denso System), restrained joint when connecting to ductile iron fitting as required on Contract Drawings.

D. HDPE Pipe Fusion
   1. Butt fusion shall be used to make end-to-end joints between “butt” or plain end pipes and fittings that have the same outside diameter and like wall thickness.
   2. Butt fusion methodology shall be in accordance with HDPE pipe manufacturer’s recommendations.
   3. For the standard practice for underground installation of thermoplastic pressure pipe refer to ASTM D2774.

E. Pipe Insert Stiffeners shall be installed within HDPE pipe that are inserted through wall penetrations or mechanical fittings/restraints.

2.6 TRACER WIRE

A. Tracer wire complete with warning mesh shall be installed on all buried, non-metal pipe and piping.

B. The wire shall be installed in such a manner as to be able to properly trace all pipe and piping without loss or deterioration of signal or without the transmitted signal migrating off the tracer wire.

C. Tracing wire shall be RWU90, number 10 gauge (AWG), single or seven strand, insulated copper wire with 60 mil of black, cross-linked polyethylene (XLPE) insulation specifically manufactured for direct burial applications.

D. All spliced or repaired wire connection in the tracer wire system shall be made using a Model Number 454, Catalogue Number 30-454, Wing Nut Wire Connector (for two to four number ten wires), or approved equivalent, and made waterproof using an approved buried service wire closure. The buried service wire closure shall be either a Klik-It II Number C8816 Buried Service Wire Closure or a Raychem GHFC-2-90 H-Frame Gel Closure or approved equivalent.

E. All tracer wire welds onto existing cast or ductile iron pipe shall be completely sealed with Denso System.

2.7 GATE VALVE

A. Resilient Seated Gate Valves, 75 mm to 500 mm:
   1. The gate valves shall be manufactured in accordance with AWWA standard C509, C515 and be approved by UL/ULC/FM and fusion epoxy coated inside and out in accordance with AWWA C550-13
   2. The wedge shall be of cast iron completely encapsulated with rubber. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond.
   3. Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA requirements. The NRS stem stuffing box shall be the "O" ring seal type with two "O" rings located above thrust collar. The two "O" rings shall be replaceable with the gate valve fully open and subjected to fully rated working pressure.
   4. There shall be two low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of wedge and shall be made of solid bronze. There shall be a smooth, unobstructed waterway free of all pockets, cavities and depressions in the seat area.
   5. The entire gate valve including the gland cover, body and bonnet, shall be epoxy coated both on the interior and exterior. Each valve shall have maker's name, pressure rating and year in which manufactured, cast on the body.
   6. For valves requiring indicator post
      a. UL/ULC listed, iron body, bronze mounted, non-rising stem rated 1,207 kPa WOG, AWWA C111/A21.11 mechanical joint ends.
      b. Double disc type gate, bronze wedge pins, parallel seat, gate stem sealed with double O-ring pressure and dirt seal.
      c. Bolted flanged bonnet for mounting indicator post, indicator post to be locking type with an adjustable barrel and weather sealed indicator window to display OPEN and SHUT positions.
   7. The pressure rating shall be 1724 kPa under AWWA specifications and 1379 kPa under ULC.
   8. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to requirement for both AWWA (twice the specified working pressure) & ULC requirements. Bolting shall be stainless Type 316.
   9. Acceptable Manufacturers
      a. Clow

b. Mueller
c. Approved equal

B. Valve and Box:
1. All valve and box sections shall be heavy duty screw type valve boxes.
2. Valve box top section to have 229mm larger and 187mm smaller, outer diameter with 187mm diameter “RECLAIM” lid’’.
3. Valve box bottom section to have 260mm larger and 146mm smaller, outer diameter.
4. Valve box extension section, (where required), shall have 188mm larger and 146mm smaller, outer diameter.
5. Base (Bonnett) section to have 375mm (max) larger and 187mm smaller, inner diameter.
6. Valve and Box acceptable manufacturers
a. Star Pipe Products
b. Bibby-Ste-Croix
c. Approved equal

2.8 LAGOON DEWATERING (ABOVE GROUND) BALL VALVE

A. 100mm diameter Class 300 Ball Valve.

B. 100mm diameter Male Camlock Fitting and Cap.

C. Acceptable Manufacturers:

D. Apollo

E. Crane

F. Nibco

G. Watts

H. Approved equal

2.9 INLINE 300 BALL CURB VALVE

A. 50mm diameter inline Ball Curb Valve.

B. Curb box and valve stem to Ball Curb Valve.

C. Acceptable Manufacturers:

D. Apollo

E. Crane

F. Nibco

G. Watts

2.10 Approved equalECCENTRIC REDUCER

A. 250 x 300 Ductile Iron flanged eccentric reducer (c/w associated bolts and thick red rubber gaskets conforming to ASME B16.21, AWWA C207 and ASTM D1330 Gates 1 and 2)

B. Ductile iron flanged eccentric reducer shall be fitted with a Z-5 anode in accordance with OPSS.MUNI 442.

C. Eccentric Reducer to be installed to existing 300mm diameter Uni-flange Adaptor and proposed 250mm diameter HDPE flanged fitting.

D. All associated bolts and flanges to be coated with Denso System.

2.11 FLANGE TEE

A. Ductile Iron Flanged Tee, in accordance with ANSI/AWWA-C110/A21.10 Standard (c/w associated bolts and thick rubber gaskets conforming to ASME B16.21, AWWA C207 and ASTM D1330 Gates 1 and 2). Flanged Tees to be restrained to connecting pipe.

B. Ductile Iron Flanged Tee to be installed to proposed flanged ends of PVC (2000PV Megalug) and HDPE pipe.

C. All associated bolts and flanges to be coated with Denso System.

D. Straight Tee Fittings to include thrust block in accordance with OPSD 1103.010 and be fitted with a Z-5 anode in accordance with OPSS.MUNI 442.

2.12 YARD HYDRANT

A. Yard hydrant shall be a 50mm Inlet/Outlet Woodford Freezeless Utility Hydrant or approved equivalent.

B. Yard hydrant shall be freezeless utility with automatic draining when hydrant is shut off to prevent freezing.

C. Hydrant shall maintain a wheel handle operation to open and close water flow.

D. All working parts shall be removable through the top of the hydrant.

E. Lever handles shall be easily removable to prevent unauthorized usage.

F. Shall maintain a 6mm galvanized pipe operating rod.

G. Maximum working pressure of 860 KPa.

H. Yard Hydrant Manufacturer
   1. Woodford Manufacturing Company
   2. Approved equivalent.

2.13 CLEAN-OUTS

A. Clean-outs to be constructed from HDPE, PE 4710, DR17 pipe, c/w butt fused two 45 degree bends.

B. Contain a EMCO A0721-001 Monitoring Well Manhole cover or approved equivalent connected to the HDPE pipe by a Fernco Flexible Coupling.

C. All buried metal components including but not limited to valves and fittings shall be treated against corrosion using the Denso Tape system as manufacturer by Denso North America.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. The CONTRACTOR shall locate existing utilities prior to the commencement of work.

C. Coordinate and schedule with OWNER, for the use of any existing Treatment Train, UV Disinfection Building, Control Building facilities, equipment, utilities or components to facilitate the installation of proposed piping. The CONTRACTOR may not operate any existing facilities within OWNER plant.

D. Do not allow or cause any of the work performed or installed to be covered up or enclosed by work of this Section prior to required inspections, measurements, tests, or approvals.

E. Do not proceed with backfilling operations within a specific excavation area until the excavation area is approved as complete by ENGINEER. Do not cause excavations to be backfilled until ENGINEER has approved excavation as complete and completed field measurements for payment purposes, and sampling and testing for analytical purposes.

3.2 PREPARATION

A. Remove scale and dirt on inside and outside of piping before assembly.

B. Carefully inspect materials for defects and promptly remove defective materials from the Site.

C. Clean pipe of accumulated debris and water before installation.

3.3 TRENCHING

A. Excavate soil required for pipe and conduit installation in accordance with Section 02300 – Excavation and Backfilling.

3.4 BACKFILLING

A. Backfill trenches to contours and elevations with approved fill materials in accordance with Section 02300 – Excavation and Backfilling.

3.5 COMPACTION

A. Compact backfilled Granular A bedding around utilities to 98% SPMDD.

3.6 PIPE INSTALLATION - NEW

A. Install new pipes as indicated on the Drawings and in accordance with OPSS.MUNI 410 and forcemains in accordance with OPSS.MUNI 412.

B. Install 50mm diameter inner diameter PEX water pipe in accordance with OPSS.MUNI 441.

C. Install pipe to lines, grades, and elevations shown on the Drawings to within a tolerance of 10 mm.

D. Connect pipes to existing pipes and structures as indicated on the Drawings, and in accordance with Ontario Building Code requirements and OPSS.

E. Install tracer wire and warning mesh on all proposed HDPE pipe installed.

3.7 RECONNECTION OF UNDERGROUND ELECTRICAL UTILITIES

A. Refer to Division 16 of the Specifications.

3.8 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field testing.

B. Pressure Testing Process Pipes and Water Supply Pipes:
   1. Isolate portions of the lines to be tested.
   2. All piping to be flushed clean prior to testing.
   3. Hydrostatic pressure testing shall be completed using potable water supplied by the CONTRACTOR.
   4. Complete testing in conformance with ASTM F2164-13.
   5. Conduct pressure testing at 1.5 times the normal operating pressure for a period of 2 hours, during which time the pressure shall not decrease or fluctuate.
      a. Water Service Piping Normal Operating Pressure 350 KPa
      b. Effluent Discharge to UV Disinfection Building Normal Operating Pressure 15 KPa
      c. Sludge Pipe Connection Normal Operating Pressure 350 KPa
      d. RAW Wastewater Supply to Aeration Tank Normal Operating Pressure 15 KPa
      e. Decant/Sump to Existing Equalization Tank Normal Operating Pressure 350 KPa
   6. Examine exposed pipe, joints, fittings, valves and appurtenances while system is under pressure.
   7. Remove and replace pipe, joints, fittings, valves and appurtenances found defective with new sound material made water tight.
   8. Repeat the pressure test until all defects have been corrected.

C. For Water Service Pipe to Yard Hydrant quality testing:
   1. Disinfection shall be completed by a specialist SUBCONTRACTOR who is fully experienced in providing disinfection services for potable water piping and shall provide references for disinfection work completed in Ontario. The specialist S shall be certified by the MECP and shall have minimum of 5 years of experience completing similar works.
   2. Flushing and disinfecting operations are to be under the direct control of the CONTRACTOR. Notify the ENGINEER and OWNER at least 10 Working Days in advance of the proposed date when disinfection operations are scheduled to commence.
   3. Ensure that no deleterious matter is allowed to enter any sections that have been flushed.
   4. Flushing and disinfection of the water service piping shall be in accordance with:
      a. AWWA C651-14, Disinfecting Water Mains
      b. Watermain Disinfection Procedure (MECP)
   5. Taking of samples and testing for chlorine residual and other required parameters (turbidity, pH, temperature) is to be carried out by licensed third party operator provided by the CONTRACTOR and approved by the ENGINEER.
   6. After the system has been recharged, the CONTRACTOR will take a sample for bacteriological testing to be tested at a laboratory approved by the ENGINEER. If there is an indication of contamination, the disinfection procedure shall be repeated at the CONTRACTOR's expense.
   7. The CONTRACTOR shall not put any part of the system into operation until laboratory testing clearance has been received by the ENGINEER and the ENGINEER has provided the CONTRACTOR with written approval.

3.9 PROTECTION OF FINISHED WORK

A. Mark and protect process piping and water service piping.

B. Prevent entry of water or foreign material to pipes.

END OF SECTION

SECTION 02831

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Installation of fence and vehicle access gates.

1.2 REFERENCES

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

B. Canadian Electrical Code (CEC).

C. Ontario Provincial Standard Specifications Municipal (OPSS.MUNI):
1. 772 - Chain Link Fence.
2. 772.07 - Chain Link Fence - Zinc Coating Repairs.
3. 904 - Construction Specifications for Concrete Structures.

D. Ontario Provincial Standard Drawings (OPSD):
1. OPSD 972.130 - Chain Link Fence Drawing.
2. OPSD 972.101 - Installation of Barbed Wire for Chain Link Fences.
3. OPSD 972.102 - Chain Link Fence Gates Drawing.

1.3 PROGRESS SUBMITTALS

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

B. Shop Drawings: Indicate plan layout, spacing of components, post foundation dimensions, hardware anchorage, and schedule of components.

C. Product Data: Include for fabric, posts, accessories, fittings, and hardware.

D. Manufacturer's Instructions: Indicate installation requirements.

1.4 QUALITY ASSURANCE

A. Perform work of this Section in accordance with OPSS.MUNI 772, OPSS.MUNI 904, and CEC.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Store and handle materials in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 MATERIALS AND COMPONENTS

A. Materials and Components: OPSS.MUNI 772.

B. Concrete: OPSS.MUNI 904.

2.2 COMPONENTS

A. Line Posts: 60.3 mm outside diameter.

B. Corner and Terminal Posts: 89 mm outside diameter.

C. Gate Posts: 114.3 mm outside diameter Schedule No. 40.

D. Gate Frame: 42.9 mm outside diameter, hot dip galvanized.

E. Provide required materials and labour to tie-into existing fence to remain. Height of new fence to match existing fence.

PART 3 EXECUTION

3.1 PREPARATION

A. Remove debris and correct ground undulations along fence lines to obtain a smooth uniform gradient between posts.

3.2 INSTALLATION

A. Place concrete for posts in accordance with OPSS.MUNI. 904.

B. Install framework, fabric, accessories and gates in accordance with OPSS.MUNI 772 and OPSD 972.130, 972.101, and 972.102.

C. Place fabric on outside of posts and rails.

D. Position bottom of fabric 50 mm above finished grade except on soft ground where fabric shall extend below grade to compensate for shifting sand or soil.

E. Install gate with fabric to match fence.

3.3 TOLERANCES

A. Maximum Variation from Plumb: 6 mm.

B. Maximum Offset from True Position: 25 mm.

3.4 FIELD QUALITY CONTROL

A. Section 01400 - Quality Requirements: Field inspection.

B. Repair damaged galvanized surfaces in accordance with OPSS.MUNI 772.07.05.

C. Apply field repair coating to damaged galvanized surfaces at dry film thickness at least equal to specified galvanized coating thicknesses.

END OF SECTION

SECTION 02923

HYDROSEEDING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Preparation of subgrade.

B. Placing topsoil.

C. Seeding.

D. Mulching and fertilizing.

E. Installation of erosion control blanket.

F. Maintenance for seed establishment.

1.2 REFERENCES

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

B. American Society for Testing and Materials (ASTM):
   1. D2974 - Standard Test Method for Moisture, Ash and Organic Matter of Peat and Other Organic Soils.
   2. D4972 - Standard Test Method for pH of Soils.

C. Ontario Guidelines on Erosion and Sediment Control for Urban Construction Sites.

D. Section 02480 – Landscaping and Restoration

1.3 DEFINITIONS

A. Weeds: Include, but are not limited to, Dandelion, Jimsonweed, Quackgrass, Horsetail, Morning Glory, Rush Grass, Mustard, Lambsquarter, Chickweed, Cress, Crabgrass, Canadian Thistle, Nutgrass, Poison Oak, Blackberry, Tansy Ragwort, Bermuda Grass, Johnson Grass, Poison Ivy, Nut Sedge, Nimble Will, Bindweed, Bent Grass, Wild Garlic, Perennial Sorrel, and Brome Grass.

B. Noxious Weeds:
   1. Harmful, undesirable, hard to control.
   2. Include but are not limited to: Johnson Grass or Johnson Grass Crosses, Canadian Thistle, Quackgrass, Wild Garlic and Wild Onion, Annual Blue Grass, Corn Cockle, Dodder, and Blindweed.

1.4 PROGRESS SUBMITTALS

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

B. Seeding and Erosion Control Plan: At least 21 days prior to placing topsoil, submit to ENGINEER for approval CONTRACTOR's Seeding and Erosion Control Plan including, but not limited to, the following:
   1. Seed mixture(s) and fertilizers for the Site and application rates.
   2. Time of year for planting such mixtures.
   3. Methods of preparing seedbed, seeding, sodding, and rolling seeded and sodded areas.
   4. Methods to provide erosion control until seed is placed and grass is established (i.e., use of any or a combination of emulsifiers, tackifiers, mulches, adhesives, nurse crop seed, and erosion control matting or blankets).

C. Seed Certificates: At least 21 days prior to seeding submit certificates from seed vendors for each seed mixture required, stating botanical and common name, percentage by weight and percentages of purity, germination, and weed seed for each species.

D. Fertilizer Certificate: At least 21 days prior to placing fertilizer, submit certificate confirming conformance with recommendations provided by laboratory based on topsoil analysis.

E. Erosion Control Blanket: At least 21 days prior to delivering erosion control blanket, submit manufacturer product data and delivery, handling, storage, installation, and repair methods.

F. Topsoil Source: Submit name of proposed imported topsoil source at least 14 days prior to commencing transport of topsoil to the Site.

G. Test Results: At least 14 days prior to commencing transport to the Site, submit test results of imported topsoil. Indicate, by test results, information necessary to determine suitability, including, but not limited to, organic content, pH, phosphorus, potassium, calcium, and magnesium; and laboratory or supplier recommendation for fertilizer application rate for specified seed mixture.

1.5 CLOSEOUT SUBMITTALS

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

B. Maintenance Data: Include maintenance instructions, cutting method, and maximum grass height; types, application frequency, and recommended coverage of fertilizer.

1.6 QUALITY ASSURANCE

A. Perform work of this Section in accordance with applicable local or provincial standards.

B. Provide seed mixture in containers showing percentage of seed mix, year of production, net weight, date of packaging, and location of packaging.

1.7 QUALIFICATIONS

A. Seed Producer: Established vendor capable of providing adequate seed quality and quantities.

B. Fertilizer: Established vendor capable of providing adequate fertilizer quality and quantities.

C. Installer: Company specializing in planting and establishment of multiple acre grading and planting projects with 5 years documented experience.

1.8 REGULATORY REQUIREMENTS

A. Comply with regulatory agencies for fertilizer composition.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Deliver grass seed mixture in original sealed containers bearing seed Supplier's label and certificate indicating the content of species, grade, and mass. Seed in damaged packaging will be rejected.

C. Deliver fertilizer in waterproof bags showing weight, chemical analysis, and name of manufacturer.

D. Deliver mulch and erosion control agent in moisture-proof containers showing manufacturer, content, and net weight (air dry).

E. Deliver erosion control blankets in a rolled mat form protected with an outer waterproof wrap bearing manufacturer's label indicating product name.

F. Store materials in accordance with manufacturer's instructions and in a manner to prevent damage or deterioration.

G. Remove from the Site seed which has become wet, moldy, or otherwise damaged in transit or storage.

H. Store seed in weatherproof enclosures.

1.10 ENVIRONMENTAL REQUIREMENTS

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

B. Do not apply materials over snow, ice, frozen ground, or standing water.

C. Do not apply seed slurry when wind conditions are such that material would be carried beyond designated area or that materials would not be uniformly applied.

1.11 SEQUENCING AND SCHEDULING

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

B. Schedule topsoil placing to permit seeding operations under optimum conditions during normal planting seasons.

C. Coordinate planting with specified maintenance periods to provide maintenance until acceptance by ENGINEER.

D. Seed areas within 7 days of completion of final grading.

E. Apply fertilizer at least 1 week after application of lime (if lime application is required).

F. Install erosion control blanket on specified areas within 24 hours of seeding and prior to any rainfall event unless specified otherwise.

PART 2 PRODUCTS

2.1 SEED MIXTURE

A. Grasses:
1. *Aveena sativa* (Agricultural Seed Oats): 5 percent by dry weight.
2. *Elymus canadensis* (Canada Wild Rye): 10 percent by dry weight.
3. *Festuca arundinacea var. Mustang* (Mustang Tall Fescue): 15 percent by dry weight.
4. *Festuca ovina* (Sheep's Fescue): 20 percent by dry weight.
5. *Festuca rubra var. commutata* (Victory Chewing's Fescue): 20 percent by dry weight.
6. *Festuca rubra var. rubra* (Native Red Fescue): 5 percent by dry weight.
7. *Panicum virgatum* (Switch Grass): 5 percent by dry weight.
8. *Schizachyrium scoparium* (Little Bluestem): 5 percent by dry weight.
9. *Sorghastrum nutans* (Indian Grass): 5 percent by dry weight.

B. Forbs:
1. *Desmodium canadense* (Showy Tick-trefoil): 4 percent by dry weight.
2. *Verbena stricta* (Hoary Vervain): 2 percent by dry weight.
3. *Vicia americana* (American Purple Vetch): 4 percent by dry weight.

C. Plant Seed: Fresh, clean, newly collected seed or grass seed harvested the previous year and complying with the tolerance for purity and germination established by Official Seed Analysis of North America; minimum germination known and minimum purity of 75 percent and minimum purity of 97 percent obtained from an approved seed house. Note: This requirement may not apply for native plants.

D. Weed Seed Content: Not over 0.25 percent and free of noxious weeds.

2.2 TOPSOIL

A. Utilize stockpiled topsoil.

B. Where additional topsoil is required, imported topsoil shall be from an approved source.

C. All soil used for finish grading top-soiling shall consist of friable, neither heavy clay nor of very light sandy nature containing minimum of 4 percent organic matter for clay loams and 2 percent for sandy loams to a maximum of 20 percent by volume. Free of subsoil, roots, grass, weeds, toxic materials, stones, foreign objects and with an acidity range (pH) of 6.0 to 7.5. Topsoil containing crabgrass, couch grass, or noxious weeds is not acceptable.

2.3 MULCHING MATERIAL

A. Free of weeds and other foreign materials, free of growth or germination inhibiting ingredients; manufactured in such a manner that after addition and agitation in slurry tanks with water, the fibers in the material will become uniformly suspended to form a homogeneous slurry; dyed a suitable color to facilitate inspection of the placement of the material. When applied, capable of forming an absorptive mat, which will allow moisture to percolate into the underlying soil.

B. Verdyol paper mulch.

2.4 FERTILIZER

A. Granular form, dry, free flowing, and free from lumps.

B. Recommended for grass, with 50 percent of the elements derived from organic sources; of proportion necessary to eliminate any deficiencies of topsoil as indicated in analysis specified in Paragraph 1.4 F.

2.5 WATER

A. Clean, fresh, and free of any contaminants and substances or matter which could inhibit germination and vigorous growth of complex natural plant communities.

2.6 EROSION CONTROL BLANKET

A. The following products are acceptable:

Product	Manufacturer	
SC-125BN	Straw (Biodegradable Net)	North American Green

2.7 ACCESSORIES

A. Lime (if required based on topsoil analysis): Ground agricultural limestone, minimum 85 percent of total carbonates graded as follows:

Percent Passing By Weight	Sieve Size
90	No. 18
50	No. 120

B. Stakes: Softwood lumber, chisel pointed.

C. Erosion Control Blanket Staples: U-shaped and constructed of wire with a diameter of at least 2.5 mm with legs at least 150 mm long and 25 mm apart.

2.8 SOURCE QUALITY CONTROL

A. Section 01400 - Quality Requirements: Requirements for source testing and analysis of mix formulation for hydroseeding.

B. Analyze topsoil for organic content, pH, potassium, phosphorus, calcium, and magnesium at a rate of 1 test for each 1 hectare of topsoil placement.

C. Test in accordance with the following methodology:

Parameter	Test Method
Organic Content	ASTM D2974
Potassium, Phosphorus, Calcium, Magnesium	(1)
pH	ASTM D4972

(1) In accordance with provincially accredited method.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify that prepared soil base is ready to receive work of this Section.

3.2 PREPARATION - SUBGRADE

A. Prepare subgrade to eliminate uneven areas and low spots. Maintain lines, levels, profiles, and contours. Make changes in grade gradual. Blend slopes into level areas.

B. Remove foreign materials, weeds, and undesirable plants and their roots. Remove contaminated soil.

C. Scarify subgrade to a depth of 75 mm where topsoil shall be placed. Repeat cultivation in areas where equipment, used for hauling and spreading topsoil, has compacted subsoil.

D. Remove surface debris, roots, vegetation, lumps, and stones in excess of 25 mm.

E. Obtain ENGINEER's approval of subgrade grade and depth before placing topsoil.

3.3 PLACING TOPSOIL

A. Spread topsoil to a minimum settled depth of 100 mm over area to be seeded. Rake until smooth.

B. Place topsoil during dry weather and on dry, unfrozen subgrade.

C. Remove vegetable matter and foreign non-organic material from topsoil while spreading.

D. Grade topsoil to eliminate rough, low, or soft areas, and to ensure positive drainage.

E. Obtain ENGINEER's approval of topsoil grade and depth before starting seeding.

3.4 HYDROSEEDING

A. Seeding and mulching shall be a 1-step process in which seed, fertilizer, hydraulic mulch, and mulch adhesive are applied simultaneously in a water slurry via hydraulic seeder/mulcher.

B. Apply seed at a rate of 40 kg/ha. Use seed oats at 5 times recommended rate for seeding past October 1st.

C. Only include mulch and mulch adhesive on areas not covered with erosion control blanket.

D. Hydraulic Seeder/Mulcher: Apply seed, fertilizer, hydraulic mulch, and temporary cover adhesive using an acceptable hydraulic seeder/mulcher. The hydraulic seeder/mulcher shall be equipped with mechanical agitation equipment capable of mixing the materials into a homogeneous slurry and maintaining the slurry in a homogeneous state until it is applied. The discharge pumps and gun nozzles shall be capable of applying the materials uniformly.

E. Volume Certification: Hydraulic seeding/mulching equipment shall have the tank volume certified by a plate affixed by manufacturer and confirmed to ENGINEER by means of measurements or tests prior to the commencement work. This plate shall be affixed in plain view on the hydraulic seeder/mulcher and shall not be removed or altered. The plate shall certify tank volume only, and shall imply equipment conformance to other requirements of this Section.

F. Application of Materials: Measure the quantity of each material to be charged into the hydraulic seeder/mulcher tank either by mass or by a system of mass-calibrated volume measurements acceptable to ENGINEER. Add the materials to the tank while it is being loaded with water. Thoroughly mix the materials into a homogeneous water slurry and distribute uniformly over the designated surface area via the hydraulic seeder/mulcher. Apply seed, fertilizer, and where applicable, hydraulic mulch adhesive within 2 hours of being charged into the hydraulic seeder/mulcher tank. During loading of the hydraulic seeder/mulcher tank, add materials in the following sequence: seed, then fertilizer, then, where applicable, hydraulic mulch and adhesive.

G. Blend into existing adjacent grass areas to bond new growth to existing adjacent areas or to previous applications to form uniform surfaces.

3.5 EROSION CONTROL BLANKETS

A. Identify seeded areas with stakes and string around area periphery.

B. Cover seeded slopes in areas shown on the Drawings, with erosion control blankets to form a continuous mat.

C. Install erosion control blankets and anchor in accordance with manufacturer's instructions.

D. The placement and stapling of erosion control blankets shall follow application of seed and fertilizer on the same day. However, ENGINEER may require that erosion control blanket placement and stapling precede application of seed and fertilizer when the condition of the soil warrants an immediate erosion control measure.

3.6 OVERLAP

A. Seeding and mulching and erosion control blanket shall overlap adjoining vegetation by 300 mm.

3.7 MAINTENANCE FOR SEED ESTABLISHMENT

A. Start maintenance immediately after area seeded.

B. Maintain seeded area for not less than the period stated below and longer, as required to establish an acceptable stand, as determined by ENGINEER:
   1. Not less than 60 days after last area seeded.
   2. If planted in fall and not given full 60 days of maintenance or if not considered acceptable by ENGINEER at completion of 60 days, continue maintenance the following spring until acceptable vegetative cover is established.

C. Maintain vegetative cover by watering, fertilizing, weeding, mowing, trimming, overseeding, and other operations such as rolling, regrading, and replanting as required to establish a continuous, stable and, acceptable vegetated soil cover, free of eroded or bare areas.

D. Vegetative cover will be accepted by ENGINEER provided all requirements have been complied with, including completion of 60-day maintenance period, and the following.
   1. Vegetative cover is properly established.
   2. Turf is free of eroded, bare, or dead spots and 98 percent free of noxious weeds.
   3. No surface is visible when vegetative cover has been cut to a height of 100 to 125 mm.

3.8 CLEANING

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

B. Clean up immediately, soil, mulch, broken sod, or other debris spilled onto pavement and dispose of deleterious materials.

C. Take precautions and prevent contamination by seeding and mulching slurry of structures, signs, guardrails, fences, utilities, or other surfaces not specified to be landscaped.

D. Where contamination occurs, remove seeding slurry to satisfaction of, and by means approved by ENGINEER.

3.9 PROTECTION OF FINISHED WORK

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

B. Protect landscaped areas from damage.

END OF SECTION

SECTION 03300

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Cast-in-place concrete in included but not limited to, concrete tanks and sumps structural base slab and walls, catwalks and structural concrete foundation slab on grade.

B. Concrete formwork, shoring, bracing, and waterstops.

C. Concrete reinforcement and accessories.

D. Concrete curing and sealing.

1.2 REFERENCES

A. Section 01000 - General Requirements: Requirements for references.

B. ASTM International:
1. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
2. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete.
3. ASTM C920 – Standard Specification for Elastomeric Joint Sealant.
4. ASTM C1064/C1064M - Standard Test Method for Temperature of Freshly Mixed Portland Cement Concrete.
5. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink).
6. ASTM C1193 – Standard Guide for Use of Joint Sealants.
7. ASTM D412 – Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers – Tension.
8. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types).
9. ASTM D5249 – Standard Specification for Backer Material for Use with Cold-and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.

C. Canadian Standards Association:
1. CSA A3001 - Cementitious Materials for Use in Concrete.
2. CSA A23.1/A23.2 - Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
3. CSA A23.3 - Design of Concrete Structures.
4. CSA A283 - Qualification Code for Concrete Testing Laboratories.
5. CSA G30.18 - Carbon-Steel Bars for Concrete Reinforcement.
6. CSA S269.1 – Falsework and Formwork.

D. Ontario Provincial Standards Specifications:
1. OPSS 904 - Construction Specification for Concrete Structures.

2. OPSS 905 - Construction Specification for Steel Reinforcement for Concrete.
3. OPSS 919 - Construction Specification for Formwork and Falsework.

E. Reinforcing Steel Institute of Canada (RSIC): Manual of Standard Practice.

1.3 PROGRESS SUBMITTALS

A. Section 01000 - General Requirements: Requirements for progress submittals.

B. Shop Drawings:
1. Where construction joints are proposed in addition to those specified, submit, minimum 20 days prior to planned construction, a concrete pour plan complete with drawings showing locations and sequence of proposed joints and concrete pours.
2. Submit reinforcement Shop Drawings for review by the ENGINEER:
   a. Indicate bar sizes, spacings, locations, and quantities of reinforcing steel, bending and cutting schedules, and supporting and spacing devices with identifying code marks to permit correct placement without reference to the Drawings in accordance with RSIC Manual of Standard Practice.
   b. Detail placement of reinforcing where special conditions occur.
   c. Design and detail lap lengths and bar development lengths in accordance with CSA A23.3.

C. Product Data: Include for joint devices, waterstops, attachment accessories, admixtures, curing compound, concrete anchors, floor seal and bonding agent.

D. Concrete Mix Design Data: Submit mix design minimum 10 days prior to producing concrete for each class of concrete.

E. Aggregate Source Data: Prior to aggregate production, submit details of source and methods proposed for producing aggregate.

F. Test Reports: If requested, submit, minimum 10 days prior to intended use, test reports of current representative samples of the following materials: coarse aggregate, fine aggregate, water, cement, reinforcement mill test certificates.

G. Certificates: Certify that mix proportions meet or exceed specified requirements and will produce concrete of specified quality and yield rand that strength will comply with specified requirements.

H. Concreting Methods and Procedures: Submit 10 days prior to placement of concrete, proposed methods of mixing, transporting, conveying, placing, spreading, consolidating, finishing, curing, and protection of concrete. Include procedures for hot or cold weather concreting and for protecting the concrete from freezing during cold weather, as required. Include plan for monitoring, controlling and recording temperatures of the curing enclosure and concrete surface during hot or cold weather.

I. Provide accurate records of poured concrete items indicating date, location of pour, quality, air temperature and test samples taken.

J. Prepare, submit, and coordinate inspections by ENGINEERand the OWNER.

K. Provide shop drawings for review by the ENGINEERof all wall formwork and catwalks slab falsework/formwork system, sealed by a Professional Engineer in Ontario.

1.4 CLOSEOUT SUBMITTALS

A. Section 01000 - General Requirements: Requirements for closeout submittals.

B. Record Documents: Indicate actual locations of embedded utilities and components which are concealed from view.

1.5 QUALITY ASSURANCE

A. Complete testing of concrete material as per Section 01400 and the requirements of this section.

B. Perform work of this Section in accordance with CSA A23.1/A23.2 and structural notes on the Drawings.

C. Acquire cement and aggregate materials from same source for all work.

D. Conform to CSA A23.1/A23.2 when concreting during hot weather.

E. Conform to CSA A23.1/A23.2 when concreting during cold weather.

F. Perform formwork in accordance with CSA A23.1/A23.2 and CSA S269.1.

G. Immediately remove from Site forms that cannot be properly cleaned or repaired.

H. Perform reinforcement in accordance with RSIC Manual of Standard Practice and CSA A23.1/A23.2 and CSA A23.3 as applicable.

I. Provide the ENGINEERwith access to fabrication plant to facilitate inspection of reinforcement. Provide notification of commencement and duration of shop fabrication in sufficient time to allow inspection.

J. Remove immediately from Site reinforcement without rolled-in grade marks or certified mill test reports.

K. Perform leak tests on all water or liquid retaining structures in accordance with the provisions of Article 3.16 and as witnessed by ENGINEER.

1.6 QUALIFICATIONS

A. Supplier:
   1. Certified ready-mix supplier approved by the ENGINEER.
   2. Plant certification complying with Ready Mix Concrete Association of Ontario.

B. Testing Agency: Independent testing laboratory complying with CSA A283 and approved by the Engineer, to carry out concrete testing in accordance with CSA A23.1/A23.2 and OPSS 904.

C. Design formwork and falsework under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in the Province of Ontario.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01000 - General Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Store materials off ground in ventilated and protected manner to prevent deterioration from moisture.

C. Store reinforcement in bundles with identifying tags or markings on racks or sills that will permit easy access for identification and handling and prevent it from becoming coated with any material that would adversely affect the bond.

D. Maintain individual bar identification after bundles are broken.

1.8 ENVIRONMENTAL REQUIREMENTS

A. Cold Weather Requirements:
   1. Apply these requirements when the air temperature is expected to drop below 5 degrees C.
      a. Submit to the ENGINEERfor review proposed equipment and methods before concreting in cold weather.
      b. Provide temperature-controlled enclosures using steam at a low pressure or vented-type portable heaters to provide a suitable temperature above 5 degrees C for placing concrete. Protect concrete from local concentrations of heat and adverse effects of combustion products. Do not use Salamander type heaters.
   2. Keep concrete continuously moist and maintain temperature surrounding the concrete above 10 degrees C for the duration of the curing period. Concrete shall be cooled gradually at the end of the curing period in accordance with Table 21 in CSA A23.1.
   3. Lean concrete working slabs shall be protected from freezing until a minimum compressive strength of 5 MPa has been achieved.
   4. The subgrade below all raft slabs, slabs-on-grade and lean concrete working slabs shall be protected from freezing during construction. Provide heated enclosures and insulation as required. The subgrade below completed tanks may be protected by filling with water to a minimum depth of 2,000 mm. Place log booms, 200 mm in diameter, at a maximum spacing of 5,000 mm in each direction to abate ice pressure on tank walls. Break ice on formation

B. Hot Weather Requirements:
   1. Apply when the air temperature is above 27 degrees C.
   2. Submit to the ENGINEERfor review proposed equipment and methods before concreting in hot weather.

C. Concrete Temperature Upon Delivery to Site: In accordance with Table 14 of CSA A23.1/A23.2 for the thickness of concrete section.

1.9 SEQUENCING AND SCHEDULING

A. Section 01000 - General Requirements: Requirements for coordination.

B. Coordinate the placement of embedded components with erection of concrete formwork and placement of form accessories.

C. If formwork is placed after reinforcement resulting in insufficient concrete cover over reinforcement, before proceeding request instructions from the ENGINEER.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design, ENGINEER, and construct formwork, shoring, and bracing to conform to design and code requirements; resultant concrete shall conform to required shape, line, and dimension. Formwork, shoring and bracing design shall be stamped by a professional Engineer registered in the Province of Ontario and qualified to complete such work. Pour rates for walls and stripping times shall be clearly indicated on the Drawings.

2.2 WOOD FORMS

A. Form Materials: CSA S269.1 and OPSS 919.

B. Plywood: Douglas Fir species, solid one-side factory coated grade; sound undamaged sheets with clean, true edges.

C. Lumber: CSA S269.1. Spruce, pine, or fir species, construction grade; grade stamp clearly visible.

2.3 PREFABRICATED FORMS

A. Preformed Steel Forms: Minimum 1.5 mm thick, matched, tight fitting, stiffened to support weight of concrete without deflection detrimental to tolerances and appearance of finished surfaces.

2.4 FORM ACCESSORIES

A. Form Ties: Removable or snap-off type, galvanized metal, fixed or adjustable length, cone type with 25 mm back break dimension, free of defects that could leave holes larger than 25 mm in concrete surface.

B. For concrete walls of water retaining structures, use form ties with a rubber or neoprene water seal at the mid-point.

C. Form Release Agent: Colourless mineral oil which will not stain concrete, or absorb moisture, or impair natural bonding or colour characteristics of coating intended for use on concrete.

D. Corners: Chamfer, wood strip type; 20 by 20 mm size; maximum possible lengths; on all exposed corners.

E. Nails, Spikes, Lag Bolts, Through Bolts, and Anchorages: Sized as required, of sufficient strength and character to maintain formwork in place while placing concrete.

2.5 REINFORCEMENT

A. Reinforcing Steel: CSA G30.18, 400 MPa yield grade, deformed carbon steel bars. Use Grade 400W where reinforcing steel is to be tack welded.

2.6 REINFORCEMENT ACCESSORIES

A. Tie Wire: Minimum 1.5 mm thick annealed type.

B. Chairs, Bolsters, Bar Supports, and Spacers: Sized and shaped for strength and support of reinforcement during concrete placement conditions. Do not use masonry block.

2.7 CONCRETE MATERIALS

A. Cement: CSA A3000:
   1. Type GU (Type 10), General Use Portland Cement, gray color.

B. Fine and Coarse Aggregates: CSA A23.1/A23.2.

C. Water: To CSA A23.1/A23.2, clean and not detrimental to concrete, free from injurious amounts of oil, acid, alkali, organic matter, sediment, or other deleterious substance.

2.8 CONCRETE ADMIXTURES

A. Air Entrainment: ASTM C260.

B. Chemical: ASTM C494, Water reducing.

C. Superplasticizer: ASTM C494.

D. Provide admixtures from same source manufacturer.

E. Supplementary Cementing Materials: CSA A3001.

2.9 JOINT DEVICES

A. Backer Rod and Sealant:
   1. Backer Rod: Round foam rod compatible with sealant; ASTM D5249, Backer Material oversized 30 to 50 percent larger than joint width.
   2. Elastomeric Joint Sealant: For use in isolation or control joints where shown on the drawings. Sealant shall be a multiple component, high performance, polyurethane

sealant to ASTM C920, Type M, Grade P (or Grade NS for vertical joints), Class 25 or 50, Use T, M and I.

3. Approved products:
   a. MasterSeal NP2 (vertical joints), MasterSeal SL2 (horizontal joints) by BASF,
   b. Sikaflex 2c NS (vertical joints), Sikaflex 2c SL (horizontal joints) by Sika Canada Inc.,
   c. Or approved equivalent.

B. Ribbed PVC Waterstops:
   1. Polyvinyl chloride, minimum 12 MPa tensile strength, minimum 10 degrees C to plus 79 degrees C working temperature range.
   2. Centre bulb, ribbed profile, 150 mm wide and minimum 6mm thick, in accordance with call-outs and standard PVC Waterstop Detail on the Drawings. Supply in maximum possible lengths utilizing factory welded corner and intersection sections and perform heat welded joints in straight sections using Manufacturer approved equipment.
   3. Approved Products
      a. Sika Greenstreak Model 732 by Sika Canada Inc.
      b. RCB-638LB by BoMetals, Inc.
      c. Type 9 by DuraJoint
      d. Or, approved equivalent.

C. Hydrophilic waterstop, non-bentonite, rubber strip type such as Sika Hydrotite CJ-Type by Sika Canada, at locations shown on the drawings.

D. Retro-fit waterstops; Sika Greenstreak, (model # 667) Sika Canada Inc. or equivalent and installed per manufacturer's instructions.

2.10 CONCRETE MIX

A. Mix and deliver concrete in accordance with CSA A23.1/A23.2.

B. Select proportions for normal weight concrete in accordance with CSA A23.1/A23.2.

C. Provide concrete to the following criteria:

Unit	**Measurement**
Compressive Strength (28-day)	32 MPa for tanks and sumps base and walls, catwalks and benching. .
Compressive Strength (56-day)	35 MPa for Blower foundation pad.
Exposure Class (Table 2, CSA A23.1)	A-2 for tanks and sumps base and walls, catwalks and benching. C-1 Blower foundation pad
Aggregate Size (maximum)	20 mm. 10 mm for Benching only.

D. Use accelerating admixtures in cold weather only when approved by ENGINEER. Use of admixtures will not relax cold weather placement requirements.

E. Do not use calcium chloride.

F. Use set retarding admixtures during hot weather only when approved by the ENGINEER.

G. Add water reducing admixture to mix at the Site.

2.11 CONCRETE ACCESSORIES

A. Bonding Agent: Water-based epoxy-modified cementitious bonding agent such as Sika Armatec 110 EpoCem by Sika Canada or approved equivalent.

B. Non-shrink Grout: ASTM C1107/C1107M, Premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents; capable of developing minimum compressive strength of 16 MPa at 2 days and 50 MPa at 28 days.

C. Post-installed Concrete Anchors: Hilti HIT-HY 200 Safe Set adhesive system. Anchor rod material, size, grade, and embedment as detailed on the Drawings.

D. Wet Curing Blankets: Sika UltraCure DOT by Sika Canada Inc or Horizontal Drip Curing Sheets by Drip It.

E. Floor Curing and Sealing Compound:
   1. Product shall have a minimum 25 percent solids content. Product shall be clear, solvent-free (water based or exempt-solvent-based). Apply in two coats to finished concrete surface, one coat for curing and one for sealing and dustproofing, at intervals and coverage rates as recommended by Manufacturer.
   2. Acceptable Products:
      a. Florseal WB 25 as manufactured by Sika Canada.
      b. MasterKure CC 250 XS by BASF; Luster Seal 350 by The Euclid Chemical Company.
      c. Luster seal 350 by the Euclid Chemical company.
      d. Or an approved equivalent.

2.12 SOURCE QUALITY CONTROL

A. Section 01000 - General Requirements.

B. ENGINEER may perform tests of cement, aggregates, water, and the mixture thereof at batch plant to ensure conformance with specified requirements.

2.13 FABRICATION - REINFORCEMENT

A. Fabricate concrete reinforcing in accordance with RSIC Manual of Standard Practice.

B. Locate reinforcing splices not shown on the Drawings, at point of minimum stress. Review location of splices with ENGINEER.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01000 - General Requirements: Verification of existing conditions before starting work.

B. Verify lines, levels, openings, and centers before proceeding with formwork. Ensure that dimensions agree with the Drawings.

C. Verify requirements for concrete cover over reinforcement.

D. Verify that anchors, seats, plates, reinforcement, and other items to be cast into concrete are accurately placed, positioned securely, and will not cause hardship in placing concrete.

E. Verify that construction joints and waterstops are located as shown on the Drawings.

3.2 PREPARATION

A. Earth forms are not permitted.

B. Prepare previously placed concrete in accordance with CSA A23.1/A23.2 by cleaning with steel brush to remove laitance and mortar and applying epoxy bonding agent in accordance with manufacturer's instructions. Maintain the same temperature for the previously cured concrete and newly placed concrete during placing and curing.

C. In locations where new concrete is doweled to existing work, drill holes in existing concrete and bond dowels with adhesive system in accordance with manufacturer's specifications.

3.3 ERECTION - FORMWORK

A. Erect formwork, shoring, and bracing to achieve design requirements, in accordance with CSA S269.1.

B. Provide bracing to ensure stability of formwork. Shore or strengthen formwork subject to over stressing by construction loads.

C. Arrange and assemble formwork to permit dismantling and stripping. Do not damage concrete during stripping. Permit removal of remaining principal shores.

D. Align joints and make watertight. Keep form joints to a minimum.

E. Obtain approval before framing openings in structural members which are not shown on the Drawings.

F. Provide fillet and chamfer strips on external corners of concrete exposed to view unless otherwise shown on the Drawings.

G. Provide recessed grooves for backer rod and joint sealant at locations as shown on the Drawings.

H. Where forms are to be partially filled, fix wooden strips approved by the ENGINEERto form reglets to define limits between successive pours.

I. Construct forms tight fitting to prevent cement migrating out of plastic matrix.

3.4 APPLICATION - FORM RELEASE AGENT

A. Apply form release agent on formwork in accordance with manufacturer's recommendations.

B. Apply prior to placement of reinforcing steel, anchoring devices, and embedded items.

C. Do not apply form release agent where concrete surfaces will receive special finishes or applied coverings which are affected by agent. Soak inside surfaces of untreated forms with clean water. Keep surfaces coated prior to placement of concrete.

3.5 INSERTS, EMBEDDED PARTS, AND OPENINGS

A. Provide formed openings where required for items to be embedded in passing through concrete work.

B. Locate and set in place items which will be cast directly into concrete.

C. Coordinate with work of other Sections in forming and placing openings, slots, reglets, recesses, sleeves, bolts, anchors, other inserts, and components of other work.

D. Install accessories in accordance with manufacturer's instructions, straight, level, and plumb. Ensure items are not disturbed during concrete placement.

E. Install PVC waterstops at construction joints horizontally and vertically as shown on the drawings. Install waterstops according to manufacturer's instructions, continuous without displacing reinforcement and tied rigidly to the reinforcing steel. Wet setting of waterstops is not permitted. Waterstops shall be cut to length in the field from rolls of maximum available length. Heat weld joints watertight according to manufacturer’s approved method. Use factory welded corners and intersections unless approved by the ENGINEER.

F. Install strip type hydrophilic waterstops as detailed on the Drawings, in a continuous fashion to create a watertight installation. Install waterstops in accordance with manufacturer's instructions. Concrete surface must be clean and free of loose particles, dust, laitance, oils or other contaminants. The waterstops shall be bonded to the concrete using an approved adhesive and joined by butt jointing. Fill any holes and bond gaps in joints using the approved extrudable swelling waterstop material (bentonite-free). All waterstops shall be installed with the minimum concrete cover as required by the waterstop manufacturer for the applicable product (minimum 75 mm for Sika Hydrotite CJ-Type).

G. Install Retro-fit waterstops per manufacturer’s instructions.

H. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection. Locate openings at bottom of forms to allow flushing water to drain.

I. Close temporary openings with tight fitting panels, flush with inside face of forms, and neatly fitted so joints will not be apparent in exposed concrete surfaces.

3.6 PLACEMENT - REINFORCEMENT

A. Place reinforcement in accordance with CSA A23.1/A23.2.

B. Install reinforcement as shown on Drawings and in accordance with reviewed Shop Drawings.

C. Comply with CSA A23.1/A23.2 for reinforcement installation not shown on the Drawings.

D. Comply with CSA A23.1/A23.2 and RSIC Manual of Standard Practice for bar support systems and patterns.

E. Make only those splices shown on the Drawings with lengths in accordance with CSA A23.3 and RSIC Manual of Standard Practice.

F. Place, support, and secure reinforcement against displacement. Do not deviate from required position.

G. Accommodate placement of formed openings and pipe penetrations.

H. Notify the ENGINEERat least 24 hours in advance of completion of reinforcement placing to permit time for inspection, final adjustment, and review by the ENGINEERprior to placing concrete.

I. Conform to CSA A23.1, Table 17, and Drawings for concrete cover over reinforcement.

3.7 OBSTRUCTIONS TO REINFORCEMENT

A. In the event conduits, piping, inserts, sleeves, or other items interfere with reinforcement placing, immediately notify the ENGINEERand obtain approval from the ENGINEERfor adjustments.

B. Do not cut bars to clear obstructions without consulting the ENGINEER.

3.8 FIELD BENDING REINFORCEMENT

A. Do not field bend reinforcement except as authorized by the ENGINEER.

B. When field bending is authorized, bend without heat, applying a slow and steady pressure and with the use of the proper sized pin.

C. Inspect and replace bars which develop cracks or split.

3.9 TOLERANCES

A. Construct formwork to maintain tolerances required by CSA S269.1.

B. Unless specified otherwise, reinforcing steel spacing shall not vary by more than 12 mm from dimensions shown on the Drawings.

3.10 PLACING CONCRETE

A. Place concrete in accordance with CSA A23.1/A23.2.

B. Notify the ENGINEERminimum 48 hours prior to commencement of concrete placing operations to allow the ENGINEERopportunity to review methods of conveying, spreading, consolidating, finishing, curing, and protecting concrete.

C. Ensure reinforcement, inserts, embedded parts, formed expansion and contraction joints, and waterstops are not disturbed during concrete placement.

D. Place wall grout at horizontal wall construction joints, depth 150 mm, before placing normal concrete. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.

E. Place concrete continuously between predetermined expansion, control, and construction joints.

F. Do not interrupt successive placement; do not permit cold joints to occur.

G. Screed floors and slabs-on-grade to elevations shown on the Drawings.

3.11 CONCRETE FINISHING

A. Finish exposed concrete floor and catwalk surfaces in accordance with CSA A23.1.

B. Provide formed concrete surfaces to be left exposed with a smooth rubbed finish.

C. Screed floor slab surface elevations per the drawings.

D. Do not use steel trowel finishing on air-entrained concrete.

E. After final screed and floating, provide a non-slip, broom finish on catwlks and exterior slabs.

F. Maintain floor slope as shown on the drawings

3.12 CURING AND PROTECTION

A. Cure and protect concrete in accordance with CSA A23.1/A23.2.

B. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.

C. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete, following curing period specified in Table 19 for given exposure class of CSA A23.1/23.2.

3.13 CURING AND SEALING COMPOUND

A. Clean and prepare concrete surfaces to be sealed in accordance with sealer manufacturer's instructions.

B. Provide dust-free conditions, temperature and moisture requirements in accordance with sealer manufacturer's instructions.

C. Apply to surface of fresh concrete immediately after final finishing procedures have been completed.

D. Apply to interior concrete floors and equipment bases where other covering or protection is not specified.

E. Apply by low-pressure sprayer with number of coats and application rate as specified by manufacture to provide high gloss curing, sealing and dustproofing properties.

3.14 PATCHING

A. Allow the ENGINEERto inspect concrete surfaces immediately upon removal of forms.

B. Excessive honeycomb or embedded debris in concrete is not acceptable. Notify the ENGINEERupon discovery.

C. Patch imperfections in accordance with CSA A23.1/A23.2.

D. Tie Rod Holes: Within 3 days following removal of forms, fill tie rod holes with non-shrink, nonmetallic, sand-cement grout. Wet the holes prior to filling. Tamp grout into place. Cover until set.

3.15 DEFECTIVE CONCRETE

A. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances, or specified requirements.

B. Repair or replacement of defective concrete will be determined by the ENGINEER.

C. Do not patch, fill, touch up, repair, or replace exposed concrete except upon express direction of the ENGINEERfor each individual area.

3.16 LEAKAGE TEST

A. Perform leakage test in accordance with ACI 350.1 for each cell or chamber in all water retaining structures (new and modified structures). Test to be performed after repair of all defective concrete and prior to installation of waterproofing membrane, tank coatings, benching and backfilling. More than one cell or chamber may be tested at the same time, provided they are not adjacent to each other such that all walls can be inspected on the outside for visible leakage.

B. After the structure has passed the qualitative criteria, the permissible quantitative leakage is 0.100 percent of volume in a 24-hour period per ACI 350.1-10. The test shall be conducted when the temperature is above 5 degrees C. The test period shall be the theoretical time required to lower the water surface by 9.5 mm assuming a loss of water at the maximum allowable rate, but need not be longer than 5 days.

3.17 BENCHING CONCRETE

A. Place, finish and cure all benching concrete in accordance with the requirements of CSA A23.1/A23.2, Subsections 7.6.4, Bonded toppings, and 7.6.5, Curing. The benching concrete shall be bonded to the base course concrete using an approved epoxy bonding agent. Tensile bond strength of the benching concrete shall be tested in accordance with Clauses 7.6.4.2.3 and 7.6.4.2.4 of CSA A23.1/A23.2.

3.18 FORM REMOVAL

A. Give the ENGINEERadvance notice prior to form removal.

B. Comply with CSA A23.1/A23.2.

C. Do not remove forms or bracing until concrete has gained sufficient strength to carry its own weight and imposed loads and to prevent damage to corners and edges.

D. Use the following minimum times, from time of placement of concrete to concrete formwork removal, provided the curing requirements of CSA A23.1/A23.2 are followed:
   1. Walls, column, column capital and sides of footings: 24 hours.
   2. Suspended slab, after concrete has reached 75% of its specified 28-day compressive strength determined by a field cured test cylinder.

E. Loosen forms carefully. Do not wedge pry bars, hammers, or tools against finished concrete surfaces scheduled for exposure to view.

F. Store removed forms in manner that surfaces to be in contact with fresh concrete will not be damaged. Discard damaged forms.

3.19 FIELD QUALITY CONTROL

A. Section 01000 - General Requirements: Field inspection and testing.

B. Inspect erected formwork, shoring, and bracing to ensure that work is in accordance with formwork design, and that supports, fastenings, wedges, ties, and items are secure.

C. Do not reuse wood formwork more than three times for concrete surfaces to be exposed to view. Do not patch formwork.

D. Third party testing firm retained by the Contractor shall take four concrete test cylinders will be for every 50 m^3 or less of each class of concrete placed each day.

E. One additional test cylinder will be taken by the third party testing firm during cold weather concreting, cured on job site under same conditions as concrete it represents.

F. One slump test will be taken for each set of test cylinders taken. Slump test will be taken by the third party testing firm at the beginning of each, the middle of, and the end of a particular mixer/agitator truck.

G. Methods of Testing: In accordance with CSA A23.2 or ASTM, as applicable.
   1. Securing composite samples; CSA A23.2 - 1C.

2. Molding and securing specimens from each sample; CSA A23.2 - 3C.
3. Compressive Strength: Specimens will be tested at 7 and 28 days; CSA A23.2-9C.
4. Slump for each strength test; CSA A23.2 - 5C.
5. Total air content for each strength test; CSA A23.2 - 4C or A23.2 - 7C.
6. Temperature of concrete sample and mixing water for each strength test or as required; ASTM C1064/C1064M.

H. Submit copies of test reports to the ENGINEER.

3.20 CLEANING

A. Section 01000 - General Requirements: Requirements for cleaning installed work.

B. Clean forms as erection proceeds, to remove foreign matter within forms.

C. Clean formed cavities of debris prior to placing concrete.

D. Flush with water or use compressed air to remove remaining foreign matter. Ensure that water and debris drain to exterior through cleanout ports.

E. During cold weather remove ice and snow from within forms. Do not use de-icing salts. Do not use water to clean out forms unless formwork and concrete construction proceed within heated enclosure. Use compressed air or other means to remove foreign matter.

3.21 PROTECTION OF FINISHED WORK

A. Section 01000 - General Requirements: Requirements for protecting installed work.

B. Do not permit traffic over unprotected floor surfaces.

3.22 JOINT FILLERS

A. Prepare surfaces and apply sealant in construction joints in accordance with manufacturer's instructions.

END OF SECTION

SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Aluminum guardrails.

B. Aluminum checker plate and embedded stainless steel angles.

C. Cover aluminum access hatches.

D. Mechanical equipment and pipe supports and Electrical equipment supports including unistruts.

1.2 REFERENCES

A. Section 01000 - General Requirements: Requirements for references.

B. ASTM International:
1. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes
2. ASTM-B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes [Metric].
3. ASTM - B632M - Standard Specification for Aluminum-Alloy Rolled Tread Plate.
4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
5. ASTM F593 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
6. ASTM F594 - Standard Specification for Stainless Steel Nuts.
7. ASTM - F836M - Standard Specification for Style 1 Stainless Steel Metric Nuts.

C. AWS D1.6/AWS D1.6M Structural Welding Code-Stainless Steel

D. Canadian Institute of Steel Construction: CISC Code of Standard Practice for Structural Steel - Handbook of Steel Construction

E. Canadian Standards Association:
1. CSA A23.1/A23.2 - Concrete Materials and Methods of Concrete Construction/Methods and Standard Practices for Concrete
2. CSA G40.20/G40.21M - General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steels
3. CSA S16 - Design of Steel Structures
4. CAN/CSA S136 - North American Specification for the Design of Cold-Formed Steel Structural Members
5. CSA W47.1 - Certification of Companies for Fusion Welding of Steel Structures
6. CSA W59.2 Welded Aluminum Construction.

7. CSA W117.2 - Safety in Welding, Cutting, and Allied Processes

F. Canadian General Standards Board:
1. CAN/CGSB 1.108-M Bituminous Solvent Type Paint
2. CAN/CGSB 1 GP 181M Coating, Zinc Rich, Organic, Ready Mixed

G. Canadian Welding Bureau (CWB): Qualification Standards

H. Ontario Building Code 2012 (OBC)

I. Steel Structures Painting Council:
1. SSPC SP 3 - Power Tool Cleaning
2. SSPC SP 6 - Commercial Blast Cleaning

1.3 PROGRESS SUBMITTALS

A. Section 01000 - General Requirements: Requirements for progress submittals.

B. Shop Drawings: Take measurements at the Site to confirm dimensions prior to preparation of Shop Drawings. Indicate profiles, sizes, connection attachments, reinforcing, anchorage, size and type of fasteners, and accessories. Include erection drawings, elevations, and details.

C. Design Data for Metal Connections and Guardrail Design: Provide calculations and drawings bearing the seal and signature of a professional structural engineer licensed in the Province of Ontario.

D. Indicate welded connections using standard CWB welding symbols. Indicate net weld lengths.

E. Welders Certificates: Certificates of qualification for welders employed on the Works, verifying CSA W47.1 and CSA W47.2 qualification within the previous 12 months.

F. Mill Test Reports: Submit two test reports on metal material if requested by the Engineer.

1.4 QUALITY ASSURANCE

A. Perform work of this Section in accordance with the CISC Handbook of Steel Construction, OBC, the Owner's standards, and applicable local, provincial and federal standards.

B. Qualify welding processes and welding operators in accordance with CWB standards.

C. Where welding of metals is requiring special techniques, certification shall include the welding of such metals and using such techniques and verification of welding procedures to the satisfaction of the Engineer. Certification for welding of aluminum shall be to CWB standards.

1.5 QUALIFICATIONS

A. Fabricator: Company specializing in performing the work of this Section with minimum three years documented experience.

B. Erector: Company specializing in performing the work of this Section with minimum three years documented experience.

C. Design structural connections not shown on the Drawings, and guardrail system under direct supervision of a professional structural engineer experienced in design of this work and licensed in the Province of Ontario.

1.6 REGULATORY REQUIREMENTS

A. Conform to applicable codes.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01000 - General Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Transport and deliver metal fabrications using methods and equipment such that fabricated parts are not stressed beyond specified limits.

C. Store fabricated parts on skids or supports to prevent damage to paintwork and/or coatings.

D. Lift fabricated parts at points that will not cause overstress to material or damage paintwork or coatings.

E. Remove any mud from fabricated assemblies before erection.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Design details and connections in accordance with CSA S16, CSA S136 and CSA S157, as applicable, to resist all applicable forces, moments, and shears.

B. Design shall allow for dead loads, live loads, construction loads, and seismic loads in accordance with OBC Division B, Part 4.

C. Detailed design of guard systems shall be completed by the supplier in accordance with OBC and applicable provincial/federal regulations.

2.2 MATERIALS – STAINLESS STEEL

A. Welding Materials: AWS D1.6/AWS D1.6M.

B. Structural Bars and Shapes: ASTM A276.

C. Stainless Steel: Type 316L.

D. Anchor Rods: ASTM F593, Type 316, stainless steel. Hilti Hit-Hy 200 Adhesive System or equivalent approved chemical adhesive system.

E. Grout: ASTM C1107 Non-shrink type, premixed compound consisting of nonmetallic aggregate, cement, water reducing and plasticizing agents, capable of developing minimum compressive strength of 16 MPa at 2 days and 50 MPa at 28 days.

2.3 MATERIALS - ALUMINUM

A. Welding Materials: CSA W59.2.

B. Aluminum Material Alloy and Temper for Grating, Plate and Sections: Alloy 6061-T6.

C. Checkered Plate: ASTM B632/632M

D. Aluminum Material: Plate to ASTM B209M, bars, rods, wire, profiles and tubes to ASTM B221M, and Rolled Tread Plate to ASTM B632M Alloy 6061-T6.

E. Fasteners: Stainless steel bolts to ASTM F593, nuts to ASTM F594 or ASTM F836M, Type 316 stainless steel.

2.4 FABRICATION

A. Tolerances:
   1. Squareness: 3 mm maximum difference in diagonal measurements.
   2. Maximum Offset between Faces: 1.5 mm.
   3. Maximum Misalignment of Adjacent Members: 1.5 mm.
   4. Maximum Bow: 3 mm in 1.2 m.
   5. Maximum Deviation from Plane: 1.5 mm in 1.2 m.

B. Fit and shop assemble items in largest practical sections for delivery to the Site.

C. Fabricate items with joints tightly fitted and secured.

D. Continuously seal joined members by continuous welds.

E. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Reduce exposed edges to small uniform radius. Remove weld splatter and slag.

F. Exposed Mechanical Fastenings: Flush countersunk screws or bolts, unobtrusively located and consistent with design of component, except where specifically noted otherwise.

G. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as fabrication, except where specifically noted otherwise.

2.5 FINISHING - ALUMINUM

A. Finish coatings in accordance with AAMA 608.1.

B. Interior Aluminum Surfaces: Anodized to clear color, to 0.02 mm thickness.

C. Apply two coats of bituminous paint to concealed aluminum surfaces in contact with cementitious or dissimilar materials

2.6 STAINLESS STEEL

A. Embedded stainless steel angles for supporting Checker plate shall conform to ASTM 276.

B. Size as shown on the drawings.

C. Installed for flush mount checker plate.

D. Welding shall conform to AWS D1.6/AWS D1.6M..

2.7 GUARDRAIL

A. Fabricate two-rail guard, details and layout as shown on the Drawings.

B. Round pipe rail and post sections to match existing, post connectors, post to concrete/base plate connection and splices shall be designed by the rail fabricator. Pipe sizes and spacing to meet the load requirements and dimensional requirements of OBC 2012.

C. Entire railing assembly shall be Aluminum. .

D. Shop drawings shall be submitted in accordance with the Drawings.

2.8 CHECKERED PLATE

A. Supply and install Aluminum checkered plate covers as indicated on the Drawings. Checkered plate to be fastened to supporting members with stainless steel countersunk machine screws tapped in the field. Checkered plate to bear on 3 mm full face neoprene border gasket secured in place with suitable adhesive as indicated on the Drawings.

B. Minimum design load for checkered plated is 4.8 kPa (100 psf), unless indicated otherwise on the Drawings. Limit deflection under a concentrated mid span load of 1.0 kN to 1/360th of the span, and under a superimposed 4.8 kPa uniformly distributed load to 6 mm maximum.

C. Provide sealed lifting handles.

2.9 MECHANICAL AND ELECTRICAL EQUIPMENT SUPPORTS

A. Fabricate all equipment/pipe supports, details and layout as shown on the equipment/pipe shop drawings and design drawings.

B. Equipment/pipe supports shall be designed by the contractor to meet the load and dimensional requirements per the equipment/pipe shop drawings, design drawings and specifications.

C. Entire equipment/pipe supports assembly including all hardware and bolts and nuts shall be Stainless Steel.

D. Shop drawings shall be submitted in accordance with the equipment/pipe shop drawings and design drawings

2.10 EXTERIOR ALUMINUM ACCESS HATCHES

A. Supply and install aluminum hatches as shown on the Drawings.

B. Coordinate size and opening requirements with mechanical drawings.

C. Field measure and confirm sizing prior to manufacturing.

D. Cover: Shall be reinforced to support a specified load of 4.8 kPa, with a maximum deflection of 1/150th of the span.

E. Operation of the cover shall be smooth and easy with controlled operation throughout the entire arc of opening and closing.

F. Operation of the cover shall not be affected by temperature.

G. Cover: Shall be minimum 6 mm (1/4") thick aluminum tread plate (diamond pattern).

H. Hinges: Shall be specifically designed for horizontal installation and shall be through bolted to the cover with tamperproof Type 316 stainless steel lock bolts and shall be through bolted to the frame with Type 316 stainless steel bolts and locknuts.

I. Hatches shall all be water tight.

J. Lifting mechanisms: Manufacturer shall provide the required number and size of compression spring operators enclosed in telescopic tubes to provide, smooth, easy, and controlled cover operation throughout the entire arc of opening and to act as a check in retarding downward motion of the cover when closing.

K. A removable exterior turn/lift handle with a spring loaded ball detent shall be provided to open the cover and the latch release shall be protected by a flush, gasketed, removable screw plug.

L. Hardware:
   1. Hinges: Heavy forged Type 316 stainless steel hinges, each having a minimum 6 mm (1/4 inch) diameter Type 316 stainless steel pin, shall be provided and shall pivot so the cover does not protrude into the channel frame.
   2. Cover shall be equipped with a hold open arm which automatically locks the cover in the open position.
   3. Cover shall be fitted with the required number and size of compression spring operators. Springs and spring tubs shall be Type 316 stainless steel.
   4. A Type 316 stainless steel snap lock with fixed handle shall be mounted on the underside of the cover.
   5. Hardware: Shall be Type 316 stainless steel throughout.
   6. Finishes: Factory finish shall be mill finish aluminum with bituminous coating applied to the exterior of the frame.

M. Acceptable Manufacturers and Models
   1. Bilco Canada Inc.
   2. MSU Mississauga Ltd.

3. Approved equivalent.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01000 - General Requirements: Verification of existing conditions before starting work.

B. Verify that field conditions are acceptable and are ready to receive work.

3.2 PREPARATION

A. Supply metal items required to be cast into concrete with anchor bolt setting templates.

3.3 INSTALLATION

A. Install metal fabrications in accordance with CSA S16, reviewed Shop Drawings, and manufacturer's instructions, if applicable.

B. Install items plumb and level, accurately fitted, and free from distortion or defects and as detailed on the Drawings. Insert shim as required to obtain detailed top of steel elevation. Field weld and grout as required at with non-shrink grout after final alignment.

C. Provide for erection loads, and for sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.

D. Field weld components as approved by the Engineer.

E. Perform field welding in accordance with CSA W59.2, AWS D1.6, and CSA W117.2, as applicable.

F. Obtain approval prior to Site cutting or making adjustments not scheduled.

G. Grout under base plates with non-shrink grout to achieve full plate bearing. Trowel grouted surface smooth, splay neatly to 45 degrees.

3.4 EMBEDDED PARTS

A. Set metal fabrications to be embedded in concrete to conform to dimensions and locations shown on the Drawings and in accordance with CSA A23.1/A23.2.

B. Rigidly secure embedded parts during concrete operations to ensure proper location.

C. Correct displacement, whether caused by movement of forms or movement of metal fabrications relative to the forms or otherwise, to their specified location.

D. Methods used to secure embedded parts in position and to ensure that they are held in their required position will be subject to review by the Engineer.

E. Coordinate installation of embedded parts with Section 03300.

3.5 TOLERANCES

A. Maximum Variation from Plumb: 6 mm per story, non-cumulative.

B. Maximum Offset from True Alignment: 6 mm.

C. Maximum Out-of-Position: 6 mm.

3.6 FIELD QUALITY CONTROL

A. Section 01000 - General Requirements: Field inspection and testing.

B. Field quality control will be in accordance with CISC standards.

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. 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.

B. 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 STANDARDS

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 Electrical Safety Authority (ESA) inspection fees for equipment supplied by CONTRACTOR to be paid by CONTRACTOR.

1.4 FACTORY TESTING

A. Where witnessed factory testing is specified, the Supplier shall give 20 Working days notice of the date when equipment will be ready for testing. Confirmation of the test date and time shall be provided 10 Working Days in advance of the tests. Equipment shall not to be delivered to the site until factory testing has been satisfactorily completed.

B. When certified factory testing of the equipment or any component is specified, the supplier shall provide 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.

1.5 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 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 DELIVERY, RECEIVING AND STORAGE EQUIPMENT

A. Arrange with the suppliers for delivery of all items of equipment to the Site as required to meet the schedule.

B. Arrange for delivery of all anchor bolts, templates, embedded metals, and other materials required during the concreting placement and assembly of equipment. Provide materials sufficiently in advance such that they are incorporated into the formwork prior to concrete pores.

C. 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 OWNER AND/OR ENGINEER and the supplier of any damages or defects in the equipment delivered.

D. 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.

E. Equipment storage, safekeeping and relocation of equipment from one area of the site to another, for whatever reason, shall be the sole responsibility of CONTRACTOR from the time of initial off-loading at the site until the date of completion and acceptance by OWNER. Provide all labour, materials, and equipment to store equipment delivered to site in accordance with the manufacturers recommendations.

3.2 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 OWNER AND/OR 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.

3.3 TIME OF COMPLETION

A. Delay in delivery of equipment or installation materials does not relieve CONTRACTOR of the responsibility to complete the Contract within the agreed date for contract completion.

3.4 MANUFACTURERS SERVICES AND CERTIFICATION OF INSTALLATION

A. 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.

B. Provide all materials, labour and equipment necessary to make any adjustments to the installation as required by the manufacturer or OWNER AND/OR ENGINEER until the equipment is fully tested and commissioned.

C. 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 OWNER AND/OR 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.

D. 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 OWNER AND/OR ENGINEER.

3.5 ACQUAINTANCE WITH WORK

A. CONTRACTOR shall be fully acquainted with all work involved in the complete installation of all equipment. At no time shall CONTRACTOR make any claim that any misunderstanding existed in regard to the nature or amount of work to be done in relation to the installation, testing and commissioning of all specified equipment.

B. Obtain all necessary details from Equipment suppliers including dimensions and other information pertinent to the Work of this Contract.

3.6 MATERIAL AND WORKMANSHIP

A. Material and equipment shall conform to the latest edition of applicable standards in force at the time of tendering. In the case of any conflict between the Contract Documents with any standards, the more stringent of the two shall apply.

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.

3.7 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.

3.8 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 OWNER AND/OR ENGINEER.

B. Provide eye bolts or hooks for the safe handling of the equipment during installation. Eye bolts shall be left in place.

3.9 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 and then again at the point substantial completion is obtained.

3.10 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.

3.11 ANCHOR BOLTS

A. Unless otherwise specified, supply all anchor bolts as stainless steel, such anchor bolts being of a diameter, size, and grade as recommended by the manufacturers of the equipment and machinery being installed and as a minimum as identified on MATERIALS Note 5 on Drawing S-002. All anchors shall be the Hilti Hit-HY 200 adhesive anchoring system, expansive anchor types shall not be permitted. 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 OWNER AND/OR ENGINEER; these must be properly positioned by means of substantial templates.

3.12 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. Where the final size of equipment varies from the shape, dimensions of bases and anchor bolt locations noted in the Contract Documents, the CONTRACTOR shall adjust the size of the concrete bases and anchor bolts at no additional cost to the OWNER 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 ENGINEER.

3.13 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. Adjust final shape and dimensions of cabinet bases to suit equipment manufacturers drawings. Bases shall be a minimum of 50 mm larger than the supplied equipment base in each direction.

3.14 FIELD WELDINGS AND FABRICATION

A. Ascertain details of field welding and fabrication to be carried out for the erection and installation of the various items of equipment.

B. Fabricate the equipment in accordance with CSA Standard S16, Steel Structures for buildings and the manufacturer's instructions.

C. Have the welding shielded, conforming to CSA Standard W59.0, General Specifications.

3.15 EQUIPMENT GUARDS

A. Provide guarding for any all equipment in full compliance with the CSA Z432-2016 Safeguarding of Machinery and requirements of Bruce Power L.P. Where the manufacturers standard equipment does not comply with the CSA Z432-2016 standard, the CONTRACTOR shall provide all labour, materials, and equipment to fabricate and install supplementary guarding as required to comply with the standard at no additional cost to the OWNER. 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.

3.16 PROTECTION OF EQUIPMENT

A. 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 OWNER AND/OR ENGINEER.

3.17 ALIGNMENT

A. 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:
   1. Level base, use machinists level on all machined surfaces.
   2. Base is to be true and leveled.
   3. 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.
      a. Soft foot of motor shall be checked to be within a tolerance of 0.03 m.
      b. Shaft shall be aligned within a tolerance of ± 0.025 mm to 0.070 mm.
      c. Piping strains to pump shall be within a tolerance of ± 0.025 mm to 0.070 mm.
   4. Provide OWNER AND/OR ENGINEER with alignment report.

3.18 VIBRATION MONITORING

A. Without exception, all rotating equipment shall be checked and tested for vibration.
   1. 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.
   2. Provide OWNER AND/OR ENGINEER with the original Vibration Monitoring reports and all copies necessary for the Maintenance Data.

3.19 TESTING AND COMMISSIONING

A. Unless otherwise specified, furnish a certificate of final inspection and approvals from the electrical inspection authority to OWNER AND/OR ENGINEER.

END OF SECTION

SECTION 11378

FINE BUBBLE DISC MEMBRANE AERATION SYSTEM

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish and deliver all materials and equipment for the fine bubble aeration system in the Bruce Power Sewage Processing Plant (SPP) North Train Aeration Tanks.

B. Furnish all equipment as shown on the drawings and as specified herein.

C. Provide services and testing associated with the equipment.

D. All items furnished by the equipment supplier under this section are for installation by the Contractor.

1.2 EQUIPMENT COMPONENTS INCLUDED

A. 304LStainless steel drop leg

B. PVC manifolds and air distributors

C. PVC diffuser holders, subplates and retainer rings

D. 304 Stainless steel supports and anchors

E. Bolts, nuts and gaskets for aeration system flange connections

F. Liquid purge systems

G. Membrane disc diffusers with integral O-ring gaskets

1.3 RELATED WORK AND COMPONENTS NOT INCLUDED

A. Section 11010 – Equipment General Requirements

B. Section 11427 – Positive Displacement Blowers

C. Section 15010 – Mechanical General Requirements

D. Section 15060 – Common Work Results for Process Piping (and associated sections)

E. Section 15201 – Pipe Support Systems

F. Section 15205 – Process Valves

1.4 SUBMITTALS

A. Submit information to establish compliance with the specifications in accordance with the provisions of Section - 1330 Submittal Procedures.

B. Submittal drawings showing plan, elevation and cross sections of the equipment. Layout drawings shall be developed with consideration for all process piping present in Aeration tanks. Limits of scope of supply shall be identified.

C. Component details of the aeration equipment showing diffusers, diffuser holders, gaskets, retainer rings, supports, threaded union and/or flanged joints and a purge system.

D. Materials and Manufacturing specifications shall be fully detailed. Full bill of materials shall be provided.

E. Equipment booklet/cutsheets including:
   1. Equipment data sheets.
   2. Performance data including oxygen transfer calculations.
   3. Headloss calculations and pressure requirements.
   4. Descriptive literature and bulletins.
   5. Customer contact list with telephone numbers (minimum of 5 contacts from similar size facilities).

F. Operation and maintenance manual with installation instructions. Submit after approval of equipment and prior to shipment.

G. Detailed list of any exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.

H. Membrane longevity tests reports in accordance with Section 2.02.A.4.h.

I. Heat transfer calculations in accordance with Section 2.

1.5 PREQUALIFICATION REQUIREMENTS

A. The following manufacturer(s) are pre-qualified:
   1. Xylem Sanitaire Products
   2. Or OWNER AND/OR ENGINEER approved equal.

B. Other manufacturers shall pre-qualify prior to bidding, as specified below.
   1. Provide equipment furnished by a single manufacturer qualified and experienced in the production of similar equipment.
   2. Complete set of drawings, specifications, catalogue cut sheets, and detailed descriptive material of proposed major equipment items. This information shall identify all technical and performance requirements stipulated on each drawing and in each specification section.
   3. The detailed drawings and equipment list must be signed and sealed by a professional engineer.
   4. Any proposed changes to the equipment detailed on the contract documents, if approved, shall be accomplished at no additional cost to the OWNER. The CONTRACTOR shall assume the cost of, and responsibility for, satisfactorily accomplishing the necessary structural, mechanical, piping, and electrical changes required by the proposed system as approved by the ENGINEER.

5. Manufacturer shall furnish the ENGINEER the following information 15 days prior to opening of bids:
   a. List of at least ten (10) Canadian. installations of the proposed type of fine bubble aeration equipment, all of which must have been in successful operation for a minimum of five (5) years and all of which shall have been designed for with an equal or greater no. of fine bubble diffusers than the specified equipment under this specification. In lieu of this experience requirement the aeration system supplier shall furnish a bond, in the amount of two times the value of the purchase order for the system equipment, guaranteeing the replacement cost of the system should it fail to perform as specified. This bond shall remain in force for three (3) years after startup of the aeration system.
   b. Three (3) of the existing installations listed above shall be submitted with:
      1) Satisfactory operational data
      2) Photographs of overall view of the installed system
      3) Details of the diffuser element, diffuser element holder, retainer, gasket and orifice.
      4) Details showing how the diffuser element holder is attached to the distribution header.
      5) Details of the stainless steel manifold supports and the stainless steel distribution supports (guide and fixing).
      6) Details of the distribution header joints.
      7) Engineering reports stating clear water oxygen transfer efficiency, including description of test facility, methods of sampling, and calculations and certified oxygen transfer curves.
      8) A statement of the equipment manufacturer listing any deviations or exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.
      9) Testimonials from the end users.
   c. List of at least ten (10) Canadian installations where the aeration manufacturer or manufacturer's representative has completed a cleaning service for the fine bubble diffused aeration system, with at least five (5) of the services being provided over ten (10) years ago. In lieu of this experience requirement the aeration system supplier shall furnish a bond, in the amount of two times the value of the purchase order for the system equipment, guaranteeing the replacement cost of the system should it fail to perform as specified. This bond shall remain in force for three (3) years after startup of the aeration system.
   d. Three (3) of the existing installations listed above shall be submitted with:
      1) Satisfactory operational data showing reduction in dynamic wet pressure (DWP) after cleaning
      2) Photographs of overall view of the cleaning system
      3) A statement of the equipment manufacturer listing any deviations or exceptions taken to these specifications. Include specification reference and proposed alternative with reason stated for exception.
      4) Testimonials from the end users.

C. Within five (5) days prior to the opening of bids, the ENGINEER shall issue an addendum listing manufacturers who have pre-qualified. CONTRACTORS listing equipment manufacturers who have not pre-qualified shall be considered non-responsive and shall subject their bid to automatic rejection.

D. Incomplete pre-qualification submittals shall not be evaluated by the ENGINEER and shall automatically represent rejection of the submittal.

1.6 EQUIPMENT WARRANTY

A. The requirements of the General and Supplementary Conditions and the requirements as specified hereinafter shall apply.

B. Manufacturer shall guarantee all equipment furnished to be free from defects in materials and workmanship under normal use and service for a period of twelve (12) months after the date first placed in service, or eighteen (18) months after delivery, whichever occurs first.

PART 2 MECHANICAL EQUIPMENT

2.1 FINE BUBBLE AERATION SYSTEM DESIGN AND PERFORMANCE REQUIREMENT

A. Design Conditions
1. The aeration tanks are configured as follows (dimensions in meters), refer to Contract drawings:

Tank/Pass	Length	Width	SWD	Grids	Diffusers/ Pass	Holders/P ass
Tank 1, Pass 1	18.9	3.7	3.9	2	156	156
		Tank Total		2	156	156
		Tank Count		2	156	156
		Project Total		2	156	156

2. Design aeration system to transfer not less than the following kilograms of oxygen per day in clean water at 14.7 PSI, 20C and zero dissolved oxygen at the specified submergences, air rate and pressure.

	Std. O2 Transfer Rate (SOTR)	Volumetric Air Flow	Operating Pressure At top of Drop	Diffuser Submergence	SOTE
	kg/hr/tank	m^3/hr/tank	kpa(g)	m	
Peak SOR	55	854.1	41.28	3.63	23% (minimum)

3. Design air distributors with centerline spacing not to exceed 1.2 meters to maximize oxygen transfer efficiency and mixing efficiency to minimize solids deposition between air distributors.

B. Materials, Fabrication, and Finishing
1. Stainless Steel – Pipe, Fittings and Supports
   a. Fabricate all welded parts and assemblies from sheets and plates of stainless steel with a 2D finish conforming to ASTM A240, 554, 774, 778.
   b. Fabricate non-welded parts and flanges from sheets, plates or bars of stainless steel conforming to ASTM A240 or ASTM A276.

c. Welds & Welding Procedure
   1) Weld in the factory with ER 316L filler wire using MIG, TIG or plasma-arc inert gas welding processes. Provide a cross section equal to or greater than the parent metal.
   2) Provide full penetration butt welds to the interior surface with gas shielding of interior and exterior of joint.
   3) Continuously weld both sides of face rings and flanges to eliminate potential for crevice corrosion.

d. Corrosion Protection and Finishing: Clean all welded stainless steel surfaces and welds after fabrication by using the following procedure:
   1) Pre-clean all outside weld areas to remove weld splatter with stainless steel brushes and/or deburring and finish grinding wheels.
   2) Finish clean all interior and exterior welds and piping by full immersion pickling and rinse with water to remove all carbon deposits and contaminants to regenerate a uniform corrosion resistant chromium oxide film per ASTM A380 Section 6.2.11, Table A2.1 Annex A2 and Section 8.3.
   3) Corrosion protection techniques not utilizing full immersion methods are unacceptable and will be cause for rejection of the equipment.

2. Natural Rubber – Furnish all fixed and expansion joint O-ring gaskets of natural rubber/SBR with a Shore A durometer of 45 ± 5.
3. Polyvinyl Chloride (PVC) – Pipe and Fittings
   a. Produce PVC pipe and fittings from PVC compound with a minimum tensile strength of 48,000kPa.
   b. Provide lower drop pipe, manifold and air distributors as follows:

Diameter	Wall Thickness	ASTM
100 mm	SDR 33.5	D3915, 3034,124524
150 mm & larger	Schedule 40	D1784, D1785, D2466,12454-B

   c. Design air distributors and manifolds to withstand 54° C mean wall temperature.
   d. Add two parts by weight of titanium dioxide per 100 parts of resin to PVC compounds for manifolds, air distributors, joints and PVC diffuser assembly components to minimize ultraviolet light degradation.
   e. Factory solvent weld all PVC joints and fittings. Field solvent welding will NOT be permitted.
4. EPDM - Membrane Diffusers and Gaskets
   a. Manufacture circular membrane diffuser discs with integral O-ring of EPDM synthetic rubber compound with precision die formed slits. Thermoplastic materials (ie plasticized PVC or polyurethane) are not acceptable.
   b. Add carbon black to the material for resistance to ultraviolet light.
   c. Design diffuser as one piece injection molded part with a minimum thickness of 2 mm for 225 mm diameter unit.
   d. Limit the maximum tensile strength of the diffuser to 69 kPa when operating at 44 m^3-air/h-m^2-diff of material. Furnish proportionately thicker material for larger diameter disc diffusers to limit the maximum tensile stress and to resist stretching.
   e. Produce diffusers free of tears, voids, bubbles, creases or other structural defects.
   f. Furnish diffuser material to meet the following:

Item	**Value/Units**	**ASTM**
Base Polymer	EPDM	D573
UV Resistance	Carbon Black	
Specific Gravity	1.25 or less	
Durometer – Minimum	58% ± 5%	D2240
Modulus of Elasticity	3450 kPa	D412
Ozone Resistance	No cracks	D1171

(72 hrs: 40°C pphm)	@ 2X magnification	Test A
Tensile Strength	8270 kPa	D412
Elongation - % - Retained 70 hrs @ 100°C - minimum at break	 75% Max 350%	 D573 D412

g. Membrane Longevity
   1) Longevity of the proposed membrane diffusers shall have been demonstrated in at least three full-scale municipal installations operating continuously for a minimum of three years.
   2) Test reports, prepared by an independent testing agency, shall confirm membrane longevity through compliance with the following maximum allowed percent (+/-) change in each membrane property. Tests conducted in-house by the Supplier shall not be acceptable.
   3) Data for a minimum of three diffusers from each installation shall be provided.

Property	Maximum Change
Durometer	5%
Weight	5%
Permanent Set	0.5%

   4) Test reports shall be submitted with the Bid Proposal.

C. System Components
   1. Droplegs - Provide a 304 stainless steel dropleg from the air main connection to the dropleg connection on the manifold.
      a. Provide a Van Stone style flange with a 1034 kPa pound bolt pattern for the top connection.
      b. Provide a band clamp coupling with gasket for the lower dropleg to manifold connection.
      c. Provide a sway brace type of support for droplegs greater than 20ft long.

         Note to Designer: Design airmain supports to carry the full weight of the dropleg. Dropleg must be supported to maintain a plumb position so that lateral loads are not imposed on the air manifold. Airmain and supports to be furnished as specified in airmain section by Contractor.

   2. Manifolds – Provide PVC manifolds for connection to the air distribution headers.
      a. Fabricate manifolds with 100 mm diameter fixed threaded union or flanged joints for connection to the air distributors.
      b. Design manifold, distributor connections and supports to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 52º C
      c. Support manifold with a minimum of two supports.
      d. Connect manifolds with fixed threaded union or flanged joints to prevent rotation or blow apart.
   3. Air Distributors and Diffuser Holders - Provide 100 mm diameter PVC air distributors perpendicular to the air manifold
      a. Fabricate distributors with single PVC diffuser holders solvent welded to the crown of the air distributor for complete air seal and strength.
      b. Provide minimum solvent weld area of 97 square centimeters.
      c. Design distributors and holders to resist a dead load of 890 N applied vertically to the outer edge of the diffuser holder.
      d. Provide 100 mm diameter threaded removable end caps complete with gasket, threaded coupling and end plate for clean out at the end of each distributor.
   4. Air Distributor and Manifold Connection Joints
      a. Join air distributor sections with positive locking fixed threaded union or flange type joints for all submerged header joints to prevent blow apart and rotation.

b. Bell and spigot, slip on or expansion type joints are not acceptable for submerged joints.
c. Design threaded union joints with spigot section connected to one end of the distribution header, a threaded socket section connected to the mating distribution header, an O-ring gasket and a threaded screw on retainer ring. Solvent welding shall be done in the factory.
d. Fixed joints shall be designed to resist 108 N-m (5.5 kg-m) torque without joint movement or failure.
e. All fixed joints shall have interlocking splines and grooves to prevent rotation of the air distributors. All rotational forces shall be transferred through the interlocking splines. Joints that require the o-ring to transfer rotational forces between the splines are not acceptable. If positive locking fixed joints are not used, all distributor connections shall be 56.7 kg flanges.
f. Design flanged joints with a 56.7 kg drilling angle face ring, follower flange and stainless steel hardware.

5. Supports- Provide each section of manifold and air distributor with a minimum of two (2) supports.
   a. Limit maximum support spacing to 2.5 meters.
   b. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 52º C and to minimize stress build up in the piping system.
   c. Design supports to be adjustable without removing the air distributor from the support.
   d. Design supports to allow for complete removal from the tank, less the anchor bolt, to facilitate installation of additional headers and in-tank maintenance. Support structures which consist of rods Epoxied directly into the tank floor are not acceptable.
   e. Manifold Support – 150 mm diameter and larger
      1) Design supports to include hold down guide straps, support structure and anchor bolts.
      2) Design guide straps with a 50 mm minimum width to eliminate point load on manifold and minimize binding.
      3) Design support for 50 mm plus or minus vertical adjustment for leveling of manifold.
      4) Attach supports to tank floor with two stainless steel anchor bolts.
   f. Air Distributor and Manifold Supports – 110 mm diameter.
      1) Design supports with hold down straps, support structure and anchor bolt.
      2) Design support for 40 mm (plus or minus) vertical adjustment for leveling air distributor to plus or minus 6 mm.
      3) Guide support
         a) Guide straps to have 38 mm wide top and bottom contoured bearing surface with chamfered edges to minimize binding and resistance to movement of air distributor under full buoyant uplift load.
         b) Design strap with 3 mm clearance around distributor so strap is self-limiting and cannot be over tightened.
      4) Fixed supports
         a) Fixed straps to have 38 mm wide top and bottom contoured bearing surface with punched burrs to positively grip the air distributor when tightened.
         b) Design strap to be self-limiting to prevent stressing the distributor if the clamp is over tightened.
      5) Attach air distributor supports to tank floor with one stainless steel anchor bolt. Attach manifold supports to tank floor with two stainless steel anchor bolts.

6. Diffuser Assemblies - Furnish diffuser assemblies including diffuser, with integral diffuser gasket, holder, retaining ring and air flow control orifice.

a. Membrane Diffuser
   1) Incorporate an integral check valve into the membrane diffuser.
   2) Design and test diffusers for a dynamic wet pressure (DWP) of 300 mm ±20% water column @ 1.6 m^3-air/h-m^2-diff and 50 mm submergence.
   3) Visual Uniformity - Observe diffusers for uniform air distribution across the active surface of the diffuser at 1.6 m³/h-m² and 50 mm submergence. Active surface is defined as the perforated horizontal projected area of the diffuser.
   4) M³/hr defined at 20°C, 1 atm, 36% RH
   5) Quality Control – Test diffuser using primary sampling criteria outlined in Military Standard 105E.

7. Anchor Bolts
   a. Design anchor bolts for embedment in 27,500 kPa concrete with a pullout safety factor of 4.
   b. Provide a mechanical stainless steel expansion type anchor bolt system.
8. Liquid Purge System - Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid including airlift purge eductor line and manual control valve.
9. Fine Bubble aeration system supplier shall provide 100 mm stainless steel butterfly valves suitable for low pressure air supply service. An isolation butterfly valve shall be provided at the top of each drop leg.

PART 3 SERVICE, INSTALLATION AND PERFORMANCE

3.1 SHOP OXYGEN TRANSFER TEST

A. Conduct a performance test to demonstrate capability of the aeration equipment to meet the specified oxygen transfer requirements.

B. Base all tests on the following criteria:
   1. Two design conditions that the consultant engineer selects at each diffuser density will be tested. In the case of more than three densities on a project, the Engineer will define zones to be tested after award of the project.
   2. A minimum of 3 test runs for each specified design condition to be run in complete accordance with ASCE Clean Water Test Procedure (2006 or latest edition)
   3. Conduct tests in a full scale aeration test tank (minimum of 300 sq. ft.) at the specified submergence and water depth with a diffuser density equivalent to the specified tank configuration. Diffuser density is defined as the ratio of the total tank surface area to the total active diffuser surface area.
   4. Conduct shop test with air rate and mass rate of oxygen transfer directly proportional to the ratio of the shop test tank volume and the design tank volume.
   5. Plot of standard condition pounds of oxygen transferred per day per 1000 cubic feet of tank volume versus standard condition cubic feet of air per minute per 1000 cubic feet of tank volume. (lbs-02/day/1000 cubic feet-tank) vs. (SCFM/1000 cubic feet-tank)
      a. Standard conditions of oxygen transfer are defined as 68o F, 1 atmosphere ambient pressure, clean water.
      b. Standard air is defined as 68 °F, 1 atmosphere, 36% R.H., containing 23% oxygen by weight.

C. Certify and stamp all tests by a Professional Engineer, licensed in the Province of Ontario.

D. Include all costs for testing (exclusive of witnesses' expenses) in the equipment price. All tests may be witnessed at Owner/Engineer option. Cost of travel and living expenses for Owner/Engineer to be paid by the Owner.

E. Submit all test data from oxygen transfer tests for approval by the Engineer prior to manufacturing equipment.

3.2 OPERATION AND MAINTENANCE MANUAL

A. Three (3) paper copies with an electronic copy of the Operation & Maintenance Manuals shall be furnished during start-up. These manuals shall include maintenance instructions for all equipment provided.

3.3 FIELD SERVICES, START-UP AND TRAINING

A. The services of the field representative shall include minimum two (2) days, exclusive of travel time, completed in (2) travel trips. The services provided include verification of proper equipment installation and training of the owner's personnel. The CONTRACTOR shall notify the manufacturer a minimum of ten working days prior to the time that the field services are desired.

B. The CONTRACTOR shall notify aeration equipment provider when the installation has been completed. A representative of the supplier shall inspect the installation. The Owner shall be advised in writing of any corrections or adjustments that are required for the equipment installation. After the installation has been completed to the supplier's satisfaction, a letter of certification that all equipment is installed in accordance with its instructions and that the equipment is ready for operation shall be furnished.

C. The field person shall do a functional check of each item furnished and start-up of the process. During this time, the field representative will provide operation training, which shall include familiarization with the biological process controls, its requirement and review of the Operation and Maintenance Manuals.

D. CONTRACTOR shall ensure all required associated systems (e.g. blowers) are available for startup/field inspections associated with the fine bubble aeration system.

END OF SECTION

SECTION 11379

COARSE BUBBLE AERATION EQUIPMENT

PART 1 GENERAL

1.1 SCOPE

A. Description of Work
   1. Provide all labour, material and equipment to furnish and install the coarse bubble aeration system as shown on the contract drawings and as specified herein in the Bruce Power Sewage Process Plant (SPP) North Train aerobic digester tanks.

B. Work and Components Included
   1. The Equipment Manufacturer shall furnish the items listed below:
      a. Drop Pipe(s) and isolation valves
      b. Manifold(s)
      c. Distribution Header(s)
      d. Coarse Bubble Diffusers
      e. Supports
   2. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and manufacturer's service.

1.2 QUALIFICATIONS

A. Approved Suppliers:
   1. Evoqua Water Technologies
   2. Or OWNER AND/OR ENGINEER approved equal.

B. Alternate Manufacturers and Suppliers
   1. It is the intention of this specification to cover minimum acceptable quality for a complete aeration system installation with the exception of the motor controls, electrical work and piping requirements. Refer to Division 16 and Division 15 as required.
   2. Part numbers or trade names are used in this specification only to facilitate the general configuration and description of the equipment desired and in no way implies that equal equipment of other manufacturers cannot be used. Products of other manufacturers will be considered in accordance with the Alternate Equipment section of this specification.

C. Manufacturer's Experience
   1. The equipment Manufacturer shall have not less than ten (10) successful years experience in the design, construction and operation of coarse bubble diffused aeration equipment.
   2. The Engineer may require evidence, in the form of operating records, from these plants to substantiate any claims concerning the ability of the equipment to perform as required.

1.3 RELATED WORK AND COMPONENTS NOT INCLUDED

A. Section 11010 – Equipment General Requirements

B. Section 11427 – Positive Displacement Blowers

C. Section 15010 – Mechanical General Requirements

D. Section 15060 – Common Work Results for Process Piping (and associated sections)

E. Section 15201 – Pipe Support Systems

F. Section 15205 – Process Valves

1.4 SUBMITTALS

A. Shop Drawings
1. Shop drawings shall be submitted to the ENGINEER for approval. Shop drawings shall include dimensional layouts, materials, details of appurtenances, anchoring, installation, and operation instructions. Fabrication and installation shall be in accordance with such approved drawings.
2. Certified diffuser performance test data shall be submitted. It shall include air flow versus headloss data, and Standard Oxygen Transfer Tests conducted in clean water in accordance with the latest Standard published by the ASCE Subcommittee on Oxygen Transfer Standards.
3. SOTE calculations to verify the clean water oxygen transfer efficiency of the diffuser at both design and maximum airflow.
4. Headloss Calculations for the complete aeration system from the top of the drop leg. Calculations shall include the total headloss across the membrane, balancing orifice, piping system and static head at both design and maximum airflow.
5. Six (6) copies of the manufacturer’s operation, installation and maintenance manual shall be submitted for approval prior to shipment of the equipment.
6. Complete bill of materials shall be provide as part of submittal package.

B. Alternate Equipment
1. If the Contractor desires to offer equipment as an alternate to the specified equipment, he shall submit, within 14 days after the bid opening, substantial descriptive information in order that the Engineer may determine if the proposed alternate is equal or superior quality to that specified.
    a. No alternate will be considered unless, in the opinion of the Engineer and Owner, it conforms to the specification in all respects except manufacturer and model and minor details. Material variances will not be allowed.
    b. Alternate equipment which is a "standard product" of the Manufacturer shall be modified, redesigned, or furnished with special features or special materials as may be necessary to conform to the requirements of this specification and contract drawings.
    c. The Owner reserves the right to decide whether or not the proposed alternate will be acceptable.
2. The Contract, if awarded, will be on the basis of material and equipment specified without consideration of alternate equipment. In the event an alternate is allowed, the Contract price will be adjusted accordingly by a change order.
    a. By submitting a bid, the Contractor agrees and understands that Contract award will be made on the basis of the specified equipment.
    b. If an alternate is found to be not acceptable, the Contractor shall be responsible for supplying the equipment specified.

3. Descriptive information shall include the following:
   a. List of twenty (20) installations of equipment in successful operation of the design in all essential regards as specified.

1.5 DEFINITIONS

A. SCFM: Standard cubic feet per minute is understood to be air at 68°F, 14.7 PSIA and 36% relative humidity flowing at a rate of 1 cubic feet per minute.

B. SOTR: Standard oxygen transfer rate is understood to be the rate of oxygen transferred to tap water (pounds of oxygen per hour) at standard conditions of 20°C, 0.0 mg/l residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).

C. SOTE: Standard oxygen transfer efficiency is understood to be the percentage of oxygen transferred under standard conditions of 20°C, 0.0 mg/l residual dissolved oxygen concentration, and a barometric pressure of 760 mm Hg (dry air).

D. SWD: Side water depth is understood to be the overall dimension from the high point of the basin floor to the water surface.

1.6 GUARANTEE AND WARRANTY

A. The equipment shall be guaranteed to meet or exceed the design criteria detailed in Part 2 of this specification.

B. Manufacturer shall warrant that the complete system shall be free from defective material and workmanship for a period of one (1) year after final acceptance of the equipment or eighteen (18) months after shipment, whichever occurs first.

PART 2 PRODUCTS

2.1 GENERAL

A. The design and layout shown on the drawings are based on the manufacturer identified in Section 2.2. If equipment other than that of the manufacturer shown is submitted to the Engineer for consideration as an equal, it shall be the responsibility of the Bidder wishing to make the substitution to submit with the request a revised drawing of the mechanical equipment and basin layouts acceptable to the Engineer. This revised drawing shall show the proposed location of the substitute unit, and area required for withdrawal space of replacement or serviceable components. This drawing shall also show clearances of adjacent equipment and service area required by that equipment.

B. Changes in architectural, structural, electrical, mechanical and plumbing requirements for the substitution shall be the responsibility of the Bidder wishing to make the substitution. This shall include the cost of redesign by affected designers. Any additional cost incurred by affected subcontractors shall be the responsibility of the Bidder and not the Owner.

2.2 MANUFACTURERS

A. Evoqua Water Technologies, Waukesha, WI.

B. Or pre-approved equal.

2.3 EQUIPMENT

A. Drop Pipe
1. A 304 L stainless steel upper drop pipe shall be provided for each aeration grid to a point approximately 5’ above the manifold. The drop pipe shall start at the top of the basin with a flanged connection as shown on the contract drawings. Upper drop pipe shall have a minimum wall thickness of 0.109” and shall conform to ASTM A-774 & A-778.
2. A SCH 40 PVC lower drop pipe shall be provided from the upper drop pipe to the manifold. Lower drop pipe shall conform to ASTM D-1784 & D-1785. PVC piping with a wall thickness less than SCH 40 shall not be acceptable.
3. Provide stainless steel butterfly isolation valves suitable for low-pressure process air service at the top of each drop leg.

B. Manifold
1. A SCH 40 PVC manifold shall be provided perpendicular to the distribution headers and as shown on the contract drawings. Manifold shall conform to ASTM D-1784 & D-1785. PVC piping with a wall thickness less than SCH 40 shall not be acceptable.

C. Distribution Headers
1. SCH 80 PVC distribution headers shall be provided perpendicular to the manifold and as shown on the contract drawings. Distribution headers shall have a minimum size of 4” (100 mm). Headers shall be fabricated in sections up to 20’ (6 m) in length and shall conform to ASTM D-1784 & D-1785. PVC piping with a wall thickness less than SCH 80 shall not be acceptable. Header piping shall be drilled and tapped with a ¾” threaded connection at the crown of the distribution headers for attachment of the diffusers.
2. Maximum spacing between distribution headers shall be as shown on the contract drawings.

D. Coarse Bubble Diffusers
1. Design
   a. The coarse bubble aeration system shall be designed to provide 40 SCFM of low pressure process/mixing air per 1,000 ft^3 of operational volume within the SPP North Train Aerobic Digesters. Refer to Contract drawings for Dimensions. The digesters will operate with a maximum SWD of 13 ft. Refer to Section 2.4 for additional details.
   b. Each disc check diffuser shall be of the non-clog type which during aeration causes the disc to lift and allows air to exit below the disc. Each diffuser shall consist of an ABS plastic body, PVC disc type check valve and a stainless steel retainer. When air flow stops, the disc seats by pressure head of liquid and thus prevents back flow. The maximum recommended air volume per diffuser is 25 standard cubic feet per minute (scfm) and total headloss for coarse bubble aeration system (as measured at top of drop leg) shall not exceed 6.3 PSIG.
2. Materials
   a. The diffuser base shall be of molded Cycolac® ABS plastic. The base shall be equipped with lugs for engagement of the disc valve retainer ring. The base stem shall have 3/4" NPT male threads for connection to the air header system. The base shall include an air flow control orifice to maintain adequate headloss for uniform air distribution throughout the system.

b. The disc check valve shall be of injection molded PVC plastic. The disc shall be designed to cover entire air discharge area of the diffuser base.
c. The retainer ring shall be constructed of 304 stainless steel. The retainer ring shall attach to the base housing by spring action of the mounting prongs into the base lugs.

3. Operation
a. The diffuser disc shall be designed to open under air pressure, to release air in a steady stream of bubbles and to close when air flow to diffuser is stopped, thus preventing backflow of fluids and clogging. The diffuser shall be designed to operate at a design air flow rate of 20 scfm, with maximum allowable flow rate of 25 scfm.

E. Supports
1. Manifold & Drop Pipe Supports
a. Manifold and drop pipe supports to be fabricated from 304 stainless steel. Each support shall have a support cradle with a minimum 2” wide bearing surface and shall be secured to the concrete bottom with two (2) 304 stainless steel threaded rods with a minimum diameter of ½”. Each rod will be anchored to the concrete by a vinylester resin adhesive designed for long term wet base conditions. Maximum spacing between supports shall be 12’-0” center to center.
2. Distribution Header Supports
a. Distribution header supports **(flat bottom tank only)** to be fabricated from 304 stainless steel. Each support shall have a support cradle with a minimum 2” wide bearing surface and shall be attached to one (1) 304 stainless steel threaded rod with a minimum diameter of 3/8”. Rod will be attached to the concrete floor with one (1) stainless steel drop in wedge anchor. Maximum spacing between supports shall be 12’-0” center to center.
b. Distribution header supports **(sloped bottom tank)** to be fabricated from 304 stainless steel. Each support shall have a support cradle with a minimum 2” wide bearing surface and shall be secured to the concrete bottom with two (2) 304 stainless steel threaded rods with a minimum diameter of ½”. Each rod will be anchored to the concrete by a vinylester resin adhesive designed for long term wet base conditions. Maximum spacing between supports shall be 12’-0” center to center.

F. Design
1. The system shall be designed for contraction/expansion over a temperature range of 140 °F without deforming any component. Fixed supports will anchor the header against movement and intermediate supports will allow for longitudinal movement. One fixed support shall be provided for each straight pipe run.
2. Fixed or expansion joints shall be provided as required.
3. Flanged joints shall Van Stone with through bolts. The flanged joints shall transmit the longitudinal forces caused by expansion and contraction of the air distribution header. All flanged joints shall have 45 to 55 durometer, Shore A, neoprene gaskets.

2.4 PERFORMANCE REQUIREMENTS

A. The minimum system requirements shall be per the following:

Basin Name: SPP North Train Aerobic Digesters

Number of Tanks	2 (2 stage digester)
Dimensions	
Length	34 ft/17 ft
Width	12 ft
Sidewater Depth	13 ft (max)
Required Air Rate	40 SCFM/1,000 ft^3 operating tank volume
Maximum allowable pressure drop (max airflow) (top of drop pipe)	6.3 PSIG

PART 3 EXECUTION

3.1 INSTALLATION

A. Prior to connecting the diffuser to the headers, the Contractor shall carefully clean all piping, headers, and accessories through which air is delivered, so that all dust, dirt, oil, grease, or other foreign material will be effectively removed from contact with the air being blown through the diffusers. This cleaning shall be done with clean water at velocity of 2 to 3 feet per second or with process air at 2000-3000 feet per minute. All diffusers shall be leveled to within 3/8 inch of a common horizontal plane.

3.2 FIELD TESTING

A. After the piping, headers, and diffusers for any tank have been installed, clear water shall be introduced into the tank until the diffusers have been covered about 2 inches. Compressed air shall then be released through the piping and any leaks through joints, piping, and the like shall be repaired. This test shall be repeated until the entire system is tight, to the satisfaction of the Engineer. Testing will be done by the Contractor under the direction of the Engineer.

B. By visual inspection, air release shall be shown to be uniform for each diffuser and header section.

C. The Contractor shall make all modifications and repairs until the system passes all tests at no cost to the Owner.

3.3 FIELD SERVICE

A. The manufacturer shall furnish the services of a competent representative experienced in the operation of the equipment to inspect the installation of his equipment and instruct the plant operating personnel in the proper operation and maintenance of the diffused air equipment. A total of two (2) eight-hour days in two (2) trip shall be provided. Contractor to coordinate field service with equipment manufacturer and engineer and shall provide at least two (2) weeks notice for scheduling purposes.

END OF SECTION

SECTION 11427

ROTARY POSITIVE DISPLACEMENT BLOWERS

PART 1 GENERAL

1.1 SCOPE OF WORK

A. Furnish all labor, materials, equipment and incidentals required and install complete, ready for operation and field test four (4) new rotary positive displacement blowers and appurtenances, as shown on the Drawings and as specified herein.

B. These Specifications are intended to give a general description of what is required, but do not cover all details that will vary in accordance with the requirements of the equipment application. It is, however, intended to cover the furnishing, delivery, complete installation and field testing of all materials, equipment and all appurtenances required to complete the Work of this Section, whether specifically mentioned in these Specifications or not. It is the CONTRACTOR's responsibility to comply with all the aspects of these specifications. Costs for evaluating proposals for similar or alternate equipment will be borne by the CONTRACTOR.

C. The entire blower package and its components shall comply with all applicable safety and environmental regulations. This specification does not limit the responsibility of the CONTRACTOR, who is expected to supply high quality equipment.

1.2 RELATED WORK AND COMPONENTS NOT INCLUDED

A. Section 11010 – Equipment General Requirements

B. Section 11378 – Fine Bubble Aeration System

C. Section 11379 – Coarse Bubble Aeration Equipment

D. Section 15010 – Mechanical General Requirements

E. Section 15060 – Common Work Results for Process Piping (and associated sections)

F. Section 15201 – Pipe Support Systems

G. Section 15205 – Process Valves

H. Instrumentation work, except as otherwise specified herein, is included in Division 13.

I. Electrical work, except as otherwise specified herein, is included in Division 16.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

B. Certified shop and installation drawings showing materials, details of construction, dimensions and battery limits for other Sections.

C. The materials list should include:
1. Blower Data
2. Complete bill of materials for all equipment
3. Manufacturer of all components supplied
4. Model numbers of all component supplied
5. RPM
6. Design/Max Capacity – m^3/min (including capacity curves)
7. Design/Max Discharge pressure
8. Weight of package assembly, blower stage and motor
9. Free field sound pressure level of complete package (sound attenuation/weather enclosure) at 1m distance, +/- 2 dB(A)
10. List of recommended spare parts for 2 years' operation.
11. Brake horsepower required at rated capacity and pressure
12. Rated maximum pressure rise of blowers
13. Motor Data
14. Accessories and other appurtenances (including enclosure heater).
15. Test report upon request, per DIN EN 10204, in accordance with ISO 1217.

D. Complete blower package operating and maintenance instructions professionally published, hard copy and electronic copy, shall be furnished for all equipment included under these specifications in accordance with Section 01600.

1.4 QUALITY ASSURANCE

A. Qualifications
1. All blowers and appurtenances furnished under this Section shall be furnished by a single manufacturer who is fully experienced, reputable and qualified in the manufacture of the equipment to be furnished. Blower manufacturer shall also provide a written warranty for the blower package and shall state that they have reviewed the design and application and that the equipment has not been misapplied or the package been poorly designed.
2. Equipment manufacturer must work according to a recognized ISO quality system.
3. The listing of any manufacturer by name shall not imply tacit approval of same. The selected manufacturer shall be required to meet the specifications.
4. Blower shall be Aerzen Model GM Positive Displacement blowers (or approved equal). Contractor shall purchase blowers and appurtenances as described in Part 2 of these specifications.

1.5 SYSTEM DESCRIPTION

A. All of the equipment specified herein is intended to be standard equipment for use in a domestic wastewater treatment system.

B. Design Criteria:

1.	Quantity of Blowers	4
2.	Design (Max) flow (Nm^3/min)	11.4/11.4/7.2/7.2
3.	Discharge Pressure Rise (kPag)	48.2
4.	Inlet Pressure (kPa)	98.0
5.	Motor Hp (Nominal, VFD rated)	25/25/20/20
6.	Inlet Temperature (˚C)	-38 to 40

7. Barometric Pressure (kPaa) 98.0
8. Ambient Relative Humidity (%) 0 to 100%
9. Free Field Sound Pressure @ 1m 70dB(A)

1.6 DELIVERY, STORAGE AND HANDLING

A. All equipment shall be completely factory assembled to the extent possible, practical, and safe for transport and on-site handling.

B. Factory-assembled parts and components shall not be dismantled (other than per 1.06.A). Contractor shall not be required to do any jobsite assembly of the blower package and shall not disassemble any factory-assembled component without the blower manufacturer's written approval.

C. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion. No shipment shall be made until approved by the ENGINEER in writing.

D. All equipment delivered to the site shall be stored in accordance with the manufacturer's instructions.

1.7 MAINTENANCE

A. Spare Parts and tools
   1. Furnish the following minimum spare parts:
      a. One complete set of V-belts, as required for each blower.
      b. One additional set of filter elements for each air inlet filter for each blower.
      c. First change of oil.
   2. Spare parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long-term storage in a humid environment. One set of Tools required for changing oil and performing belt maintenance shall be provided.

PART 2 PRODUCTS

2.1 GENERAL

A. Blower packages shall be designed to minimize the life-cycle costs and maximize plant reliability. In addition, sound emission within and from the plant shall be minimized: at the machine location, at the air intake and at the discharge piping system. The design and the selection of the components shall be based on a useful life of at least 20 years. The components of the package shall be of a fully engineered, standard design.

B. No special foundations shall be required to handle dynamic loads. The blower packages will be installed directly on a concrete slab without grouting the base frame. There shall be 4 easily accessible anchor points. CONTRACTOR shall coordinate anchorage requirements with blower supplier. CONTRACTOR shall provide all necessary anchoring hardware.

C. The blower casing shall be of one piece construction, with separate side plates that are bolted and pinned to the housing. Materials shall be close-grained cast iron EN-GJL-200 (GG-20) equivalent to ASTM A48 class 30 suitably ribbed to prevent distortion under the specified operating conditions. Inlet and outlet shall be flanged connections. The casing shall

incorporate an internal pulsation cancellation to reduce transmitted vibration. Blowers that do not incorporate pulsation cancellation shall provide design and sizing calculations for discharge silencer to comply with this requirement for the entire range of operation of the blower. The vibration level as measured at the blower casing, in the X/Y planes of the bearings, shall meet VDI 3836 in addition to DIN ISO 10816-3 for Roots-type blowers.

D. Each blower shall be factory tested per DIN EN 10204, in accordance with ISO 1217 performance test to verify flow and BHP at maximum blower capacity. Slip test only shall not be acceptable. The acceptance criteria are +5% tolerance on power and –5% tolerance on flow regardless of the size of the machine.

E. Each impeller shall be of the “stiff” design with first lateral critical speed at least 120% of the maximum allowable operating speed. The impellers shall be of the straight, three-lobe type, and shall operate without rubbing or liquid seals or lubrication. Rotor/shaft shall be drop forged in one single piece of C45N (AISI 1043 equivalent) for blowers with under 10” nominal flange size. A single-piece shaft passing through the rotor is acceptable. Material at this larger size shall be EN-G75-500-7 (ASTM 65-45-12 equivalent). Cast, hollow rotors shall be capped, dust tight. Open rotors are not acceptable. The impellers shall be statically and dynamically balanced per DIN ISO 1940. Each impeller/shaft shall be supported by anti-friction bearings, and fixed to control the axial location of the impeller/shaft in the unit. A double sealing arrangement shall be provided to prevent lubricant from contaminating the air stream but may not use any type of lip type seal.

F. The impeller shall be timed by a pair of single helical gears with hardened and ground teeth. Gear material shall be 16MnCr5E comparable with AISI 5115. Gears shall be mounted on the shafts with a tapered interference fit, and secured by a locknut.

G. Seal shall be designed to prevent lubricant from leaking into the air stream as well as to prevent oil from leaking out of the machine. Four rotary piston ring shaft seals, an oil slinger and an O-ring seal shall be provided at the point where the shaft passes through the sideplate. Further provision shall be made to vent the impeller side of the oil seal to atmosphere to eliminate any possible carry-over of lubricant into the air stream.

H. The timing gears and the bearings shall be splash lubricated. Grease lubrication shall be not acceptable.

I. A recessed oil sight glass must be provided on each oil sump. Protruding sight glasses are not acceptable.

J. The blower(s) shall be covered by a warranty for 18 months from date of shipment or 12 months from date of commissioning, minimum.

K. Painting shall be per supplier’s standard meeting the following criteria. Aluminum, stainless steel, and brass shall not be painted. The supplied motor shall not be over sprayed and will be supplied with the motor manufacturer’s standard protection and paint color. Painted Cast Iron and Carbon Steel shall be Alkyd Resin Primer and Final coat with a total dry film thickness of 70□m. Galvanized components may only be painted with appropriate surface preparation.

L. All rotating/moving parts shall include equipment guards which satisfy Bruce Power Equipment guarding requirements. Refer to Section 11010.

2.2 BLOWER ACCESSORIES

A. The package layout must minimize the space requirement including the space required for accessing all accessories of the package (including but not limited to: belt drive, pressure safety valve, check valve, flexible connectors and lubrication points on motor and blower) for regular maintenance and periodic checking. The sound enclosure shall not interfere with this requirement and shall not require disassembly of the piping or the use of tools to meet the aforementioned requirements. Operator shall not be required to reach over any component of the blower package to perform oil filling and draining.

B. Each blower shall be supplied with one combination inlet filter silencer. The filter media efficiency must meet the requirements of Filter class G4 acc. to DIN EN 779. The inlet filter silencer shall be suitable for indoor installation and mounted directly to the inlet flange of the blower. Silencer shall be located upstream of the inlet filter. Filter and silencer performance losses shall be included by the blower vendor in the blower performance calculation. The inlet silencer shall be a combination chamber and absorptive design for maximum sound attenuation.

C. Each blower shall be supplied with one combination base frame and discharge silencer. The silencer shall be a chamber type design for maximum sound attenuation and shall not use fibrous materials or any absorption materials or internal diffusers. The silencer shall feature a single shell made from EN: S235JR, DIN: St 37-2, US: equivalent to ASTM A283 Grade B. The silencer must be designed per Pressure Devise Guideline PED 97/23/EG (AD 2000). The temperature rating shall be 150ºC. The design of the silencer must accommodate being bolted directly to the blower discharge flange with no intermediary pieces and to insure that there will be no disturbing pipe beating sound or pipe harmonics whether one blower or multiple blowers are running. Discharge silencer performance losses shall be included by the blower vendor in the blower performance calculation. The discharge silencer shall be designed to reduce the pressure sound level by an average of 20dB across the blower performance range. The blower manufacturer shall supply a stainless steel grounding lug fully welded to the base. The base frame shall be designed to maintain alignment of both the blower internal components and the drive during operation. The base frame and discharge silencer combination shall be designed to resist distortion while being installed on vibration isolating mounts.

D. Each blower package shall be connected to the process piping via flexible connector(s) located downstream of the discharge silencer (and upstream of the inlet silencer if the Specifications require the inlet air to be piped to the blower package). The flexible connectors shall be sized for a standard, schedule 40 pipe diameter and shall prevent the transmission of sound and vibrations from the blower package into the piping. The flexible connectors shall be suitable for the maximum operating temperature and pressure ratings of the equipment in the air stream. Pipe supplier must ensure no pipe load is applied to the flexible sleeve.

E. Each blower shall be supplied with a motor that shall operate on 575 Volts, 3 Phase, 60 Hertz current, 1800 or 3600 RPM Totally Enclosed Fan Cooled. All frame sizes shall be NEMA standard suitable for overhung belt drive. The motor will be mounted on a pivoting base to provide automatic tensioning of the belts. The motor nominal rating after any corrections for ambient conditions shall be at least 10% above the maximum operating brake horsepower. The motor shall have a minimum 1.15 service factor. Should an unloading valve be required due to a Soft-start or Wye-Delta starter, the valve shall be supplied by the blower manufacturer. It shall be an automatic type mechanically operated valve requiring no electrical connections mounted upstream of the check valve and be fully integrated to the blower package.

F. Each blower shall be supplied with a V-belt drive of the high capacity type, oil and heat resistant. Drive shall be designed for a minimum service factor of 1.3 times nominal power (HP). Belt tensioning shall be automatic, without the use of any devices or interaction on the part of the operator. Neither slide rails nor load-adjusting springs shall be used. Sheaves shall be dynamically balanced.

G. The accessories such as V-belt drive, motor, inlet filter, inlet silencer, discharge silencer, relief valve, check valve, vibration isolation feet, inlet and discharge flex connectors, and instrumentation shall be factory assembled. V-belts and flexible connections may be shipped loose for transportation considerations. The only connections required by the contractor shall be piping and the electric power.

H. Each blower shall be supplied with vibration isolating feet directly underneath the baseframe. The feet are for attenuating vibration such that no special installation base or additional measures shall be required to further reduce vibrations transmitted to the piping.

I. The belt drive shall be guarded in compliance with OSHA regulations. Portions of the guard shall be easily removable allowing for belt inspection and replacement.

J. Each blower shall be supplied with a single pressure safety valve on the discharge side of the blower mounted downstream of the discharge silencer and upstream of the check valve. The safety valve shall be set to protect the blower from exceeding its maximum pressure rating. The materials selected for the valve internals shall enable safe and reliable operation at the site conditions. The valving shall be suitably sized for the unit it is protecting. The valve shall be field adjustable and spring loaded. If the blower package is supplied with a sound enclosure, the pressure relief valve shall also be housed by the sound enclosure and shall relieve into a segmented section of the sound enclosure.

K. Each blower shall be supplied with one check valve that shall be installed on the discharge line. For blower sizes above nominal size of DN80, check valve shall be of the full-bore low pressure-drop, flapper type design with a steel body, and steel flap embedded in EPDM with full-contact seal. The valve shall be removable without disturbing the piping. For nominal DN50 size blowers, the check valve shall be of Viton material. The vendor shall include the pressure losses produced by the check valve in the blower performance calculation. The check valve shall be factory- assembled.

L. Each blower shall be supplied with the following instrumentation: one pressure gauge that shall be supplied to measure the discharge pressure, with an isolation ball valve. The scale shall be appropriately selected for the application pressure range. The pressure gauge shall have a stainless steel case and be glycerin-filled for pulsation dampening. Minimum dial diameters shall be 63mm. A filter maintenance indicator shall be provided. Minimum dial diameters shall be 63mm. The scale shall be appropriately selected for the filter vacuum range.

M. The blowers (each) shall also be provided with the following accessories: suction (vacuum) pressure switch (to alert operators of filter replacement), discharge pressure switch, discharge temperature switch with thermowell, motor protection thermistor, and local E-stop integral to blower package.

N. Blowers shall be shipped filled with oil from factory.

O. Each blower shall be supplied with a sound enclosure covering the entire blower package including the drive motor, the inlet silencer, and the discharge silencer. The sound enclosure must be designed for easy inspection and maintenance of all blower package components.

The enclosure shall be designed to allow side-by-side installation, with all maintenance possible from the front and rear only. An oil level indicator must be installed on the enclosure, allowing oil level monitoring without opening the enclosure. The enclosure shall provide suitable protection for outdoor installation. Additional protection from the elements may be required. Details are as follows:

1. Panels shall be made of galvanized steel sheet, powder coated.
2. The enclosure and the blower package must be both mounted on a skid / oil-drip pan designed for meeting environmental protection standards and for easy transportation and installation.
3. A grounding strap shall be installed between the blower base and the package skid to bypass any vibration isolating mounts.
4. Quick release panels, each less than 22kg must provide easy and quick access for routine maintenance of the blower and the package components. Should the panels be heavier than 22kg, hinged doors must be supplied, with the appropriate frame, reinforcements and supporting elements.
5. A mechanical, shaft-driven ventilation fan - integral to the sound enclosure - shall provide ventilation and cooling. Motor-driven fans shall not be permitted. Cooling fan shall be sized for sufficient heat removal from the sound enclosure under all operating conditions.
6. Electrical components, instrumentation and instrument connections shall not be mounted or interface with moving panels of the sound enclosure.
7. Acoustic hood heater with thermostat (Caloritech - 800Watts) shall be installed inside the package for outdoor installation.
8. The acoustical enclosure shall be suitable for outdoor installation. Blowers will be installed on a concrete pad outdoors.

PART 3 EXECUTION

3.1 INSTALLATION

A. The Contractor shall install the blowers in accordance with the manufacturer’s written instructions and as directed on site by the Manufacturer’s representative. The Contractor shall be responsible for coordinating related items not covered in this section of the specifications, such as piping, fittings, additional valves, supports, motor controls and wiring.

B. Blower shall not, under any conditions be allowed to sit outdoors unprotected. During installation the blower package(s) shall be suitably protected until commissioning is started.

C. Blower and motor alignment shall follow manufacturer’s installation guidelines.

D. The blower package installation shall be verified by the manufacturer’s representative.

3.2 FIELD TESTING

A. After installation of all equipment has been completed and as soon as conditions permit, the manufacturer shall verify the blower installation. This includes inspection, dynamic testing, commissioning and training. This will be conducted in a single trip, of Three (3) eight-hour days.

END OF SECTION

SECTION 11441

SUBMERSIBLE PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submersible RAS/WAS pumps
   2. Sludge wasting/decant transfer pumps

B. Related Sections:
   1. Section 01330 – Submittals
   2. Section 01810 - Equipment Testing and Facility Commissioning
   3. Section 01820 – Demonstration and Training
   4. Section 11010 – Equipment General Requirements

1.2 REFERENCES

A. Comply with the latest edition of the following codes and standards, and where no codes and standards are listed under a standards authority, all applicable codes and standards of that standards authority, and all amendments thereto:
   1. Ministry of the Environment and Climate Change (MOECC) – Design Guidelines for Sewage Works (2008).
   2. Canadian Electrical Code
   3. Canadian Standards Association (CSA).
   4. American National Standards Institute (ANSI)
      a. ASME/ANSI B16.1-2010 Gray iron Pipe Flanges and Flanged Fittings: Classes 25, 125 and 250).
   5. Ministry of Labor (MOL) – Class 1, Group D, Division 1 (environmental compatibility).
   6. EEMAC – MG 1, Class F insulation. EEMAC standards are outdated but may be considered if there are no current equivalent applicable standards available. If EEMAC standards are to be applied, the Consultant will review the standards and approve any references to EEMAC standards in order to meet the Region’s energy efficiency objectives.
   7. National Electrical Manufacturers Association (NEMA) latest edition.

1.3 SCOPE OF WORK

A. The work of this Section consists of supplying, testing, delivering and commissioning the installation of submersible pumps in accordance with these specifications, designed for continuous/intermittent operation as described herein.

B. Unit Responsibility: The work requires that the submersible pump, complete with all accessories, be the end Product of one system manufacturer or system supplier. Unless otherwise indicated in the Contract Documents, the Contractor shall obtain each system from the supplier of the equipment, which supplier shall furnish all components and accessories of

the system to enhance compatibility, ease of operation and maintenance, and as necessary to place the equipment into operation in conformance with the specified performance requirements, features and functions without altering or modifying the Contractor's responsibilities under the Contract Documents. The Contractor is responsible for providing the equipment systems as specified in this Section.

C. Purchase and install application specific process pumps for Nine (9) Submersible RAS/WAS pumps and Two (2) Sludge wasting/decant transfer pumps. Furnish installation components and scope of work required for installation of the process pumps as outlined in this Specification.

D. These Specifications are intended to give a general description of what is required, but do not cover all details that will vary in accordance with the requirements of the equipment furnished. Refer to equipment manufacturer's standards and recommendations for further technical details.

1.4 PUMP REQUIREMENTS

A. The pump units and associated equipment shall conform in general to the requirements specified in this Section and the MOECC's Design Guidelines for Sewage Works (2008) and suitable for installation at the locations shown on the Contract Drawings.

Pump Tag Number	Qty	Location	Capacity L/S	TDH (M)	Minimum Efficiency	Discharge Piping
WW-79610-P6 THRU WW-79610-P14	9	Settling tank sludge hopper	9.2	2.1	40%	75 mm
WW-79610-P15 WW-79610-P16	2	Decant/sludge transfer sump	5	6.9	40%	75 mm

1.5 SUBMITTALS

A. Shop Drawings:
   1. Submit Shop Drawings in accordance with Section 01330 – Submittal Procedures.
   2. Shop Drawings: Indicate layout, general assembly, components, dimensions, weights, clearances, and methods of assembly.
   3. Product Data: Include manufacturer's literature including product performance, general assembly, controls, wiring diagrams, and service connections.
   4. Manufacturer's Certificates: Certify that equipment meets or exceeds specified requirements at specified operating conditions to include manufacturers pump curves at 60 percent, 80 percent, and 100 percent of rated speed.
   5. The following data forms are attached as supplements to this Specification Section:
      a. Table 1 and Table 2 Data Forms for Submersible Pumps for performance Requirements. This has been completed by the Consultant and included in the Specification Section.
      b. Table 3 Data Form for submersible pumps for supplier data. This will be submitted by the Contractor to the Consultant for review as part of the shop drawings.

B. Informational Submittals:
   1. Factory Functional Test Report.
   2. Factory Acceptance Test (FAT) Report.

3. Site Acceptance Test (SAT) Report.
4. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified in the Contract Documents.
5. Special shipping, storage and protection, and handling instructions.
6. Manufacturer's printed installation instructions.
7. Manufacturer's Certificate of Proper Installation.
8. List of suggested spare parts required to maintain the equipment in service for a period of five years. Include a list of any special tools required for checking, testing, parts replacement, and maintenance with current price information.
9. List any special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
10. Operation and Maintenance Data: As specified in Section 01700: Execution and Closeout Requirements - Operation and Maintenance Data.

1.6 QUALITY ASSURANCE

A. To ensure single source responsibility, all equipment and material specified in this Section shall be furnished and coordinated by the equipment supplier.

B. The equipment covered by these Specifications shall be new and unused and shall be standard equipment of proven field operation of at least 10 years. As part of the submittal for Shop Drawings, the equipment supplier shall supply ENGINEER with details of previous installations. The equipment furnished shall operate satisfactorily when installed.

C. All equipment furnished shall be new and suitable for the conditions of service to which they will be subject. Workmanship shall be of the highest quality and shall be carried out by competent and experienced workmen. All parts shall be protected so that no damage may occur during a long delay from the time of shipment to the time of completion of installation.

1.7 QUALIFICATIONS

A. The equipment manufacturer shall have at least 10 years' experience in the design, application, and supply of process pumps in water or wastewater treatment plants, and shall submit a list of not less than 25 operating installations as evidence of meeting the experience requirement. This experience shall be evidenced by process performance data that is submitted showing actual data on a minimum of five (5) existing installations that are operating successfully as required in the submittal section.

B. The equipment supplier shall submit to the engineer for approval a minimum of 14 days prior to the bid opening a process guarantee. Said guarantee shall be valid for a period of 12 months from the date of plant start-up.

1.8 COMMISSIONING AND MANUFACTURERS SERVICES

A. Include allowance in bid for supervision and/or commissioning of installation of supplied equipment by manufacturers representative. Additional supervision/commissioning may be ordered by ENGINEER at no additional cost if, in opinion of ENGINEER, installation or commissioning procedures have been compromised in any way.

B. Include allowance in bid for installation certification and all startup costs. Submit original certificate to ENGINEER.

1.9 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 PUMPS

A. In the event that the Contractor places an order for the equipment, the order shall refer to the equipment specified in this Section and the information in the accompanying Table 1 and 2 Data Forms.

B. The pump shall be or have:
1. Volute made of cast iron, close coupled to the motor and with duck feet to be mounted on cast-in-place concrete base as shown on the Contract Drawings.
2. Impeller made of cast iron, of the enclosed type and shall be in static and dynamic balance. The shaft shall be made of stainless steel and suitable for the motor.
3. The pump unit shall be fitted with a bail or two eye bolts for attachment to the lifting chain so as to provide a direct pull over the center of gravity.
4. Each pump shall have, as an integral part, sliding guide brackets suitable to slide along guide rails for lowering or raising the unit for servicing.
5. Equip each pump with a heavy cast iron combination type discharge connection and elbow to lock the pump to the discharge piping. Design the arrangement so that when the pump is lowered along the rails, it connects automatically to the discharge piping with a positive sealing action. Provide an elbow discharge flange faced and drilled according to ASME/ANSI B16.1 125 Class for standard flanged fitting with two bolt holes straddling the horizontal axis.
6. A suitable base or cradle shall be provided for each pump.
7. Each pump shall be furnished with leakage detection sensors for integration into the electrical control system. The leakage detection will consist of a sensor in the sealed chamber to detect leakage through the lower sealing surfaces. Provide sensors capable of initiating an alarm signal before leakage can progress into the motor housing. Provide all electrical appurtenances required for the sensors.
8. Provide lifting chains and pump cable in lengths as required on the Contract Drawings.
9. Electrical requirements shall be as required on the Contract Drawings and in this Section. The pumps shall be supplied with continuous kW (horsepower) rated cables for power and controls (sensors).
10. The motor shall be capable of operating the pump continuously at any point of the selected impeller curve without exceeding the nominal motor rating. The duty point shall lie within the envelope encompassing 50% to 150% of the best efficiency point.
11. Provide motors that are watertight, air or oil-filled, submersible and with Class F insulation. Provide motors that are CSA approved. EEMAC standard MG-1 may be utilized where no such other standard exists and as approved by the Consultant.
12. Motor voltage shall be 575 V / 3 ph / 60 Hz.

13. Seal the shaft against leakage between the motor housing and pump casing with a self-aligning double mechanical seal. Provide sealing faces of tungsten carbide on tungsten carbide for the lower seal and tungsten carbide on carbon for the upper seal.
14. Anti-friction bearings shall be suitable for a minimum B10 bearing life of 50,000 hours life under operating conditions.
15. The pump shall be capable of passing solids that are 75 mm in diameter.
16. The pump shall be suitable for installation in areas designated by the Ministry of Labour as Class I, Zone 1 Group IIA (refer to the Canadian Electrical Code, North American Hazardous Area Classification).
17. All necessary appurtenances and accessories required for the operation, installation, and removal of the pumps as described in the Contract Documents shall be provided.

2.2 DESIGN REQUIREMENT - MOTORS

A. Suitable for application with capacity sufficient to operate continuously the driven load without overloading, connected across-the-line, or controlled through variable speed controller as listed.

B. Build in accordance with:
   1. CSA C22.2 No. 100 - Motors and Generators
   2. EEMAC M1-7 - Motors and Generators
   3. NEMA Standard MG 1 Motors and Generators

C. Induction Motors:
   1. Squirrel cage induction type, with a service factor of 1.15 at 40 degrees C ambient, minimum Class F insulation, Design B torque characteristics, high efficiency.
   2. Larger then 1/2 HP shall be rated for 575 VAC, 3 phase, 60 Hz service unless otherwise specified.
   3. TEFC enclosure, suitable for moist and corrosive environment, adequately sized, gasketted, EEMAC 4 terminal boxes complete with threaded hub for conduit entry and ground connection.
   4. Sealed ball bearing type on motors less than 50 HP. Heavy-duty, grease lubricated, ball or roller type, designed and selected to meet the specific application requirements on larger motors. Basic Rating Life (ABMA L10) of 100,000 hours.

D. Inverter Duty Motors:
   1. Specifically designed to meet NEMA MG 1-2003, Part 31 requirements. The "oversized", "heavy duty" or similarly labeled motors are not considered equal and not acceptable.
   2. Motors to be matched to the equipment with no less than 10:1 speed range, suitable for operation on 3 phases, VFD power supply.
   3. Motors to operate at rated load with variation in the voltage or the frequency not exceeding +/-10 percent of rated voltage at rated constant volts/hertz ratio except for specific torque boost situations.
   4. Temperature rise at rated load shall be 80 degrees C or less on sine wave power and 105 degrees C or less on inverter power. The motor service factor shall be 1.15 on sine wave power and 1.0 on inverter power at 40 degrees C ambient.
   5. The motor insulation system will be Class F or better, spike-resistant, non-hygroscopic, chemical and humidity resistant, including Class H materials for additional phase insulation. The winding system to withstand 2000 V transients without premature motor failure and have no cable limitations in motor application.

6. Motor enclosure shall be totally enclosed fan cooled (TEFC), totally enclosed non-ventilated (TENV), or totally enclosed blower cooled (TEBC) (non-sparking) construction and suitable for severe environments.

E. Accessories, based on application:
1. Winding over-temperature protection (mandatory over 50 HP).
2. Anti-condensation heaters.
3. Moisture, leak detection for submersible motors.
4. Suitable protection relays where required for application and warranty coverage.

2.3 ACCESSORIES

A. Provide pump manufacturers foot, 316 stainless steel guide rail system and lifting chain for a complete submersible solution.

B. Provide 316 stainless steel pump nameplate for external mounting at the station. Include pump make and model, kW, impeller size, model number, voltage, and all other pertinent information.

2.4 ACCEPTABLE SUPPLIERS

A. Flygt Model NP 3085 SH 3

B. Approved Equivalent.

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor shall fully coordinate the delivery, installation and testing of all equipment.

B. The Contractor shall be responsible for coordinating the location of the hatch cover for the removal of the pump.

3.2 INSTALLATION

A. Install pumps and all related accessories in accordance with the manufacturer’s instructions and to the satisfaction of the Consultant.

B. Make all necessary piping and cable connections.

C. Employ skilled mechanics to supervise the installation.

3.3 TESTING AND COMMISSIONING

A. Perform testing and commissioning in accordance with Section 01810 – Testing and Commissioning.

B. Arrange and pay for the services of qualified technical representatives of the pump supplier to commission the installation.

C. Obtain a certificate from the supplier stating that his qualified representative has found the installation to be to his satisfaction.

3.4 SUPPLEMENTS

A. The supplements listed below, attached following “End of Section”, form part of this Section:
   1. Table 1 Data Form for Submersible RAS/WAS pumps
   2. Table 2 Data Form for Sludge wasting/decant transfer pumps
   3. Table 3 Data Form for Submersible Pumps - To be completed by manufacturer and sent in with shop drawings.

END OF SECTION

Table 1 Data Form

For

Submersible RAS/WAS pumps

Project Bruce Power Third Train Contract No. _____

Location Settling tank sludge hopper

Notes:

1. Prepare quotations in accordance with MOECC Design Guidelines for Sewage Works, as supplemented by this Table.
2. Complete Table 3 fully and submit prior to shop drawing submittal.

Pumps - General

No. of pumps required: 9
Pump Type: Submersible RAS/WAS Pump
Pump Application: Submersible
Liquid Pumped: Municipal Sewage
Make/Model: Flygt – NP 3085 SH 3

Pump Mechanical Features

Maximum Speed (synch): 1800 rpm
Service (continuous/intermittent): Intermittent (rated for min 10 starts / hr)

Pump Operating Conditions

Design Point Capacity (each pump): 9.2 L/s
Design Point Total Dynamic Head (m): 2.1 m
Pump Rated Power (kW): 2.2 kW (3 HP)

Special Requirements

See specification requirements of this Section.

Table 2 Data Form

For

Sludge wasting/decant transfer pumps

Project Bruce Power Third Train Contract No. _____

Location Decant/sludge transfer sump

Notes:

3. Prepare quotations in accordance with MOECC Design Guidelines for Sewage Works, as supplemented by this Table.
4. Complete Table 3 fully and submit prior to shop drawing submittal.

Pumps - General

No. of pumps required: 2
Pump Type: Submersible Pump
Pump Application: Submersible
Liquid Pumped: Sludge waste / Decant water
Make/Model: Flygt – NP 3085 SH 3

PUMP MECHANICAL FEATURES

Maximum Speed (synch): 1800 rpm
Service (continuous/intermittent): intermittent (rated for 10 starts / hr)

Pump Operating Conditions

Design Point Capacity (each pump): 5 L/s
Design Point Total Dynamic Head (m): 6.9 m
Pump Rated Power (kW): 0.5 kW (0.67 HP)

Special Requirements

See specification requirements of this Section.

Table 3 Data Form

For

Submersible Pumps

Project No. _____ Contract No. _____

Location: _____

Contractor's Reference

Contractor's name, address and phone number: _____

Contractor's reference number and date: _____

Pump Data

Number of pumps: _____ Pump Manufacturer: _____
Place of Manufacture: _____
Model Number and Type: _____
Speed: ____ rpm Performance Curve Attached: _____

Performance for each pump at or near design point:
L/s at _____ m TDH
kW (HP) _____ % Efficiency

Suction Diameter: _____ mm Discharge Diameter: _____ mm
Size of Impeller: _____ mm Maximum Impeller Size: _____ mm
Maximum Diameter of Solids: _____ mm
Weight of Pump/Motor: _____ kg

Pump Motor Data

Motor Manufacturer: _____
Place of Manufacture: _____
Model Number and Type: _____
Type of Motor Cooling System: _____
Nominal Rating of Motor: _____ kW
Starting Inrush: _____ A Maximum Inrush: _____ A
Voltage/Phase/Frequency: _____
Full Load Speed: _____ rpm
Temperature Rise at Full Load: _____ ° C
Permissible Number of Starts per hour: _____

Pump Motor Data (Continued... 2)

Cable(s) to Motor for Power (and Sensor) - Type, length, conductor number and size: _____

Bearing Type at: Pump End: _____

Other End: _____

Average Bearing Life: _____

Nominal Bearing Operating Pressure: _____ kPa (psi)

Painting Finish: _____

Deviations

List all exceptions to the Specification. Use a separate sheet if necessary. If none, state "NO DEVIATIONS": _____

Alternatives

State "See Separate Letter" / Sheet OR "None Proposed", whichever applies _____

Submitted by: _____ Signature: _____

Date: _____

SECTION 11545

PARSHALL FLUMES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supplying, testing, delivering, installing, and commissioning of Parshall fume.

1.2 REFERENCES

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

B. ASTM International:
1. ASTM D256 – Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics.
2. ASTM D638 – Standard Test Method for Tensile Properties of Plastics.
3. ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
4. ASTM D941 – Standard Test Method for Open Channel Flow Measurement of Water with the Parshall Flume.
5. ASTM D2583 – Standard Test Method for Indentation Hardness of Rigid Plastics by Means of a Barcol Impressor.

C. ISO 9826 – Measurement of Liquid Flow in Open Channels – Parshall and SANIIRI Flumes.

D. JIS B7553 – Parshall Flume Type Flowmeters.

E. Section 13250 – Open Channel Flow Meters –Radar.

1.3 PROGRESS SUBMITTALS

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

B. Drawings:
1. Project specific drawings, showing:
   a. Critical dimensions.
   b. Joints, connections, fasteners.
   c. Sizes, spacing, and locations of structural members, ribs, anchoring clips, and dimensional bracing.
   d. Materials and thicknesses of construction.
   e. Minimum and maximum flow rates.
2. Generic layouts or check marked brochures shall be rejected without review.

C. Product Data:
1. All submittals, specifications, drawings, brochures, installation instructions, descriptive literature, etc. shall have all units of measurement in both Imperial and SI units.
2. Receiving, handling, and storage instructions.

D. Samples: Submit 6-inch (15.24 cm) square laminate Sample of representative laminate, upon request.

E. Specifications:
   1. Project specific specifications.
   2. Generic or check marked specifications shall be rejected without review.

F. Discharge Tables:
   1. Level-to-flow discharge tables, showing:
      a. Flow equations.
      b. Submergence transition, where published.
      c. Accuracy, where published.
      d. Plan view layout showing critical dimensions and primary point of measurement (Ha).
   2. Discharge table source.

G. Manufacturer's Instructions: Indicate installation instructions.

H. Test Data:
   1. Independent certified test results confirming material properties.
      a. Test results are to be performed on specimens representative of the resins and reinforcements submitted upon with such resins and reinforcements listed by the certifying party.
      b. Data shall be no more than 3 years old.

1.4 CLOSEOUT SUBMITTALS

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

B. Record Documents: Indicate actual location of equipment and calibration results.

C. Operation and Maintenance Data: Indicate operation and maintenance instructions.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the products specified in this Section with minimum 5 years documented experience.

B. Installer: Company specializing in performing the work of this Section and approved by manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

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

C. All parts should be inspected upon delivery to the Site, noting any missing items or visible damage.

D. Verify that interior flow surfaces have not been damaged or otherwise marked during transit.

E. Inspect flanges, anchor clips, and dimensional bracing.

F. For smaller boxed items, verify that all packaging seals are in place and that there is no visible damage to the packaging.

G. Investigate for order correctness and count.
   1. Once the order has been received review the packing list against what has been received. Should any items not appear to be present or the configuration of the items does not match the description on the packing list, contact Openchannelflow immediately.
   2. Small connection hardware (nuts, bolts, etc.) not attached to the flumes ship in individual boxes – with those contents clearly marked. Special care should be taken to secure these and any other small items that can be misplaced on a job site.

H. Storage:
   1. Flumes not intended for immediate installation may be stored until the Site is ready for their installation.
   2. Flumes should only be stored in a location that is clean, level, and protected from construction traffic.
   3. When shipped on pallets, flumes should be left on those pallets until needed. Otherwise flumes should be stored upside down so that the interior flow surfaces are protected. Flumes should then be covered as an additional protection for the flow surfaces.

I. Handling:
   1. Flumes are specialty items and are fabricated to strict dimensional tolerances. While rugged and designed for a long service life, they must be handled with care. Flow surfaces are particularly important and in handling flumes this should always be kept in mind.
   2. When cranes, hoists, and other machinery are used to lift flumes or flume sections, spreader bars and lifting straps should always be used. When performing any overhead lift, all lifting eyes must be used in conjunction with good rigging practices. Rigging and lifting sequences and schedules of equipment are solely the responsibility of the installing party.
   3. Chains, ropes, and the like should never be used to move or position any flume as they may serrate the fiberglass laminate or compromise the protective gel coat surfaces.

1.7 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution Requirements: Requirements for warranties.

B. Flumes shall be warranted to be free of defects in workmanship and materials for 5 years with a completed warranty registration.

C. The warranty period shall begin from the date of shipment.

PART 2 PRODUCTS

2.1 SYSTEM DESCRIPTION

A. Coordinate provision of parshall flume with open channel flow meter instrumentation as detailed in Section 13250. Parshall flume and level measurement instrumentation (as detailed in Section 13250) shall act as a complete system for the monitoring and recording of flows through the Bruce Power Sewage Processing Plant (SPP) third train.

B. Configuration:
1. Single Flume:
a. Size:
1) Parshall flume shall be sized to the following flow rate:

Design AADF	795 cubic meters per day
Peak Day Flow	2,385 cubic meters per day

b. Construction:
1) One-piece construction (1- to 48-inch Parshall flumes).
2) Two-piece construction, with connection hardware (60- to 96-inch Parshall flumes).
3) Three-piece construction, with connection hardware (120- to 144-inch Parshall flumes).
4) Multi-piece construction, with connection hardware, for insertion through a 22 1/2 inch (57.15 cm) diameter manhole opening.

C. Materials of Construction
1. Fiberglass reinforced plastic laminate.
2. ISO Certified Polyester Laminating Resin:
a. Styrene free.
b. Low VOC.
c. Typical cast (unreinforced) resin properties shall meet or exceed:
d. Tensile Strength (ASTM D638): 11,600 psi (80 MPa).
e. Tensile Modulus (ASTM D638): 490,000 psi (3.4 GPa).
f. Tensile Elongation (ASTM D638): 3.5 percent.
g. Flexural Strength (ASTM D790): 16,300 psi (112 MPa).
h. Flexural Modulus (ASTM D790): 500,000 psi (3.4 GPa).
3. Orthophthalic resins shall not be allowed.
4. E-glass:
a. Minimum of 30 percent of laminate content by weight.
b. Silane coupling agent.
c. C-glass shall not be allowed.
5. Laminate Thickness:
a. Floor:
1) 1/4 inch (0.635 cm) (1- to 48-inch Parshall flumes).
2) 1 3/8 inches (3.49 cm), with 1-inch (2.54 cm) thick encapsulated reinforcing core (60- to 144-inch Parshall flumes).
b. Sidewalls:
1) 1/4 inch (0.635 cm) (1-to 48-inch Parshall flumes).
2) 3/8 inches (0.935 cm) (60-to 144-inch Parshall flumes).

D. Gel Coat:
1. Interior Surfaces: White gloss.
2. Exterior Surfaces: Gray.
3. 15 mil cured thickness.

4. UV inhibitors in all gel coat formulations.
5. CCP Armorcote 991, without exception.

E. Dimensional Bracing:
1. Removable pultruded fiberglass bracing with Type 304 stainless steel hardware capable of providing sufficient strength and structural support to resist the stresses of shipping and installation (cribbing of the flume is still required during installation).
   a. 1 inch by 1 inch (2.54 cm by 2.54 cm) (1-3-inch Parshall flumes).
   b. 2 inch by 2 inch (5.08 cm by 5.08 cm) (6-48-inch Parshall flumes).
   c. 3 inch by 3 inch (7.62 cm by 7.62 cm) (60-96-inch Parshall flumes).

F. Flanges:
1. Integral Top and End Flanges:
   a. 2 inches (5.08 cm) wide (minimum) (1- to 9-inch Parshall flumes).
   b. 3 inches (7.62 cm) wide (minimum) (12- to 84-inch Parshall flumes).
   c. 4 inches (10.16 cm) wide (minimum) (96- to 144-inch Parshall flumes).

G. Stiffening Ribs:
1. Knee joined encapsulated stiffening ribs to provide sufficient strength and rigidity to allow the flume to be self-supporting and capable of holding the rated maximum head of water without visible distortion. Steel stiffening ribs shall be used for large Parshall flumes.

H. Anchoring Clips:
1. Pultruded fiberglass anchoring clips laminated to the exterior of the flume to aid in securing the flume during installation.
2. Pre-drilled with 5/8-inch (1.59 cm) diameter hole.
3. Installed on 3- to 144-inch Parshall flumes.

I. Dimensional Tolerances:
1. Flume throat dimensions shall be plus or minus:
   a. 1/16 inch (1.59 mm) (12-inch or smaller Parshall flumes).
   b. 3/32 inch (2.38 mm) (18- to 24-inch Parshall flumes).
   c. 1/4 inch (6.3518 mm) (36- to 96-inch Parshall flumes).
   d. 1/2 inch (12.7 mm) (144-inch Parshall flumes).
2. Other flume dimensions shall be plus or minus:
   a. 1/8 inch (3.18 mm) (24-inch or smaller Parshall flumes).
   b. 1/2 inch (12.7 mm) (36- to 96-inch Parshall flumes).
   c. 1 inch (25.4 mm) (120- to 144-inch Parshall flumes).

2.2 MANUFACTURERS

A. Tracom Fiberglass Products.

B. ENGINEER approved equivalent.

2.3 ACCESSORIES

A. End Connections - Wing Walls:
1. Inlet radius wing walls to span channel. Refer to structural drawings for flume channel details.
2. Outlet flat wing walls perpendicular to the flow stream to span the channel. Refer to structural drawings for details.

3. Channel Depth: Refer to structural drawings.

B. Staff/Level Gage:
1. High visibility, direct read level gauge with 3/4-inch (1.095 cm) black letters/numerals on a high visibility yellow-green background.
2. Dual scale gradated in 2 mm, cm, 1/100-foot, and 1/10-foot increments.

C. Parameter Monitoring Options: Refer to Section 13250. Flume shall include provisions for location for installation of level measurement device (for flow determination).

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify that the flume dimensions are correct and that the Site conditions are suitable for installing the flume.

C. Flumes supplied with bolt-on end adapters or wing walls must remain sealed between the joints. Where required, apply 1 or 2 continuous beads of silicone on all seating surfaces before proceeding with the installation.

3.2 INSTALLATION

A. Install the Parshall flume according to manufacturer's instructions.

B. The flat floor of the flume (the crest) should be set upstream.

C. The crest of the flume must be installed level from front-to-back and from side-to-side (using a level on the crest – not the top – of the flume).

D. The inlet of the flume must be set at or above the invert of the inlet channel/pipe. If set higher, a 1:4 (rise:run) slope ramp should be grouted from the channel/pipe to the inlet of the flume. The inlet of the flume should never be below the invert of the channel/pipe.

E. The outlet of the flume should be set at or above (ideally) the invert of the outlet channel/pipe to help transition solids out of the flume and to minimize the chance of submergence.

F. The internal dimensions of the flume are critical to its proper operation. The flume must be braced internally (plywood and lumber are typically used) during installation to ensure that distortion does not occur. The dimensional bracing on the top of the flume is provided to ensure dimensional accuracy. The bracing should be left on the flume until the installation has been completed. For installations where the flume is set in concrete, the bracing may be removed once the installation has been completed and verified. For installations where the flume is freestanding or otherwise not set in concrete, the bracing should be left in place.

G. Flumes supplied with end adapters and pipe stubs may also be supplied with flexible couplings and stainless steel bands. Considerable force must be exerted by the coupling

sealing surfaces during installation, if the coupling installs with little effort or appears loose, stop and contact the coupling manufacturer.

H. Larger flumes may be placed on piers (poured perpendicular to the flow stream) or concrete blocks to allow sufficient access during installation.

I. Key the flume into the concrete by securing the anchoring clips on the sides of the flume to rebar with wire. The anchoring clips are not intended to prevent the flume from floating or shifting during installation.

J. The flume should be weighted as well as lined and braced internally to prevent flotation and/or distortion during installation. Floor distortion is a particular concern on flumes with large, flat bottoms. Make sure to take the necessary steps to avoid distortion before proceeding.

K. Flowable grout should be used to secure the flume in place. The initial lift should be slowly poured from one side of the flume so that the grout will flow under the flume to the other side, thereby helping to eliminate any void areas under the flume.

L. The initial lift should just cover the bottom of the flume and extend no more than 6 inches (15.24 cm) up the sidewalls. It (and all subsequent lifts) should be allowed to set before proceeding. Pouring grout too much or too fast can deform the floor or sides of the flume, shift it out of alignment, or move it out of level. As the grouting continues, periodically check that the sidewalls have not distorted.

M. Use vibrator sticks or chaining to ensure that no void or air pockets remain in the grout. Care must be taken when using a vibrator stick, as excessive use can cause distortion of the flume.

N. On larger flumes, grout one section between piers (or blocks) at a time, letting the grout set before proceeding to the next section. A grout hose may be required due to the distances involved. Flow grout from only 1 side of the flume.

O. Once the initial pour has set, grout up the sidewalls in 6- to 10-inch (15.24 to 25.4 cm) lifts, letting each lift set before proceeding.

P. The finished surface or shoulder of grout should be even with the top of the flume and should be sloped towards the flume so that any overflow will drain back in to the flume.

3.3 FIELD QUALITY CONTROL

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

B. Notify ENGINEER 10 days prior to quality control testing.

C. Manufacturer shall provide a representative to inspect and test the installation. The manufacturer’s representative shall provide a minimum of two (2) eight hours site visits over two (2) trips.

D. Submit a certified performance report to ENGINEER.

E. Submit 6 copies of performance data to ENGINEER.

3.4 ADJUSTING

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

B. Verify that the complete installation meets the criteria above and any additional criteria supplied by ENGINEER.

3.5 CLEANING

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

B. Clean the flow surfaces in accordance with the manufacturer's operation and maintenance instructions.

C. Remove all trash and debris, leaving the Site in a clean condition.

END OF SECTION

SECTION 11610

RECTANGULAR CLARIFIER MECHANISM

PART 1 GENERAL

1.1 DESCRIPTIVE WORK

A. Provide all labor, material and equipment to furnish and install sludge collection equipment suitable for installation in one (1) basin. The basin shall have a 13 ft (3.91m) maximum side water depth and contain one (1) settling tank(s).

B. The settling tank shall have one (1) collector mechanism. Each mechanism bay shall measure 3.66 m wide by 15.85 m long, including the sludge hopper (no cross collector).

C. Collector chains shall run over four (4) pairs of sprocket wheels at a speed of approximately 0.3 m per minute so that the flights will clean the sludge from the tank bottom into sludge hoppers. The utilization of four (4) pairs of sprocket wheels will allow for the surface to be skimmed on the return run, surface skimming shall concentrate the floating material in front of the scum removal mechanism.

1.2 RELATED WORK AND COMPONENTS NOT INCLUDED

A. Section 11010 – Equipment General Requirements

B. Section 15010 – Mechanical General Requirements

C. Concrete work is included in Division 3 and shown on Structural Drawings.

D. Instrumentation work, except as otherwise specified herein, is included in Division 13.

E. Electrical work, except as otherwise specified herein, is included in Division 16.

1.3 SUBMITTALS

A. Submit in accordance with Section 01330, copies of all materials required to establish compliance with this Section. Submittals shall include at least the following:

B. Certified shop and installation drawings showing materials, details of construction, dimensions and battery limits for other Sections.

C. The materials list should include:
1. Complete bill of materials for all equipment
2. Manufacturer details/cutsheets of all components supplied
3. General arrangement drawings – plan, section, details.
4. Required concrete tank modifications/details.
5. List of recommended spare parts for 2 years' operation.
6. Brake horsepower required for drive system
7. Motor Data

8. Accessories and other appurtenances (including but not limited to skimmer mechanism)

D. Complete clarifier mechanism operating and maintenance instructions professionally published, hard copy and electronic copy, shall be furnished for all equipment included under these specifications in accordance with Section 01600.

1.4 WORK AND COMPONENTS INCLUDED

A. The Manufacturer shall furnish the items listed below:
1. Collector chain
2. Flights
3. Wear shoes
4. Collector chain sprockets
5. Shafting, keys and set collars
6. Head shaft wall bearings
7. Idler shaft wall bearings
8. Return tracks and support brackets
9. Deflector track angles and supports (if required, as determined by the Manufacturer, to clear obstructions inside collector tank)
10. Floor and track wear strips
11. Speed reducer and motor
12. Drive base
13. Drive sprocket, torque overload device and appropriate guards
14. Driven sprocket
15. Drive chain and drive chain tightener
16. Associated attachment bolts and anchor bolts
17. Skimmer system and all associated accessories.

B. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and Manufacturer's service.

1.5 QUALITY ASSURANCE

A. Collector Chain Quality Control
1. The collector chain manufacturer shall submit previously certified design documentation stating that the collector chain has been tested on an endurance testing apparatus at a minimum load of 1800 lb (8 kN) and that the attachment link has been tested to a minimum 15 degrees of twist. Collector chain that does not meet these requirements shall not be allowed.
2. Certified documentation shall be submitted at drawing submittal stating that the Manufacturer of the collector chain has an established quality control program for materials and manufacture. The program consists of proof load and ultimate tensile strength tests.

B. The following standards apply to the work and products specified herein.
1. American Society for Testing and Materials (ASTM)
a. ASTM A36 – Standard Specification for Carbon Structural Steel
b. ASTM A48 – Standard Specification for Gray Iron Castings
c. ASTM D570 – Standard Test Method for Water Absorption of Plastics
d. ASTM D638 – Test Method for Testing Properties of Plastics

e. ASTM D785 – Standard Test Method for Rockwell Hardness of Plastics and Electrical Insulating Materials
f. ASTM D2584 – Standard Test Method for Ignition Loss of Cured Reinforced Resins
g. ASTM D4020 – Standard Specification for Ultra-High-Molecular Weight-Polyethylene Molding and Extrusion Materials
h. ASTM A351 – Standard Specification for Stainless Steel Castings

2. American National Standards Institute (ANSI)
   a. ANSI B15 – Ball Bearing, Load Ratings and Fatigue Life
   b. ASME B29.21M-2013 – 700 Class Welded Steel and Cast Chains, Attachments and Sprockets for Water and Sewage Treatment Plants
3. The Society of Protective Coatings (SSPC)
   a. SSPC-SP-10 – Surface Preparation Specification No. 10 Near White Blast Cleaning
4. National Electrical Manufacturers Association (NEMA)
5. American Welding Society (AWS)
6. American Gear Manufacturers Association (AGMA)
7. American Society of Mechanical Engineers (ASME)
8. American Bearing Manufacturers Association (ABMA)

C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Envirex, Evoqua Water Technologies, LLC of Waukesha, Wisconsin

B. Or approved equal.

2.2 DESIGN CRITERIA

A. The Manufacturer shall select the collector components based up design calculations incorporating the following criteria:
   1. Operation under wet tank conditions
      a. Wear strip friction factors:
         1) 0.20 to 0.30 (UHMW-PE on UHMW-PE)
         2) 0.05 to 0.10 (UHMW-PE on stainless steel)
      b. Bearing friction:
         1) 0.05 per shaft assembly
      c. Shaft deflection:
         1) Not to exceed 0.033 inch per foot (3 mm/m) of shaft length
         2) Fiberglass: Not to exceed 0.008 inch per foot (2 mm/m) of shaft length
      d. Sludge load – longitudinal collectors:
         1) 2 lb per ft (3 kg per m) of flight length – 8 inch tall (200 mm) flight

B. In no event shall the collector components be less than specified herein. Alternate manufactures shall submit complete design calculations in accordance with the Substitute Equipment Section of this specification.

C. The rectangular clarifier mechanism will be installed in the Bruce Power SPP North Train Final Settling Tank. Refer to Structural and Mechanical Drawings for dimensions and details.

2.3 COLLECTOR EQUIPMENT COMPONENTS

A. Collector Chain
1. Collector chain shall be NCS720S-NX non-metallic type having 6-inch (150 mm) pitch links with an average weight of 1.3 lb/ft (1.9 kg/m). The chain shall have a published working load not less than 3100 Lbf (13.8 kN) and a minimum ultimate tensile strength of 6000 lb (26.7 kN). The chain shall be manufactured of unfilled acetal resin and molded with the barrel and side bars as an integral assembly. The chain shall be assembled with pins not less than 15/16-inch (24 mm) diameter, manufactured of reinforced nylon resin and designed to provide full dead load bearing capacity throughout the full length of the link side bar hubs. The pins shall have a T-head to engage retainer lugs molded integrally with one link side bar hub as a positive means to prevent pin rotation. The pins shall be locked in position by a retainer ring molded integrally with the opposite side bar hub and provide a positive locking contact around the full periphery of the pin. The pins shall be pressed into the link side bar hubs to exclude abrasives using a tool supplied by the Manufacturer. Pins having dual purpose retainer and anti-rotational lugs will not be acceptable.
2. The attachment links shall be of similar construction to the plain chain links, with the flight pusher plate extending the full depth of the flight and molded integrally with the link sidebars. The attachment mounting hole spacing shall conform to ASME B29.21M-2013 and shall accommodate four (4) 3/8-inch (10 mm) diameter Type 316 stainless steel hex head attachment bolts. Bolts shall be fastened with Type 316 stainless steel “Nylock” hex locknuts and Type 316 stainless steel flat washers. The attachment link shall be capable of twisting a minimum of 15 degrees across the face of the attachment without failure.
3. Collector chain shall be tested and manufactured per the minimum quality assurance program specified under the Collector Chain Testing Section of this specification.

B. Flights
1. Flight shall be 3 inch (75 mm) x 8 inch (200 mm) nominal size fiberglass construction, essentially rectangular in cross section. The member shall have a product of the modulus of elasticity (E, psi) and the moment of inertia (I, in^4) of not less than 6.83 x 106 lb-inch2 (19.5 kN-m2) about its minor y-y axis (parallel to the direction of flow). The flight shall be of pultruded isopthalic composite construction with a minimum fiberglass content of 55%, to insure member strength and total encapsulation of the glass fibers to prevent wicking. The use of extenders in the resin is prohibited.
2. Maximum water absorption shall be no greater than 0.6% after immersion for 48 hours at 73-degree F (23 degree C) in accordance with ASTM D570. The flight section shall include a scraper lip on the leading edge of the flight to optimize cleaning of the tank floor. Polypropylene filler blocks shall be furnished to allow the flight to be securely bolted to the chain attachment. The blocks shall provide an interference fit with the flight to maintain proper positioning during assembly. Flight spacing shall be approximately 10 ft (3 m) for longitudinal collectors. Flights shall be accurately drilled and notched at the factory and banded together for shipment.

C. Wearing Shoes
1. Each flight shall be provided with 1/2 inch (13 mm) thick wearing shoes to run on floor wear strips and on support tracks of the return run. The shoes shall be molded of UHMW-polyethylene per ASTM D4020 with a minimum tensile strength of 6,000 psi (41,370 kPa) at 73 degrees F (23-degree C). Wearing shoes running on the floor wear strips shall be located central to the chain attachment.
2. The return run wearing shoes shall include a guide lug to insure proper tracking of the flight while travelling on the return track.

3. All UHMW-PE wearing shoes shall be reversible providing two (2) usable wearing surfaces.

D. Collector Chain Sprockets
1. Sprockets for the collector chains shall be molded totally of polyurethane or cast nylon. Sprockets shall be of split construction and have double life tooth profile compatible with non-metallic chain.
2. Sprocket halves shall be assembled on the shafting with Type 316 stainless steel clamping bands or bolts which exert compressive force around the full periphery of the hub. The clamping bands shall include provisions to restrict lateral movement. Type 316 stainless steel bolts shall be located along the split line near the periphery and so designed to draw the sprocket halves together in lateral alignment.
3. Head shaft sprockets shall have chain saver rims.
4. Head shaft sprockets shall have a keyway machined into the hub in such a way as to restrict lateral movement of the key or contain two (2) set screws to insure chain alignment.
5. Head shaft sprockets shall not be less than 22.24-inch (565 mm) pitch diameter and have 23 teeth.
6. Idler shaft sprockets shall not be less than 16.61-inch (422 mm) pitch diameter and have 17 teeth.
7. Longitudinal collector idler shaft sprockets shall rotate freely on bearing sleeves clamped to the static shaft.
8. Shaft, bearings and sprockets shall be shipped unassembled to prevent damage to bearings and sprockets during shipping and handling.

E. Head shaft
1. Head shaft shall be solid cold-finished steel, straight and true.
2. Head shafts shall contain keyways with fitted keys and shall be sized to transmit the power required.
3. The shaft assembly shall be held in alignment with split set collar; and, the driven sprocket or set collar for the driven end of the shaft.

F. Idler Shafts
1. Longitudinal Collector Idler Shafts
   a. All longitudinal collector idler shafts shall be solid, cold-finished steel, straight and true.
   b. All shafting shall extend across the full width of the tank. Stub shafts shall not be acceptable.
   c. All shafting shall be static shafts.
   d. All shafting shall be supported by minimum 3/8 inch (10 mm) thick fabricated steel support brackets. Each bracket shall be secured with minimum of two (2) 5/8 inch (16 mm) dia. anchors.

G. Shafting Set Collars
1. Shafting set collars shall be molded of UHMW-polyethylene. The collars shall be of split construction and shall include a shoulder at each end to contain the clamping band; or bolted and set screwed.

H. Collector Shaft Bearings
1. Head shaft shall be provided with wall bearings and shall be of cast steel per ASTM A216, Grade WCB housing, water lubricated, self-aligning type, having a solid polyurethane hub ball. The housing shall be of split construction and specially designed to prevent the accumulation of settled solids on its surface. The housing shall have

provisions for greasing when the tank is drained. These bearings shall be anchored directly to the concrete wall in a manner that shall permit their easy alignment.

2. Longitudinal idler sprocket sleeves
    a. Bearing sleeves shall be molded of UHMW-polyethylene. UHMW-polyethylene shall be of 100% virgin. The sleeves shall be of split construction and shall include a shoulder at each end to restrict lateral movement of the sprocket. The sleeve halves shall be secured to the shaft by two (2) Type 316 stainless steel clamping bands which exert compressive force around the full periphery of each shoulder. The shoulders shall include retainer rings to contain the clamping bands.

I. Return Tracks
1. Return tracks shall be 3 x 3 x 3/8-inch (75 x 75 x 10 mm) fiberglass angles with non-metallic supporting brackets fastened by minimum two (2) 1/2 inch (13 mm) dia. anchor bolts to the channel walls. Each bracket shall be designed to cantilever the return track approximately 9 inches (230 mm) off the channel wall. UHMW-polyethylene wear strips and mounting hardware shall be provided. Support brackets shall be spaced approximately 10 ft (3 m) apart.

J. Deflector Track Angles
1. Deflector track angles shall be provided, if determined by the Manufacturer to be required, to prevent flights from contacting other components within the collector tanks. Angles shall be 3 x 3 x 3/8 inch (75 x 75 x 10 mm) fiberglass or steel angles attached to the channel wall with non-metallic or steel brackets and fastened with minimum two (2) anchor bolts per bracket. UHMW-polyethylene wear strips and stainless steel mounting hardware shall be provided.

K. Wear Strips
1. Removable wear strips shall be provided for the return tracks and deflector angles (if required) consisting of 3/8 inch (10 mm) thick UHMW-polyethylene material in 10 ft (3 m) sections with each section having five (5) countersunk holes. UHMW-polyethylene shall be of 100% virgin material. Wear strips shall be field fastened with Type 316 stainless steel convex washers, self-drilling and tapping 1/4 inch (6 mm) dia. stainless steel fasteners. All splices shall be beveled at 45 degrees to allow for a smooth transition of the wear shoes in the direction of flight travel to prevent the shoes from hanging up on an uneven edge.
2. Removable wear strips shall be provided for the floor and deflector angles (if required) consisting of 3/8 inch (10 mm) thick UHMW-polyethylene material in 10 ft (3 m) sections with each section having five (5) countersunk holes. The floor shall have two (2) lines of wear strips and are secured with Type 316 stainless steel convex washers, 1/4 inch (6 mm) dia. Type 316 stainless steel pan head screws and vinyl anchors. Anchors shall be set in pre-drilled holes.

L. Drive Units
1. The motor shall be rated at 1/2 hp (0.37 kW) and 1.15 Service Factor, totally enclosed, fan cooled, ball bearing, constant speed of ample power for starting and continuously operating the mechanism under normal operating conditions without overloading. The motor shall conform to NEMA or IEC standards and be suitable for operation on 3-phase voltage and frequency in accordance with local practices.
2. The speed reducer shall be of the helical gear type, fully housed, running in oil, with anti-friction bearings throughout. The speed reducer shall be designed and manufactured to AGMA standards and sized based on calculated average sludge load, stated under Design Criteria of this Specification, and have a 1.25 Service Factor.
3. The motor shall be directly connected to the speed reducer. V-belt drives will not be acceptable.

4. The drive motor shall be 575V rated and suitable for operation in a Class 1, Zone 2 electrically classified area. Refer to electrical drawings.

M. Drive Base
1. Each drive unit shall be supported by a stainless steel drive base. The drive base shall be designed to support the complete drive unit including forces encountered at the design torque overload protection setting.

N. Drive Sprocket and Torque Overload Protection
1. The drive sprocket shall consist of a polymeric plate section mounted to a Type 316 stainless steel driving hub. The sprocket plate section shall be molded of polyurethane. The sprocket shall be not less than 9.26-inch pitch diameter and have 11 teeth.
2. The drive sprocket shall be provided with a shear pin device to provide for protection of the drive equipment in the event of excessive loading. Aluminum shear pins shall be provided to transmit torque from the driving hub to the sprocket shear plate.
3. The driver sprocket hub shall be provided with an actuating pin that, upon torque overload, shall contact the actuator arm of the double throw limit switch which, in turn, shall shut-off the motor and energize the alarm circuit. The limit switch shall be a combination NEMA 4X / 7 enclosure and shall be provided with a stainless-steel support bracket for positioning adjacent to the overload device. Electrical controls for alarms shall be furnished by the Electrical Contractor as detailed in Division 16.

O. Driven Sprocket
1. The driven sprocket body shall be molded of high performance polyurethane. The body shall be molded concentric and perpendicular to the bore with the rim mounting holes accurately located to insure concentricity of the sprocket assembly. The body halves shall be assembled on the head shaft with four (4) stainless steel studs with hex nut, flat washer, and lockwashers to exert compressive force at the hub, thereby securing the sprocket assembly to the shaft. Six (6) stainless steel studs shall be located along the split line so designed to draw the sprocket halves together in alignment. The body shall have a machined keyway designed to restrict the lateral movement of the key. The sprocket hub shall be of the offset design.
2. The tooth segments shall allow replacement without removal of the sprocket hub or having to replace the entire sprocket assembly. Driven sprockets containing non-replaceable integral tooth segments will not be allowed. The toothed rim shall be molded in four (4) segments and each segment shall be bolted to the body with four (4) diameter bolts. The sprocket rim shall be not less than 33.25 inch (845 mm) pitch diameter and have 40 teeth. All sprocket hardware shall be Type 316 stainless steel.

P. Drive Chain
1. The collector drive chain shall be NH78 non-metallic, having 2.61 inch (66 mm) pitch links with an average weight of 1.4 lb/ft (2.1 kg/m). The chain shall have a published working load not less than 1750 lb (7.8 kN), based upon strength and fatigue considerations. The chain links shall be manufactured of acetal resin and connected with 7/16 inch (11 mm) diameter stainless steel pins. The pins shall be constructed to prevent rotation. Chains made of glass reinforced resins that require an abrasion resisting bushing to insulate the pin from the link barrel shall not be acceptable.

Q. Drive Chain Tightener
1. The drive chain arrangement shall include a chain tightener to take-up excessive slack in the drive chain. The tightener assembly shall include a stainless-steel slide base with a self-centering polyurethane idler sprocket.

R. Chain Guard
   1. The drive chain and sprockets located above the operating platform shall be covered with a removable metal guard of No. 14 gauge (2 mm) Type 304 stainless steel.

S. Shop Painting and Finish Field Painting
   1. All iron and steel surfaces shall be blast-cleaned in accordance to SSPC-SP10 and shop primed in accordance with Division 9.
   2. Finish field painting shall be in accordance with Division 9.
   3. All pre-painted purchased equipment such as motors, reducers shall be furnished with original factory finish.
   4. Shafting, machined and or polished surfaces shall be provided with a temporary protective coating of a nondrying oily-type rust preventative compound.
   5. Fiberglass, plastic, aluminum, stainless steel, and galvanized surfaces need not be coated.

T. Anchors and Fasteners
   1. All anchor bolts shall be Type 316 stainless steel furnished by the Manufacturer, of ample size and strength for the purpose intended. All anchor bolts shall be set by the Contractor in accordance with the Manufacturer's instructions.
   2. All fasteners shall be Type 316 stainless steel, unless otherwise specified.
   3. All field installed stainless steel fastener connections shall be made with an anti-seize lubricant, designed to further reduce the possibility of galling.

U. Electrical Controls
   1. Except for shear pin limit switch, no electrical controls are included in this section. Refer to Division 16 of these specifications.

V. Screed Board
   1. For new tanks, a radius screed for finishing of grout for the curved end of the tank shall be furnished by the Manufacturer.

2.4 SKIMMER EQUIPMENT

A. Descriptive Work
   1. Provide all labor, material and equipment to furnish and install one manual worm gear operated skimmer pipe 10 inch. Mechanism shall be as shown on the plans and specified herein.
   2. The skimmer pipe shall span one 12 ft wide channel. Mechanism shall be capable of minimum 75 degree rotation in either direction.

B. Work and Components Included
   1. The Manufacturer shall furnish the items listed below:
      a. Pipe
      b. End supports
      c. Set collars
      d. Seals
      e. Grease lines
      f. Manual operating mechanism
      g. Associated attachment bolts and anchor bolts

2.5 SKIMMER EQUIPMENT COMPONENTS

A. Pipe
   1. Pipe shall be steel and be 10 inch diameter with nominal 1/4 inch (6 mm) wall thickness. A 60 degree wide slotted opening shall be cut symmetrical about the vertical axis to provide a weir over which scum can flow into the pipe when rotated. Edges of the slot shall be parallel to the longitudinal axis of the pipe. Full periphery bands not less than 2 inch (50 mm) wide shall be left in the pipe at intervals not exceeding 2 ft (610 mm) to act as stiffeners.

B. End Supports
   1. The revolving pipe shall be supported at each end in such a manner that a slight vertical or horizontal misalignment will not interfere with the smooth operation of the pipe. The pipe shall be supported by and revolve in a rolled steel collar which shall be welded to an adjustable steel plate. The end supports shall have a replaceable UHMW-polyethylene bearing liner securely fitted within the internal periphery of the collar to provide ample bearing surface for the pipe without crushing the seal.

C. Seals
   1. A suitable watertight seal shall be provided for the open end of the pipe. This seal shall be so constructed that it will remain effective even with a slight misalignment of the pipe and collar. The seal shall not be affected by grease, mild acids, or alkalies. The seal shall be readily renewable without removing the pipe from the supporting brackets and shall not bind or impede the smooth action of the revolving pipe.
   2. Plywood fillers shall be furnished with the open end supports to provide a watertight connection to the tank walls without grouting.

D. Set Collar
   1. A formed 1/4 inch (6 mm) thick steel set collar shall be provided at the non-drive end support to retain the skimmer pipe end seal. The worm gear shall retain the end seal on the drive end support.

E. Operating Mechanism
   1. The skimmer pipe shall be manually operated by means of a vertical worm gear drive. The worm gear drive shall consist of a cast semi-steel worm gear wheel and steel worm rigidly mounted on a structural steel support. The worm shaft shall revolve in bearings and the worm gear shall drive the pipe. The bearings shall be cast iron with bronze bushings and the worm shaft shall be 1018 cold-finished steel. The worm gear and worm shall be replaceable. Two flexible grease lines shall be connected to the rotating worm gear and one grease line to each worm bearing. Grease lines shall be run to the operating floor level, and be secured to steel attachment brackets.
   2. The steel vertical pipe stem shall be suitably secured to the worm shaft in such a manner that slight misalignment shall not affect the mesh of the worm and worm wheel. The pipe stem shall be kept vertical using a steel guide anchored to the operating floor.]
   3. An 18 inch (457 mm) diameter hot dipped galvanized cast iron handwheel with handle shall be provided to operate the worm gear drive. The worm drive reduction shall provide an adequate mechanical advantage so that slight pressure on the handwheel will turn the pipe and allow easy, accurate adjustment.

F. Equipment Manufacturer shall furnish its standard warranty against defects in material and workmanship for all Equipment provided by Equipment Manufacturer under this Section. The Equipment Manufacturer shall warrant the Equipment, or any components thereof, through the earlier of eighteen (18) months from delivery of the Equipment or twelve (12) months from initial operation of the Equipment.

PART 3 EXECUTION

3.1 INSTALLATION

A. The collector mechanism shall be erected and installed in strict conformance with the approved shop drawings and Manufacturer's installation instructions.

3.2 MANUFACTURER ON-SITE SERVICES

A. Provide Manufacturer service technician for start-up, field testing, verification of any final adjustments necessary for the contractor to complete and operator training.

B. Minimum service requirements:
   1. Field testing, start-up, and operator training: two (2) trip(s) totaling two (2) full day(s) on-site.
   2. A written report covering the technician's findings and installation approval shall be submitted to the Engineer covering all inspections and outlining in detail any deficiencies noted.

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. Comply with the requirements of the following Reference Standards:
   1. Section 01400 - Quality 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 01300 - 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 - Materials and Equipment: 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, refer to area classification and installation location included on the Drawings. 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. Provide all materials, labour, and equipment to 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 fully functional process measurement devices operation and as required by the equipment manufacturer.

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. Provide a qualified manufacturer representative to 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). Supply a copy of the configuration files once completed in the field.

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 01400 - Quality Requirements: Requirements for manufacturer's field services.

B. Provide manufacturer's representative to configure, calibrate, test, and 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.

D. Provide manufacturer’s representative to provide training for all devices to OWNER staff. Provide training requirements included in Part 3.8.

3.5 SYSTEM STARTUP

A. Section 01800 - Facility Operation: 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 01800 - Facility Operation: 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 01800 - Facility Operation: 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 three (3) non-consecutive 8-hour days of training, spread over 10 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 13110

ULTRASONIC LEVEL TRANSMITTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Ultrasonic Level Sensor and Transmitter

1.2 REFERENCES

A. Section 01400 - Quality 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).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Siemens – Sitrans LUT 400 series.

B. Endress+Hauser - Prosonic S FMU90 series.

C. Substitutions: Approved equivalent by Engineer.

2.2 DESCRIPTION

A. Contactless material/fluid level measurement, where level is calculated based on the measurement of the travel time (temperature compensated) of an ultrasonic signal transmitted from and received by the same sensor.

2.3 TRANSMITTER/CONTROLLER

A. Remote type, microprocessor based with backlit LCD integral display of measured 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 (NEMA 4X) rated suitable for outdoor installation, location, as listed.
   2. Operating Temperature: Minus 45 degrees C to 90 degrees C, 0 to 95 percent relative humidity.
   3. Transmitter shall be installed in an enclosure w/window to protect it from environmental conditions.

C. Control Interface
   1. Analog Output Signals:
      a. AO1: Level, 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 (alarm, pump control, etc.), SPDT type, dry contacts, rated 5 A at 120 VAC and 2 A at 24 VDC):
      a. DO1: Instrument malfunction.
   3. Digital Communication: HART Revision 5.0 or newer, data to include (as minimum):
      a. Level (PV).
      b. 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. Ultrasonic type with build in temperature compensation, contactless fluid level measurement, where level is calculated based on the measurement of the travel time (temperature compensated) of an ultrasonic signal transmitted from and received by the same sensor.
   1. Range: As listed.
   2. Beam angle: less than 12 degrees.
   3. Transmission distance (sensor to transmitter): minimum 200 m.
   4. 25.4 mm NPT conduit or bracket connection.

B. Process connection, type and size as listed:
   1. Threaded, NPT sized connection
   2. Suspended, less than 100 mm for 0 to 10 m range, less the 150 mm for 0 to 20 m range.

C. Process Measurement Performance Requirements:
   1. Accuracy: Plus or minus 0.25 percent of calibrated span.
   2. Resolution: 2 mm.
   3. Process Fluid Temperature: minus 45 to 90 degrees C, 0 to 100 percent relative humidity.
   4. Mounting: Vertical position, sensor mounting/ housing type (flange, nozzles, etc.) as listed.

D. Environmental Requirements:
   1. Enclosure: Sealed, capable of withstanding accidental submersion, corrosion resistant, polycarbonate, PVDF or metal, chemically compatible sensor facing, CSA, (NEMA) rated, suitable for location, as listed.
   2. Temperature: Minus 40 to 50 degrees C, 0 to 95 percent relative humidity.

2.5 SENSOR MOUNTING

A. Mounting Hardware: Stainless steel wall mounted bracket and rigid metal conduit for mounting the transducer in suitable distance from the wall with axis perpendicular to fluid surface.

2.6 ACCESSORIES

A. Stainless-steel process ID tag.

B. Sensor to transmitter cable.

C. External enclosure w/window to protect transmitter from environmental conditions.

D. Submerge shield.

E. Mounting brackets/hardware for sensor and transmitter.

2.7 INSTRUMENT LIST

Process Tag	**Service**	**Range**	**Options**	**Notes**
LE/LIT-01 (WW-67961-LS100)	Level Measurement of Aerobic Digester Stage 1	0-10 m	Cantilever & wall bracket	LIT: Type 4X, LE: 7 (Class 1, Zone 2, Group IIA
LE/LIT-02 (WW-67961-LS101)	Level Measurement of Aerobic Digester Stage 2	0-10 m	Cantilever & wall bracket	LIT: Type 4X, LE: 7 (Class 1, Zone 2, Group IIA)
LE/LIT-03 (WW-67961-LS103)	Level Measurement of Digester Supernatant/Sludge Wasting Sump	0-10 m	Cantilever & wall bracket	LIT: Type 4X, LE: 7 (Class 1, Zone 1, Group IIA

General Notes:

LIT – transmitter/controller, LE - 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. Ranges sized according to actual process conditions; final spans confirmed during construction.

3.2 INSTALLATION

A. Install manufacturer supplied devices and components into process system.

B. Connect wiring.

3.3 FIELD QUALITY CONTROL

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

B. Verify that there is no obstruction in the sensor beam wave angle.

C. Configure, calibrate, and test instruments.

D. Configure digital communication and device variables (registers). Coordinate testing with SCADA integrator and verify HART data network communication

END OF SECTION

SECTION 13120

MAGNETIC FLOW METERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Magnetic flow meters.

1.2 RELATED SECTIONS

A. Section 13105 – General Instrumentation Requirements.

1.3 REFERENCES

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

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).

E. NSF International (NSF).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Krohne Canada, Optiflux 2000 series.

B. Endress+Hauser, Promag 400W series.

C. Approved equivalent by Engineer.

2.2 DESCRIPTION

A. Instrument to continuously measure the volumetric flow rate of the electrically conductive fluid.

2.3 TRANSMITTER/CONTROLLER

A. Remote type, microprocessor based with backlit LCD integral display of measured flow 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., units, range, zero and span adjustment, pulse volume), non-volatile memory, remote mounted, as indicated.

B. Environmental Requirements:
   1. Enclosure: Corrosive resistant, metal or polycarbonate, horizontal or vertical surface mounted, NEMA 4X rated, CSA approved, suitable for location, as listed.
   2. Operating Temperature: Minus 20 degrees C to 60 degrees C, 0 to 95 percent relative humidity.
   3. Transmitter shall be installed in an enclosure w/window to protect it from environmental conditions.

C. Control Interface:
   1. Analog Output Signals:
      a. AO1: 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 (alarm, flow direction, instrument fault, empty pipe, etc.), SPDT type, dry contacts, rated 5 A at 120 VAC and 2 A at 24 VDC):
      a. DO1: Instrument malfunction.
      b. DO2: Flow totalizer (pulse - remote volume calculations).
   3. Digital Communication: HART Revision 5.0 or newer, data to include (as minimum):
      a. Flow (PV).
      b. Flow totalizer (volume).
      c. Instrument malfunction alarm.

D. Power requirements: less than 0.5 A at 120 VAC plus or minus 10 percent, 60 Hz.

E. Connections: Minimum three (pre-stamped at the bottom for polycarbonate enclosures) openings for cable/raceway entries suitable for NPT sized fittings.

2.4 FLOW TUBE SENSOR

A. Magnetic field technology, measurement of the volume flow rate of the electrically conductive fluid based on Faraday's law of induction, where the voltage induced by flowing fluid is proportional to flow rate. Position independent operation.
   1. Flow Span: As listed.
   2. Transmission Distance (sensor to transmitter): Minimum 200 m.
   3. 25.4 mm NPT conduit connection.

B. Non-wetted Materials: Type 304 stainless-steel flowtube sensor, Type 304 stainless-steel housing, Type 304 stainless-steel flanges according to ASME B16.5 Class 150, silicone rubber housing sealant.

C. Process wetted Materials: Lined with mechanically resistant material and chemically compatible with process fluid, fluid isolated electromagnetic pulsed DC coils, and corrosion resistant electrodes. Liner and electrode types shall be determined based on an application basis. The following provides typical selections (liner/electrode):
   1. Sewage: Polyurethane/Hastelloy C-276.

D. Process Connection: Type and size as listed.
   1. Flange type, ASME B16.5 Class 150 FF (unless listed otherwise).

E. Process Measurement Performance Requirements:
   1. Measured Fluid Conductivity (limits): Not less then 0.5 µS/mm.
   2. Accuracy: Plus or minus 0.5 percent of calibrated span (assuming five pipe diameters upstream and three pipe diameters downstream of straight run).
   3. Velocity Range: 0.3 m/s to 5 m/s under normal flow conditions.
   4. Operating/Process Fluid Temperature: 0 to 60 degrees C.
   5. Sensor Pressure: Entire flow tube must meet ratings of flanges.
   6. Mounting: Horizontal, or vertical position with empty tube, reverse flow detection.

F. Environmental Requirements:
   1. Enclosure: Flange mounted assembly with sensor box, capable of withstanding accidental submersion, corrosion resistant, metal, NEMA 6P rated, CSA approved, suitable for location, as listed.
   2. Operating Temperature: Minus 5 to 60 degrees C, 0 to 95 percent relative humidity.

2.5 ACCESSORIES

A. Stainless-steel process ID tag.

B. Permanently attached engraved manufacturer tags for each flowtube and transmitter associating both devices.

C. Enclosure w/window to protect transmitter from environmental conditions.

D. Type 304 stainless-steel grounding rings for all non-metallic, plastic, or lined, piping.

E. Type 304 stainless-steel lining protectors (when required for liner mechanical protection).

F. Flow tube sensor to transmitter sensor signal cable (as shown on the Drawings; minimum 10 m). Where remote transmitter and sensor separation distance for device locations shown on Drawings cannot be accommodated, flow meter manufacturers wall mounted field indicator units shall be supplied for each flow meter. Field indicator units shall include backlit LCD display indicating measured process values and units.
   1. Endress + Hauser RIA16 series.

G. Mounting hardware: where applicable for remote mounted transmitter, provide mounting bracket as required to mount to pipe or wall/railing.

H. Provide pipe reduction/expansion fittings as required to accommodate flow meter sizing.

I. Factory calibration certificate.

2.6 INSTRUMENT LIST

Process Tag	Service	Range	Options	Notes
FE/FIT-001 (WW-67961-FE2000)	SPP North Train RAS/WAS Flow	0 to 25 L/s		FIT: NEMA 4X, located outdoor on electrical stand complete with enclosure for environmental protection FE: NEMA 7 Ex. Proof – Class 1, Zone 2, Group IIA
FE/FIT-003 (WW-67961-FE130)	SPP East Train RAS/WAS Flow	0 to 25 L/s		FIT: NEMA 4X, located outdoor on electrical stand complete with enclosure for environmental protection FE: NEMA 7 Ex. Proof – Class 1, Zone 2, Group IIA
FE/FIT-004 (WW-67961-FE131)	SPP West Train RAS/WAS Flow	0 to 25 L/s		FIT: NEMA 4X, located outdoor on electrical stand complete with enclosure for environmental protection FE: NEMA 7 Ex. Proof – Class 1, Zone 2, Group IIA

FIT: Flow Indicating Transmitter
FE: Flow Element

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Determine liner and electrode types based on an application basis. Manufacturer shall review, verify, and confirm proposed selections.

C. Ranges sized according to actual process conditions; final spans confirmed during construction.

3.2 INSTALLATION

A. Install manufacturer supplied devices and components. Observe flowtube direction arrows. Install flow meter such that the device will remain flooded at all times.

B. Install flowtube not less than five pipe diameters upstream and three pipe diameters downstream to obtain rated accuracy or according to manufacturer's requirements. Typically install flow meters ten pipe diameters downstream from pumps or cross-connections and upstream from control valves. Do not install a meter where gas can collect or a line can self-drain when flow stops.

C. Install grounding rings. Drill and tap pipeline and flowmeter flanges on both sides with 1/4-inch bolts. Provide bonding jumpers and bond flowtube. Use green (or green with yellow strip) insulated wire.

D. Install the transmitter remotely from flowtube as indicated.

E. Install and connect flowtube and transmitter. Install separate raceways for signal and power wiring (with exception of loop powered devices). Sensor signal cable connection shall be without joints or splices. Provide flexible weatherproof conduit for flowtube connection.

F. Configure, calibrate, and test instruments.

G. Configure digital communication and device variables (registers). Coordinate testing with SCADA integrator and verify HART data network communication.

END OF SECTION

SECTION 13130

LEVEL SWITCHES – FLOAT TILT TYPE

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Tilt float type level switch.

B. Tilt float type level switch mounting hardware.

1.2 REFERENCES

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

B. Section 13105 – General Instrument Requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Flygt, ENM-10.

B. Approved equivalent

2.2 DESCRIPTION

A. Instrument that opens or closes electrical circuits in response to process liquid level changes. When liquid level reaches the sensor, it tilts and activates the mechanical switch inside.

2.3 LEVEL SWITCHES – TILT FLOAT TYPE

A. Sensor: Mechanical, non-mercury switch, hermetically sealed in a suitable, chemically compatible float material, suspended on the cable.
   1. Float Material: PTFE.
   2. Cable: FEP, length as required by application.
   3. Pressure: Minimum 69 kPa.
   4. Process Liquid Temperature: minus 40 to 60 degrees C.
   5. Liquid Density: 0.8 g/cc to 1.5 g/cc.
   6. Switch Level Operational Hysteresis: Approximately 100 mm.
   7. Output: One SPDT mechanical (reed) switch changeover contact, rated minimum 5 A at 120 VAC and 2 A at 24 VDC.
   8. Switch Size: Approximately 100 to 160 mm height, 55 to 100 mm in diameter.

B. Accessories:
   1. Stainless-steel process ID tag.

2.4 MOUNTING HARDWARE

A. DIRECT: Direct mount on the wall hanger brackets.

B. SWAY: Sway control rings with horizontal hanger at the top.
   1. Rings will prevent floats from entangling together.
   2. Hanger will include nylon or rubber cable "squeeze connectors" to hold float cables, and be of sufficient length so the spacing between connectors is at least 1.5 m diameter of the float switch.

C. VERTICAL-HANGER: Vertical hanger assembly, top removable without the need to enter the station sump (e.g., tank) to verify switch operation, or to adjust control/alarm levels.
   1. Hardware:
      a. Vertical guide rail (I-beam) extending from pumping station (e.g., tank.) top to the bottom, installed in accessible location (e.g., hatch).
      b. Metal chain connected, float mounting hangers that hold and slide on the guide rail.
      c. Galvanized or stainless-steel brackets, metal chain, shackles, chain hook, nylon or rubber cable "squeeze connectors"(to minimize cable wear), and accessories.

2.5 INSTRUMENT LIST

Process Tag	Equipment Description	Options	Notes
LSH-001 (WW-67961-LS102)	SPP Third Train Aerobic Digester Stage 1	SWAY	Class1, Zone 2, Group IIA
LSH-003 (WW-67961-LS104)	SPP Third Train Decant/Sludge Wasting Sump	SWAY	Class1, Zone 1, Group IIA
LSL-003 (WW-67961-LS105)	SPP Third Train Decant/Sludge Wasting Sump	SWAY	Class1, Zone 1, Group IIA

Note: Actual installation orientation to be field confirmed.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions and as shown on the Drawings.

B. Terminate float switch cables on terminal strips mounted in an explosion proof IS-junction box suitable for area classification Class 1 Zone 1 Group IIA, located for ease of maintenance. Locate weatherproof cable connectors on the bottom of the box only.

C. Mount sway control rings and hanger brackets using cinch anchors.

D. Provide galvanically isolated intrinsic barriers in electrically hazardous applications.

E. Provide and install electrical supply and any mounting accessories as required.

3.2 FIELD QUALITY CONTROL

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

B. Verify operation and adjust levels to meet process requirements.

END OF SECTION

SECTION 13140

PRESSURE TRANSMITTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure transmitter.

B. Pressure sensor.

C. Accessories.

1.2 RELATED SECTIONS

A. Section 13105 – General Instrument Requirements.

1.3 REFERENCES

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

B. Section 13105 – Pressure Instrument Requirements.

C. Section 13145 – Press Instrument Accessories.

D. Canadian Standards Association (CSA).

E. National Electrical Manufacturers Association (NEMA).

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Rosemount (Emerson), 3051 series.

B. Siemens Sitrans P MK II series.

C. Approved Equivalent

2.2 DESCRIPTION

A. Instrument that continuously measures pressure of a process medium.

2.3 PRESSURE TRANSMITTERS

A. Transmitter: Two-wire, electronic based pressure transmitter with integral LCD display of measured value in engineering units (mmH_2O, kPa), HART protocol, sensor/electronics failure mode and annunciation, field configurable using HART configurator, programmable limit and control settings (e.g., units, range, zero and span adjustment), non-volatile memory, sensor mounted.
   1. Corrosive resistant, metal enclosure, horizontal or vertical surface mounted.
      a. CSA (NEMA) type rated and suitable for location, as listed.
   2. Operating Temperature: Minus 45 to 60 degrees C, 0 to 95 percent relative humidity.
   3. Power Requirements: 24 VDC, plus or minus 6 V, 2-wire loop powered.
   4. Analog Output Signal: 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).
      a. Configurable Output Failure Mode: Fail low (less than 3.75 mA) or high (greater than 21.75 mA) upon sensor/electronics failure.

B. Sensor: Capacitance or piezoresistive type with isolating diaphragm, process connection wetted parts materials and fill fluid suitable for measured liquid. Sensor suitable for operation in vertical and horizontal position.
   1. Accuracy: Plus or minus 0.1 percent of calibrated span.
   2. Stability: Plus or minus 0.2 percent of calibrated span for 12 months.
   3. Isolating Diaphragm: Type 316L stainless steel.
   4. Sensor Fill Fluid: Silicone.
   5. Overpressure Limits: Minimum 6,895 kPa (sensor/transmitter must withstand the limit without damage).

C. Accessories:
   1. Stainless-steel process ID tag.
   2. Pressure instrument accessories, as indicated.
   3. Type 316 stainless steel, "tree" mounting assembly.
   4. Mounting brackets/hardware.
   5. Calibration Certificate
   6. Pressure Hydrostatic Test
   7. CRN

2.4 INSTRUMENT LIST

Process Tag	Service	Range	Options	Notes
PIT-001 (WW-67961-PS106)	SPP Third Train Blower header Pressure	0 to 60kPa(g)	Class 1 Zone 2 Group IIA	PIT: NEMA 4X, located outdoor as shown on drawing

Note: Ranges sized according to actual process conditions; final spans confirmed during construction.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Ranges sized according to actual process conditions; final spans confirmed during construction.

3.2 INSTALLATION

A. Assemble into complete devices with pressure instrument accessories.

B. Install complete assemblies into process system.

C. Connect wiring.

3.3 FIELD QUALITY CONTROL

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

B. Configure, calibrate, and test instruments.

END OF SECTION

SECTION 13145

PRESSURE INSTRUMENT ACCESSORIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Isolation valves.

B. Connection assemblies.

C. Diaphragm seals.

1.2 REFERENCES

A. Section 14000 - Quality Requirements: Requirements for references.

B. American Society of Mechanical Engineers:
   1. ASME B31.1 - Power and Piping Code.
   2. ASME B40.100 - Pressure Gauges and Gauge Attachments.

C. American National Standards Institute:
   1. ANSI B16.1 – Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.
   2. ANSI B16.5 – Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

1.3 MANUFACTURERS

A. Wika.

B. Ashcroft

C. Winters

PART 2 PRODUCTS

2.1 ISOLATION VALVES

A. See Process Valve Specifications for small diameter ball valves.

2.2 CONNECTION ASSEMBLIES

A. Field or factory assembly of suitable fittings and valves, seal and leak tested, attached to the pressure instrument. (See mechanical drawings details).
   1. Ratings: Minimum, 150 psi at 100 degrees C, or better to match process limits.
   2. Materials and Components: As specified under this Section.
   3. Process Connection: Male or female NPT threaded ends, size to match process and instrument connection ports.

B. Assembly is not considered equal to integral manifold. Provide only when listed in specifications. Ports configuration in accordance with ASME B31.1, or custom as indicated.

2.3 CONNECTING FITTINGS

A. Couplings, elbows, nipples, connecting pipes, tees, plugs, caps, bushings, unions, reducers, etc., size to match connected devices.

B. Material: Stainless steel, or better to match process media.

PART 3 EXECUTION

3.1 INSTALLATION

A. Assemble into complete devices.

B. Install all isolation components, fill with instrument-side liquid, and field calibrate as required.

C. Test complete assemblies for leaks.

D. Install complete assemblies into process system.

3.2 SCHEDULE

A. Process Type and Accessory Required:
   1. Sewage: Connection Assembly, Connection Fittings, Isolation Valve, Diaphragm Seal.

END OF SECTION

SECTION 13200

PRESSURE GAUGES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Pressure gauge requirement.

B. Pressure gauge types.

1.2 REFERENCES

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

B. American National Standards Institute/American Society of Mechanical Engineers: ANSI/ASME B40.100 - Pressure Gauges and Gauge Attachments.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Ashcroft.

B. Trerice.

C. Wika.

D. Winters.

2.2 DESCRIPTION

A. A mechanical instrument designed to measure the internal pressure and/or vacuum of a vessel, pipe, or a system. Bourdon tube sensing element; when the sensing element is subjected to pressure, it flexes and the resulting motion is transmitted as a measurement through a mechanical movement to the dial face pointer.

2.3 GENERAL

A. Pressure Gauges:
   1. Conform to ANSI/ASME B40.100.
   2. CRN approved and suitable for specified application.

B. Environmental Requirements, Ambient Air:
   1. Temperature: 0 to 60 degrees C. Minus 40 to 60 degrees C for outdoor locations.
   2. Relative Humidity: 95 percent, non-condensing.
   3. Corrosive resistant enclosure.

C. Process Ratings:
   1. Operating Temperature: 0 to 100 degrees C.
   2. Range and Scale: Sized in accordance with ASME B40.100.
      a. Normal Operating Pressure: Confined to 25 to 75 percent of the gauge scale.
      b. If pulsation is present in the process, maximum operating gauge pressure should not exceed 50 percent of full-scale range.

D. Process Connection: 1/2 inch (12.7 mm) NPT, bottom, unless specified otherwise.

E. Filling Liquid:
   1. Glycerin, process media temperature less than 98 degrees C.
   2. Standard instrument oil, process media temperature less than 150 degrees C.
   3. Silicon for higher temperatures.

F. All gauges shall be factory calibrated.

2.4 PRESSURE GAUGES – TYPE A

A. Critical process type gauge, large size, high accuracy.

B. Size: 6-inch (152 mm) dial; aluminum face, white background with black graduations and dual markings (psig and kPa).

C. Accuracy: ASME B40.1 Grade 2A, or EN 837 plus or minus 0.6 percent of scale range.

D. Case: Painted cast aluminum, phenolic, or stainless-steel case, blowout protection, stainless-steel friction type ring and laminated glass window.

E. Movement: Stainless-steel bourdon tube and socket, micrometer adjustable type pointer.

2.5 PRESSURE GAUGES – TYPE B

A. General industrial type gauge, medium size, good accuracy.

B. Size: 4 1/2-inch (114 mm) dial; white background with black graduations and dual markings (psig and kPa).

C. Accuracy: ASME B40.1 Grade 1A, or EN 837 plus or minus 1.0 percent of scale range.

D. Case: Painted cast aluminum or stainless-steel case, solid front, blow-out back case, stainless-steel friction type ring and laminated glass window, liquid fill capability.

E. Movement: Stainless-steel bourdon tube and socket, micrometer adjustable type pointer.

2.6 PRESSURE GAUGES – TYPE C

A. General industrial type gauge, small size, good accuracy.

B. Size: 2 1/2-inch (63.5 mm) dial; white background with black graduations and dual markings (psig and kPa).

C. Accuracy: ASME B40.1 Grade 1A, or EN 837 plus or minus 1.0 percent of scale range.

D. Case: Painted cast aluminum or stainless-steel case, blow-out back case, stainless-steel friction type ring and laminated glass window, liquid fill capability.

E. Movement: Stainless-steel bourdon and socket, or bronze bourdon tube with brass socket, micrometer adjustable type pointer.

2.7 PRESSURE GAUGES – TYPE D

A. Differential, general industrial type gauge, medium size, good accuracy.

B. Size: 4 1/2-inch (114 mm) dial; white background with black graduations and dual markings (psig and kPa).

C. Accuracy: ASME B40.1 Grade A, or EN 837 plus or minus 1.6 percent of scale range.

D. Case: Painted cast aluminum or stainless-steel case, solid front, blow-out back case, stainless-steel friction type ring and laminated glass window, liquid fill capability.

E. Movement: Stainless-steel bourdon tube and socket, micrometer adjustable type pointer.

2.8 PRESSURE GAUGES – TYPE E

A. General service type, small size, basic accuracy.

B. Size: 2 1/2-inch (63.5 mm) dial; white background with black graduations and single markings (psig or kPa).

C. Accuracy: ASME B40.1 Grade B, or EN 837 plus or minus 2.5 percent of scale range.

D. Case: Stainless-steel case, blow-out back case, with molded acrylic window.

E. Movement: Stainless-steel or brass bourdon tube and socket, plain type pointer.

2.9 SPARES

A. Supply 10 percent spare, rounding up, (minimum two) of each type, size, and range of pressure gauge as listed in the Instrument List below.

2.10 INSTRUMENT LIST

Drawing	Equipment Description	Physical Tag	Range	Options
NK37-DRAW-79600-10016	Blower Header Pressure Guage	WW-67963-PG107	0-101.325 kPa	Type B, Connection Assembly, Isolation Valve, Diaphragm seal, Flushing Ring/Port
NK37-DRAW-79600-10016	North Train Blower #1 Discharge Pressure Gauge	WW-67963-PG112	0-101.325 kPa	Type B, Connection Assembly, Isolation Valve, Diaphragm seal, Flushing Ring/Port
NK37-DRAW-79600-10016	North Train Blower #2 Discharge Pressure Gauge	WW-67963-PG117	0-101.325 kPa	Type B, Connection Assembly, Isolation Valve, Diaphragm seal, Flushing Ring/Port
NK37-DRAW-79600-10016C	North Train Blower #3 Discharge Pressure Gauge	WW-67963-PG122	0-101.325 kPa	Type B, Connection Assembly, Isolation Valve, Diaphragm seal, Flushing Ring/Port
NK37-DRAW-79600-10016C	North Train Blower #4 Discharge Pressure Gauge	WW-67963-PG127	0-101.325 kPa	Type B, Connection Assembly, Isolation Valve, Diaphragm seal, Flushing Ring/Port
NK37-DRAW-79600-10016C	North Train Aeration Tank Header Pressure Gauge	WW-67963-PG128	0-101.325 kPa	Type B, Connection Assembly, Isolation Valve, Diaphragm seal, Flushing Ring/Port
NK37-DRAW-79600-10016C	North Train Aerobic Digester Header Pressue Guage	WW-67963-PG129	0-101.325 kPa	Type B, Connection Assembly, Isolation Valve, Diaphragm seal, Flushing Ring/Port

Note: Ranges sized according to actual process conditions; final spans confirmed during construction.

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 of wetted parts with process media, ratings, selection of proposed process gauges, materials, and assemblies.

C. Range and Scale: Sized according to the actual process conditions and confirmed during construction.

3.2 INSTALLATION

A. Assemble into complete devices with pressure instrument accessories.

B. Install complete assemblies into process system.

3.3 FIELD QUALITY CONTROL

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

B. Field test instruments. Gauges not having a rated accuracy shall be replaced.

END OF SECTION

SECTION 13220

DISSOLVED OXYGEN LUMINESCENT ANALYZER

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Dissolved Oxygen Analyzer.

1.2 REFERENCES

A. Section 01400 - Quality 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 17289: International Organization for Standardization,”optical measurement method” to determine dissolved oxygen.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. HACH, LDO probe (Model 2) with sc200 series controller.

B. Rosemount Analytical.

C. Substitutions: Approved equivalent by Engineer.

2.2 DESCRIPTION

A. On-line analyzer shall be calibration-free and continuously monitor dissolved oxygen in aqueous solutions using luminescent sensor technology.

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: minus 40 to 90 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.
   4. Transmitter shall be installed in an enclosure w/window to protect it from environmental conditions.

C. Control Interface:
   1. Analog Output Signals:
      a. AO1: DO level, 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. DO (PV).
      b. Compensating value (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. Luminescent sensor technology, LED light source excites luminescent platinum sensor material in the probe that in turn emits light with characteristics that are directly proportional to the amount of dissolved oxygen present. The emitted light is measured with a photo detector. Sensor shall be “zeroed” between measuring cycles and include temperature element for automatic temperature compensation.

B. Encapsulated construction, round, "pen" shape body to facilitate different mounting arrangements (e.g., sanitary, immersion, 1 inch NPT threaded, convertible, submersible). Arrangement shall match specified installation method and mounting hardware.
   1. Materials: Stainless-steel body with CPVC ends, replaceable sensor cap, chemical resistant body and sensor “head” materials 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 10 m length with plug-in signal connector.

C. Process Measurement Performance Requirements:
1. Measurement Range: 0.01 to 20.00 mg/L dissolved oxygen.
2. Resolution: 0.01 mg/L.
3. Accuracy: Plus or minus 0.2 ppm.
4. Repeatability: Plus or minus 0.1 ppm.
5. Response Time: Less than 60 seconds to 95 percent at 20 degrees C.
6. Temperature Accuracy: Plus or minus 0.2 degrees C.

D. Environmental Requirements:
1. Ambient Air Temperature: Minus 20 degrees C to plus 50 degrees C.
2. Process Fluid: Aerated Activated sludge (sewage).
3. Process Fluid Operating Temperature: 0 to 50 degrees C.
4. Ambient Relative Humidity: 95 percent, non-condensing.
5. Sensor Immersion Depth: 10 m, maximum.
6. Sensor Pressure: 345 kPa (50 psi), maximum.
7. Flow Rate: 3 m/s, minimum.
8. Measured Aqueous Solution pH Range: 2.0 to 12.0.
9. Transmission Distance: Up to 100 m from the transmitter/controller; up to 300 m with additional termination device/signal amplifier.
10. Sensor Shelf Life: Minimum 1 year.

2.5 MOUNTING OPTIONS/HARDWARE

A. Sensor manufacturer’s mounting hardware, unless indicated otherwise.

B. DIR – Flow-through, Direct Mounting:
1. Pipe Size up to 50 mm (2 inch): Direct mounting in 2-inch full size tee with suitable hexagonal reducing bushing. Match process piping material; tee and bushing shall be included in the Contract.
2. Pipe Size Over 50 mm (2 inch): Direct mounting with half coupling (or threadolet) welded to process pipe with suitable hexagon reducing bushing, match process piping material; half coupling (or threadolet) and bushing shall be included in the Contract.
3. If sensor body/assembly does not allow for direct mounting, provide manufacturer’s sensor specific insertion or union mount assembly, including required extensions, spacers, or accessories, materials matching respective process piping material allowing installation into 2-inch NPT threaded coupling.

C. FLT - Immersion, Tank Float Mounting Assembly:
1. Handrail mounting hardware including swivel/pivot/pole (minimum 2.1 m long, longer as required to meet operating water level as indicated on drawings) clamp assembly.
2. Ball float assembly with sensor installation fitting.

D. 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).

E. RGD – Submersion Type, Rigid Mounting: (It is required mounting configuration)
   1. Pipe/wall mounting hardware with clamp assembly,
   2. Pole (minimum 2.1 m long, longer as required to meet operating water levels as shown on the Drawings) with sensor installation fitting.

2.6 SENSOR CLEANING SYSTEM

A. Dedicated cleaning system for each instrument, self-contained, automatic (adjustable timer or transmitter/controller request) with manual bypass option, sensor cleaning system to suit process conditions to prevent erroneous values and maintenance problems.
   1. Type: Compressed air blast.

B. Complete assembly to match sensor mounting type, CPVC or Type 316 stainless steel, cleaning nozzle/head, cleaning device, solenoid valves, fittings, tubing, pressure and flow reducing control valves, selection, and isolation valves, and other external components necessary for cleaning system operation.

C. Complete Control System: Corrosion resistant, Type 4X control panel with timer, relays, control circuitry, and panel power cord (15 A, 120 VAC, 1.5 m length with encapsulated 5-15R plug).

D. Tubing: Any flexible tubing used for transition between sensor and rigid pipe shall be rated for and remain flexible across full ambient temperature range. Tubing shall be UV stabilized.

E. Accessories: Mounting hardware and other external components necessary for cleaning system operation.

2.7 ACCESSORIES

A. Stainless-steel process ID tag.

B. Enclosure w/window to protect transmitter from environmental conditions.

C. Printed manual.

2.8 INSTRUMENT LIST

Process Tag	**Service**	**Range**	**Options**	**Notes**
AE/AIT-001 (WW-67961-DOX1004)	SPP Third Train Aeration Tank	0-20 mg/L DO	Remote mount transmitter; automatic cleaning system; rigid sensor mount	Sensor shall be rated for Class 1, zone 2 and mounting option shall be RGD, Submersion type, Rigid mounting

General Notes:

AIT – transmitter/controller, AE – level sensor.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01 70 00 - 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. Install and connect sensor cleaning/auxiliary systems. Provide and connect supply systems (water/air cleaning line, valves, fittings, control circuits) as required.

C. Connect wiring.

3.3 FIELD QUALITY CONTROL

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

B. Configure, calibrate, and test instruments.

C. Configure digital communication and device variables (registers). 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. Furnish services of 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.

END OF SECTION

SECTION 13250

OPEN CHANNEL FLOWMETER - RADAR

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Open Channel Flowmeter-Radar Sensor.

B. Open Channel Flowmeter-Radar Controller.

1.2 REFERENCES

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

B. Section 11545 – Parshall Flumes. Refer to this section for details pertaining to flume associated with Open channel flow measurement.

C. American Society of Mechanical Engineers: ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

D. Canadian Standards Association (CSA).

E. National Electrical Manufacturers Association (NEMA).

F. ISO 9826: International Organization for Standardization, Measurement of liquid flow in open channels.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. VEGAPULS WL61 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.

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, and Explosion Proof.
   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, 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 15 m.
   2. Transmission distance (sensor to transmitter): minimum 200 m.
   3. Process fitting: Thread G 1 ½, mounting strap or bracket connection, vertical position.

B. Process connection: open, suspended above liquid.

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) rated, suitable for location, as listed.
   2. Operating Temperature: Minus 40 degrees C to 50 degrees C, 0 to 95 percent relative humidity.

2.5 SENSORS MOUNTING

A. Oversized rigid frame preventing movement (wind, snow load), and transmission of vibrations to the level sensor with fixed indicator showing final calibrated elevation of the sensor face.

B. Corrosion resistant stainless-steel sun and snow shield (minimum 900 by 900 mm, 3:4 slope) for outdoor installations.

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
FE/FIT-002 (WW-67961-LT10000)	Plant influent Parshall flume	0 to 5m	Suspended mounting	LIT: Type 4X, LE/TE: 7 (Class 1, Zone 1, Group IIA)

General Notes:

LIT – transmitter/controller, LE – level sensor, TE – temperature sensor.

Hazardous Location: Class 1, Zone 1, 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. The mounting location must be at least 4 km away from radio astronomy stations, unless special permission was granted by the responsible national approval authority.

C. When installed within 4 to 40 km of a radio astronomy station, the instrument must not be mounted higher than 15 m above the ground.

D. 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. Configure digital communication and device variables (registers). 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.

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 add new signals and devices, to the existing PAC control panel within this Project. Including wiring, tests, installation and commissioning.

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 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 (20 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. 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.

E. 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.

F. 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.

G. 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.

H. 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.

I. 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.

J. 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.).

K. 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.

L. TECK cable entering the panel to have grounding lock nuts applied to all cables and be bonded to the panel ground.

M. 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.

2.4 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. Multi-colour or all black TECK wiring is not acceptable for use with I/O wiring. It is expected that TECK cables will be blue for digital input wiring, and blue or red for digital outputs, depending on voltages.

2.5 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 City SCADA group.
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.

2.6 PROGRAMMABLE LOGIC CONTROLLERS

A. Refer to Section 13450, Programmable Controllers for information.

2.7 CONTROL DEVICES - GENERAL

A. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

2.8 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.

2.9 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.

2.10 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.

2.11 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.

2.12 IDENTIFICATION

A. 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.

B. Terminal Blocks: Each terminal to be clearly marked with factory pre marked number and/or letter tag identifiers.

C. 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 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.

3.3 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.

3.4 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.

3.5 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.

3.6 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. (Existing, provided as reference.)

B. Programming software.

C. Cables and accessories.

D. Appendix A – I/O List (Revised, to include I/O for the Sewage Processing Plant North Train project.

1.2 RELATED SECTIONS

A. Section 13340 – Control Panels.

B. Section 13621 - Control System Documentation.

C. Section 13623 - Control System Testing and Commissioning.

D. Section 13480 – Process Control System Integrator

E. Section 13485 – Process Control Software Programming

1.3 REFERENCES

A. Section 01400 - Quality 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 (Existing, information provided as reference.)

A. Description: PAC System RX3i, manufactured in accordance with C22.2 NO. 286-17

B. Manufacturer: GE Fanuc. 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/
3. Power Supply: IC694PSA040.
4. Ethernet Module: IC695ETM001-HT (Optional)
5. Digital Input (DI) Module: IC694-MDL240, 120VAC Discrete Input, 16 Point (Quantity as Shown on I/O List).
6. Digital Output (DO) Module: IC694-MDL916, 120VAC/ 24 VDC Discrete Output, 16 Point Isolated Relay N.O. Form A. (Quantity as Shown on I/O List).
7. Analog Input (AI) Module with HART: IC695ALG626, 16 Channel Analog Input Module with HART Communication, (Quantity as Shown on I/O List).
8. Analog Output (AO) with HART Module: IC695ALG728, 8 Channel Voltage/Current with HART. (Quantity as Shown on I/O List).
9. Expansion Back Plane Module: IC695-LRE001, RX3i Expansion Back Plane Module.
10. Expansion Back Plane: IC694CHS392, 10 Slot RX3i Serial Expansion Backplane.
11. Expansion Power Supply Module: IC694-PWR321.

D. Location:
1. SPP: Control Panel.

E. Quantities: As shown on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Refer to Section 13622 - Control System 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 for detailed I/O listing for PLC.

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 01400 - Quality 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(Future)
			I:7.7	AI	WW_79610_P2_SI	Raw Wastewater P2 Speed Indication(Future)
			I:7.8	AI	WW_79610_P3_SI	Raw Wastewater P3 Speed Indication(Future)
			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	**Spare**	
			I:10/7	DI	**Spare**	
			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
	Previous Controls Upgrade Signals
	Spare

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. Packaged systems integration level - submitted after review of packaged system submittals to present interface between control systems.
   2. "Issued for Programming" level.
   3. FAT level - submitted prior to FAT.
   4. SAT level - submitted prior to SAT.

C. Process control system FAT and SAT plan including checkout and verification forms.

D. Process control system startup and commissioning plan to include:
   1. Complete plan to fully test and commission the system.
   2. Proposed timeline schedule and description of each task.
   3. Purpose of tasks, outline of tests to be performed, procedures.
   4. Evaluation of results, check lists, and sign-off sheets.

E. Provide a process control system operator manual. Submit for reviews 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. Process Control Narrative (PCN).
   2. Process Control System Operator Manual.

H. Packaged Systems Process Control Narratives: Coordinate, organize, review, request modifications, and confirm the development of the packaged system's system technical documentation related to controls and instrumentation for Operation and Maintenance manuals. Coordination of process logic shall be the responsibility of Operations with the Consultant providing approval.

I. 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.).

J. Programming, integration, and configuration records. Include documentation specific to the process control system implementation and programming work.

K. 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.

1.5 CLOSEOUT SUBMITTALS

A. Provide all as-built documentation and software fully updated with any changes made in the field and/or during commissioning. Include an as-built version of all documentation listed in Part 1.4.

1.6 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.

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; substitutions shall be submitted for approval at time of bid and shall subject to approval at the sole discretion of the OWNER.

1.7 SEQUENCING AND SCHEDULING

A. Coordinate tests with work of other specification Sections.

B. Schedule time required into Project construction and completion for functional testing, startup and commissioning of packaged systems.

C. 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.

1.8 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.

1.9 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.

B. Development of Project process control system/SCADA standard. Coordinate with OWNER as required.

C. The overall programming of packaged control systems shall be a Supplier responsibility; however, the process control system integrator shall provide details on Project standards related to process control system. The work in general include:
   1. Publication and delivery of Project process control system/SCADA standard to Supplier in regards to presentation of information, tagging, controls and monitoring, alarms and events.
   2. Review of drawings and submittals for completeness and compliance with Project process control system/SCADA standard to ensure compatibility of packaged control systems with work provided by others including multiple Suppliers (example: feed pumps, dewatering system, and chemical systems).
   3. Coordination of programming efforts, data exchange, implementation and interface with ancillary systems, reviews and comments, and provide assistance to packaged systems Suppliers.
   4. Interface of Supplier's packaged control system to the SCADA system for monitoring, control and data acquisition.

D. 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 Project-specific process control narrative.

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. The integrators is responsible for using the process narrative to develop and finalize a full process control narrative and associated system programming. Such process control narratives are subject to Engineer/Owner approval as noted in Section 1.4 H.

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 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.

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 "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.

2.7 OTHER PROGRAMMING AND CONFIGURATION

A. SCADA Configuration: integrator shall install required software and configure all computers (including server) and control equipment including but not necessary 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.

2.8 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.

2.9 MAINTENANCE SERVICE

A. Provide services for 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 PROCESS CONTROL NARRATIVES

A. Integrator shall be provided with electronic versions of process narrative and relative materials.

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. Provide a minimum of three (3) eight hour days held non-consecutively over a 10 day period.

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 get around.
      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.
   3. Provide simulators (software subroutines, etc.) for practice purposes.

3.5 PROTECTION

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

B. Prior to energization of process measurement devices, clean inside of all enclosures such that it is free of any dust and debris, free of any substance that may cause corrosion, or items that may cause an arc to occur (wire strands).

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.

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. Central 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 01400 - Quality Requirements: Requirements for references.

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.

B. Section 01810 – Testing and Commissioning

1.3 REFERENCES

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

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 start-up, SAT and the commissioning period.

END OF SECTION

SECTION 14611

HOISTS, PORTABLE LIFTING SYSTEMS AND CRANES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Davit Lifting Systems for Submersible Pumps.

B. Davit Lifting Systems for Aerobic Digester Decanting Arms.

1.2 REFERENCES

A. Section 11441 – Submersible Pumps

B. Division 11 – Equipment General Requirements

C. Division 15 – Mechanical General Requirements

D. Structural Drawings, Notes and Division 3 regarding davit base and anchoring details.

E. American Gear Manufacturers Association (AGMA).

F. ASTM International (ASTM): A36/A36M - Standard Specification for Carbon Structural Steel.

G. American Welding Society (AWS): D14.1 - Specifications for Welding Industrial and Mill Crane and Other Material Handling Equipment.

H. Canadian Standards Association (CSA):
   1. G40.20/G40.21 - General Requirements for Rolled or Welded Structural Quality Steels.
   2. S16-09 – Design of Steel Structures.
   3. W47.1 – Certification of Companies for Fusion Welding of Steel Structures.
   4. W48 - Filler Metals and Allied Materials for Metal Arc Welding.
   5. W59 – Welded Steel Construction.
   6. Z432 - Safeguarding of Machinery.

I. Canadian Institute of Steel Construction (CISC): Canadian Handbook of Steel Construction.

J. Crane Manufacturers Association of America (CMAA).

K. Monorail Manufacturers Association (MMA) - Specifications for Monorail Systems.

L. Ontario Building Code 2016 (OBC).

1.3 SYSTEM DESCRIPTION

A. The Davit Lifting System is used to service equipment at locations indicated in the Contract drawings. The lifting Davit shall be portable and lightweight such that a single davit can be moved as required to permanently mounted base assemblies.

1.4 PROGRESS SUBMITTALS

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

B. Shop Drawings:
   1. Submit design calculations and Shop Drawings stamped and signed by a professional engineer licensed in the Province of Ontario.
   2. Indicate general assembly arrangement, overall dimensions, clearances, hook capacities, lifts, speeds, materials and finishes, components, accessories, other important features, and operating data.
   3. Indicate overall layout and installation details for suspension systems, bracing, crane rails and anchorage and safety stops.

C. Product Data:
   1. Include engineering data, bill of material showing overall and component sizes, types, and ratings.
   2. Include catalog cuts and outline drawings for purchased mechanical components.
   3. Indicate points for lubrication and schedule of lubricants including type, quantity, and frequency.

D. Manufacturer's Certificates: Certify that products meet or exceed specified requirements.

E. Manufacturer's Instructions: Submit 2 installation manuals before shipment of equipment. Include instructions for storing, handling, preparation, installation, setup, and adjustment of products.

F. Manufacturer's Field Reports: Certify that equipment and operating system has been installed in accordance with the manufacturer's requirements.

1.5 CLOSEOUT SUBMITTALS

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

B. Record Documents: Indicate actual locations of equipment. Indicate amps and voltage on each phase at startup.

C. Operation and Maintenance Data:
   1. Indicate operation and maintenance data, and parts lists including list of recommended spare parts, for the specific equipment supplied.
   2. Prepare instruction data complete with clear, concise drawings for plant operating and maintenance staff, indicating operation and maintenance of each component, recommended frequency of inspection and lubrication, lubrication points, lubrication charts, recommended procedures for setting up and dismantling, tolerances, equipment clearances, levels and elevation, and all other direction necessary for proper operation and maintenance.

3. Provide drawings of the hoist, stamped by a professional engineer licensed in the Province of Ontario.

D. Warranties: Completed original warranty forms filled out in OWNER's name and registered with manufacturer.

1.6 QUALIFICATIONS

A. Supplier and Installer: Company with at least 5 years continuous current experience in supply and installation of the work of this Section.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Accept equipment on the Site in factory containers. Inspect for damage.

C. Arrange delivery of materials in accordance with construction schedule to avoid double handling.

D. Store in a clean dry area. Protect all materials and components from damage to structural properties and finishes. Protect from flooding and water ingress damage mechanical, and operating equipment.

1.8 SEQUENCING AND SCHEDULING

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

B. Sequence work to the appropriate stage of building structural and mechanical.

1.9 MANUFACTURER'S WARRANTY

A. Section 01700 - Execution Requirements: Requirements for warranties.

B. Provide 1-year manufacturer's warranty for all equipment and accessories.

C. Fill out original warranty forms in OWNER's name and register with manufacturer.

1.10 SYSTEM STARTUP AND COMMISSIONING

A. Section 01800 – Facility Operation: Requirements for commissioning.

B. Arrange for the Engineer and manufacturer's representative to be present at the time of commissioning. Provide 7 days prior notice to the Engineer. Provide 1 day for startup and commissioning and for operation and maintenance instruction.

C. Instruct OWNER's personnel in the safe and proper operation of the equipment. Familiarize OWNER's personnel with the contents of the operation and maintenance manual.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Refer to the Drawings for further details regarding davit location and mounting details.

B. All lifting systems shall be capable of overcoming the initial dislodging force, overcoming friction including pump and lifting chain weight (the sum of all of these weights is referred to as the minimum weight).

C. Lifting davit and manual chain hoist/winch shall be manufactured from materials that are compatible and shall not corrode, and will operate safely, in all weather conditions (equipment will be installed outdoors).

D. Design in accordance with CSA Z432.

2.2 DAVIT LIFTING SYSTEM FOR SUBMERSIBLE PUMPS

A. Provide 1 lightweight, portable lifting davit as specified herein and shown on Contract Drawings:
   1. Lightweight, corrosion-resistant, aluminum alloy construction, with powder coated finish, radius adjustment via radius strap, Easily Moved Equipment Model Gen2 1100CH Davit.
   2. Minimum 500 kg (1,100 lb.) lifting capacity @ radius of 1000 mm. Radius shall be adjustable (minimum seven positions).
   3. 7.0 m available lifting height.
   4. Total assembled weight less than 20 kg (45 lb).
   5. Lifting davit shall be supplied with a portable pedestal socket extender mounting assembly rated for a minimum of 1000 kg and having a length of 1000 mm. The base of the portable pedestal socket extender shall be suitable be for use with flush mount round sockets which will be embedded in concrete catwalks adjacent to pump sumps.
   6. Pump Davit retrieval system shall be provided with eight (8) flush mount round sockets (for installation by CONTRATOR). Refer to Structural drawings for socket locations.
   7. The lifting davit shall be supplied with one (1) manual chain hoist. Hoist capacity shall be equal to the lifting capacity of the davit specified and be supplied with 10 m of galvanized chain.

2.3 DAVIT LIFTING SYSTEM FOR AEROBIC DIGESTER DECANTING

A. Provide 2 lightweight, portable lifting davit as specified herein and shown on Contract Drawings:
   1. Lightweight, corrosion-resistant, aluminum alloy construction, with powder coated finish, radius adjustment via radius strap, Easily Moved Equipment Model Gen2 1100W Davit.
   2. Minimum 500 kg (1,100 lb.) lifting capacity @ radius of 1000 mm. Radius shall be adjustable (minimum seven positions).
   3. 7.0 m available lifting height.
   4. Total assembled weight less than 20 kg (45 lb).
   5. Lifting davit shall be supplied with a portable pedestal socket extender mounting assembly rated for a minimum of 1000 kg and having a length of 1000 mm. The base of the portable pedestal socket extender shall be suitable be for use with flush mount round sockets which will be embedded in concrete catwalks adjacent to pump sumps.

6. Pump Davit retrieval system shall be provided with two (2) flush mount round sockets (for installation by CONTRATOR0. Refer to Structural drawings for socket locations.
7. The lifting davit shall be supplied with manual winch with automatic brake. Winch capacity shall be equal to or greater than capacity the davit specified and be supplied with 20 m of aircraft cable

2.4 FINISHING

A. Manufacturer standard finishes suitable for the working environment (outdoors) and application (wastewater treatment facility).

B. Clearly mark the rated capacity of the gantry crane, lifting davit, and jib crane in 125 mm high letters. Use chrome yellow letters on a black background on both sides of the lift system.

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 ready to receive work.

C. Notify the Engineer, in writing, of defects or unacceptable conditions found.

3.2 INSTALLATION

A. Coordinate column mounted jib crane loads with pre-engineered building supplier.

B. After installation, touch up damaged and abraded areas using the same materials as applied in the factory.

3.3 FIELD QUALITY CONTROL

A. A qualified technical representative of the equipment supplier shall supervise the field testing of the total monorail-hoist system.

B. Load Test: The minimum test load shall be 125 percent of the rated load capacity. Operate each lift system with the maximum lifting arm extension for the lifting davit and for the full length of the lifting beam for the gantry and jib cranes under the test load. Raise the test load to the hook height limit and lower until the cable is slack. After a 5-minute waiting period, raise the test load 1 foot and hold in that position, without slipping, for minimum 10 minutes.

C. Correct defects immediately upon discovery. Retest until installation is in satisfactory working order.

3.4 MANUFACTURER'S FIELD SERVICES

A. Arrange for manufacturer's representative to be at the Site for 1 person-day, travel time excluded, for certification of the installation, functional and performance testing, and operator training.

3.5 DEMONSTRATION

A. Demonstrate in the presence of OWNER, the Engineer, and manufacturer's representative that all equipment and accessories are installed properly and performing satisfactorily.

3.6 PROTECTION OF FINISHED WORK

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

B. Do not permit use of installed work until final field testing and commissioning.

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.

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 and industry standards 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. National Plumbing Code of Canada.
8. The CSA Group.
    a. All moving equipment shall comply with CSA Z432-04 – Safeguarding of Machinery.
9. 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. 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.

E. Where materials require special inspection and approval of CSA or local authorities, obtain such approval for particular installation.

F. 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 to 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 316stainless steel unless stated otherwise.
   2. Perform work in accordance with general requirements, Section 05500 and Section 15201.

B. Provide all anchor bolts for equipment supplied equipment, as required by equipment vendors where not part of equipment vendor scope. Anchors shall utilize the Hilti Hit-HY 200 adhesive system. Expansion anchor systems shall not be permitted.

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. Color 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.

H. Provide the requirements of Sections 01700 and 01810.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide all labor, 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. Use 316 stainless steel Hilti Hit-HY 200 adhesive

system. Expansion anchor systems shall not be permitted. Bolts and rods shall as a minimum comply with ASTM F593 Grade 8.

F. All moving equipment shall comply with CSA Z432-04 – Safeguarding of Machinery. Where the manufacturers standard equipment fails to comply with CSA Z432-04 the CONTRACTOR shall provide supplementary removable guarding to bring the installation into full compliance with CSA Z432-04.

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 piping before turning system over to OWNER.

3.6 DEMONSTRATION

A. Section 01810 - 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 15050

PIPE WELDING REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Electrodes

1.2 RELATED SECTIONS

A. Section 01300 – Administrative Requirements

1.3 REFERENCES

A. American Society of Mechanical Engineers (ASME):
   1. ASME B31.1 - Power Piping.
   2. ASME B16.25 – Butt Welding Ends.
   3. ASME Boiler and Pressure Vessel Code, Section IX - Welding, Brazing, and Fusing Qualifications.

B. ASTM International:
   1. ASTM A774 – Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.

C. CSA Group (CSA):
   1. CSA B51-14 - Boiler, pressure vessel, and pressure piping code.
   2. CSA W47.1 - Certification of companies for fusion welding of steel
   3. CSA W48-14 - Filler Metals and Allied Materials for Metal Arc Welding.
   4. CSA W59 - Welded Steel Construction (Metal Arc Welding).
   5. CSA W117.2-12 - Safety in Welding, Cutting and Allied Processes.
   6. CSA W178.1 - Certification of Welding Inspection Organizations.
   7. CSA W178.2 - Certification of Welding Inspectors.

D. Technical Standards and Safety Authority (TSSA):
   1. O. Reg. 220/01 - Boilers and Pressure Vessel Regulation,
   2. BPV-13-01-Rev 2 - BPV CAD Amendment.
   3. TSSA Director’s Orders as issued from time to time.

1.4 ENVIRONMENTAL REQUIREMENTS

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

1.5 SUBMITTALS

A. Submittals shall be in accordance with Section 01330 – Submittals.

B. Submit welding quality control program and inspection and test plan. Inspection and test plan to include:
   1. Inspection frequency requirements for visual examinations and other non-destructive test methods including liquid dye penetrant, magnetic particle, radiographic, and ultrasonic.
   2. Additional testing requirements upon test failure, including quantity and type of tests.

C. Submit Inspection and testing reports.

D. Submit weld procedures, registered in accordance with CSA B51. Submit welder qualifications on an annual basis. Each welder to possess identification symbol issued by authority having jurisdiction.

E. Submit welding inspector qualifications.

1.6 QUALIFICATIONS

A. Welders shall be qualified by authority having jurisdiction. Welders to possess valid certificate for each joint, position, and process used.

B. Inspectors to be qualified to CSA W178.2.

C. Welding inspecting companies to be certified to CSA W178.1.

PART 2 PRODUCTS

2.1 ELECTRODES

A. Electrodes to be certified by Canadian Welding Bureau to CSA W48 standard.

B. Keep electrodes, filler wires, and fluxes clean, dry, and properly stored according to manufacturer's recommendations. Do not use electrodes, filler wires, or fluxes that are damp, greasy, or oxidized

PART 3 EXECUTION

3.1 EXAMINATION

A. Perform work in accordance with CSA W117.2, Safety in Welding, Cutting and Allied Processes.

B. Copy of weld procedure shall be available for inspection at all times welding is performed.

C. Unless otherwise specified, Welding shall be in accordance with ASME B31.1, ASME Boiler and Pressure Vessel Code, and applicable requirements of the authority having jurisdiction.

D. Consumable inserts may be used if included in the qualified welding procedure specification. Match the chemistry of the consumable insert with the base metal and weld metal chemistry as required to meet composition requirements over full joint.

E. Equip welders working close to inflammable materials with fire extinguishers. Observe necessary fire prevention precautions such as shields to avoid fire hazard.

F. Verify that surfaces and Site conditions are ready to receive work.

G. Welding Electrodes: Verify proper grade and type, free of moisture and dampness, and coating is undamaged. Remove welding rods that do not meet the Contract requirements prior to commencing the welding procedures.

H. Required Examinations:
   1. Perform examinations in accordance with ASME B31.1 – Power Piping and approved inspection and test plan.
   2. Perform examinations for every pipe thickness and for each welding procedure, progressively, for all piping covered by this Section.
   3. Examine at least one of each type and position of weld made by each welder or welding operator.
   4. For each weld found to be defective under the acceptance standards or limitations on imperfections contained in the Piping Code, examine 2 additional welds made by the same welder that produced the defective weld. Such additional examinations are in addition to the minimum required. Examine, progressively, 2 additional welds for each tracer examination found to be unsatisfactory.

I. Inspection: Provide access to ENGINEER for inspection of all shop and field work and review of all records of examinations.

J. Pressure Tests:
   1. Piping: Hydrostatically test at the pressure in accordance with ASME B31.1 and approved inspection and test plan.
   2. Piping Pressure Test Procedures: As specified in Section 15955.

3.2 PREPARATION

A. Assign each qualified welder or welding operator an individual identification number or symbol.

B. Review weld procedures, quality requirements, and defect limits before any work is started.

C. Pipe End Preparation:
   1. Machine Shaping: Preferred.
   2. Oxygen or Arc Cutting: Smooth to touch, true, and slag removal by chipping or grinding.
   3. Beveled Ends for Butt Welding: ASME B16.25.

D. Surfaces:
   1. Clean and free of paint, oil, rust, scale, slag, or other material detrimental to welding.
   2. Clean stainless steel joints with stainless steel wire brushes or stainless steel wool prior to welding.
   3. Thoroughly clean each layer of deposited weld metal, including final pass, prior to the deposition of each subsequent layer of weld metal with a power-driven wire brush.

E. Alignment and Spacing:
   1. Align ends to be joined within existing commercial tolerances on diameters, wall thicknesses, and out of-roundness.
   2. Root Opening of Joint: As stated in the qualified welding procedure

3. Minimum Spacing of Circumferential Butt Welds: Minimum four times pipe wall thickness or 25 mm, whichever is greater.

F. Climatic Conditions:
1. Do not perform welding if there is impingement of any rain, snow, sleet, or high wind on the weld area, or if the ambient temperature is below 0 degrees Celsius.
2. Ensure pre-heating and conditions meet the requirements of the qualified weld procedure. At minimum for Stainless Steel and Alloy Piping: If the ambient temperature is less than 0 degrees Celsius, local preheating to a temperature warm to the hand is required.

3.3 APPLICATION

A. WELDING
1. Tack Welds:
a. Shall be performed by a qualified welder using the same procedure as for completed weld, made with electrode the same or equivalent to electrode to be used for first weld pass.
b. Remove cracked tack welds.
2. Weld Passes:
a. As required in the welding procedure.
b. Clean each layer of deposited weld metal as outlined in the weld procedure, prior to depositing each subsequent layer of weld metal.
c. Chip or grind out surface defects that may affect soundness of weld.
3. Weld Quality: Free of cracks. Incomplete penetration, weld undercutting, excessive weld reinforcement, porosity slag inclusions, and other defects in excess of limits shown in the applicable code must be rectified
4. Stainless steel pipe welding: gas tungsten arc welding or TIG in accordance with approved procedure. Gas metal arc welding (MIG) is not acceptable.
5. Ensure preheat and post weld heat treatment is completed in accordance with qualified welding procedure.

3.4 FIELD QUALITY CONTROL

A. Do not conceal welds until they have been inspected, tested, and approved by inspector.

B. Permanently mark each pressure weld with the welder or welding operator who performed the weld. If more than one welder or welding operator welds a joint, each shall apply their identification in a manner to indicate the part of the weld they completed.

C. Provide for inspector to visually inspect all welds during early stages of welding procedures for all welders.

D. Perform examinations and tests on all welds in accordance with applicable codes and approved Inspection and Test plan.

E. Visual Examinations: Include entire circumference of weld externally and, wherever possible, internally.

F. Upon failure of visual examination perform additional testing as defined in Inspection and Test plan. Additional welds for testing to be selected at random by Contract Administrator.

G. Hydrostatically test welds to requirements of ASME B31.1 and Inspection and Test Plan.

H. Defects causing rejection shall be as described in ASME B31.1 and ASME Boiler and Pressure Vessel Code as adopted by TSSA. In addition, one or more of the following defects may cause rejection of welds:
   1. Failure to meet non-destructive testing (NDT) requirements or other code tests.
   2. Welding performed by unqualified personnel.
   3. Welds not reasonably uniform in appearance.
   4. Evidence of peening.
   5. Cracks.
   6. Oxidation around weld.
   7. Lack of fusion.
   8. Lack of penetration.
   9. Presence of porosity, slag inclusion or overlaps.
   10. Undercutting adjacent to completed welds or evidence of undercutting by grinding.
   11. Weld leaks during pressure test.
   12. Excessive reinforcement
   13. Presence of excessive weld spatter around the joint

I. Cut out and replace welds of poor or doubtful quality with satisfactory welds.

J. Re inspect and re test repaired or re worked welds at no additional cost to The Region.

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 Piping

B. Section 15060-18 HDPE Piping

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 A193/A193M - Standard Specification for Alloy Steel and Stainless Steel Bolting Materials for High Temperature or High Pressure Service and Other Special Purpose Applications.
   4. ASTM A312/A312M - Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes
   5. ASTM B32 - Standard Specifications for Solder Metal.
   6. ASTM B813 - Standard Specification for Liquid and Paste Fluxes for Soldering of Copper and Copper Alloy Tube.
   7. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
   8. ASTM D1785 - Standard Specification for Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   9. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.

10. ASTM D2846/D2846M - Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Hot- and Cold-Water Distribution Systems.
11. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
12. ASTM D3212 - Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
13. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings.
14. ASTM F493 - Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
15. 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. Underwriters Laboratories Canada (ULC).

1.4 DEFINITIONS

A. The following are industry abbreviations for plastic materials:
1. CPVC: Chlorinated polyvinyl chloride plastic.
2. PE: Polyethylene plastic.
3. PVC: Polyvinyl chloride plastic.
4. HDPE: High Density Polyethylene

B. The following are industry abbreviations for metal materials:
1. CLDI: Cement-lined ductile iron.
2. CS: Carbon steel.
3. SS: Stainless Steel.

C. The following are industry abbreviations for rubber materials:
1. EPDM: Ethylene-propylene-dieneterpolymer rubber.
2. NBR: Acrylonitrile-butadiene rubber.

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 15050.

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 ASME & 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, 316 stainless 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. CPVC Piping: ASTM F493.
   2. PVC Piping: ASTM D2564. Include primer according to ASTM F656.

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 where 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.
   4. When joining dissimilar metals provide isolation kits including purpose made gasket, washers, and bolt sleeves to prevent galvanic corrosion. Refer to Part 2.6.

G. Mechanical Couplings: Provide mechanical couplings for grooved end piping.
   1. Manufactured from stainless steel.
   2. Stainless steel bolt option.
   3. Rubber Gasket of same material as approved piping gaskets or EPDM for general water/wastewater service.
   4. Manufacturers:
      a. Standard of Acceptance: Victaulic Coupling
         1) Style 77S (200 mm – 450 mm)
         2) Style 77DX (20 mm – 150 mm)
      b. Equivalent Grinell product
      c. Equivalent Viking Johnson product.

H. 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.

2.9 CHAINWHEELS

A. Provide stainless steel chainwheels for valves elevated above 2.0 m in elevation above finished floor and/or grade. Orientate valves such that chains are accessible and donot obstruct access/egress.

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 manufacturer's instructions. Orientate valves such that operator wheels are accessible and not otherwise trapped between or against walls and other piping/equipment.

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. Welding: Comply with CSA W47.1 and Section 15050

B. Join pipe and fittings according to the following requirements and individual sections specifying piping systems.

C. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

D. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

E. 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.

F. 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.

G. 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.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. 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.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D3139.

K. Plastic Non-pressure Piping Gasketed Joints: Join according to ASTM D3212.

L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D2657.

M. Plain-End Pipe and Fittings: Butt fusion.

N. Plain-End Pipe and Socket Fittings: Socket fusion.

O. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

P. 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 15050.

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 15955.

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	Piping Specification	Pipe Material	Piping Sizes	Class or Schedule	Joints and Fittings	Remarks
Raw wastewater supply to Third Train	15060-18	HDPE	250 mm	SDR 17	Fusion; mechanical	Buried
RAS/WAS Piping	15060-01	SS 316L	100 mm; 150 mm	Schedule 10	Flanged; mechanical; welded	Above grade, heat trace and insulate
Blower Piping	15060-01	SS 316L	100 mm; 150 mm	Schedule 10	Flanged; mechanical; welded	Above grade, heat trace and insulate
Effluent	15060-18	HDPE	200 mm	SDR 17	Fusion; mechanical	Buried
Sludge	15060-18	HDPE	100 mm	SDR 17	Fusion; mechanical	Buried / Above Grade
Decant water	15060-18	HDPE	100 mm	SDR 17	Fusion; mechanical	Mostly buried. Heat trace and insulate above grade portion
Drain	15060-18	HDPE	50 mm	SDR 17	Fusion; mechanical	Buried. Provide P-trap

END OF SECTION

SECTION 15060-01

STAINLESS STEEL PROCESS PIPING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Stainless Steel pipe and pipe fittings.

B. Related Requirements:
   1. Section 15060 - Common Work Results for Process Piping.

1.2 REFERENCES

A. ASTM International (ASTM):
   1. A182/A182M – Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forges Fittings, and Valves and Parts for High-Temperature Service.
   2. A194/A194M – Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.
   3. A240 – Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   4. A312/A312M – Standard Specification for Seamless and Welded Austenitic Stainless Steel Pipes.
   5. A320/A320M – Standard Specification for Alloy-Steel and Stainless Steel Bolting for Low-Temperature Service.
   6. A563 – Standard Specification for Carbons and Alloy Steel Nuts.
   7. A774/A774M - Standard Specification for As-Welded Wrought Austenitic Stainless Steel Fittings for General Corrosive Service at Low and Moderate Temperatures.
   8. A778 – Standard Specification for Welded, Unannealed Austenitic Stainless Steel Tubular Products.
   9. D1330 – Standard Specification fro Rubber Sheet Gaskets.

B. American National Standards Institute (ANSI):
   1. B16.5 – Standards of Pipes and Fittings: Flanges.
   2. B16.11 – Standards of Pipes and Fittings: Forged Steel Fittings.
   3. B16.21 – Standards of Pipes and Fittings: Nonmetallic Flat Gaskets for Pipe Flanges.

C. American Water Works Association (AWWA): C207 – Standard for Steel Pipe Flanges for Waterworks Service, Sizes 100 mm through 3600 mm.

1.3 ENVIRONMENTAL REQUIREMENTS

A. 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.

2.2 STAINLESS STEEL PIPING AND FITTINGS

A. Pipe:
1. 50 mm and Smaller: Schedule 40S, ASTM A312/A312M, Type 304 seamless, pickled and passivated.
2. 60 mm thru 150 mm: Schedule 10S, ASTM A778, "as-welded" grade, Type 304L.
3. 200 mm and Larger: Schedule 10S, ASTM A778, "as-welded" grade, Type 304L.

B. Joints:
1. 50 mm and Smaller: Threaded or flanged at equipment as required or shown.
2. 60 mm and Larger: Butt-welded or groove shouldered at valves, dismantling joints, and equipment.

C. Fittings:
1. 50 mm and Smaller: Threaded forged, 1000 CWP, ASTM A182/A182M, Grade 304L.
2. 60 mm and Larger: Butt-welded, ASTM A774/A774M, Grade 304L conforming to MSS SP 43, "as-welded" grade, pickled and passivated; fitting wall thickness to match adjoining pipe; long radius elbows unless shown otherwise.

D. Branch Connections:
1. 50 mm and Smaller: Tee or reducing tee in conformance with Fittings above.
2. 60 mm and Larger: Butt-welding tee or reducing tee in accordance with Fittings above.

E. Flanges:
1. Forged Stainless Steel: ASTM A182/A182M, Grade 304L, ANSI B16.5 Class 150 or Class 300, slip-on weld neck or raised face.

F. Unions: 50 mm and Smaller: Threaded forged: ASTM A182/A182M, Grade 304L, 13800 or 20700 kpag WOG, integral ground seats, AAR design meeting the requirements of ANSI B16.11, bore to match pipe.

G. Bolting: Forged Flanges: Type 304L stainless steel, ASTM A320/A320M Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts.

H. Gaskets:
1. Flanged, Water and Sewage Service: 5 mm thick, unless otherwise specified, red rubber (SBR), hardness 80 (shore A), rated to 93 degrees C, conforming to ANSI B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2.
2. Flanged, Air and Fuel Gas Service: 3 mm thick, unless otherwise specified, homogeneous black rubber (EPDM), hardness 60 (Shore A), rated to 150 degrees C minimum, conforming to ANSI B16.21 and ASTM D1330 Steam Grade.

I. Thread Lubricant: 50 mm and smaller: Teflon tape.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are sealed, cleaned, and conditioned as required to receive work.

3.2 INSTALLATION

A. Install piping in accordance with manufacturer's instructions.

B. Install piping in accordance with the applicable codes and standards.

3.3 TOLERANCES

A. Maximum Variation from True Position: 3 mm.

B. Maximum Offset from True Alignment: 3 mm.

3.4 ADJUSTING

A. Adjust system control valves as directed by ENGINEER.

END OF SECTION

SECTION 15060-02

HDPE PROCESS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. HDPE pipe and pipe 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.

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.

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.

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 17 (or thicker)
   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.

2.3 FITTINGS

A. 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.

2.4 JOINTS

A. 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.

B. 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.

C. Gaskets: 3 mm material as specified in Section 15060 – Common Work Results for process piping.

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 15060.

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 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. Refer to attached master equipment list.

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 OWNER REQUIREMENTS

A. Provide labels for all equipment, panels, piping, valves, and instrumentation in accordance with Bruce Power L.P. requirements. Refer to attached master equipment list.

2.2 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.
   5. Bruce Power L.P. identification tag

2.3 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.

2.4 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*
Water & Wastewater	Adhesive Tape	White	Green	Terminations and every 12 feet	Service, Flow Direction
Compresses Air	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
Blowers	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

PIPING INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Piping Insulation

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. Minimum acceptable insulation thickness is 25 mm.

B. 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. Aluminum:
   1. Aluminum alloy, with protective liner factory attached to interior surface. Stucco embossed finish.
   2. Thickness: 0.4 mm.
   3. Fittings: Preformed aluminum jackets, two piece elbows and flange covers, secured with stainless steel bands.
   4. Manufacturers:
      a. Ideal Products.
      b. ITW Insulation Systems.
      c. Shur fit.
      d. Approved Equivalent

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

B. Pressure testing of piping systems and adjacent equipment to be complete, witnessed, and certified.

C. Verify pipe sizes, dimensions, locations, and lengths with actual field installation.

D. Surfaces to be clean, dry, free from foreign material.

3.2 INSULATION SCHEDULE

		NPS 1 1/4	NPS 2.5	NPS 4	NPS 8
Application	Jacketing Material	to 2	to 4	to 6	and over
Wastewater (Outdoors)	Aluminum	25 mm	40 mm	50 mm	50 mm

3.3 GENERAL

A. Insulate full surface, all in-line equipment and entire length including elbows, tees, reducers, flanges, dampers, etc. Insulation of same thickness throughout.

B. Insulate vapor seal hangers, supports, anchors, and other piping appurtenances that are secured directly to cold surfaces.

C. Install all materials in accordance with manufacturer's instructions unless otherwise specified.

D. Do not insulate flexible pipe couplings and expansion joints.

E. Piping specified for painting that is to be insulated shall be prime coated in accordance with Section 09900 – Painting and Protective Coatings. Finish coating is not required.

F. Install insulation after piping system has been pressure tested and leaks corrected.

3.4 INSTALLATION

A. Clean and dry surfaces before applying insulation.

B. Install insulation with staggered joints and pack openings with loose insulation, using manufacturer's 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 vapor 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.

G. Connection to Existing Piping: Cut back existing insulation to remove portion damaged by piping revisions. Install new insulation.

3.5 JACKETS

A. Aluminum:
   1. Use continuous friction type joint to hold jacket in place, providing positive weatherproof seal over entire length of jacket.
   2. Secure circumferential joints with preformed snap straps containing weatherproof sealant.
   3. On exterior piping, apply coating over insulation and vapor barrier to prevent damage when aluminum fitting covers are installed.
   4. Do not use screws or rivets to fasten the fitting covers.
   5. Install removable prefabricated aluminum covers on exterior flanges and unions.
   6. Caulk and seal all exterior joints to make watertight.

B. PVC:
   1. Caulk jacket overlaps at joints and seams and cover with PVC tape.

3.6 PLACEMENT

A. Slip insulation on pipe or tubing before assembly, when practical, to avoid longitudinal seams.

B. Insulate valves and fittings with molded and preformed insulation components of same material.

C. Seal and tape joints.

3.7 VAPOUR BARRIER

A. Provide continuous vapor barrier at joints between rigid insulation and pipe insulation.

B. Install vapor barrier jackets with pipe hangers and supports outside jacket.

C. Do not use staples and screws to secure vapor sealed system components.

D. Seal joints and protrusions in insulation with vapor barrier cement.

3.8 PIPE SUPPORTS, VALVES, FLANGES, AND APPURTENANCES

A. Pipe supports are not to penetrate pipe insulation, vapor barrier, or jackets. Ensure all pipe supports are selected to be outside the insulation and that appropriate saddles and shields are provided.

B. Insulate valves and appurtenances for freeze protection, anti-sweat, heat conservation (90 to 455 degrees C) and high temperature insulation.

C. If valves and appurtenances are not insulated, and insulation thickness exceeds 25 mm, bevel insulation at flanges to allow bolt access for maintenance and removal. Provide cone reducers for jacket.

D. Where valves and appurtenances are insulated, provide prefabricated 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.

E. Verify adequate clearance between insulation and actuators or linkages to avoid interference with moving elements.

F. Leave nameplates, code inspection plates, or stampings visible after insulation is complete. Bevel and seal insulation and jacket around exposed area.

G. Roof and Overflow Drain Sumps: Insulate the underside.

H. Roof Drains: Insulate vertical drops from roof drain to horizontal pipe, exposed and concealed horizontal piping, and 3 m down on vertical risers from horizontal pipe.

I. Heat Traced Piping: Apply insulation after heat-tracing work is completed and reviewed by Consultant.

3.9 INSULATION SUPPORT

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 support at 3.0 m centers on vertical piping longer than 65 meters. Make support width 9.5 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. 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.
   2. 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.
   2. Material of Construction of all supports, bolts, and anchors: SS 316/316L throughout. No substitution allowed.
   3. Design, size, and locate piping support systems throughout facility, whether shown on the drawings or not.
   4. Piping Smaller than 750 mm: Supports are shown only where specific types and locations are required; additional pipe supports shall be required.
   5. Piping 750 mm and Larger: Support systems have been designed for piping shown.
   6. 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. 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.
         3) For process tubing (SS, PVDF), support as recommended by the tubing supplier.
      b. 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 SS 316/316L 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. All support and hanger material including hardware shall be 316 stainless steel meeting the requirements of ASTM A276 and ASTM F593.

2.2 SADDLE SUPPORTS

A. Pedestal Type: Schedule 40 pipe stanchion, saddle, and anchoring flange. All 316 SS.
1. Adjustable Saddle: MSS SP 58 and SP 69, Type 38.
a. Taylor; Figure 526.
b. Trumbull; Figure 364.
c. Approved equal.

2.3 WALL BRACKETS

A. Fabricated stainless steel 316 bracket as shown on the drawings to be designed by contractor for all pipe locations and shop drawings to be submitted to Consultant for approval.

B. Use roller chair for all pipelines where longitudinal movement due to expansion and contraction will occur. Review pipe anchor locations with Consultant

2.4 PIPE CLAMPS

A. Riser Clamp: MSS SP 58 and SP 69, Type 8.
1. Anvil International; Figure 261SS.
2. Approved equal.

2.5 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.

2.6 ACCESSORIES

A. Insulation Shields:
   1. Type: Stainless steel, MSS SP 58 and SP 69, Type 40.

B. Welding Insulation Saddles:
   1. Type: MSS SP 58 and SP 69, Type 39.

2.7 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.

2.8 PIPE ALIGNMENT GUIDES

A. Type:
   1. Piping 200 mm and Smaller: Spider or sleeve type.
   2. Piping 250 mm and Larger: Roller type.

2.9 PIPE ANCHORS

A. Type: Anchor chair with U bolt strap.

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 stainless 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: Stainless steel 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 15204

PROCESS PIPING SPECIALTIES

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Connectors

B. Couplings

C. Expansion Joints

D. Flexible Expansion Joints

E. Seal Water Hose

F. Miscellaneous Specialties

G. Service Saddles

H. Pipe Sleeves

I. Accessories

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: NPS 1/2 through NPS 24.

C. American Water Works Association:
   1. AWWA C153/A21.53 - Ductile Iron Compact Fittings, 3 in. (76 mm) through 64 in. (1,600 mm), for Water Service.
   2. AWWA C210 - Liquid Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
   3. AWWA C213 - Fusion Bonded Epoxy Coating for the Interior and Exterior of Steel Water Pipelines.
   4. AWWA C219 - Bolted, Sleeve Type Couplings for Plain End Pipe.
   5. AWWA Manual M11, Steel Water Pipe—A Guide for Design and Installation.

D. ASTM International:
   1. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot Dip) on Iron and Steel Hardware.
   2. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.

1.3 PROGRESS SUBMITTALS

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

B. Action Submittals: Manufacturer's data on materials, construction, end connections, ratings, overall lengths, and live lengths (as applicable).

C. Informational Submittals:
   1. Coupling Harness:
      a. Details, ratings, calculations and test reports for thrust restraints relying on welded bars or rings.
      b. Weld procedure qualifications.
      c. Load proof testing report of prototype restraint for any size coupling.
   2. Basket Strainer:
      a. Manufacturer's written/printed installation instructions.
      b. Manufacturer's Certificate of Proper Installation as specified in Section 01640 - Manufacturers' Services.
   3. Operation and Maintenance Data as specified in Section 01430 – Operation and Maintenance Data.

PART 2 PRODUCTS

2.1 GENERAL

A. Provide required piping specialty items, whether shown or not shown on the Drawings, as required by all applicable codes and standard industry practice.

B. Rubber ring joints, mechanical joints, flexible couplings, and proprietary restrained ductile iron pipe joints are considered flexible joints; welded, screwed, and flanged pipe joints are not considered flexible.

2.2 CONNECTORS

A. Elastomer Bellows Connector:
   1. Type: Fabricated spool, with single filled arch.
   2. Materials: Nitrile tube and wrap applied neoprene cover.
   3. End Connections: Flanged, drilled Class 125 ASME B16.1 standard, with full elastomer face and steel retaining rings.
   4. Working Pressure Rating: 965 kPag, minimum, at 82 degrees C for sizes 300 mm and smaller.
   5. Thrust Restraint: Control rods to limit travel due to elongation and compression.
   6. Manufacturers and Products:
      a. EVR Rubber, Series SJ-21 and SJ-205
      b. Flexicraft, Ultraspool
      c. Global-Flex Mfg., Style REJ
      d. Redvalve, Redflex J-1
      e. Approved Equivalent

B. Metal Bellows Connector:
   1. Type: Single ply, annular corrugated metal bellows with limit rods. Circumferential convolution welds are not permitted.
   2. Material: Type 316 stainless steel.

3. End Connections: ANSI Class 150 carbon steel flanges.
4. Minimum Design Working Pressure: 1,035 kPa at 398 degrees C .
5. Length: Minimum of four convolutions and minimum manufacturer recommendation for vibration isolation.
6. Manufacturers and Products:
    a. Flexicraft
    b. Global-Flex Mfg.
    c. Unaflex
    d. Approved Equivalent.

C. Flexible Metal Hose Connector:
1. Type: Close pitch, annular corrugated with single braided jacket.
2. Material: Bronze.
3. End Connections: Female copper solder joint.
4. Minimum Burst Pressure: 3,450 kPa at 20 degrees C.
5. Length: The minimum manufacturer's recommendation for vibration isolation.
6. Manufacturers and Products:
    a. Flexicraft
    b. Global-Flex Mfg.
    c. Unaflex
    d. Approved Equivalent.

D. Closure Collar Concrete: As specified in Section 03300 - Cast-in-Place Concrete

E. Quick Connect Couplings for Chemical Services:
1. Type: Twin cam arm actuated, male and female, locking, for chemical loading and transfer.
2. Materials: Glass filled polypropylene or PVDF with EPDM, Viton A or Teflon gaskets as recommended for the type of service by the manufacturer.
3. End Connections: NPT threaded or flanged to match piping connections. Hose shank for chemical installations.
4. Plugs and Caps: Female dust cap for each male end; male dust plug for each female end.
5. Pressure Rating: 860 kPa, minimum, at 20 degrees C.

2.3 COUPLINGS

A. General:
1. Couplings shall be rated for a working pressure not less than the pressure indicated in the Piping Schedule attached to Section 15200 for the service and not less than 1,305 kPa.
2. Couplings shall be lined and coated with fusion bonded epoxy in accordance with AWWA C213 or liquid epoxy in accordance with AWWA C210-07.
3. Unless thrust restraint is provided by other means, couplings shall be harnessed in accordance with the requirements of AWWA Manual M11, and restrained with retainer bar or ring welded to pipe end, or as shown on the Drawings.
4. Sleeve type couplings shall conform to AWWA C219 and shall be hydraulically expanded beyond the minimum yield for accurate sizing and proofing of tensile strength.

B. Restrained Flange Adapter:
1. Pressure Rating:
    a. Minimum Working Pressure Rating: Not less than 1,305 kPa.

b. Safety Factor: Not less than two times the working pressure and shall be supported by the manufacturer's proof testing.

2. Thrust Restraint:
   a. Provide hardened steel wedges that bear against and engage the outer pipe surface, and allow articulation of pipe joint after assembly while wedges remain in their original setting positions on the pipe surface.
   b. Products employing set screws that bear directly on pipe will not be acceptable.

C. Dismantling Joints:
1. Pressure Rating:
   a. The minimum working pressure rating shall not be less than the rating of the connecting flange.
   b. Proof testing shall conform to the requirements of AWWA C219 for bolted couplings.

2.4 FLEXIBLE EXPANSION JOINTS

A. Design:
1. Ball and socket type for earth settlement compensation.
2. Joints shall be double ball assemblies rated for 15 degree minimum deflection and not less than 100 mm offset from centerline of connecting piping.
3. Assembly shall accommodate up to 100 mm of expansion in length.
4. Ductile iron conforming to AWWA C153/A21.53.
5. Rated for 2,415 kPa.
6. Components shall be lined and coated by the manufacturer with fusion bonded epoxy on all surfaces not bearing gaskets.
7. End Connections: Flanged or mechanical joint as shown on the Drawings and as required by connecting pipe and fittings.
8. Joints connecting to mechanical joints shall be thrust restrained.
9. Bonding:
   a. The manufacturer shall factory install thermite welded joint bonds for assembled expansion joints.
   b. Provide 600 mm bond wires for field bonds to adjacent metallic piping.
   c. Bond wires shall be No. 2 AWG with two 600 mm long THHN insulated No. 12 AWG wire pigtails.

2.5 SWIVEL JOINT

A. Style 30 swivel joint for decanting system. SS 316 construction with EPDM seals on either side of the fitting. Suitable for submerged application. Class 150 flanges.

2.6 SEAL WATER HOSE

A. EPDM black cover and EPDM tube, reinforced with two textile braids, 10 mm with male NPT ends.
1. Rated minimum working pressure of 1,380 kPa.

2.7 MISCELLANEOUS SPECIALTIES

A. Strainers, Plastic Piping Systems, 100 mm and Smaller:
   1. Type: Y pattern PVC body, 1,035 kPa non-shock rated, with screwed PVC cap and Viton seals
   2. End Connections: Screwed or solvent weld, 50 mm and smaller. Class 150 ANSI flanged, 65 mm and larger.
   3. Screen: Heavy-gauge PVC, 0.8 mm mesh, minimum 2:1 screen area to pipe size ratio.

B. Pump Seal Water Sight Flow Indicators:
   1. Bronze body, 10 mm horizontal, ball action with tempered glass.
   2. Rated 860 kPa with NPT screwed ends.
   3. Operate with a minimum flow of 0.94 Litres/ min.

2.8 SERVICE SADDLES

A. Double Strap Iron:
   1. Pressure Rating: Capable of withstanding 1,305 kPa of internal pressure without leakage or over stressing.
   2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
   3. Taps: Iron pipe threads.
   4. Materials:
      a. Body: Malleable or ductile iron.
      b. Straps: Galvanized steel.
      c. Hex Nuts and Washers: Steel.
      d. Seal: Rubber.

B. Nylon Coated Iron:
   1. Pressure Rating: Capable of withstanding 1,305 kPa of internal pressure without leakage or over stressing.
   2. Run Diameter: Compatible with outside diameter of pipe on which saddle is installed.
   3. Materials:
      a. Body: Nylon coated iron.
      b. Seal: Buna N.
      c. Clamps and Nuts: Stainless steel.

2.9 PIPE SLEEVES

A. Steel Pipe Sleeve:
   1. Minimum Thickness: 4.7 mm.
   2. Seep Ring:
      a. Center steel flange for water stoppage on sleeves in exterior or water bearing walls, 4.7 mm minimum thickness.
      b. Outside Diameter: Unless otherwise shown on the Drawings, 80 mm greater than the outside diameter of the pipe sleeve.
      c. Continuously fillet weld on each side all around.
   3. Factory Finish:
      a. Galvanizing:
      b. Hot dip applied, meeting the requirements of ASTM A153/A153M.
      c. Electroplated zinc or cadmium plating is unacceptable.
      d. Shop Lining and Coating: Factory prepare, prime, and finish coat in accordance with Section 09900 – Painting and Protective Coatings.

4. Molded Polyethylene Pipe Sleeve:
    a. Molded HDPE with integral water stop ring not less than 80 mm larger than the sleeve.
    b. Provided with end caps for support during concrete placement.
5. Modular Mechanical Seal:
    a. Type: Interconnected synthetic rubber links shaped and sized to continuously fill the annular space between the pipe and wall sleeve opening.
    b. Fabrication:
        1) Assemble interconnected rubber links with ASTM A276, Type 316 stainless steel bolts and nuts.
        2) Pressure plates shall be reinforced nylon polymer.
        3) Size: According to manufacturer's instructions for size of pipes shown to provide a watertight seal between pipe and wall sleeve opening and to withstand a hydrostatic head of 12 m of water.

2.10 ACCESSORIES

A. Ductile Iron Wall Pipe:
1. Diameter and Ends: Same as for the connecting ductile iron pipe.
2. Thickness: Equal to, or greater than, the remainder of pipe in line.
3. Fittings: In accordance with the applicable Pipe Data Sheet attached to Section 15200.
4. Thrust Collars:
    a. Rated for thrust load developed at 1,725 kPa.
    b. Safety Factor: 2, minimum.
    c. Material and Construction: Ductile iron or cast iron, cast integral with wall pipe wherever possible, or thrust rated, welded attachment to wall pipe.

B. Steel or Stainless Steel Wall Pipe:
1. Same material and thickness as connecting pipe, except that it must have a minimum thickness of 6.3 mm.
2. Lining: Same as connecting pipe.
3. Thrust Collar:
    a. Outside Diameter: Unless otherwise shown on the Drawings, 80 mm greater than the outside diameter of wall pipe.
    b. Continuously fillet welded on each side all around.

C. Strainers, Water Service, 50 mm in diameter and Smaller:
1. Type: Bronze body, Y pattern, 1,380 kPa non shock rated, with screwed gasketed bronze cap.
2. Screen: Heavy gauge Type 304 stainless steel or monel - 20 mesh.

D. Strainers, Water Service, 65 mm in Diameter and Larger:
1. Type: Cast iron or ductile iron body, Y pattern, 1,200 kPa non-shock rated, with flanged gasketed iron cap.
2. Screen: Heavy gage Type 316 stainless steel, 1.1 mm perforations.

E. Water Hose:
1. Furnish 15 m lengths of 25 mm and 15 m lengths of 40 mm rubber hose. EPDM black cover and EPDM tube, reinforced with 2 textile braids. Provide each length with brass male and female NST hose thread couplings to fit the hose nozzle and hose valve.
2. Rated minimum working pressure of 1,380 kPa.

F. Hose Nozzles: Furnish 40 mm cast brass, satin finish, nozzles with adjustable fog, straight stream, and shut off feature and rubber bumper. Provide nozzles with female NST hose thread.

2.11 MANUFACTURERE'S SERVICES

A. Provide a manufacturer's representative at the Site in accordance with Section 01640, Manufacturers' Services, Section 01662, Facility Commissioning, Section 01810, Equipment Testing and Facility Startup and Section 01820, Demonstration and Training for installation assistance, inspection and certification of proper installation, equipment testing, startup assistance, and training of OWNER's personnel for each specified component, subsystem, equipment, or system.

PART 3 EXECUTION

3.1 PREPERATION

A. Provide accessibility to piping specialties for control and maintenance.

3.2 PIPING FLEXIBILITY PROVISIONS

A. General:
   1. Thrust restraint shall be provided as specified in Section 15200 - Process Piping and Fittings.
   2. Install flexible couplings to facilitate piping installation, in accordance with approved Shop Drawings.

B. Flexible Joints at Concrete Backfill or Encasement: Install within 450 mm or 1/2 pipe diameter, whichever is less, from the termination of any concrete backfill or concrete encasement.

C. Flexible Joints at Concrete Structures:
   1. Install 450 mm or less from face of structures; joint may be flush with face.
   2. Install a second flexible joint, whether or not shown on the Drawings.
      a. Pipe Diameter 450 mm and Smaller: Within 450 mm of first joint.
      b. Pipe Diameter Larger than 450 mm: Within one pipe diameter of first joint.

D. Flexible expansion joints shall be provided to compensate for earth settlement at buried piping connections to structure wall pipes. Wrap complete joint assembly in a double layer of polyethylene encasement, as specified in Section 15200 - Process Piping and Fittings.

3.3 PIPING TRANSITION

A. Applications:
   1. Provide complete closure assembly where pipes meet other pipes or structures.
   2. Pressure Pipeline Closures: Plain end pieces with double flexible couplings, unless otherwise shown on the Drawings.
   3. Restrained Joint Pipe Closures: Install with thrust tie rod assemblies as shown or in accordance with NFPA 24.
   4. Gravity Pipe Closures: As specified for pressure pipelines, or concrete closures.

5. Concrete Closures: Use to make connections between dissimilar pipes where standard rubber gasketed joints or flexible couplings are impractical, as approved by ENGINEER.
6. Elastomer sleeves bonded to pipe ends are not acceptable.

B. Installation:
1. Flexible Transition Couplings: Install in accordance with the coupling manufacturer's instructions to connect dissimilar pipe and pipes with a small difference in outside diameter.
2. Concrete Closures:
a. Locate away from structures so there are at least 2 flexible joints between closure and pipe entering structure.
b. Clean the pipe surface before placing closure collars.
c. Wet nonmetallic pipe thoroughly prior to pouring collars.
d. Prevent concrete from entering pipe.
e. Extend collar a minimum of 300 mm on each side of joint with a minimum thickness of 150 mm around outside diameter of pipe.
f. Make entire collar in one placement.
g. After concrete has reached initial set, cure by covering with well moistened earth.

3.4 SLAB, FLOOR, WALL AND ROOF PENETRATIONS

A. Applications:
1. Watertight and Below Ground Penetrations:
a. Wall pipes with thrust collars.
b. Provide taps for stud bolts in flanges to be set flush with wall face.
2. Non watertight Penetrations: Pipe sleeves with seep ring.
3. Existing Walls: Rotary drilled holes.
4. Fire Rated or Smoke Rated Walls, Floors or Ceilings: Insulated and encased pipe sleeves.

B. Wall Pipe Installation:
1. Isolate embedded metallic piping from concrete reinforcement using coated pipe penetrations as specified in Section 09900 – Painting and Protective Coatings.
2. Support wall pipes securely by formwork to prevent contact with reinforcing steel and tie wires.

3.5 PIPING EXPANSION

A. Piping Installation: Allow for thermal expansion due to differences between installation and operating temperatures.

B. Expansion Joints:
1. Grooved Joint and Flanged Piping Systems: Elastomer bellows expansion joint.
2. Nonmetallic Pipe: Teflon bellows expansion joint.
3. Screwed and Soldered Piping Systems: Copper or galvanized and black steel pipe expansion compensator, as applicable.
4. Air and Water Service above 49 degrees C: Metal bellows expansion joint.
5. Pipe Run Offset: Flexible metal hose.

C. Anchors and Anchor Walls: Install as specified in Section 15201 - Piping Support Systems, to withstand expansion joint thrust loads and to direct and control thermal expansion.

3.6 SERVICE SADDLES

A. Ferrous Metal Piping (except stainless steel): Double strap iron.

B. Plastic Piping: Nylon coated iron.

3.7 COUPLINGS

A. Install in accordance with the manufacturer's written instructions.

B. Before coupling, clean pipe holdback area of oil, scale, rust, and dirt.

C. Do not remove pipe coating. If damaged, repair before joint is made.

D. Application:
   1. Metallic Piping Systems: Flexible couplings, transition couplings, and flanged coupling adapters.
   2. Concrete Encased Couplings: Flexible coupling.

3.8 FLEXIBLE PIPE CONNECTIONS TO EQUIPMENT

A. Install to prevent piping from being supported by equipment, for vibration isolation, and where shown on the Drawings.

B. Product Applications Unless Shown Otherwise on the Drawings:
   1. Nonmetallic Piping: Teflon bellows connector.
   2. Copper Piping: Flexible metal hose connector.
   3. Compressor and Blower Discharge: Metal bellows connector.

C. All Other Piping: Elastomer bellows connector.

D. Limit Bolts and Control Rods: Tighten snug prior to applying pressure to the system.

3.9 PIPE SLEEVES

A. Application:
   1. As specified in Section 15200 - Process Piping and Fittings.
   2. Above Grade in Nonsubmerged Areas: Hot dip galvanized after fabrication.
   3. Below Grade or in Submerged or Damp Environments: Shop lined and coated.
   4. Alternatively, Molded Polyethylene Pipe Sleeve may be applied if specified in the Contract Documents.

B. Installation:
   1. Support non-insulating type securely in formwork to prevent contact with reinforcing steel and tie wires.
   2. Caulk joint with the specified sealant in non-submerged applications and seal below grade and submerged applications with wall penetration seal.

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 and to facilitate opening/closing by personnel without stretching beyond handrails.

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. Valve schedule attached at the end of this section. Only main process valves are included in this listing. Contractor shall provide ancillary drain / vent and instrumentation valves as required and as indicated on the drawings.

2.2 BUTTERFLY VALVE

A. Butterfly Valves, Resilient Seated, 50 mm to 900 mm for Low Pressure Process Air Service:
   1. Flanged style cast iron body, stainless steel discs, Type 304 stainless steel one piece stem, self-lubricating sleeve type bearing, EPDM replaceable resilient seat suitable for operating temperatures up to 121 degrees Celsius, 1,035 kPa working pressure rating, bubble tight at 345 kPa differential pressure.
   2. Acceptable Manufacturers:
      a. Bray
      b. DeZurik
      c. Approved equal

2.3 GATE VALVE

A. Resilient Seated Gate Valves, 75 mm to 500 mm:
   1. The gate valves shall be manufactured in accordance with AWWA standard C509, C515 and be approved by UL/ULC/FM and fusion epoxy coated inside and out in accordance with AWWA C550-13
   2. The gate valves shall be non-rising stem.
   3. The wedge shall be of cast iron completely encapsulated with rubber. The sealing rubber shall be permanently bonded to the cast iron wedge to meet ASTM tests for rubber metal bond.
   4. Stems for NRS assemblies shall be cast bronze with integral collars in full compliance with AWWA requirements. The NRS stem stuffing box shall be the "O" ring seal type

with two "O" rings located above thrust collar. The two "O" rings shall be replaceable with the gate valve fully open and subjected to fully rated working pressure.

5. There shall be two low torque thrust bearings located above and below the stem collar. The stem nut shall be independent of wedge and shall be made of solid bronze. There shall be a smooth, unobstructed waterway free of all pockets, cavities and depressions in the seat area.
6. The entire gate valve including the gland cover, body and bonnet, shall be epoxy coated both on the interior and exterior. Each valve shall have maker's name, pressure rating and year in which manufactured, cast on the body.
7. For valves requiring indicator post
    a. UL/ULC listed, iron body, bronze mounted, non-rising stem rated 1,207 kPa WOG, AWWA C111/A21.11 mechanical joint ends.
    b. Double disc type gate, bronze wedge pins, parallel seat, gate stem sealed with double O-ring pressure and dirt seal.
    c. Bolted flanged bonnet for mounting indicator post, indicator post to be locking type with an adjustable barrel and weather sealed indicator window to display OPEN and SHUT positions.
8. The pressure rating shall be 1724 kPa under AWWA specifications and 1379 kPa under ULC.
9. Prior to shipment from factory, each valve shall be tested by hydrostatic pressure equal to requirement for both AWWA (twice the specified working pressure) & ULC requirements. Bolting shall be stainless Type 316.
10. Acceptable Manufacturers
    a. Clow
    b. Mueller
    c. Approved equal

B. Knife Gate Valves 600 mm and Smaller:
1. Bonnet-less lug style, outside stem and yoke, rated for 1,035 kPa CWP minimum, ASME B16.1 flanged ends, self-cleaning, non-clogging, with round port, resilient neoprene seat, drip tight shutoff.
2. Body and stem, Type 316 stainless steel, yoke sleeve bronze, gate finish ground both sides with a sharp knife edge.
3. Packing system leak tight seal around the gate, valve superstructure and yoke designed for full peripheral access to gland bolts when valve is equipped with manual or power actuator.
4. In compliance with MSS SP 81.
5. Resilient viton seat with drip tight shut off.
6. Acceptable Manufacturers
    a. Stafsjo
    b. Trueline
    c. Approved equal

2.4 CHECK VALVE

A. Swing-Flex Check Valves 50 mm to 600 mm:
1. AWWA C508, 125-pound flanged ends, ductile iron body, bronze body seat, bronze mounted clapper with bronze seat, stainless steel hinge shaft.
2. Ductile iron body, fusion bonded epoxy coating interior and exterior meeting the requirements of AWWA C550. Body and cap to be ASTM A536 Ductile Iron.
3. Disc shall be Buna N (with alloy steel and nylon reinforcement).

4. Valves, 50 mm through 300 mm rated 1,207 kPa and 350 mm through 600 mm rated 1,035 kPa CWP, non-shock. Increasing pattern body valve may be used where increased outlet piping size is shown.
5. Acceptable Manufacturers
   a. Val-Matic
   b. APCO
   c. Approved equal

2.5 COMBINATION AIR AND VACUUM RELEASE VALVE

A. Combination Air Release Valves 25 mm to 400 mm:
   1. Suitable for water service, combines the operating features of both an air and vacuum valve and air release valve. Air and vacuum portion shall automatically exhaust air during filling of system and allow air to re-enter during draining or when vacuum occurs. The air release portion shall automatically exhaust entrained air that accumulates in the system.
   2. Rated for1,035 kPa working pressure, cast iron, ductile iron body and cover, stainless steel float and trim, built and tested to AWWA C512-15.
   3. Valve single body or dual body, air release valve mounted on air and vacuum valve, isolation valve mounted between the dual valves. 25 mm through 75 mm valves with NPT threaded inlet and outlet, 100-mm and larger valves with ASME B16.1-2015 Class 125 flanged inlet and cover outlet.

2.6 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.

6. Valves with manual operator located along the inside wall of tanks/digesters shall be fitted with extension stem to facilitate opening/closing by personnel without stretching beyond handrails. Provide support to the stem extension rod as recommended by the manufacturer. Provide floor box and T wrench where required to facilitate operation from floor.

C. Indicator Post:
1. Bolted flanged bonnet on valve for mounting indicator post, indicator post to be locking type with an adjustable barrel and weather sealed indicator window to display OPEN and SHUT positions.

D. 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 (gauge) 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 gear case. 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 gear case 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 gear case 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. <u>Available Mode</u> <u>Fault Mode</u>

- Loss of main or customer 24V DC power supply power supply
- Actuator control selected to local or stop
- Motor thermostat tripped
- Actuator internal fault

- Loss of main or customer 24V DC
- Motor thermostat tripped
- 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 data logger 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. Data logger 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 data logger 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.

END OF SECTION

VALVE SCHEDULE

Bruce Power Tag	Valve	P&ID	Valve Type	Size	Operation
WW-79630-V42	Throttling Valve to North Train	P-003	Knife Gate Valve	10	Manual
WW-79630-V43	Throttling Valve to East Train	P-003	Knife Gate Valve	8	Manual
WW-79630-V44	Throttling Valve to West Train	P-003	Knife Gate Valve	10	Manual
WW-79610-V45	Aeration Tank Drain Valve	P-003	Gate Valve	8	Manual
WW-79610-V46	North Train WAS Valve	P-003	Gate Valve	4	Electric
WW-79610-V47	North Train RAS Valve	P-003	Gate Valve	4	Electric
WW-79630-V48	North Train Aeration Tank Diffuser Grid Isolation Valve #1	P-003	Butterfly Valve	4	Manual
WW-79630-V49	North Train Aeration Tank Diffuser Grid Isolation Valve #2	P-003	Butterfly Valve	4	Manual
WW-79610-V50	North Train RAS/WAS Pump #1 Discharge Isolation Valve	P-003	Gate Valve	3	Manual
WW-79610-V51	North Train RAS/WAS Pump #1 Discharge Check Valve	P-003	Swing Check Valve	3	N/A
WW-79610-V52	North Train RAS/WAS Pump #2 Discharge Isolation Valve	P-003	Gate Valve	3	Manual
WW-79610-V53	North Train RAS/WAS Pump #2 Discharge Check Valve	P-003	Swing Check Valve	3	N/A
WW-79610-V54	North Train RAS/WAS Pump #3 Discharge Isolation Valve	P-003	Gate Valve	3	Manual
WW-79610-V55	North Train RAS/WAS Pump #3 Discharge Check Valve	P-003	Swing Check Valve	3	N/A
WW-79610-V56	North Train Effluent Discharge Valve #1	P-003	Gate Valve	10	Manual
WW-79610-V57	North Train Effluent Discharge Valve #2	P-003	Gate Valve	10	Manual
WW-79630-V58	North Train Aerobic Digester Stage 1 Diffuser Grid Isolation Valve	P-004	Butterfly Valve	4	Manual
WW-79630-V59	North Train Aerobic Digester Stage 2 Diffuser Grid Isolation Valve	P-004	Butterfly Valve	4	Manual
WW-79610-V60	North Train Aerobic Digester Intermediate Valve #1	P-004	Gate Valve	8	Manual
WW-79610-V61	North Train Aerobic Digester Intermediate Valve #2	P-004	Gate Valve	8	Manual
WW-79610-V62	North Train Aerobic Digester Intermediate Valve #3	P-004	Gate Valve	8	Manual
WW-79610-V63	North Train Aerobic Digester Stage 2 Drain Valve	P-004	Gate Valve	8	Manual
WW-79610-V64	Sludge Wasting/Decant Pump #1 Discharge Check Valve	P-004	Swing Check Valve	4	N/A
WW-79610-V65	Sludge Wasting/Decant Pump #2 Discharge Check Valve	P-004	Swing Check Valve	4	N/A

WW-79610-V66	Sludge Wasting/Decant Discharge Valve #1	P-004	Gate Valve	4	Indicator Post
WW-79610-V67	Sludge Wasting/Decant Discharge Valve #2	P-004	Gate Valve	4	Indicator Post
WW-79630-V68	North Train Blower #1 Discharge Check Valve	P-005	Swing Check Valve	4	N/A
WW-79630-V69	North Train Blower #1 Discharge Isolation Valve	P-005	Butterfly Valve	4	Manual
WW-79630-RV70	North Train Blower #1 Pressure Relief Valve	P-005	PRV	3	N/A
WW-79630-V74	North Train Blower #2 Discharge Check Valve	P-005	Swing Check Valve	4	N/A
WW-79630-V75	North Train Blower #2 Discharge Isolation Valve	P-005	Butterfly Valve	4	Manual
WW-79630-RV76	North Train Blower #2 Pressure Relief Valve	P-005	PRV	3	N/A
WW-79630-V81	North Train Blower #3 Discharge Check Valve	P-005	Swing Check Valve	4	N/A
WW-79630-V82	North Train Blower #3 Discharge Isolation Valve	P-005	Butterfly Valve	4	Manual
WW-79630-RV83	North Train Blower #3 Pressure Relief Valve	P-005	PRV	3	N/A
WW-79630-NV88	North Train Blower #4 Discharge Check Valve	P-005	Swing Check Valve	4	N/A
WW-79630-V89	North Train Blower #4 Discharge Isolation Valve	P-005	Butterfly Valve	4	Manual
WW-79630-RV90	North Train Blower #4 Pressure Relief Valve	P-005	PRV	3	N/A
WW-79630-V95	Blower Header Isolation Valve #1	P-005	Butterfly Valve	6	Manual
WW-79630-V96	Blower Header isolation Valve #2	P-005	Butterfly Valve	6	Manual
WW-79630-V97	Aeration Tank Feed Line Isolation Valve	P-005	Butterfly Valve	6	Manual
WW-79630-V98	Aerobic Digester Feed Line Isolation Valve	P-005	Butterfly Valve	6	Manual
WW-79610-V99	East Train RAS/WAS Pump #1 Discharge Isolation Valve	P-006	Gate Valve	3	Manual
WW-79610-NV100	East Train RAS/WAS Pump #1 Discharge Check Valve	P-006	Swing Check Valve	3	N/A
WW-79610-V101	East Train RAS/WAS Pump #2 Discharge Isolation Valve	P-006	Gate Valve	3	Manual
WW-79610-NV102	East Train RAS/WAS Pump #2 Discharge Check Valve	P-006	Swing Check Valve	3	N/A
WW-79610-V103	East Train RAS/WAS Pump #3 Discharge Isolation Valve	P-006	Gate Valve	3	Manual
WW-79610-NV104	East Train RAS/WAS Pump #3 Discharge Check Valve	P-006	Swing Check Valve	3	N/A

WW-79610-V105	West Train RAS/WAS Pump #1 Discharge Isolation Valve	P-007	Gate Valve	3	Manual
WW-79610-NV106	West Train RAS/WAS Pump #1 Discharge Check Valve	P-007	Swing Check Valve	3	N/A
WW-79610-V107	West Train RAS/WAS Pump #2 Discharge Isolation Valve	P-007	Gate Valve	3	Manual
WW-79610-NV108	West Train RAS/WAS Pump #2 Discharge Check Valve	P-007	Swing Check Valve	3	N/A
WW-79610-V109	West Train RAS/WAS Pump #3 Discharge Isolation Valve	P-007	Gate Valve	3	Manual
WW-79610-NV110	West Train RAS/WAS Pump #3 Discharge Check Valve	P-007	Swing Check Valve	3	N/A
WW-79610-MV11	East Train WAS Valve	P-006	Gate Valve	6	Electric
WW-79610-MV12	East Train RAS Valve	P-006	Gate Valve	6	Electric
WW-79610-MV13	West Train WAS Valve	P-007	Gate Valve	6	Electric
WW-79610-MV14	West Train RAS Valve	P-007	Gate Valve	6	Electric

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:
1. Test in accordance with Division 2 – Site Work, in general
2. Perform testing after service connections, manholes, and backfilling have been completed between stations to be tested.
3. Determine groundwater level at time of testing by exploratory holes or another method acceptable to ENGINEER.
4. Pipe 1050 mm in Diameter and Larger: Joint testing device may be used to isolate and test individual joints.

3.2 HYDROSTATIC TEST FOR PRESSURE PIPING (RIGID)

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: 0.76 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 4 bolts, or use equipment vents to purge air pockets.
4. Maintain the hydrostatic test pressure continuously for a minimum of 30 minutes, 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.
7. Empty the pipe of water prior to final cleaning or disinfection.

C. Buried Piping:
1. Test after backfilling has been completed.
2. Expel air from the piping system during filling.
3. Apply and maintain the specified test pressure with a hydraulic force pump. Valve off the piping system when the test pressure is reached.
4. Maintain hydrostatic test pressure continuously for a minimum of 2 hours, reopening the isolation valve only as necessary to restore test pressure.
5. Determine actual leakage by measuring the quantity of water necessary to maintain the specified test pressure for the duration of the test.
6. Correct any leakages greater than those allowable under the Contract, and retest as specified, at CONTRACTOR's expense.

3.3 PNEUMATIC TEST FOR PRESSURE PIPING (RIGID)

A. Hydrostatic testing is the preferred method of ENGINEER due to safety considerations. Pneumatic testing should only be considered for chemical or other process piping with "dry" requirements. Do not perform pneumatic testing under any circumstances on:
1. PVC or CPVC pipe.
2. Piping larger than 450 mm.

3. Buried and other non-exposed piping.

B. Fluid: Oil-free, dry air.

C. Procedure:
1. Apply preliminary pneumatic test pressure of 172 kPa maximum to the piping system prior to final leak testing, to locate visible leaks. Apply a soap bubble mixture to joints and connections; examine for leakage.
2. Correct visible leaks and repeat preliminary testing until all visible leaks are corrected to the satisfaction of ENGINEER.
3. Gradually increase the pressure in the system to half of the specified test pressure. Thereafter, increase the pressure in steps of approximately 1/10 of the specified test pressure until the required test pressure is reached.
4. Maintain the pneumatic test pressure continuously for a minimum of 10 minutes and for such additional time as necessary to conduct soap bubble examination for leakage.
5. Correct all visible leakage and retest as specified herein, at CONTRACTOR's expense.

D. Allowable Leakage: The piping system, exclusive of possible localized instances at pump or valve packing, shall show no visual evidence of leakage.

E. After testing and final cleaning, purge with nitrogen those lines that will carry flammable gases to ensure that no explosive mixtures will be present in the system during the filling process.

3.4 HYDROSTATIC TEST FOR PRESSURE PIPING (FLEXIBLE)

A. Applies to PE, PEX and HDPE.

B. Complete hydrostatic pressure testing in accordance with ASTM F2164-13.

C. Refer to Section 02501 for details.

3.5 HYDROSTATIC TEST FOR GRAVITY PIPING

A. Testing Equipment Accuracy: Plus or minus 1.9 L of water leakage under the specified conditions.

B. Maximum Allowable Leakage: 0.078 L per hour per millimeter of diameter per 30.48 m (100 feet). Include service connection footage in the test section, subjected to the minimum head specified in the Contract Documents.

C. Gravity Sanitary and Roof Drain Piping: Test with 4.6 m of water to include the highest horizontal vent in filled piping. Where vertical drain and vent systems exceed 4.6 m in height, test systems in 4.6 m vertical sections as the piping is installed.

D. Exfiltration Test:
1. Hydrostatic Head:
a. At least 1.8 m above the maximum estimated groundwater level in the section being tested.
b. No less than 1.8 m above the inside top of the highest section of pipe in the test section, including service connections.

2. Length of Pipe Tested: Limit length such that pressure on the invert of the lower end of the section does not exceed 9.1 m of water column.

E. Infiltration Test: Groundwater Level: At least 1.8 m above the inside top of the highest section of pipe in the test section, including service connections.

F. Piping with a groundwater infiltration rate greater than the allowable leakage rate for exfiltration will be considered defective even if the pipe previously passed a pressure test.

G. Defective Piping Sections: Replace and retest as specified herein, at CONTRACTOR's expense.

3.6 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 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.

G. Supply all material, equipment, and fitting whether specifically specified or not to provide a waterproof installation for all panels, boxes, cables, and conduit.

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 16016

ELECTRICAL POWER SYSTEM STUDY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Short Circuit Study.
   2. Protective Device Evaluation and Coordination Study.
   3. Arc Flash Hazard Assessment.
   4. Harmonic Analysis Study.

1.2 REFERENCES

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

B. American National Standards Institute (ANSI).

C. Canadian Standards Association (CSA).

D. Electrical Safety Authority (ESA).

E. Institute of Electrical and Electronics Engineers (IEEE).

F. Ontario Electrical Safety Code (OESC).

1.3 SYSTEM DESCRIPTION

A. Intent of the studies is to:
   1. Establish system short circuit ratings prior to equipment manufacturing.
   2. Establish settings required for protection devices.
   3. Establish arc flash hazard for electrical equipment.
   4. Install arc flash hazard warning labels to comply with the requirements of the Ontario Electrical Safety Code.
   5. Complete desktop harmonics study prior to approval of MCC and VFDs.

1.4 PROGRESS SUBMITTALS

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

B. Short Circuit Study:
   1. Fault current calculations including a definition of terms and guide for interpretation of computer printout, electrical system design data.
   2. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short circuit duties, and commentary regarding same.

C. Protective Device Evaluation and Coordination Study:
   1. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
   2. Implemented protective devices settings. Include settings for all protective devices.

D. Arc Flash Hazard Assessment:
   1. Arcing fault magnitude, protective device clearing time, duration of arc, arc flash boundary, working distance, incident energy, hazard risk category, and recommendations on arc flash energy reduction.
   2. Label drawings and samples for each electrical system, equipment or component analyzed.

E. Harmonic Analysis Study:
   1. Harmonics Study of the new electrical system complete with measured Harmonic distortion levels for both current and voltage.
   2. Recommendations identified in the Harmonics Study that are required to satisfy IEEE 519.

F. Electrical Safety Authority and UTILITY Submittals: Submit copies of the studies to ESA for their review and approval.

1.5 CLOSEOUT SUBMITTALS

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

B. The results of the power system study shall be summarized in a final report. In addition to the copies for UTILITY and ESA provide four copies of the final report. Final reports shall be submitted in printed and electronic format (PDF).

C. The final reports shall be sealed by a Professional Engineer licensed in Ontario and it will include the following sections:
   1. Descriptions, purpose, basis, electrical system design data, and scope of the study.
   2. Protective Device Evaluation and Coordination Study: Refer to Section 16016.1, Part 1.
   3. Short Circuit Study: Refer to Section 16016.2, Part 1.
   4. Arc Flash Hazard Assessment: Refer to Section 16016.3, Part 1.
   5. Harmonics Analysis Study: Refer to Section 16016.4, Part 1.

D. Submit copies of the final to the ESA, ENGINEER, and UTILITY.

1.6 QUALIFICATIONS

A. Studies shall be completed by Company specializing in high- and low-voltage power system evaluations with minimum 5 years documented experience.

B. Studies shall be performed, sealed (stamped and signed) by a registered professional Engineer experienced in power studies in the Province of Ontario.

C. Credentials of the individual(s) performing the study and background of the firm may be requested for approval prior to start of the work. A minimum of 10 years documented experience in power system analysis is required for the individual in charge of the project.

1.7 SEQUENCING AND SCHEDULING

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

B. Schedule work to submit short circuit study to ENGINEER and UTILITY prior to receiving final approval of the power distribution equipment and/or prior to the release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacture, provide preliminary submittal of sufficient study data to ensure that the selection of equipment ratings and characteristics will be satisfactory. Submit a draft of the study to ENGINEER for review. Make all additions or changes as required by ENGINEER.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

A. Power system studies shall be completed utilizing specialized computer software.

B. The studies shall include all portions of the electrical distribution system from normal power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those which result in maximum fault conditions will be adequately covered in the study.

C. Collect electrical data for preparation of the studies. Expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment Shop Drawings and/or prior to release of the equipment for manufacturer.

D. Protective Device Evaluation and Coordination Study: Refer to Section 16016.1, Part 2 for additional requirements.

E. Short Circuit Study: Refer to Section 16016.2, Part 2 for additional requirements.

F. Arc Flash Hazard Assessment: Refer to Section 16016.3, Part 2 for additional requirements.

G. Harmonic Analysis Study: Refer to Section 16016.4, Part 2 for additional requirements.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

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

B. ENGINEER shall inspect settings in accordance with final reports.

3.2 REPORTS

A. Protective Device Evaluation and Coordination Study: Refer to Section 16016.1, Part 3 for requirements.

B. Short Circuit Study: Refer to Section 16016.2, Part 3 for requirements.

C. Arc Flash Hazard Assessment: Refer to Section 16016.3, Part 3 for requirements.

D. Harmonic Analysis Study: Refer to Section 16016.4, Part 3 for requirements.

3.3 MANUFACTURER'S FIELD SERVICES

A. Section 01400 - Quality Requirements: Requirements for preparing and starting systems.

B. Provide assistance during start up in configuration of protective devices.

3.4 ADJUSTING

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

B. Adjust protective devices to place electrical power equipment in final operating condition. The settings shall be in accordance with the protective device evaluation study, and protective device coordination study.

C. Include detailed solutions and for mitigating the total harmonic voltage distortion and total current demand distortion on the system.

END OF SECTION

SECTION 16016.1

ELECTRICAL COORDINATION STUDY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Protective device evaluation and coordination study.
   2. Configuration and testing of electrical protective devices, associated with the protective device evaluation and coordination.
   3. Objectives: The intent of the electrical protective device evaluation and coordination study is to:
      a. Verify that the specified and supplied equipment are properly rated, correctly applied and within industry and manufacturer's tolerances.
      b. Determine the correct settings for the protective devices which will minimize the damage caused by an electrical fault and allow for selective coordination between the devices.

B. Related Sections:
   1. Section 16016.2 – Short Circuit Study.
   2. Section 16016.3 – Arc Flash Hazard Assessment.

1.2 REFERENCES

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

B. Canadian Standards Association: CSA C22.1-12, Canadian Electrical Code, Part I (Latest Edition), Safety Standard for Electrical Installations.

C. Electrical Safety Authority (ESA).

D. Institute of Electrical and Electronics Engineers (IEEE).

E. Ontario Electrical Safety Code (OESC).

1.3 PROGRESS SUBMITTALS

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

B. Submit qualifications of individual(s) who will perform work for approval prior to commencement of the studies and computer software package details.

C. Submit protective device evaluation and coordination study report for review by ENGINEER, UTILITY, and ESA.

D. Final study report and design shop drawings shall be sealed (stamped and signed) by a professional engineer licenced in the Province of Ontario.

E. Reports shall be submitted in printed and electronic format (PDF).

F. Submit final relay settings files, as left in protection relays (as applicable).

1.4 QUALITY ASSURANCE

A. CONTRACTOR shall have the electrical study prepared by qualified engineers of an independent consultant, registered as a professional electrical engineer, licensed in the Province of Ontario, who has at least 10 years of experience and specializes in performing electrical power system studies. The independent consultant responsible for the scope of work in this section shall also be responsible for the inspection, testing and commissioning of the medium voltage equipment.

B. Perform studies using an industry recognized computer software package.

1.5 SEQUENCING

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

B. Coordination study, configuration and testing of electrical protective devices shall be completed before energizing the electrical system.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 DATA COLLECTION

A. Obtain and provide electrical data required for preparation of the studies.

3.2 PROTECTIVE DEVICE COORDINATION STUDY

A. Calculate by means of utilizing an industry recognized computer software package.

B. Meet or exceed CSA C22.1-2009 Canadian Electrical Code (CEC) and Ontario Electrical Safety Code 2009 (OESC).

C. Include all portions of the electrical distribution system as part of this project, from normal power source, including upstream utility protective devices, emergency power source or sources, down to and including the smallest circuit breakers in the distribution system. Prepare coordination curves to determine the required settings of protective devices to assure selective coordination.

D. Include phase and ground overcurrent protection, as well as settings for all other adjustable protective devices.

E. Provide time current curves graphically indicating the coordination proposed for the system. Graphically illustrate on log paper that adequate time separation exists between devices. Use

sufficient curves to clearly indicate the coordination achieved between devices. Maintain reasonable coordination intervals and separation of characteristic curves.

F. Plots (each curve sheet) shall include:
   1. Complete title, representative one line diagram with legend identifying the specific portion of the system covered by that particular curve sheet.
   2. Plot the specific time-current characteristics of each protective device in such a manner that the upstream devices will be clearly depicted on the sheet.
   3. Include a detailed description of each protective device identifying its type, function, manufacturer, and time current characteristics.
   4. Maximum of 8 protective devices per sheet.

G. Indicate the following specific information on the coordination curves:
   1. Device identifications.
   2. Time and current ratio for curves.
   3. Fuse circuit breaker, and relay curves, showing complete operating bands of low-voltage circuit breaker trip curves.
   4. Significant maximum symmetrical or asymmetrical short circuit cutoff point.
   5. Electric utility's relays and/or fuses including manufacturer's minimum melt, total clearing, tolerance.
   6. Medium voltage equipment relays.
   7. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
   8. Low voltage equipment circuit breaker trip devices, including manufacturers' tolerance bands.
   9. Pertinent transformer full-load currents at 75 percent and 100 percent.
   10. Ground fault protective device settings.
   11. Other system load protective devices for largest branch circuit and feeder circuit breaker in each motor control center and panelboard.

H. Develop a table to summarize the settings selected for the protective devices. Include the following:
   1. Device identification.
   2. Current transformer ratio, relay tap, time delay, and instantaneous pickup.
   3. Circuit breaker sensor rating, long-time, short-time, and instantaneous settings, and time bands.
   4. Fuse rating and type.
   5. Ground fault pickup and time delay.

3.3 REPORT

A. Summarize the results of the electrical protective device evaluation and coordination study in a final report.

B. Studies shall be performed, sealed (stamped and signed) by a registered professional Engineer experienced in power studies in the Province of Ontario. Provide five copies of the final report including copies to the UTILITY and ESA. Final reports shall be submitted in printed and electronic format (PDF).

C. Report shall include the following sections:
   1. Executive Summary: Stating objective, results, comments and recommendations.

2. Scope of the study, detailed description, purpose, basis, electrical system design data, and assumptions.
3. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.
4. Implemented protective devices settings for all protective devices.
5. Conclusion, comments, and recommendations.
6. Appendices:
    a. One line electrical coordination summary drawing.
    b. Copies of manufacturer's time current curves for the devices studied and plotted.
    c. Detailed calculations, printouts, etc.

3.4 INSTALLATION

A. Create relay settings files based upon settings in the final approved report, ready for download to all of the protection relays that are involved with the study and the project (as applicable).

B. Perform field adjustments of protective devices and modifications to equipment to place equipment in final operating condition. Adjust settings in accordance with approved short circuit and protective device coordination study.

C. Test protective devices. Verify proper tripping operation using protective devices.

3.5 FIELD QUALITY CONTROL

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

B. After developing the coordination curves, highlight areas lacking coordination. For each sheet, present a technical evaluation with a discussion of the logical compromises for best coordination. Propose approaches to effectively protect and coordinate equipment.

C. Notify ENGINEER in writing of any related regulatory or constructability issues. Proposed major corrective modifications will be taken under advisement by ENGINEER, and CONTRACTOR will be given further instructions.

END OF SECTION

SECTION 16016.2

SHORT CIRCUIT STUDY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. The intent of the short circuit study is to:
      a. Establish system short circuit ratings.
      b. Verify that the specified and supplied equipment are properly rated, correctly applied and within industry and manufacturer's tolerances prior to electrical equipment manufacturing.
      c. Provide data for related electrical studies.

B. Related Sections:
   1. Section 16016.1 – Electrical Coordination Study.
   2. Section 16016.3 – Arc Flash Hazard Assessment.

1.2 REFERENCES

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

B. American National Standards Institute (ANSI).

C. Electrical Safety Authority (ESA).

D. Institute of Electrical and Electronics Engineers (IEEE).

E. Ontario Electrical Safety Code (OESC).

1.3 PROGRESS SUBMITTALS

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

B. Submit qualifications of individual(s) who will perform work for approval prior to commencement of the studies and computer software package details.

C. Submit protective device evaluation and coordination study report for review by ENGINEER, UTILITY and ESA.

D. Final study report and design shop drawings shall be sealed (stamped and signed) by a professional engineer licenced in the Province of Ontario.

E. Reports shall be submitted in printed and electronic format (PDF).

1.4 QUALITY ASSURANCE

A. CONTRACTOR shall have the electrical study prepared by qualified engineers of an independent consultant, registered as a professional electrical engineer, licensed in the Province of Ontario, Canada, who has at least 10 years of experience and specializes in performing electrical power system studies.

B. Perform studies using the industry recognized computer software package.

1.5 QUALIFICATIONS

A. Contractor shall have the electrical study prepared by qualified engineers of an independent consultant. Consultant shall be a Registered Professional Electrical Engineer, licensed in the province where the project is completed, who has at least ten (10) years of experience and specializes in performing electrical power system studies.

B. Perform studies using the industry recognized computer software package.

C. Demonstrate company performing study has capability and experience to provide assistance during system startup.

1.6 SEQUENCING

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

B. Short circuit study must be completed and approved by ENGINEER prior to receiving final approval of the power distribution equipment and/or prior to the release of equipment for manufacturing.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 DATA COLLECTION

A. Obtain and provide electrical data required for preparation of the studies.

3.2 IMPEDANCE ONE-LINE DIAGRAM

A. Create an impedance one-line diagram. Protect electrical equipment wiring by overcurrent devices installed under this project and indicate each location where the fault current will be calculated. Clearly indicate, on the single-line, the schematic wiring of the electrical distribution system.

B. Show reference nodes on the single-line diagram referring to a formal report and include the following specific information:
   1. X/R ratios, utility contribution, and short circuit values (asymmetrical and symmetrical) at the bus of the main service, and downstream equipment containing overcurrent devices.

2. Transformer kVA and voltage ratings, percent impedance, X/R ratios and wiring connections.
3. Voltage at each bus.
4. Identifications of each bus.
5. Conduit material, feeder sizes and length.

3.3 SHORT CIRCUIT STUDY

A. Calculate by means of utilizing the industry recognized computer software package.

B. Perform study in accordance with applicable ANSI and IEEE Standards.

C. Determine available 3-phase short circuit and ground fault currents at each bus and any other critical point in the power distribution system. At a minimum include:
   1. Existing outdoor distribution switchboard main disconnect switch.
   2. Distribution switchboard branch breakers and/or branch feeder disconnect switches.
   3. Standby power generator GEN-1 (emergency power).
   4. Automatic Transfer Switch ATS-1 (emergency power).
   5. Motor Control Centre MCC-1.
   6. Panelboards and transformers (primary and secondary sides).
   7. Other significant locations throughout the power distribution system.

D. Provide calculation methods and assumptions, the base per unit quantities selected, one line diagrams, source impedance data including power company system characteristics, tabulations of calculation quantities and results, conclusions, and recommendations.
   1. Include motor contribution and future loads indicated on Drawings.
   2. Include all portions of the electrical distribution system and consider operation during normal conditions, emergency power conditions, and any other operations which could result in maximum fault conditions.
   3. Incorporate pertinent data, rationale employed, and assumptions in developing the calculations.

E. Present data determined by short circuit study in table format. Include:
   1. Node and device identification.
   2. Operating voltage.
   3. Type of protective device (i.e., fuse, molded case circuit breaker, etc.).
   4. Device short circuit rating.
   5. Calculated maximum short circuit current, 3-phase or ground fault, asymmetrical and symmetrical, and X/R ratio.

F. De-rate the devices where the tested X/R ratio is less than the calculated X/R ratio (maximum fault current multiplied by MF.)

G. Comments section indicating that device is underrated.

H. Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations will include present and future supply circuits, large motors, or generators as indicated on the Drawings.

I. Include fault contribution of largest motors in the study. Notify ENGINEER in writing if circuit protective devices are not properly rated for available fault conditions.

3.4 REPORT

A. Summarize the results of the short circuit study in a final report.

B. Studies shall be performed, sealed (stamped and signed) by a registered professional Engineer experienced in power studies in the Province of Ontario. Provide five copies of the final report including copies to the UTILITY and ESA. Final reports shall be submitted in printed and electronic format (PDF).

C. Report shall include the following sections:
   1. Executive Summary: Objective, results, comments.
   2. Scope of the study, detailed description, purpose, basis, electrical system design data, and assumptions.
   3. Fault current calculations including a definition of terms and guide for interpretation of computer printout, electrical system design data.
   4. Tabulations of equipment ratings versus calculated short circuit values and X/R ratios, and commentary regarding same.
   5. Conclusion, comments, and recommendations.
   6. Appendices:
      a. Impedance one line drawing.
      b. Project single-line drawings.
      c. Detailed calculations, printouts, etc.

3.5 FIELD QUALITY CONTROL

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

B. Analyze short circuit calculations and highlight any equipment that is determined to be underrated as specified. Propose approaches to effectively protect the underrated equipment.

C. Notify ENGINEER in writing of any related regulatory or constructability issues. Proposed major corrective modifications will be taken under advisement by ENGINEER, and CONTRACTOR will be given further instructions.

END OF SECTION

SECTION 16016.3

ARC FLASH HAZARD ASSESSMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Arc flash hazard assessment.
   2. Arc flash and electrical hazard identification.

1.2 OBJECTIVES

A. The intent of the assesssment is to:
   1. Establish arc flash hazard for electrical equipment.
   2. Install arc flash hazard warning labels to comply with the requirements of the Ontario Electrical Safety Code.

B. Provide regulatory submittals.

1.3 RELATED SECTIONS

A. Section 16016.1 - Electrical Coordination Study.

B. Section 16016.2 - Short Circuit Study.

C. Section 16075 - Electrical Identification.

1.4 REFERENCES

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

B. Canadian Standards Association: CSA Z462-08, Workplace Electrical Safety.

C. Electrical Safety Authority (ESA).

D. Institute of Electrical and Electronics Engineers: IEEE Standard 1584-2002 - Guide for Performing Arc-Flash Hazard Calculations.

E. Ontario Electrical Safety Code (OESC).

1.5 QUALIFICATIONS

A. Contractor shall have the electrical study prepared by qualified engineers of an independent consultant. Consultant shall be a Registered Professional Electrical Engineer, licensed in the

province where the project is completed, who has at least ten (10) years of experience and specializes in performing electrical power system assessments.

B. Perform assessment using the industry recognized computer software package.

1.6 PROGRESS SUBMITTALS

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

B. Submit qualifications of individual(s) who will perform work for approval prior to commencement of the assessment and computer software package details.

C. Submit arc flash hazard assessment report for review by ENGINEER and ESA.

D. Final study report and design shop drawings shall be sealed (stamped and signed) by a professional engineer licenced in the Province of Ontario.

E. Reports shall be submitted in printed and electronic format (PDF).

F. Submit label drawings and samples.

1.7 SEQUENCING

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

B. Arc flash hazard assessment shall be completed after electrical equipment data, ratings, installation details, etc. become available, and before commissioning of electrical system.

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. Arc flash hazard labels shall include the following information:
1. Warning or Danger header, black on orange or red.
2. Description: "Arc Flash and Electric Shock Hazard. Appropriate Electrical PPE Required."
3. Arc flash hazard boundary.
4. Incident energy.
5. Hazard risk category.
6. Voltage level or range.
7. Working distance (limited, restricted, prohibited).
8. Minimum PPE requirements.

C. Electrical Hazard Warning Labels: "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.

B. Retrieve relevant data from the short circuit and electrical coordination studies.

3.2 ARC FLASH HAZARD ANALYSIS

A. The arc flash hazard analysis shall be performed in accordance with CSA Z462-08 and IEEE 1584.

B. Calculate by means of utilizing the industry recognized computer software package. Calculate:
   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 on arc flash energy reduction.

C. Flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system. Include:
   1. Substations.
   2. Switchgear.
   3. Switchboards.
   4. Panelboards.
   5. Splitters.
   6. Enclosed controllers.
   7. Disconnect switches.
   8. Control Panels.
   9. Any that are likely to require examination, adjustment, servicing, or maintenance while energized.

D. Arc flash hazard analysis shall include 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. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
   3. Arc flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time shall be 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, a maximum clearing time based on the specific location shall be utilized.

4. Calculations shall be performed 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 sides of the line and load side of the disconnecting device.

3.3 REPORT

A. Summarize the results of the arc flash hazard assessment in a final report.

B. Studies shall be performed, sealed (stamped and signed) by a registered professional Engineer experienced in power studies in the Province of Ontario. Provide five copies of the final report including copies to ESA. Final reports shall be submitted in printed and electronic format (PDF).

C. Report shall include the following sections:
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 not evaluated electrical systems and equipment.
5. Conclusion, comments, and recommendations.
6. Appendices:
    a. Labels details.
    b. Detailed calculations, printouts, etc.

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. Include:
1. Control panels (processor, I/O, operator interface, network, communication, etc.) operating at 50 V or more.
2. 600/347 V and 208/120 V panelboards.
3. Junction, pull or terminal boxes.
4. Other electrical equipment operating at 50 V or more.

C. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

3.5 FIELD QUALITY CONTROL

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

B. Notify ENGINEER writing of any related regulatory or constructability issues.

END OF SECTION

SECTION 16016.4

HARMONIC ANALYSIS STUDY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Harmonic analysis study.
   2. Harmonic mitigation.

1.2 OBJECTIVES

A. The intent of the assessment is to:
   1. Contractor shall provide to the ENGINEER for review a Harmonics Study of the overall electrical system, including the new MCC (with VFDs), complete with measured Harmonic distortion levels present in all equipment. The point for this measurement shall be at the new MCC and the associated Swtichgear. Carry our the Harmonic Study for SPP operation under normal and also under standby power under specified load conditions. Testing for Harmonics shall be performed according to IEE519.
   2. Provide recommendations in the Harmonics Study that are required to satisfy IEE519 requirements.

1.3 RELATED SECTIONS

A. Section 16016.1 - Electrical Coordination Study.

B. Section 16016.2 - Short Circuit Study.

C. Section 16075 - Electrical Identification.

1.4 REFERENCES

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

B. Canadian Standards Association: CSA Z462-08, Workplace Electrical Safety.

C. Electrical Safety Authority (ESA).

D. Institute of Electrical and Electronics Engineers: IEEE Standard 519 – IEEE Recommended Practice and Requirements for Harmonic Control in Electric Power Systems.

E. Ontario Electrical Safety Code (OESC).

1.5 QUALIFICATIONS

A. Contractor shall have the electrical study prepared by qualified engineers of an independent consultant. Consultant shall be a Registered Professional Electrical Engineer, licensed in the province where the project is completed, who has at least ten (10) years of experience and specializes in performing electrical power system assessments.

B. Perform assessment using the industry recognized computer software package.

1.6 PROGRESS SUBMITTALS

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

B. Submit qualifications of individual(s) who will perform work for approval prior to commencement of the assessment and computer software package details.

C. Submit harmonic analysis report for review by ENGINEER.

D. Final study report and design shop drawings shall be sealed (stamped and signed) by a professional engineer licensed in the Province of Ontario.

E. Reports shall be submitted in printed and electronic format (PDF).

1.7 SEQUENCING

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

B. A desktop harmonics study shall be completed prior to the approval of the new MCC and VFDs

C. Measurement of harmonics at the same points for various operating scenarios on both normal and standby power. One day will reserved for measurement on normal power and another day for standby power.

PART 2 PRODUCTS (NO PRODUCTS)

PART 3 EXECUTION

3.1 DATA COLLECTION

A. Obtain and provide data required for preparation of the harmonic analysis study.

3.2 HARMONIC ANALYSIS STUDY

A. The harmonic analysis study shall be performed in accordance with IEEE 519.

B. Carry out the harmonic analysis of the electrical distribution system for the circuit conditions listed below:
   1. Existing system configuration
   2. System with new VFDs or other non linear harmonic creation loads in operation at no load, 50% and 100 load conditions.
   3. Provide following data from each study
   4. System harmonic voltages in rms and % THD
   5. System harmonic current in rms and % THD
   6. An IEEE 519 analysis at the point of common coupling with incoming utility
   7. Capacitor bank evaluation on the basis voltage, current and kVA
   8. Calculate harmonic generation of each VFD, take field measurement of VFD current harmonic generation during the process operation.
   9. If the calculated magnitude of harmonic voltages and/or currents are excessive, the corrective solution will be suggested to reduce harmonic quantities within acceptable limited.
   10. Recommend a filter and provide complete specifications for the same.

C. Results: At the conclusion of the harmonic analysis submit the following:
   1. Description, purpose, basis and scope of the harmonic study and single line diagram of the system
   2. Tables listing the individual harmonic voltages and currents and total harmonic distortions for all major buses within the electrical distribution system, waveforms for all of the calculated harmonic voltages will be displayed.
   3. Plot of frequency vs impedance for all capacitor locations (harmonic resonance scan).
   4. Complete recommendations for harmonic filters, shunt capacitors and series reactors, required for harmonic suppression
   5. Complete text report of each measurement location sorted by current and voltage and listing the harmonic component and total harmonic distortion.
   6. Waveform of each measurement sample.
   7. Detailed harmonic spectrums of harmonic generating loads.

3.3 REPORT

A. Summarize the results of the harmonic analysis study in a final report.

B. Studies shall be performed, sealed (stamped and signed) by a registered professional Engineer experienced in power studies in the Province of Ontario. Provide five copies of the final report including copies to ESA. Final reports shall be submitted in printed and electronic format (PDF).

C. Report shall include the following sections:
   1. Executive Summary: Objective, results, comments.
   2. Detailed list and calculations for each evaluated electrical system and equipment.
   3. Detailed list of not evaluated electrical systems and equipment.
   4. Conclusion, comments, and recommendations.
   5. Appendices:
      a. Detailed calculations, printouts, etc.

3.4 FIELD QUALITY CONTROL

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

B. Notify ENGINEER writing of any related regulatory or constructability issues.

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 to manufacturing, delivery, and installation. Refer to attached master equipment list.

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 including arc flash labels.

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. Metal conduit.

B. Liquidtight flexible metal conduit.

C. Electrical metallic tubing.

D. Nonmetallic conduit.

E. Electrical nonmetallic tubing.

F. Fittings and conduit bodies.

G. 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 METAL CONDUIT AND FITTINGS

A. Construction: Galvanized steel, threaded for dry location or with corrosion free epoxy enamel coating for corrosive areas.

B. Fittings and conduit bodies: steel or malleable iron, threaded type to match conduit material, couplings, elbows, nipples, locknuts, bushings, hubs, connectors, sealing rings, hazardous locations sealing fittings, etc. manufactured for use with conduit specified.

2.3 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.

2.4 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.

2.5 LIQUID-TIGHT FLEXIBLE NONMETAL CONDUIT AND FITTINGS

A. Construction: Spiral of rigid PVC reinforcement imbedded within oil resistant PVC jacket, temperature rating minus 40 degrees C to plus 105 degrees C, minimum size 21 mm.

B. Fittings: PVC, tapered hub threads, strain relief vibration proof, corrosion resistant, insulated throat connectors including locknut, washers, sealing rings manufactured for use with conduit specified.

2.6 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.

2.7 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

CABLE TRAYS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cable trays.

1.2 REFERENCES

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

B. Canadian Standards Association (CSA): C22.2 No. 126 - Cable Tray Systems.

C. Electrical and Electronic Manufacturers' Association of Canada (EEMAC): F5-1 - Cabletrough Systems and Accessories.

D. Ontario Electrical Safety Code and all Electrical Safety Authority Bulletins.

1.3 PROGRESS SUBMITTALS

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

B. Shop Drawings:
   1. Indicate manufacturer, tray type, rating, dimensions, support points, and finishes.
   2. Provide data for fittings, supports and accessories.

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.

PART 2 PRODUCTS

2.1 GENERAL

A. Furnish products listed and classified by CSA as suitable for purpose specified and shown. Provide products of one manufacturer throughout Project.

B. Manufacturers (in alphabetic order):
   1. B-Line Systems.

2. CER Canadian Electrical Raceways.
3. Pilgrim (Thomas & Betts).
4. Pursley 2000.

2.2 LADDER TYPE CABLE TRAY

A. Description: A prefabricated structure consisting of 2 longitudinal side rails connected by individual transverse members (rungs) with openings (rung spacing) exceeding 50 mm in a longitudinal direction.

B. Material: Aluminum.

C. Load:
1. CSA Class C1 at 2.0 m support spacing.
2. CSA Class D1 at 3.0 m support spacing.

D. Dimensions:
1. Inside Width: Size as indicated on Drawings.
2. Inside Depth: 120 mm.
3. Rung Spacing: 225 mm.

E. Provide manufacturer's horizontal elbows, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers, standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, bolts, nuts, washers and grounding straps.

2.3 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 these Works.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions. Install enclosures as indicated. Coordinate mounting heights and locations. Maintain spacing and clearances.

B. Provide separate cable trays for power and control signals wiring.

C. In accordance with Sections of Division 16:
   1. Support trays. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 3 m maximum. Supports shall be of cantilever or L-shaped design to facilitate access from one side of the tray. Trapeze hanging is not acceptable unless specified otherwise.
   2. Install control devices, equipment, terminal blocks, wiring ducts.
   3. Ground, bond and clean. Where expansion joints/connectors are used, bonding jumpers shall be installed to ensure continuity.
   4. Install electrical identification.

D. Provide continuity between tray components. Maintain spacing and proper bending radius. Use expansion connectors where required.

E. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly. Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

F. Connections to tray may be made using mechanical or exothermic connectors.

G. Install barriers where different voltage systems are in the same cable tray.

H. Install Warning Signs: "WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER, OR SUPPORT!", black letters on yellow background, at 5 m centers along route of cable tray, located to be visible.

I. Provide wall and surface openings for cable trays.

J. Install wall transits and seals for fire stopping and area classifications.

3.3 INTERFACE WITH OTHER WORK

A. Install cable trays 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 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 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 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 16272

DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. 3-phase dry type transformers.

1.2 REFERENCES

A. Canadian Standard Association:
   1. CSA C22.2 No. 47 - Air Cooled Transformers (Dry Type).
   2. CSA C802.2 - Minimum Efficiency Values for Dry-Type Transformers.

B. National Electrical Manufacturers Association: NEMA ST-20 - Dry Type Transformers for General Applications.

C. Ontario Electrical Safety Code (OESC).

1.3 PROGRESS SUBMITTALS

A. Product Data:
   1. Catalog numbers. Options and accessories furnished.
   2. Electrical Characteristics: Type, power rating, continuous current, voltage ratio, winding configuration, impedance ratings and characteristics, tap configurations, insulation class, rated temperature rise, and sound level. Indicate loss data, efficiency at 25, 50, 75, and 100 percent rated load for transformers larger then 112.5 kVA.
   3. Mechanical characteristics enclosure type, overall dimensions, outline and support point dimensions of enclosures and accessories, mounting arrangements, clearance requirements, feeder entry provisions, cable terminal sizes, size and location of connections, unit weight, finish, etc.

B. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.

1.4 REGULATORY REQUIREMENTS

A. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver transformers individually wrapped for protection and mounted on shipping skids.

B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.

C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 PRODUCTS

2.1 THREE PHASE TRANSFORMERS

A. Description: CSA C22.2 No. 47, assembled, air cooled, cooper windings, dry type transformer.

B. Manufacturers:
1. Cutler-Hammer.
2. Delta.
3. Hammond Power Solutions.
4. Square D by Schneider Electric.

C. Transformer Ratings:
1. Power Rating: As indicated on Drawings.
2. Primary Voltage/Connection: As indicated on Drawings.
3. Secondary Voltage/Connection: As indicated on Drawings.
4. Impedance: 6.5 percent maximum.
5. BIL: 10 kV.

D. Insulation System: Class F insulation with maximum 115 degrees C rise under continuous full load.

E. Case Temperature: Do not exceed 35 degrees C rise above ambient at warmest point.

F. Winding Taps: +/- 2–2.5 percent full capacity.

G. Efficiency: CSA-C802.2.

H. Sound Level: 55 dB maximum.

I. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

J. Mounting: Suitable for floor mounting with anti-vibration pads.

K. Coil Conductors: Continuous copper windings with terminations brazed or welded.

L. Enclosure: Type 1. Provide lifting eyes or brackets.

M. Nameplate: Include Ratings and transformer connection data.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are suitable for installing transformer supports.

3.2 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Mount dry type transformer up to 45 kVA on wall or floor as shown. Mount dry type transformer 45 kVA and above on floor unless otherwise shown.

C. Set transformer plumb and level. Ensure adequate clearance around transformers for ventilation.

D. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Loosen isolation pad bolts until no compression is visible. Remove shipping supports only after transformer is installed.

E. Make conduit connections to side panels at the bottom of enclosure. Do not connect any raceways through the top panel (cover) or top sections of side panels of the transformer enclosure.

F. Make primary and secondary connections in accordance with wiring diagram. Energize transformers after installation is complete.

G. Provide grounding and bonding.

3.3 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION

SECTION 16411

ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Main disconnect switch.

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.
   3. CSA C22.2 No. 4 - Enclosed Switches.
   4. CSA C22.2 No. 106 - HRC Fuses.

C. Ontario Electrical Safety Code and all Electrical Safety Authority Bulletins.

1.3 PROGRESS SUBMITTALS

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

B. Product Data: Include manufacture, model, type, options; classification; ratings: voltage, current, HP listing, short circuit rating; conduit entry/exit locations, cable terminal sizes and overall dimensions, data sheets and catalog numbers.

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 CLOSEOUT SUBMITTALS

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

B. Record Documents: Indicate actual layout including any changes or clarification on Shop Drawings and Drawings.

C. 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 and Contract closeout.

1.5 REGULATORY REQUIREMENTS

A. Conform to Ontario Electrical Safety Code.

B. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Section 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Store in a clean, dry space. Maintain wrapping or provide additional heavy plastic cover to protect switches from dirt, water, construction debris, and traffic. Handle carefully to avoid damage to enclosed switch components, enclosure, and finish.

PART 2 PRODUCTS

2.1 GENERAL DUTY, FLANGE TYPE, DISCONNECT SWITCHES

A. General duty, flange type disconnect (safety) switch: Non-fusible type or fusible type as indicated on the Drawings, horsepower rated, voltage, current, size and number of poles as indicated on the Drawings.

B. Manufacturer:
   1. Allen-Bradley.
   2. Cutler-Hammer.
   3. Crouse-Hinds.
   4. Square D.

C. Enclosures:
   1. Interior, Wet Location: EEMAC Type 4X, stainless steel metal enclosure.
   2. Interior, Dry Location: EEMAC Type 12, stainless steel metal enclosure.
   3. Exterior: EEMAC Type 4X, stainless steel metal enclosure.

D. Quick-make/quick-break mechanism for equipment over 3HP and enclosure base mounted operating handle.

E. Lugs or terminals for copper conductor. All current carrying parts shall be plated to resist corrosion.

F. Mechanically interlocked door to prevent opening when handle in ON position. Provision for padlocking in OFF switch position.

G. ON/OFF switch position indication on switch enclosure cover and a permanent label of switch type and rating.

2.2 ACCESSORIES

A. Auxiliary "switch close" SPDT type contact (N.O. or N.C.), rated 5A at 120 VAC in each disconnect switch. Wiring accessories as required. Provide contacts as indicated on the Drawings.

B. 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 for field panels. Provide breathers and drains for all exterior switches.

2.3 FACEPLATE DEVICE IDENTIFICATION

A. Field disconnect shall be provided with lamacoid nameplates, black with white lettering in accordance with the drawing schedules identifying powered equipment, or as otherwise specified or indicated.

B. Final nameplate wording, coloring and sizes shall be approved during Shop Drawings submission reviews.

PART 3 EXECUTION

3.1 EXAMINATION

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

B. Verify that surface or mounting is suitable for switch installation.

C. Verify that field measurements are as shown on the Shop Drawings.

3.2 INSTALLATION

A. Install switches in accordance with manufacturer's instructions.

B. Tighten mechanical fasteners after placing switches.

C. Install fuses in fusible switches.

D. Provide engraved plastic nameplates in accordance with Section 16075.

E. Motor Data: Provide neatly typed label inside door identifying motor served, nameplate horsepower, full load amperes, code letter, service factor, and voltage/phase rating.

F. Install switches and accessories in accordance with manufacturer's instructions.

G. Locate disconnect in sight from the motor and driven machinery in easily accessible locations. Field verify all locations.

H. Install breathers and drains on all exterior disconnect switches.

3.3 FIELD QUALITY CONTROL

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

B. Inspect and test each enclosed switch in accordance with CSA C22.2 No. 4.

C. Inspect each switch visually.

D. Perform several ON/OFF operations on each switch.

E. Verify circuit continuity on each pole in closed position.

F. Include description of testing and results in test report.

END OF SECTION

SECTION 16442

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Branch circuit panelboards.

1.2 REFERENCES

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

B. Canadian Standards Association:
   1. CSA C22.1 - Canadian Electrical Code Part 1 (CEC).
   2. CSA C22.2 No. 5.1 - Moulded Case Circuit Breakers.
   3. CSA C22.2 No. 29 - Panelboards and Enclosed Panelboards.

C. Ontario Electrical Safety Code and all Electrical Safety Authority Bulletins.

1.3 SYSTEM DESCRIPTION

A. Wall mounted Lighting Panel (LP-A). 72-circuit breaker panelboard rated for installation on a 120/208 V, 60 Hz, 3 phase, 4 wire system with main lugs.

B. Wall-mounted Lighting Panel (LP-B). 72-circuit breaker panelboard rated for installation on a 120/208 V, 60 Hz, 3 phase, 4 wire system with main lugs.

1.4 PROGRESS SUBMITTALS

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

B. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement and sizes.

C. Product Data: Include data sheets and catalog numbers for circuit breakers, and accessories.

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.

1.5 CLOSEOUT SUBMITTALS

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

B. Record Documents: Record actual locations of products; indicate actual branch circuit arrangement.

C. Operation and Maintenance Data: Include spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

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 01600 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.

B. Handle carefully to avoid damage to panelboard components delivered as part of MCC.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Eaton Electrical.

B. Square D.

2.2 BRANCH CIRCUIT PANELBOARDS

A. Lighting and Appliance Branch Circuit Panelboards: CSA C22.2 No. 29, Circuit breaker type. Provide 15 A breakers where spares are shown.

B. Panelboard Bus: Copper, ratings as shown on the Drawings. Copper ground bus in each panelboard; insulated ground bus where scheduled.

C. Minimum Integrated Short Circuit Rating: 10,000 A rms symmetrical for 240 V maximum panelboards.

D. Molded Case Circuit Breakers: CSA C22.2 No. 5.1, Bolt-on type thermal magnetic trip circuit breakers with common trip handle for all poles. CSA listed as Type SWD for lighting circuits. CSA Class A ground fault interrupter circuit breakers where shown on the Drawings. Do not use tandem circuit breakers. Provide device to lock circuit breaker in "OFF" position where indicated in Drawings. Provide quantity of breakers as indicated on Drawings. Breaker poles and ratings as indicated on Drawings.

E. Enclosure: As indicated in Drawings.

F. Box: Flush or surface type with door, and pull ring and latch on door. Finish in manufacturer's standard gray enamel.

G. Accessories: Provide devices to lock breaker in "OFF" position where indicated in Drawings.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install panelboards in accordance with the Ontario Electrical Safety Code.

B. Install in accordance with manufacturer's instructions.

C. Filler plates for unused spaces in panelboards.

D. Typed circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.

3.2 FIELD QUALITY CONTROL

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

B. Measure steady-state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance phase loads to within 20 percent of each other. Maintain proper phasing for multiwire branch circuits.

C. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

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.

C. FVNR: Full Voltage Non Reversing (Starter).

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 FEEDER UNITS

A. Molded Case Circuit Breakers, Frame Sizes up to 225 A (unless shown otherwise): Manually operated, fixed trip, thermal magnetic, with integral thermal and instantaneous magnetic trip in each pole.

B. Circuit Breakers, Frame Sizes Larger than 225 A (unless shown otherwise): Interchangeable, solid-state electronic trip unit (design standard - Eaton Electrical Digitrip) with electronic RMS sensing, timing, and independently front adjustable current trip settings.

C. Trip Function: LS, LSI, LSG, or LSIG as shown on the Drawings (L- Long delay trip, S – Short delay trip, I – Instantaneous trip, G - Ground fault trip).

D. Frame ratings shall be as indicated on the Drawings. All breakers will be CSA listed for application in their intended enclosures for 100 percent of their continuous ampere rating. Interrupting capacity of feeder breakers shall have a minimum symmetrical interrupting capacity of 35 kA amperes RMS at 600 VAC rated voltage.

E. Fused Disconnects: Allowed only if specifically identified on the Drawings, 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. Provide fuses as required.

2.6 COMBINATION STARTERS

A. Magnetic Controllers: CSA C22.2 No. 14, AC general purpose Class A magnetic controller for induction motors rated in horsepower or heating/resistive type loads in kW where indicated. All controllers to be EEMAC (NEMA) rated.

B. Combination Starter Controllers, FVNR Type: Motor circuit protector type circuit breaker with starter sized in HP and electronic overload protective device. Minimum starter EEMAC (NEMA) Size 1, rated for continuous horsepower rating of motor. All starters listed as Size 1 to allow for connection of up to 10 HP motor to accommodate unit actually installed.
   1. Circuit Breakers for Motors: 35 kA (minimum) RMS at 600 VAC interrupting capacity rating, thermal magnetic, motor protector type, with integral thermal and instantaneous magnetic trip in each pole.
   2. Fused Disconnects: Allowed only if specifically identified on the drawings, 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. Provide fuses as required.
   3. Electronic (solid–state) Overload: As a minimum include visible trip indicator, reset button, overload function, phase loss function, and selectable trip class. In addition (where indicated) the overload shall include additional functions like jam/stall, ground fault (earth) protection, etc.

C. Operator interface and control devices for manual and auto operation. Control inputs and status outputs as shown on the Drawings.

2.7 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.

2.8 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.

2.9 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 16505

LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Installation of Luminaires.

1.2 REFERENCES

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

B. Canadian Standards Association:
   1. CSA C22.2 No. 9 - Luminaires.
   2. CSA C22.2 No. 9 S1 Supplement to C22.2 No. 90.
   3. CSA C22.2 No. 74 - Equipment for Use With Electric Discharge Lamps.
   4. CSA C22.2 No. 141 - Unit Equipment for Emergency Lighting.

C. Ontario Building Code (OBC).

D. Ontario Electrical Safety Code (OESC).

1.3 PROGRESS SUBMITTALS

A. Submit product data sheets:
   1. Manufacture, model, type, voltage, lamp type, options.
   2. Provide luminaire photometric data.
   3. Overall dimensions, connection method.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's operation and maintenance instructions for each product.

1.5 REGULATORY REQUIREMENTS

A. Conform to Ontario Electrical Safety Code.

B. Conform to Ontario Building Code.

C. Furnish products listed and classified by CSA as suitable for purpose specified and shown.

PART 2 PRODUCTS

2.1 GENERAL

A. Equipment of each category to be same type and manufacture. All products shall be of such construction as to be approved for use in the environment or area classification in which they are located, as per CSA C22.2 Nos. 9, 9-51, 74 and 141.

2.2 LUMINAIRES

A. Equipment of each category to be same type and manufacturer. All products shall be of such construction as to be approved for use in the environment or area classification in which they are located.

B. Provide complete luminaires with lamps as shown in Lighting Fixtures Schedule on the Drawings.

C. Refer to Luminaire Schedule on drawings.

2.3 LUMINAIRES HARDWARE AND ACCESSORIES

A. Provide mounting hardware and accessories as required (see Drawings).

PART 3 EXECUTION

3.1 INSTALLATION

A. Install luminaires, exit lights, emergency lighting, batteries, chargers and accessories in accordance with manufacturer's instructions.

B. Locate luminaires as indicated. Field verify all locations. Coordinate final mounting locations of light fixtures with other trades. Locate light fixture for unobstructed light output. Do not install luminaires at locations where other equipment is to be installed or where access is difficult. Provide pendant length as required for suspended luminaires.

C. In accordance with Sections of Division 16:
   1. Support luminaires independently of connecting raceways, ductwork, piping, mechanical equipment.
   2. Install electrical identification.

D. Install surface-mounted luminaires and exit signs plumb and adjust to align with building lines and with each other. Secure to prohibit movement.

E. Align luminaires mounted in continuous rows to form straight uninterrupted line. Align luminaires mounted individually parallel or perpendicular to building grid lines.

F. Install wall-mounted luminaires, emergency lighting units, and exit signs at height as shown on the Drawings.

G. Install accessories furnished with each luminaire.

H. Connect luminaires to lighting circuits as shown on the Drawings. Connect exit lights and emergency lights to local lighting circuits as shown on the Drawings.

I. Make wiring connections to branch circuit using building wire with insulation suitable for temperature conditions within luminaire.

J. Bond products and metal accessories to branch circuit equipment grounding conductor.

K. Install specified lamps in each luminaire, emergency lighting unit, and exit sign.

L. 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.

3.2 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for proper connection and operation.

B. Replace ballasts exhibiting unacceptable noise levels.

3.3 ADJUSTING

A. Aim and adjust luminaires as required.

B. Position exit sign directional arrows as shown on the Drawings.

3.4 CLEANING

A. Clean electrical parts to remove conductive and deleterious materials.

B. Remove dirt and debris from enclosure.

C. Clean photometric control surfaces as recommended by manufacturer.

D. Clean finishes and touch up damage.

3.5 DEMONSTRATION

A. Demonstrate luminaire operation for minimum of 2 hours.

3.6 PROTECTION OF FINISHED WORK

A. Re-lamp luminaires that have failed lamps at Substantial Performance of the Works.

END OF SECTION

SECTION 16857

HEAT TRACING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Heat tracing system

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. 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: Refer to 3.3 Schedule
6. Insulation : Glass fibre, 25 mm (1 inch) minimum.

C. Self-regulating Heating Cables:
1. 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 rated for the area classification 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	East RAS/WAS Piping	Sludge Waste	100mm SS	10m	See Dwg. M-001 and E-007 One Tee connection Two Elbows
2	West RAS/WAS Piping	Sludge Waste	100mm SS	10m	See Dwg. M-001 and E-007 One Tee connection Two Elbows
3	Raw Wastewater Supply line	Sludge Waste	200mm SS	10m	See Dwg. M-001 and E-007 One Tee connection Two Butterfly Valves Two Elbows
4	Equalization Supply Line	Sludge Waste	100mm HDPE	10m	See Dwg. M-001 and E-007
5	North Train RAS/WAS Piping	Sludge Waste	100mm SS	15m	See Dwg. M-001 and E-007 One Tee connection Two Butterfly Valves Two Elbows

END OF SECTION