PROJECT TITLE

Hamlet, Ontario
Trent-Severn Waterway
Hamlet Swing & Fixed Bridges
(Bridge 57 & 58) Replacement

Historic Site of Canada
Parks Canada Agency

PROJECT NUMBER

R.073593.001

PROJECT DATE

2018-07-20

Structural Engineer:

Karen Liu

Roadway Engineer:

Sam Dinatolo

Mechanical Engineer:

Jeffrey Keyt

Electrical Engineer:

Gareth Rees

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Title and Description of Work.
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.22 Regulatory Requirements.
.23 Licence Requirements.
.24 Permits/Authorities.
.25 Signs.
.26 Additional Drawings.

1.2 PRECEDENCE

.1 For Federal Government projects, Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 RELATED SECTIONS

.1 Not Used.

1.4 WORK COVERED BY CONTRACT DOCUMENTS

.1 Work of this Contract comprises structural, mechanical, hydraulic, electrical, and road work for the replacement of the Hamlet Swing and Fixed Bridges, located in Hamlet, Ontario. The work of the bridge replacement includes all measures to deliver reliably operating swing and fixed bridges, which also includes the necessary adjustments to refine its operation, as indicated in the Contract Documents and/or Sections.

1.5 CONTRACT METHOD

.1 Construct Work under combined price contract.

1.6 LUMP SUM WORK

.1 Any work which is not included in the Unit Price Table is deemed to be included in the lump sum price.

1.7 COST BREAKDOWN

.1 Within 48 hours of notification of acceptance of bid furnish a cost breakdown by Section aggregating contract price.
.1 Submit cost breakdown prices for the lump sum work.

.2 Within 48 hours of acceptance of bid submit a list of Subcontractors and Specialty Engineers. The list shall include all Subcontractors and Specialty Engineers listed on the Qualification Forms as well as any other subcontractors.

1.8 WORK BY OTHERS

.1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Departmental Representative.

.2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Departmental Representative, in writing, any defects which may interfere with proper execution of Work.

.3 Coordinate with the affected and involved utilities as part of the demolition of the existing bridge hydraulic and electrical operating systems building.

.4 Coordinate with Hydro One.

1.9 FUTURE WORK

.1 Not used.

1.10 WORK SEQUENCE

.1 Comply with operational constraints, milestones, and completion dates. Work must be monitored and completed to meet the goals at the milestones and at the completion date.

.2 Complete the work as indicated in the Contract Documents and maintain navigation traffic at all times during construction at the Hamlet Swing and Fixed Bridges project site except as permitted in the Contract Documents.

.3 Milestone dates for work under this Contract are as follows:
.1 Work affecting navigation shall not occur until October 8, 2018.
.2 In-water work shall not occur between March 15, 2019 and May 31, 2019.
.3 Commissioning of the bridge shall be complete, and the bridge shall be re-opened to navigation and two-way vehicle traffic by June 24, 2019.
.4 All work under this Contract must be completed by July 26, 2019.

.4 Required stages:
- .1 Project award.
- .2 Prepare and submit project schedule showing critical path.
- .3 Obtain necessary permits.
  - .1 Permit to take and discharge water.
  - .2 Permit for submarine cables installation in water.
- .4 Contractor mobilization, install environmental control measures.
- .5 Initiate and maintain shop drawing submittal and review process.
- .6 Implement and maintain Traffic Control Plan.
- .7 Prepare, submit and implement construction staging plan once approved.
- .8 Implement environmental protocol measures.
- .9 Clear and level temporary staging area.
- .10 Divert traffic onto adjacent route as indicated in Roadway Drawings.
- .11 Remove existing mechanical, hydraulic, and electrical equipment and salvage equipment identified by Departmental Representative.
- .12 Demolish and decommission existing electrical control house.
- .13 Demolish existing superstructure.
- .13 Regrade approaches to proposed profile.
- .14 Maintain navigation clearance in navigation channel at all time during navigational season.
- .15 Install cofferdam.
- .16 Install micropiles and rock anchors (if applicable).
- .17 Construct footings.
- .18 Construct abutments and ballast walls.
- .19 Construct new control house and extend 600V service to the new building.
- .20 Commence mechanical and electrical equipment installation.
- .21 Construct/erect superstructure.
- .22 Complete mechanical, hydraulic and electrical equipment installation.
- .23 Submit commissioning plan.
- .24 Construct approach slabs.
- .25 Install steel beam guiderails, warning gates and navigational lighting at pivot pier and rest piers.
- .26 Commission new structure.
- .27 All disturbed soils within the construction limit will be restored to grade with top soil, and provide surface treatment with sod.
- .28 Regrade embankments.
- .29 Open bridge to traffic.
- .30 Demobilize, remove environmental control measures.

.5 Upon substantial completion of the project, and completion of commissioning, provide operation and maintenance manuals (O&M) to the Departmental Representative.

.6 Construct Work in stages to provide for continuous public usage.

.7 Maintain access to Parks Canada facilities at all times.

1.11 CONTRACTOR USE OF PREMISES

.1 Contractor has unrestricted use of site until Substantial Performance.

Exceptions are:

.1 The Contractor shall permit passage of boat/vessel traffic and maintain the navigational opening shown on the Contract Drawings during the navigational season. The winter shut down for the navigational opening of the Severn River will be from October 8, 2018 to May 20, 2019 (Non-navigation season).

.2 Contractor shall limit use of premises for Work, for storage, and for access, to allow;
.1 Owner occupancy.
.2 Public usage of the bridges (vehicular and pedestrian) prior to demolishing of Hamlet Bridges and after commissioning of the new swing bridge and the construction of the new fixed bridge.
.3 Permit passage of boat/vessel traffic during the navigational season.

.3 Coordinate use of premises under direction of Departmental Representative.

.4 Obtain and pay for use of additional off-site storage or work areas as needed for operations under this Contract due to limited staging area in the vicinity of the bridge site. Provide storage areas off site. Obtain Provincial permit for sites not on federal land. No additional compensation will be permitted. The cost associated for storage areas is deemed to be included in the Contractor’s overall bid price as part of the Lump Sum items.

.5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.

.6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work as directed by Departmental Representative.

.7 At completion of operations the condition of existing work shall be equal to, or better than, that which existing before new work started.

.8 The Contractor shall not permit any tools, equipment, vehicles, temporary structures or parts thereof used or maintained for the purpose of building or placing a work in or over the navigable water to remain in such water beyond March 15, 2019.

.9 Where a work or a portion of the work that is being constructed or maintained in navigable water causes debris or other material to accumulate on the bed or surface of such water, the Contractor shall immediately remove the debris or other material to the satisfaction of the Departmental Representative.

.10 All in-water work shall be completed prior to March 14, 2019. This includes complete removal of any temporary in-water works.

1.12 ALTERATIONS TO EXISTING BRIDGES AND BUILDING UTILITIES/COMPONENTS

.1 Remove and re-instate the following existing items.
.1 Water treatment system.

.2 Remove in good order, turn over to Department, and store within building where designated by Departmental Representative:
.1 Mechanical and electrical items as indicated.

.3 Remove, temporarily store, clean, alter to suit and reinstall:
.1 Water, rain and flow gauges at the North Rest Pier.
.2 Railings at the Rest Pier.
.3 Signs on the bridges, approaches and the piers.

1.13 DOCUMENTS REQUIRED

.1 Maintain at job site, one paper copy of each document as follows:
.1 Contract Drawings.
.2 Specifications.
.3 Addenda and amendments.
.4 Reviewed Shop Drawings.
.5 List of Outstanding Shop Drawings.
.6 Change Orders.
.7 Other Modifications to Contract.
.8 Field Test Reports.
.9 Copy of Approved Work Schedule.
.10 Health and Safety Plan and Other Safety Related Documents.
.11 Environmental Management Plan (EMP).
.12 Other documents as specified.

.2 Owner Take-Over
.1 Schedule and substantially complete work prior to request of Certificate of Substantial Completion and Final Certificate of Completion. Issuance of both certificates to be coordinated with commissioning as outlined in Section 01 91 13 – General Commissioning (CX) Requirements.

1.14 ROAD OCCUPANCY PERMIT

.1 The Contractor shall obtain permits from adjacent townships (Orillia, Severn, Gravenhurst) or Parks Canada Agency (PCA), as required, for use and occupancy of roads at end near the bridge site as required to complete the work under this contract.

1.15 PARKS CANADA PERMIT REQUIREMENTS

.1 As per the Historic Canal Regulations applicable to lands administered by the Trent-Severn Waterway National Historic Site of Canada, a permit signed by Parks Canada’s Ontario Waterways Director will be required to authorize the project prior to commencement of project activities.

.2 Release of permit requires an accepted Environmental Management Plan (EMP) and Health and Safety Plan by the Departmental Representative and Parks Canada Agency (PCA).

.3 The contractor should provide EMP for PCA to issue a heritage Canal Permit

in order to do in-water work including Submarine Cable Installation.

1.16 ONTARIO PROVINCIAL STANDARD SPECIFICATION

.1 Where reference is made to an Ontario Provincial Standard Specification (OPSS), the following shall apply: Remove and replace the term "Contract Administrator: with "Departmental Representative" in the referenced OPSS specification.

1.17 ELECTRICAL SERVICES

.1 Notify, Departmental Representative and coordinate with utility companies of intended interruption of services and assist the Departmental Representative in obtaining required permission and necessary permits.

.2 Contractor to coordinate with and pay Hydro One for the switch of the new service. Contractor will subsequently get reimbursed at cost.

.3 Establish location and extent of service lines in area of work before starting Work. Notify Departmental Representative of findings.

.4 Submit schedule to and obtain approval from Departmental Representative for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.

.5 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.6 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

.7 Record locations of maintained, re-routed and abandoned service lines.

.8 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.18 ELECTRICAL AND CONTROL SYSTEM

.1 The scope of work includes furnishing, receiving, storing, installing, commissioning and placing in service the all electrical and control system as described in the project specification and design drawings.

.2 Electrical components, equipment and system shall satisfactorily pass all applicable factory and field tests in accordance with project specification requirements.

1.19 MINIMUM STANDARDS

.1 Materials are to be new and Work is to conform to the minimum applicable standards of the latest versions of the Canadian Highway Bridge Design Code (CAN/CSA S6), the National Building Code of Canada (where applicable), the

Canadian General Standards Board, the Canadian Standards Association, and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy, the most stringent requirement is to apply.

1.20 PROTECTION

.1 Protect finished work against damage until takeover.

.2 Protect adjacent work against the spread of dust and dirt beyond the work areas.

.3 Protect operatives and other users of site from all hazards.

.4 Other considerations include:
.1 Noise constraints per noise by-laws in nearby townships.
.2 Vibration limitation.
.3 Respect tourism and nearby resort and landowners.
.4 Monitor and protect against upstream flooding during and after installation of cofferdams.

1.21 VERIFICATION OF SITE DIMENSION

.1 The Contractor is advised that all elevations and dimensions shown on the plans are approximate only. Verify all existing dimensions and grades before preparing and submitting shop drawings and before planning and undertaking any construction work. Immediately report all discrepancies, in writing, to the Departmental Representative.

1.22 REGULATORY REQUIREMENTS

.1 Compliance: Be fully acquainted with all rules, regulations and other by-laws of the appropriate Provincial and Municipal governments relating to the work of this Contract and comply with same.

.2 Comply with the regulations of the Province of Ontario with regards to every aspect of the project.

.3 Fee permits, certificates: Pay all fees and obtain all permits. Provide authorities with plans and information for acceptance certificates. Provide inspection certificates as evidence that work conforms to requirements of Authority having jurisdiction.

.4 Ensure compliance of employees with safety requirements of Contract Documents, site specific health and safety plan(s), and all applicable regulatory requirements.

1.23 LICENCE REQUIREMENTS

.1 The Contractor must be licensed to work in the Province of Ontario in accordance with all provincial laws, regulations and requirements.

1.24 PERMITS/AUTHORITIES

.1 The Contractor shall obtain, and pay for, permits from authorities as required for all operations and construction. He shall also comply with all pertinent regulations of all authorities having jurisdiction over the work. The Contractor shall provide copies of all permits to the Owner prior to starting the work.

.2 The Contractor shall be responsible for obtaining all applicable permits, inspections and approvals required and shall pay all charges in connection there with.

1.25 SIGNS

.1 Provide common-use signs related to traffic control, information, instruction, use of equipment, public safety devices, etc., in both English and French languages or by the use of commonly understood graphic symbols to the Departmental Representative's approval.

.2 No advertising will be permitted on this project.

1.26 ADDITIONAL DRAWINGS

.1 Departmental Representative may furnish additional drawings for clarification. These additional drawings have the same meaning and intent as if they were included with plans referred to in Contract Documents.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 ACCESS AND EGRESS

.1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders and scaffolding, independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.2 USE OF SITE AND FACILITIES

.1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.

.2 Where security is reduced by work provide temporary means to maintain security.

.3 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.

.4 Closures: protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

.1 Execute work with least possible interference or disturbance public and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.4 EXISTING SERVICES

.1 Notify Departmental Representative utility companies of intended interruption of services and obtain required permission.

.2 Where Work involves breaking into or connecting to existing services, give Departmental Representative 48 hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

.3 Construct barriers in accordance with Section 01 56 00.

.4 Prior to commencement of Work, arrange to locate underground utilities and service connections that may be affected by the Work.

.5 Where unknown services are encountered, immediately advise Departmental Representative and confirm findings in writing.

.6 Repair existing services damaged during construction as directed by Departmental Representative and relevant utility authority at no additional cost for this contract.

.7 Record locations of maintained, re-routed, and abandoned services.

.8 There is an existing buried and submarine cable at the site providing power and controls to the bridge. This must be maintained during the period after award of the contract to the start of the non-navigation season, or until operation of the bridge is no longer required.

.9 Provide temporary services when directed by Departmental Representative to maintain critical systems.

.10 Protect, relocate, or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.

1.5 SPECIAL REQUIREMENTS

.1 The Contractor shall obtain road occupancy permits from the road authorities for work under this Contract.

.2 Carry out noise generating Work in accordance with the noise by-law in the adjacent townships.

.3 Submit schedule in accordance with Section 01 32 16.

.4 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.

.5 Keep within limits of work and avenues of ingress and egress.

.6 Prior to cutting or drilling horizontal or vertical surfaces including concrete, concrete block or other structural substrate, determine location of reinforcing, service lines, pipes, conduits or other items by x-ray, ground penetrating radar or other appropriate method. Submit findings to Departmental Representative prior to cutting or drilling.

1.6 SECURITY

.1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.

.2 Security clearances:

.1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.

.2 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

.3 Contractor's personnel will require satisfactory RCMP initiated security screening in order to complete Work in premises and on site.

.3 Security escort:

.1 Personnel employed on this project must be escorted when executing work in non-public areas during normal working hours. Personnel must be escorted in all areas after normal working hours.
.2 Submit an escort request to Departmental Representative at least 14 days before service is needed. For requests submitted within time noted above, costs of security escort will be paid for by Departmental Representative. Cost incurred by late request will be Contractor's responsibility.
.3 Any escort request may be cancelled free of charge if notification of cancellation is given at least 4 hours before scheduled time of escort. Cost incurred by late request will be Contractor's responsibility.
.4 Calculation of costs will be based on average hourly rate of security officer for minimum of [8] hours per day for late service request and of 4 hours for late cancellations.

1.7 ROAD CLOSURES

.1 The bridge will be closed to traffic on August 28, 2018.

.2 The bridge will be re-open to traffic on May 22, 2019.

.3 During construction Route 49 (South Sparrow Lake Road, Canning Road), Route 13 (Southwood Road) and Route 11 (Hwy 11) will be used as detour.

.4 Detour details are included in the Traffic Management Plan in the Tender Documents.

1.8 TRAFFIC CONTROL

.1 The Contractor shall provide all traffic control required to complete the work. Traffic Control shall be in accordance with Ontario Traffic Manual (OTM) Book 7.

1.9 SCHEDULING OF WORK

.1 Navigation shall not be impeded during the navigational season. The navigation season is May 18, 2018 to October 8, 2018.

1.10 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment, and materials necessary to complete the work.

1.11 PRE-CONDITION AND POST-CONDITION SURVEY

.1 The Contractor shall undertake a pre-construction and post-construction survey of the following:
.1 Trent-Severn waterway.

.2 Muskoka District road 49, Canning road (CR49) and Hartley Road (for 150 m beyond the limits of construction west and east of the site).
.3 Water intakes within immediate vicinity (within 150 meters of the limits of construction along the river).
.3 All buildings within 150 m of the limit of construction, or as agreed to with the Departmental Representative.
.4 The survey shall be undertaken by a firm experienced in this type of inspection. The reports shall be signed and stamped by a Professional Engineer licensed in the Province of Ontario.
.5 The preconstruction survey (complete with notes, photographs, and video) is to be submitted prior to mobilization on site.
.6 The post construction survey shall be submitted at the time of completion of all work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

.1 The provisions of OPSS.MUNI 539 shall apply to this item except as amended or extended herein or in other Sections. Remove and replace the term "Contract Administrator" with "Departmental Representative" in the above referenced OPSS specification.

.2 The Contractor shall be responsible for making arrangements for land use beyond the boundaries of PCA-owned land. The Contractor shall also be responsible for abiding by all rules and legislation associated with the use of non-federal lands, including but not limited to, the acquisition of necessary permits, as applicable.

1.2 OUTLINE OF WORK

.1 Provide safe and adequate access, scaffolding, work platforms, containment systems and staging, on and around the structure to do all the Work indicated in the Contract Documents. The Contractor shall:

.1 Ensure a safe working environment.

.2 Facilitate progress of Work in an efficient manner.

.3 Prevent debris from falling to the waterway below during both demolition and construction.

.4 Protect areas or features adjacent to the Work during procedures.

.5 Protect Work and products against dampness and cold.

.6 Provide ambient temperatures and humidity levels for storage, application, installation and curing of materials, or for welding.

.7 Allow inspection of the work and provide boat access (including a boat operator and all necessary safety equipment) if required by the Departmental Representative for such inspections at the Contractor's expense.

.2 The work involves both works on and off site. The work must be completed in environmental conditions that allow maximum quality of work and protection for the natural environment.

.3 All access shall conform with the most current Laws, Regulations, or Statutes that apply to this type of work.

.4 The requirements of this section apply to all other sections of the specification to provide an appropriate environment to complete the work as required to achieve the best quality of the finished product.

.5 Be responsible for all re-grading of existing roads, pathways, trails, entrances, fencing, guard rails, landscaping and access routes to suit the Contractor's purposes for site access. The Contractor shall also be responsible for the restoration of all existing roads, pathways, trails, entrances, fencing, guard rails and landscaping, including sodding of disturbed areas, to pre-construction conditions or better. Any damage to trees, sod, or any other property caused by the Contractor's site access

shall be corrected to the Departmental Representative's satisfaction at the Contractor's expense.

.6 Design, construct, maintain, and remove temporary "access to" and "egress from" work areas including, but not limited to, barges, temporary work bridges, stairs, runways, ramps, ladders, scaffolding, containment systems and staging, work platforms independent of finished surfaces.

.7 Provide safe and adequate access to the Departmental Representative for inspection and measurement of all areas of the substructure and superstructure.

.8 Prevent all debris, cutwater, or other deleterious material from falling, flowing or otherwise finding its way into nearby waterways and roadways.

.9 Protect the surrounding environment and properties, the public, vehicular and pedestrian traffic in a manner acceptable to the Departmental Representative's satisfaction at each stage of the work.

.10 Supply and apply water and/or dust suppressants for dust control when directed by the Departmental Representative.

.11 Safely remove and dispose of all staging, access, containment and protection systems, scaffolds and platforms upon completion of the work.

.12 Typical locations and areas of work are shown directly or implied through reference or detail to associated working areas on the drawings. The Contractor shall provide access and protection to carry out work in these areas.

.13 Maintain access to all commercial, institutional, and private entrances at all times.

1.3 REFERENCES

.1 Ontario Provincial Standard Specifications
.1 OPSS.MUNI 539 November 2014 Construction Specification for Temporary Protection

1.4 SITE BARRIERS

.1 Site barriers must be sufficient to protect public and exclude them from the work area.

1.5 SCAFFOLDING & ACCESS

.1 Provide all barges, scaffolding, suspended platforms, ladders, access, and lifting equipment to carry out the work. Field measure to ensure proper fit. Transition area from the ladder(s) or structure to the scaffolding shall be clear of obstructions and cross bracing so people and materials can easily enter.

.2 Carry out all work in accordance with the Occupational Health and Safety

Act and the Site-Specific Safety Plan. Make all changes required by Ministry of Labour officials and address all concerns of the Departmental Representative.

.3 Make regular inspections of scaffolding and work platforms as the work progresses.

1.6 LIGHTING

.1 In all areas of work ensure sufficient and good lighting is provided to complete and inspect the work.

.2 Especially during night time work or in dark areas, provide additional lighting in work areas and to Public ways to compensate for the lack of natural lighting.

.3 Provide for the use of the Departmental Representative additional work lights for inspection.

1.7 CLIMATE CONTROL

.1 Provide heat and/or dehumidifying of site enclosures where required to complete the work.

1.8 SUBMISSIONS

.1 Submit to the Departmental Representative for review, a detailed proposal for carrying out removals and construction for each applicable work item a minimum of one (1) week prior to the commencement of any removals. Those proposals shall outline the removal and new construction techniques, sequence of operations and shall detail and dimension the Contractor's proposed staging, temporary supports/shoring, access, protection, and containment systems.

.2 Submissions for access platforms, barges, and work bridges shall bear the seal and signature of a Professional Engineer licensed in the Province of Ontario, who shall be responsible for the detailed design and subsequent inspection of the access platforms/protection system as installed on site, and shall certify in writing its compliance with the design requirements.

.3 Six (6) sets of working drawings and documents shall be submitted to the Departmental Representative for review of access and protection schemes. Work shall not proceed until the Departmental Representative has reviewed the drawings and provided written authorization for the Contractor to proceed with the work.

.4 The Departmental Representative's approval shall not release the Contractor from liability for any damage or any consequence as a result of inadequate protection design.

1.9 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 GENERAL

.1 In accordance with OPSS.MUNI 539 except as amended or extended herein or in other Sections. Remove and replace the term “Contract Administrator” with “Departmental Representative” in the above referenced OPSS specification.

2.2 MATERIALS

.1 The following alternatives are acceptable:
.1 New materials; or,
.2 Used, salvaged or recycled materials, in good condition, subject to the approval of the Departmental Representative; or,
.3 Prefabricated, portable components in a good, safe condition, approved by the Contractor’s design engineer as to type, materials and detail.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

.1 The provisions of OPSS 517 shall apply to this item except as amended or extended herein or in other Sections. Remove and replace the term “Contract Administrator” with “Departmental Representative” in the above referenced OPSS specification.

1.2 OUTLINE OF WORK

.1 Install cofferdam per contract documents, and dewater all excavations as required to complete the work under this Contract.

1.3 REFERENCES

.1 Ontario Provincial Standard Specifications
.1 OPSS 517 November 2016 Construction Specification for Dewatering of Pipeline, Utility, and Associated Structure Excavation.

1.4 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 GENERAL

.1 In accordance with OPSS 517 except as amended or extended herein or in other Sections. Remove and replace the term “Contract Administrator” with “Departmental Representative” in the above referenced OPSS specification.

PART 3 - EXECUTION

3.1 GENERAL

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 MEASUREMENT AND PAYMENT PROCEDURES

.1 Lump Sum Price – For the work which is not designated in the Unit Price Table there shall be no measurement and shall be deemed to be included as part of the contract Lump Sum Price. This item includes all costs associated to perform the work including but not limited to material, equipment, personnel, and overhead. Items included in the Lump Sum Price are, but not limited to, the following:

.1 Miscellaneous Site Work and General Requirements.

.2 Site Safety.

.3 Supply and installation of temporary erosion, shop drawings, preparation of schedules, sedimentation control measures and dewatering activities.

.4 Earth excavation for structure and backfill at the structure in accordance with the drawings and specifications. The earth excavation and backfill included in the Lump Sum Price is limited to the end of the frost tapers shown on the Contract Drawings.

.5 Micropiles, tremie concrete, reinforcing steel, and testing.

.6 Supply and placement of concrete in abutments, wingwalls, approach slabs, piers, rest piers, traffic gate footings, control console.

.7 Supply, Fabrication, Delivery and Erection of structural, mechanical and hydraulic steel components including all temporary works, bearings, supports and all anchorages. Balance plates are excluded from the Lump Sum Price, and is considered unit.

.8 Design, construction, and maintenance of all temporary structures (temporary support and foundations, shoring, bracing, working platforms, scaffolding, stability bracing, cofferdams etc.) required to complete the work.

.9 Supply and installation of rest pier SSP including all anchorages.

.10 Supply, Fabrication, Delivery and Erection of Railing, and all anchorages.

.11 Coating of structural steel, railings, mechanical and hydraulic components.

.12 Supply and installation of bridge timber deck and timber running boards, including all deck components including flashing bolts anchors.

.13 Supply and installation of joint armouring angles and anchorages.

.14 Salvage and deliver to/store at the designated place per instruction of Departmental Representative, the existing bridge hydraulic and electrical system for re-use by owner.

.15 Removal and disposal of the existing bridge structure including all the electrical, mechanical and hydraulic equipment to the limits shown on the contract drawings.

.16 Removal of topsoil, wooden posts and steel cables, signs, asphalt roadway and granular materials, and boulders.

.17 Supply and installation of traffic lights, warning, traffic signs including all foundation work.

.18 Contractor to coordinate with and pay Hydro One for the new 600V services. Contractor will subsequently get reimbursed at cost.

.19 Design, supply and installation of a control house with mechanical and electrical room and storage facility including all connections to

existing services.
.20 Design, supply and installation of concrete block retaining wall with the finish per selection and instruction of Departmental Representative.
.21 Design, supply and installation of doors, windows, and frames in the control house including all associated accessories, utilities and hardware. Removal and restoration of the existing water system.
.22 Supply and installation of miscellaneous metals including ladders and railings.
.23 Removal of the existing control house in its entirely including the foundations, decommission of the mechanical and electrical room in the basement including capping all utilities and removal and disposal of septic tank.
.24 Remove and salvage bridge mechanical and electrical systems including Operator control station, traffic gates, electrical components including all hydraulic power units, cylinders and valves, balance wheels, end castors, end lifts and locking pin assembly for the re-use by the owner.
.25 Supply and installation of all mechanical components including: center bearing, span drive machinery, balance wheel and track, end support castors, end lift/support machinery, hydraulic system live load rollers, full open and closed stops. This item also includes balance calculations and balance testing of the swing span as well as any adjustment required to balance the bridge.
.26 Supply and installation, testing and commissioning of Hydraulic Equipment including hydraulic piping and hoses including clips, fasteners, cast in place concrete trench and cover.
.27 Supply and installation, testing and commissioning of electrical components including: all electrical service and MCC, bridge PLC control system, lighting and power for the new control house including the mechanical and electrical room, electric power and control in-ground troughs, handholes, junction boxes, conduits, hangers, etc. for the new electrical and storage building and the new swing span.
.28 Commissioning.
.29 Training.
.30 Preparation of Operation and Maintenance Manuals (O&M).
.31 Clearing and grubbing.
.32 Traffic Control, temporary signs, and barricades for bridge closure.
.33 Roadway dust control.
.34 Construction Camera with the minimum interval of 10 minutes.
.35 CCTV.

.2 All work that is not specifically addressed and covered in the Unit Price Item list but is indicated to be completed or required to be completed in order to complete the work is to be deemed included in the Contract Lump Sum.

.3 The following Item titles, units and their respective associated sections list work included in each item. Further description of the work can be found in the sections referenced.
.1 Items which are measured by the metre shall be measured along centreline of installation unless otherwise indicated.
.2 Longitudinal and transverse measurement shall be made on the actual flat or sloped surface.
.3 In computing volumes of excavation, average end area method will be

used unless otherwise directed by Departmental Representative.
.4 All volume measurements refer to in-place measures unless specified otherwise.
.5 Materials which are specified for measurement by mass shall be weighed on scales approved by Departmental Representative. Units used to haul material being paid for by mass shall bear legible identification numbers plainly visible to scale person as it approaches and leaves scale-house.
.6 The numbers of the items described below correspond to the numbers in the Unit Price Table.

.4 Item No. 1 – Common Excavation other than for bridge structure
.1 Item No. 2 shall be paid in cubic meters measured as actual volume removed for road construction based on cross section as detailed in Section 31 23 33.01 – Excavating, Grading and Backfilling. This item excludes earth excavation for structure which is included in the Lump Sum Price.

.5 Item No. 2 - Asphalt Type Hot Mix Asphalt HDBC
.1 Item No. 3 shall be paid in tonnes as determined by actual weigh slips as detailed in Section 32 12 16.

.6 Item No. 3 - Asphalt Type Hot Mix Asphalt HL1
.1 Item No. 4 shall be paid in Tonnes as determined by actual weigh slips as detailed in Section 32 12 16.

.7 Item No. 4 - Asphalt Tack Coat
.1 Item No 5 shall be paid in square meters as detailed in Section 32 12 13.16.

.8 Item No. 5 – Supply, place and compact Granular A
.1 Item No. 8 shall be paid in Tonnes (including supply placement and compaction as determined by actual weigh slips. This item excludes structural backfill which is included in the Lump Sum Price.

.9 Item No. 6 – Supply, place and compact Granular B Type II
.1 Item No. 9 shall be paid in Tonnes (including supply placement and compaction as determined by actual weigh slips. This item excludes structural backfill which is included in the Lump Sum Price.

.10 Item No. 7 - Top Soil Placement and Grading
.1 Item No. 13 shall be paid in cubic metres as measured on site as detailed in Section 32 91 19.13.

.11 Item No 8 – Supply and place Sod
.1 Item No 15 shall be paid in square metres laid as detailed in Section 32 92 23.

.12 Item No. 9 – Supply and place Geotextiles
.1 Item No. 32 shall be paid in square metres as detailed in Section 31 32 19.01.

.13 Item No. 10 – Compaction of Subgrade
.1 Item No. 33 shall be paid in square metres as detailed in Section 31 23 33.01 and 31 22 13.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Particular requirements for Quality Assurance inspection and testing to be carried out by testing laboratory designated by Departmental Representative.

1.2 APPOINTMENT AND PAYMENT

.1 Departmental Representative will appoint and pay for services of testing laboratory except follows:
.1 Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
.2 Inspection and testing performed exclusively for Contractor's convenience.
.3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
.4 Mill tests and certificates of compliance.
.5 Tests specified to be carried out by Contractor under supervision of Departmental Representative.
.6 Additional tests specified as follows:
.1 Concrete testing will be arranged and paid for by the Contractor using an independent CSA Certified Testing Company and field personnel. This includes all site tests of the plastic concrete during placement and all compression tests (including curing) and other tests performed on the hardened concrete. Representative samples from each concrete pour shall be taken and tested. The Departmental Representative may run parallel test at their discretion.
.2 Asphalt mix design and tests, field compaction tests, field sample collection, and testing of the asphalt.
.3 Mastic asphalt mix design and tests, field sample collection and testing of the asphalt.
.4 Concrete mix design development and laboratory testing as may be required to meet Contract requirements.
.5 All electrical inspections required by the authority having jurisdiction.
.6 All other testing and inspections identified in the Contract Documents, where the Contractor is to arrange and pay for the inspection and tests (micropiles, metalizing, coating, galvanizing, metal fabrication and others).
.7 Inspection and testing required by the Contractor as defined elsewhere in the Contract Documents.

.2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Departmental Representative to verify acceptability of corrected work.

1.3 CONTRACTOR'S RESPONSIBILITIES

.1 Provide labour, equipment and facilities to aid the Departmental

Representative with any quality assurance testing and all inspections in the order of:
.1 Provide access, including boat access if required, to Work for inspection and testing.
.2 Facilitate inspections and tests.
.3 Make good Work disturbed by inspection and test.
.4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.

.2 Notify Departmental Representative 48 hours minimum sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.

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

.4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by Departmental Representative.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 ADMINISTRATIVE

.1 Schedule and administer project meetings throughout the progress of the work at the call of Departmental Representative.

.2 Prepare agenda for meetings.

.3 Distribute written notice of each meeting 4 days in advance of meeting date to Departmental Representative.

.4 Provide physical space and make arrangements for meetings.

.5 Preside at meetings.

.6 Unless directed otherwise by Departmental Representative, record minutes of meetings. Minutes shall be circulated to attending parties and affected parties not in attendance within three (3) days after meeting.

.7 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

.1 Within ten (10) days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.

.2 Departmental Representative, Contractor, major Subcontractors, field inspectors and supervisors are required to be in attendance.

.3 Establish time and location of meeting and notify parties concerned minimum five (5) days before meeting.

.4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.

.5 Agenda to include:

.1 Appointment of official representative of participants in the Work.

.2 Schedule of Work: in accordance with Section 01 32 16.

.3 Schedule of submission of shop drawings, samples, mock-ups, colour chips. Submit submittals in accordance with Section 01 33 00.

.4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section 01 52 00.

.5 Delivery schedule of specified equipment.

.6 Site security in accordance with Section 01 56 00.

.7 Health and safety in accordance with Section 01 35 29.

.8 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.

.9 Owner provided products.
.10 Record drawings and specifications in accordance with Sections 01 33 00 and 01 78 00.
.11 Maintenance manuals in accordance with Section 01 78 00.
.12 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00.
.13 Monthly progress claims, administrative procedures, photographs, hold backs.
.14 Appointment of inspection and testing agencies or firms.
.15 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

.1 During course of Work, schedule progress meetings Bi-weekly. Additional meeting may be scheduled as required.

.2 Contractor, major Subcontractors involved in Work and Departmental Representative are to be in attendance.

.3 Notify parties minimum seven (7) days prior to meetings.

.4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within five (5) days after meeting.

.5 Departmental Representative will provide written notification of change to meeting schedule established upon contract award twenty four (24) hours prior to scheduled meeting.

.6 Agenda to include the following:
.1 Review, approval of minutes of previous meeting.
.2 Review of Work progress since previous meeting.
.3 Field observations, problems, conflicts.
.4 Problems which impede construction schedule.
.5 Review of off-site fabrication delivery schedules.
.6 Corrective measures and procedures to regain projected schedule.
.7 Revision to construction schedule.
.8 Progress schedule, during succeeding work period.
.9 Review submittal schedules: expedite as required.
.10 Maintenance of quality standards.
.11 Review proposed changes for effect on construction schedule and on completion date.
.12 Other business.
.1 Progress on action items from previous meetings.
.2 Any complaints from residents in vicinity of construction/ demolition.
.3 Construction budget/cash flow review and update.
.4 Review of health and safety issues or concerns.
.5 Shop drawing status and reviews.
.6 Site instructions.
.7 Environmental issues.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 DEFINITIONS

.1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.

.2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally Bar Chart should be derived from commercially available computerized project management system.

.3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.

.4 Construction Work Week: Monday to Friday, inclusive, will provide five day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.

.5 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.

.6 Master Plan: summary-level schedule that identifies major activities and key milestones.

.7 Milestone: significant event in project, usually completion of major deliverable.

.8 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

.9 Project Planning, Monitoring and Control System: overall system operated by Departmental Representative to enable monitoring of project work in relation to established milestones.

1.2 REQUIREMENTS

.1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.

.2 Plan to complete Work in accordance with prescribed milestones and time frame.

.3 Limit activity durations to maximum of approximately ten (10) working days, to allow for progress reporting.

.4 Ensure that it is understood that Award of Contract or time of beginning, rate of progress, Certificate of Substantial Performance and Certificate of Completion as defined times of completion are of essence of this contract.

.5 Refer to Section 01 14 00 for scheduling of work restrictions.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Submit to Departmental Representative within seven (7) working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.

.3 Submit Project Schedule to Departmental Representative within seven (7) working days of receipt of acceptance of Master Plan.

1.4 PROJECT MILESTONES

.1 Include mandatory project milestones for both Master Plan and Detailed Schedule, but not be limited to, the following:

.1 Project award.
.2 Obtain necessary permits.
.3 Contractor mobilization.
.4 Implement and maintain traffic control plan.
.5 Relocate utility poles.
.6 Clear and level temporary staging area.
.7 Divert traffic onto the detour routes.
.8 Clear and level staging area.
.9 Install cofferdam.
.10 Remove existing mechanical, hydraulic, and electrical equipment.
.11 Demolish and decommission existing control house.
.12 Remove existing superstructure and substructure.
.13 Install micropiles.
.14 Construct footings.
.15 Construct abutments, excluding top of ballast walls, and east pier without interference with existing structure during navigation season.
.16 Commence mechanical and electrical equipment installation including electrical equipment and storage house.
.17 Erect steel superstructure.
.18 Construct necessary temporary works for superstructure.
.19 Install railings.
.20 Install timber deck, running boards and curbs.
.21 Commencement and completion of mechanical and electrical equipment installation.
.22 Complete ballast wall.
.23 Commencement and completion of approach slabs, and joint installation.
.24 Complete approaches.
.25 Paving.
.26 Pavement marking.
.27 Install steel beam guiderails.

.28 Install new traffic signals, warning gate system.
.29 Commission new structure.
.30 Switch traffic to new bridges and decommission existing traffic signals.
.31 Place top soil and sod.
.32 Complete landscaping.
.33 Demobilize.

1.5 MASTER PLAN

.1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).

.2 Departmental Representative will review and return revised schedules within five (5) working days.

.3 Revise impractical schedule and resubmit within five (5) working days.

.4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 PROJECT SCHEDULE

.1 Develop detailed Project Schedule derived from Master Plan.

.2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:
.1 Award.
.2 Shop Drawings, Samples.
.3 Permits.
.4 Mobilization.
.5 Excavation.
.6 Backfill.
.7 Building footings.
.8 Slab on grade.
.9 Structural Steel.
.10 Mechanical.
.11 Hydraulics.
.12 Electrical.
.13 Controls.
.14 Siding and Roofing.
.15 Interior Architecture (Walls, Floors and Ceiling).
.16 Plumbing.
.17 Lighting.
.18 Piping.
.19 Controls.
.20 Heating, Ventilating, and Air Conditioning.
.21 Millwork.
.22 Fire Systems.
.23 Testing and Commissioning.
.24 Supplied equipment long delivery items.
.25 Departmental Representative supplied equipment required dates.

.3 The maintenance and adherence to the schedule is considered an integral part of the work. Schedules must be realistic. If they are constantly not met and/or if they are not updated and accepted by the Departmental Representative and/or if additional effort is not applied to the project to catch up to the schedule then up to 10% of the items will be deemed to be incomplete work and never paid at the sole discretion of the Departmental Representative. The actual completion time of the tasks shall be tracked beside the schedule.

1.7 PROJECT SCHEDULE REPORTING

.1 Update Project Schedule on every two (2) weeks reflecting activity changes and completions, as well as activities in progress. Provide the updated schedule to the Departmental Representative a minimum of two (2) business days prior to scheduled progress meetings.

.2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

.3 Contractor to provide and set up a construction camera to monitor progress of the construction. A minimum time interval of 10 minutes is required.

1.8 PROJECT MEETINGS

.1 Discuss Project Schedule at regular site meetings specified in Section 01 31 19, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.

.2 Weather related delays with their remedial measures will be discussed. The Contractor must anticipate normal to severe winter conditions. Only extreme one in 50 year weather events will be considered for adjustments to schedule. Weather records will be based on the nearest Environment Canada weather monitoring station. The following table provides the water elevation and occurrence of 50-year events.

Water Elevation (m)	50-year Occurrence
213.50-213.74	10
> 213.50	24
213.75-213.99	10
> 213.75	14
> 214.00	4

.3 No progress payment will be made until the construction progress schedule is approved and no subsequent payment will be made without an updated schedule.

.4 Distribute copies of approved schedule to:

.1 Job site office (must be hard copy).
.2 Sub-contractors.
.3 Other parties as directed.

.5 Instruct recipients to report to Contractor within five (5) days, any problems anticipated by timetable shown in schedule.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 ADMINISTRATIVE

.1 Submit to Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples in SI Metric units.

.4 Where items or information are not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work are coordinated.

.8 Contractor's responsibility for errors and omissions in submission is not relieved by Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Departmental Representative review.

.10 Keep one reviewed copy of each submission on site.

.11 Submit number of hard copies specified for each type and format of submittal and also submit in electronic format as pdf files. Forward pdf, NMSEdit Professional spp, MS Word, MS Excel, MS Project and Autocad dwg files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

1.2 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit drawings stamped and signed by professional engineer registered or

licensed in Province of Ontario, Canada.

.3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.4 Allow five (5) working days for Departmental Representative's review of each submission.

.5 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Departmental Representative prior to proceeding with Work.

.6 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.7 Accompany submissions with transmittal letter, in duplicate, containing:
- .1 Date.
- .2 Project title and number.
- .3 Contractor's name and address.
- .4 Identification and quantity of each shop drawing, product data and sample.
- .5 Other pertinent data.

.8 Submissions shall include:
- .1 Date and revision dates.
- .2 Project title and number.
- .3 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
- .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating weight.
  - .8 Wiring diagrams.
  - .9 Single line and schematic diagrams.
  - .10 Relationship to adjacent work.
  - .11 Equipment identification.

.9 After Departmental Representative's review, distribute copies.

.10 Submit three (3) hard copies and one electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.

.11 Submit three (3) hard copies and one electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Departmental Representative where shop drawings will not be prepared due to standardized manufacture of product.

.12 Submit three (3) hard copies and one electronic copy of test reports for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
.2 Testing must have been within 3 years of date of contract award for project.

.13 Submit three (3) hard copies and one electronic copy of certificates for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
.2 Certificates must be dated after award of project contract complete with project name.

.14 Submit three (3) hard copies and one electronic copy of manufacturer’s instructions for requirements requested in specification Sections and as requested by Departmental Representative.
.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.15 Submit three (3) hard copies and one electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.

.16 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.17 Submit three (3) hard copies and one electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.

.18 Delete or identify information not applicable to project.

.19 Supplement standard information to provide details applicable to project.

.20 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

.21 The review of shop drawings by the Departmental Representative is for the sole purpose of ascertaining conformance with general concept.
.1 This review shall not mean that the Departmental Representative approves detail design inherent in shop drawings, responsibility for which shall remain with Contractor submitting same, and such review shall not relieve Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting requirements of construction and Contract Documents.
.2 Without restricting generality of foregoing, Contractor is responsible for dimensions to be confirmed and correlated at job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for co-ordination of Work of sub-trades.

1.3 SAMPLES

.1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.

.2 Deliver samples prepaid to Departmental Representative's business address.

.3 Notify Departmental Representative in writing, at time of submission of deviations in samples from requirements of Contract Documents.

.4 Where colour, pattern or texture is criterion, submit full range of samples.

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

.6 Make changes in samples which Departmental Representative may require, consistent with Contract Documents.

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

1.4 MOCK-UPS

.1 Not used.

1.5 PHOTOGRAPHIC DOCUMENTATION

.1 Submit electronic copy of colour digital photography in jpg format, fine resolution monthly with progress statement and as directed by Departmental Representative.

.2 Project identification: name and number of project and date of exposure indicated.

.3 Number of viewpoints: 4 locations.
.1 Viewpoints and their location as determined by Departmental Representative.

.4 Frequency of photographic documentation: weekly as directed by Departmental Representative.
.1 Upon completion of Work and as directed by Departmental Representative.

1.6 CERTIFICATES AND TRANSCRIPTS

.1 Immediately after award of Contract, submit Workers' Safety and Insurance Board Experience Report.

.2 Submit transcription of insurance immediately after award of Contract.

1.7 FEES, PERMITS AND CERTIFICATES

.1 Provide authorities having jurisdiction with information requested.

.2 Pay fees and obtain certificates and permits required.

.3 Furnish certificates and permits.

.4 Submit acceptable certificate stating that suspended ceiling systems provide adequate support for electrical fixtures, as required by current bulletin of Electrical Safety Authority (ESA.)

1.8 CORRESPONDENCE

.1 All correspondence shall conform to a standard such that is easily identifiable and referenced.

.2 Each submittal shall be numbered and shall include a title page describing the date and version of the submittal.

.3 Electronic submissions shall:
.1 All have a title format that identifies the project, the nature of the submittal, the number of the submittal and the contents of the submittal such that they are easy to electronically sort and identify. The titles will be similar in form to “Project R.073593.001 Hamlet Swing & Fixed Bridges: Shop Drawing X – Location”;
.2 The format of electronic submissions shall be pdf.
.3 The electronic mail submissions shall be divided into sections such that the file size of each submission is less than 5 megabytes.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Canadian Standards Association (CSA): Canada
.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

.2 National Building Code 2015 (NBC):
.1 NBC 2015, Division B, Part 8 Safety Measures at Construction and Demolition Sites.

.3 National Fire Code 2015 (NFC):
.1 NFC 2015, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.

.4 Province of Ontario:
.1 Occupational Health and Safety Act Revised Statutes of Ontario 1990, Chapter O.1 as amended, and;
.1 Regulations for Construction Projects, O. Reg. 213/91 as amended.
.2 Regulations for Diving Operations, O. Reg. 629/94 as amended.
.2 O. Reg. 490/09, Designated Substances.
.3 Workplace Safety and Insurance Act, 1997.
.4 Other municipal, provincial, and federal statutes and authorities having jurisdiction.

.5 Treasury Board of Canada Secretariat (TBS):
.1 Treasury Board, Fire Protection Standard April 1, 2010 www.tbs-sct.gc.ca/pol/doc-eng.aspx ?id=17316&section=text.

.6 Canadian Labour Code, Part 2, Canada Occupational Safety and Health Regulations.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Submit site-specific Health and Safety Plan: Within seven (7) days after date of Notice to Proceed and prior to commencement of Work. Health and Safety Plan must include:
.1 Results of site specific safety hazard assessment.
.2 Results of safety and health risk or hazard analysis for site tasks and operation.
.3 Measures and controls to be implemented to address identified safety hazards and risks.
.4 Contractor’s and Subcontractor’s Safety Communication Plan.
.5 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations.

.3 Submit copies of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative monthly.

.4 Submit copies of reports or directions issued by Federal, Provincial or Territorial health and safety inspectors.

.5 Submit copies of incident, near miss, and accident reports and/or confirmation monthly that no incidents have occurred.

.6 Submit WHMIS MSDS - Material Safety Data Sheets.

.7 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within ten (10) days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 5 days after receipt of comments from Departmental Representative.

.8 Departmental Representative's review of Contractor's final Health and Safety plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.

.9 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

.10 Submit names of personnel and alternates responsible for site safety and health.

.11 Submit records of Contractor's Health and Safety meetings when requested.

.12 Submit Workplace Safety and Insurance Board (WSIB) - Experience Rating Report.

.13 If diving work is required, submit a separate site-specific Health and Safety Plan for Diving Operations, at least 7 days prior to commencement of diving work. Health and Safety Plan must include:
.1 Site-specific safety hazard assessment and measures to be taken to address the anticipated hazards associated with diving work.
.2 Diving Contractor’s and Contractors’ Safety Communication Plan. Must include contact information for all key contacts.
.3 Contingency and Emergency Response Plan addressing standard operating procedures specific to the Diving Operations to be implemented during emergency situations.
.4 Diving Contractor’s Health and Safety Policy.
.5 Name of Health and Safety Coordinator.

1.3 FILING OF NOTICE

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

.2 Contractor shall agree to install proper site separation and identification in order to maintain time and space at all times throughout the life of the project.

1.4 WORK PERMIT

.1 Not used.

1.5 SAFETY ASSESSMENT

.1 Perform site specific safety hazard assessment related to project.

1.6 MEETINGS

.1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.7 REGULATORY REQUIREMENTS

.1 Comply with the Acts and regulations of the Province of Ontario.

.2 Comply with specified standards and regulations to ensure safe operations at site.

.3 Do Work in accordance with Section 01 41 00.

1.8 PROJECT/SITE CONDITIONS

.1 Work at site will involve control of the site, work near water and work in the vicinity of a swing bridge. The Owner will operate the bridge on demand during the navigation season determined elsewhere in the specifications.

.2 Known and obvious hazards include but are not limited to:
- .1 Working with preservative treated timber.
- .2 Mechanical systems.
- .3 Corroded metals from structure.
- .4 Work near water.
- .5 Work near utilities.
- .6 Work on the roadway.
- .7 Working at heights.
- .8 Heavy and moving equipment.
- .9 Electrical service.
- .10 Lead in coating that was not remixed during previous cleaning and coating of steel and on steel faying surfaces.

1.9 GENERAL REQUIREMENTS

.1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.

.2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns either accepting or requesting improvements.

.3 Relief from or substitution for any portion or provision of minimum Health and Safety standards specified herein or reviewed site-specific Health and Safety Plan shall be submitted to Departmental Representative in writing.

1.10 COMPLIANCE REQUIREMENTS

.1 Comply with Ontario Occupational Health and Safety Act, R.S.O. 1990 Chapter 0.1, as amended.

1.11 RESPONSIBILITY

.1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.

.2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

.3 Where applicable the Contractor shall be designated "Constructor", as defined by Occupational Health and Safety Act and Regulations for Construction Projects for the Province of Ontario.

.4 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific health and Safety Plan.

1.12 UNFORSEEN HAZARDS

.1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, immediately stop work and advise Departmental Representative verbally and in writing.

.2 Follow procedures in place for Employees Right to Refuse Work as specified in the Occupational Health and Safety Act for the Province of Ontario.

1.13 HEALTH AND SAFETY CO-ORDINATOR

.1 Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:

.1 Have site-related working experience specific to activities associated with the Work.

.2 Have working knowledge of occupational safety and health regulations.

.3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.

.4 Be responsible for implementing, enforcing daily and monitoring

site-specific Contractor's Health and Safety Plan.
.5 Be on site during execution of Work and report directly to and be under direction of the Site Supervisor.

1.14 POSTING OF DOCUMENTS

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

.1 Contractor's Safety Policy.
.2 Constructor's Name.
.3 Notice of Project.
.4 Name, trade, and employer of Health and Safety Representative or Joint Health and Safety Committee members (if applicable).
.5 Ministry of Labour Orders and reports.
.6 Occupational Health and Safety Act and Regulations for Construction Projects for Province of Ontario.
.7 Address and phone number of nearest Ministry of Labour office.
.8 Material Safety Data Sheets.
.9 Written Emergency Response Plan.
.10 Site Specific Safety Plan.
.11 Copy of valid certificate of first aid personnel on duty.
.12 WSIB "In Case of Injury At Work" poster.
.13 Location of toilet and cleanup facilities.
.14 Any special handling or procedures specific to the site.

1.15 CORRECTION OF NON-COMPLIANCE

.1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.

.2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.

.3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected.

1.16 BLASTING

.1 Blasting or other use of explosives is not permitted.

1.17 POWDER ACTUATED DEVICES

.1 Use powder actuated devices only after receipt of written permission from Departmental Representative.

1.18 WORK STOPPAGE

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

.2 Assign responsibility and obligation to Health and Safety Coordinator to stop or start Work when, at Health and Safety Coordinator's discretion, it is necessary or advisable for reasons of health or safety. Departmental Representative may also stop Work for health and safety considerations.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Repair/Upgrade-Replacement of Hamlet Swing and Fixed Bridges Basic Impact Assessment (BIA), Amec Foster Wheeler, July 2018.

1.2 DEFINITIONS

.1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.

.2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.3 REFERENCES

.1 Standard Acquisition Clauses and Conditions (SACC)
.1 SACC 3.1031-2, Contract Cost Principles

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets. Include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two (2) copies of WHMIS MSDS.

.3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Departmental Representative.

.4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.

.5 Address topics at level of detail commensurate with environmental issue and required construction tasks.

.6 Include in Environmental Protection Plan:
.1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan.
.2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from site.
.3 Name(s) and qualifications of person(s) responsible for training site personnel.
.4 Descriptions of environmental protection personnel training program.
.5 Erosion and Sediment Control Plan identifying type and location of

erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with Erosion and Sediment Control Plan, Federal, Provincial, and Municipal laws and regulations.

.6 Drawings indicating locations of proposed temporary excavations material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site, as well as dewatering and any water treatment systems.

.7 Traffic Control Plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather.

.1 Plans to include measures to minimize amount of material transported onto paved public roads by vehicles or runoff.

.8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.

.1 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.

.9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.

.10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.

.11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.

.12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.

.13 Waste Water Management Plan identifying methods and procedures for management and discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.

.14 Historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources including species at risk, and wetlands.

.15 Pesticide treatment plan to be included and updated, as required.

.16 Fire protection plan including emergency response procedures, instructions, and reports to be used in event of fire.

1.5 FIRES

.1 Fires and burning of rubbish on site is not permitted.

1.6 DRAINAGE

.1 Develop and submit erosion and Sediment Control Plan (ESC) as part of the EMP submission identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with Erosion and Sediment

Control Plan, Federal, Provincial, and Municipal laws and regulations.

.2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for Erosion and Sediment Control Plan.

.3 Provide temporary drainage and pumping required to keep excavations and site free from water including any temporary treatment systems or settling areas.

.4 Ensure pumped water into waterways, sewer or drainage systems is free of suspended materials.

.5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements. The following factors must be considered in determining the suitability of specific erosion control practices:
.1 Soil Characteristics: Soil texture and chemistry can affect the performance of many erosion control practices. Grain size characteristics of concrete sediment must be considered when selecting filter fabric material. Filter fabric material shall be designed around the principles of preventing particle movement through the material.

1.7 SITE CLEARING AND PLANT PROTECTION

.1 Protect trees and plants on site and adjacent properties as indicated.

.2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.

.3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage.
.1 Avoid unnecessary traffic, dumping and storage of materials over root zones.

.4 Minimize stripping of topsoil and vegetation.

.5 Restrict tree removal to areas designated by Departmental Representative.

.6 Restrict grubbing and clearing to locations identified in the Contract Drawings.

1.8 WORK ADJACENT TO WATERWAYS

.1 Construction equipment to be operated on land only.

.2 Install sediment fences and erosion control structures prior to any work adjacent to waterways.

.3 The Contractor shall employ appropriate sediment retention methods to ensure no sediment is discharged into the watercourse. Turbidity barriers and floating booms shall be located as shown on the Erosion Sediment Control

Plan provided by the Contractor. The Contractor is responsible for the design of the turbidity barriers.
.1 CCME Canadian Water Quality Guidelines for the Protection of Aquatic Life will form the baseline for water and streambed quality monitoring and assessment.
.2 Maintain water alkalinity and pH between 6.5 and 9.0. Water with pH > 9 cannot be released directly back into the watercourse. Aqueous substances with a pH ≥ 12.5 are corrosive and considered a hazardous waste under Ontario Regulation 347 of the Environmental Protection Act and wastewater in this condition must be either removed from site or treated before it is released.
.3 Maximum increase of 8 NTU from background levels for a short-term exposure (e.g., 24-h period). Maximum average increase of 2 NTU from background levels for a longer-term exposure (>24 h). If elevated turbidity beyond 8 NTU from background levels for a short-term exposure is observed at the source of in-water work, the Departmental Representative will assess potential impact to the aquatic environment. Additional mitigation measures may be required.
.4 Maximum increase of suspended sediment concentrations by more than 25 mg/L over background levels during any short-term exposure period (e.g., 24-h). For longer term exposure (> 24 h), average suspended sediment concentrations shall not be increased by more than 5 mg/L over background levels. If elevated turbidity beyond 25 mg/L from background levels for a short-term exposure is observed at the source of in-water work, the Departmental Representative will assess potential impact to the aquatic environment. Additional mitigation measures may be required.

.3 Do not use waterway beds for borrow material.

.4 Waterways to be kept free of excavated fill, waste material and debris.

.5 Design and construct temporary crossings to minimize erosion to waterways. Temporary crossings shall not be composed of loose aggregate / granular material.

.6 Do not skid logs or construction materials across waterways.

.7 Do not blast under water.

1.9 IN-WATER WORK

.1 All in-water work must occur within the approved in-water construction timing window as identified by the Ministry of Natural Resources and Forestry (MNRF), for the protection of Walleye during migration, and specified in the Contract Specifications. The in-water construction timing window for the project location is June 1st through March 14th. No in-water work is permitted March 15th through May 31st.

.2 All work must comply with the Fisheries Act, as regulated by the Department of Fisheries and Oceans (DFO).

.3 In-water work shall be performed in a manner that minimizes the disturbance of the watercourse bottom and dispersion of sediment.

1.10 POLLUTION CONTROL

.1 Maintain temporary erosion and pollution control features installed under this Contract.

.2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.

.3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area.
.1 Provide temporary enclosures where required to carry out the work or as directed by Departmental Representative.

.4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris.

.5 Spills of deleterious substances:
.1 Immediately contain, limit spread and clean up in accordance with provincial regulatory requirements.
.2 Report immediately to Ontario Spills Action Centre: 1-800-268-6060.
.3 Further information on dangerous goods emergency cleanup and precautions including a list of companies performing this work can be obtained from the Transport Canada 24-hour number 1-888-226-8832.

1.11 HISTORICAL/ARCHAEOLOGICAL CONTROL

.1 Provide historical, archaeological, cultural resources, biological resources, and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands known to be on project site: and identifies procedures to be followed if historical archaeological, cultural resources, biological resources and wetlands not previously known to be onsite or in area are discovered during construction.

.2 Plan: include methods to assure protection of known or discovered resources and identify lines of communication between Contractor personnel and Departmental Representative.

1.12 NOISE CONTROL

.1 Minimize the noise levels from construction activities by using proper muffling devices, in addition to appropriate timing and location of these activities to reduce or minimize the effects of noise on nearby residents, recreationists, and wildlife.

.2 Work shall be conducted in accordance with the “Noise Control By-Law” in adjacent townships: Orillia, Severn, and Gravenhurst) and any other applicable by-laws.

1.13 SPILL CONTAINMENT

.1 The Contractor shall have one spill containment kit on each side of the bridge on site and available at all times. Spill kit must have a capacity

to handle the volume of chemical liquids of the largest sized tank at the site.

.2 During all operations, such as refueling, the operations shall be completed within a secondary containment system capable of preventing release of spills or leaks into the environment. Containment system must be of appropriate capacity to handle volumes expected from accidental release

1.14 NOTIFICATION

.1 Departmental Representative will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.

.2 Contractor: after receipt of such notice, inform Departmental Representative of proposed corrective action and take such action for approval by Departmental Representative.
.1 Take action only after receipt of written approval by Departmental Representative.

.3 Departmental Representative will issue stop order of work until satisfactory corrective action has been taken.

.4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

.5 In the event of a spill, the Departmental Representative and the Ontario Spill Action Centre (1-800-268-6060) shall be notified immediately; remediation will be conducted immediately to contain and clean up in accordance with provincial regulatory requirements AND to the satisfaction of the Departmental Representative; documentation of remediation, testing and results will be provided to the Departmental Representative.

.6 Should any suspected species at risk – snakes or turtles and/or eggs be encountered during construction, project staging, implementation, or demobilization, Departmental Representative and Parks Environmental Assessment (EA) Staff shall be notified. Contractor shall stop work immediately and contact the Departmental Representative for guidelines on how to proceed. Additional measures to avoid impacts may be required before work can restart. Stand back and allow the animal to leave the site.

1.15 ENVIRONMENTAL MITIGATION MEASURES FOR PLACEMENT OF TREMIE CONCRETE

.1 Ensure concrete forms are tight and no flow is occurring.

.2 Isolate area with curtain or impermeable material specified for concrete particulates; ensure fish exclusion is followed.

.3 Isolated area should be the minimum size required to complete task.

.4 For tremie pours, CO_2 system must be installed and operating along the entire length of the isolated area; The tank shall be used to release carbon dioxide

gas into an affected area to neutralize pH levels. Ensure sufficiently sized tanks for the concrete volumes used.

.5 Workers shall be trained in the use of the system.

.6 Use of neutralizing acids is not permitted.

.7 pH monitoring conducted inside and outside the containment area.

1.16 DECOMISSIONING OF MONITORING WELLS

.1 Monitoring wells/piezometers shall be decommissioned by a licensed water well contractor in accordance with Regulation 903 of the Ontario Water Resources Act

1.17 TERRESTRIAL FLORA, FAUNA, AND HABITAT

.1 Work with a conservation landscape architect to minimize the potential negative impacts on the adjacent surrounding.

.2 Removal and pruning of trees are to be conducted outside the regional migratory bird breeding season (April 1st to August 28th) in compliance with the Migratory Birds Convention Act. It Is not anticipated that the removal and pruning of a select number of trees will have significant impacts on local fauna, nesting habitat, or migratory stopover habitat for birds of the region.

.3 Contractor to inspect the bridge / decommission it before the Bird nesting station.

1.18 SPECIES AT RISK

.1 To ensure compliance with SARA, field confirmation of Barn Shallow nesting should be conducted during the construction staging of the Project and a written record of the findings (with photos, if nests or remnants of nests are observed) should be provided by PCA.

1.19 PERMIT TO TAKE WATER (PTTW) REQUIREMENTS

.1 To ensure exemption as a water taking and not require a PTTW, ensure:

.1 Water is being diverted to create and maintain a dewatered work area located in a water body for a construction-related project by means of a pump.

.2 Water taken from the water body is returned dir3ectly to the same water body. The water cannot be stored or used for any other purpose.

.3 There is no introduction of visible petroleum hydrocarbon film or sheen present in the returned water.

.4 The water quantity and quality is not affected upstream or downstream of the work area.

.5 Erosion and sediment control measures are:

.1 Used during the return of the water to the water body.

.2 Used, operated and maintained in accordance with recommendations provided by the manufacturers of the control

measures.
.3 Recovered and disposed of, along with all materials collected or trapped by those measures, when the water is no longer being taken.
.6 No pump is refueled within 30 meters of the water body.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.

.2 Ensure public waterways, storm and sanitary sewers remain free of waste and volatile materials disposal.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.4 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
.2 Clean all areas of accumulated sediments, debris and other materials deposited as a result of construction activities.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Temporary Erosion and Sedimentation Control Plan: in accordance with Section 01 52 00.

.2 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.

.3 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES AND CODES

.1 Perform Work in accordance with the Canadian Highway Bridge Design Code (CHBDC) CSA S6-14, including all amendments up to bid closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply as directed by the Departmental Representative.

.2 Perform work in accordance with all electrical codes and all codes which have statue of Municipal, Provincial, or Federal law.

.3 Perform work in adherence to Fisheries Act, federal and provincial Species at Risk Acts, federal and provincial Environmental Protection Acts, and Migratory Bird Convention Act.

.4 Meet or exceed requirements of:
- .1 Contract Documents.
- .2 Specified standards, codes and referenced documents.

1.2 HAZARDOUS MATERIAL DISCOVERY

.1 Stop work immediately and notify Departmental Representative if materials which may contain designated substances or PCB's are discovered in course of work.

1.3 BUILDING SMOKING ENVIRONMENT

.1 Comply with smoking restrictions.

1.4 NATIONAL PARKS ACT

.1 Not used.

1.5 RELICS AND ANTIQUITIES

.1 Relics and antiquities, and items of historical or scientific interest such as cornerstones and contents, commemorative plaques, inscribed tables, and similar objects found on site shall remain the property of Parks Canada. Protect such articles and request directives from Departmental Representative.

.2 Should historic objects be uncovered during excavating, stop work immediately and notify the Departmental Representative. Do not resume work until directed to by the Departmental Representative.

1.6 IAQ - INDOOR AIR QUALITY

.1 Not used.

1.7 ACCESSIBLE DESIGN

.1 Not used.

1.8 STATISTICAL INFORMATION

.1 Not used.

1.9 TAXES

.1 Pay applicable Federal, Provincial and Municipal taxes.

1.10 EXAMINATION

.1 Examine existing conditions and determine conditions affecting work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Inspection and testing, administrative and enforcement requirements.

.2 Tests and mix designs.

.3 Mill tests.

.4 Equipment and system adjust and balance.

1.2 RELATED SECTIONS

.1 Section 01 29 83 – Payment Procedures: Testing Laboratory Services.

.2 Section 01 91 00 - Commissioning - General Requirements.

1.3 DEFINITIONS

.1 Certificates of Conformance: documents issued by one of the Contractor's Quality Engineers confirming that the specified components of the Work are in General Conformance with the requirements of the Contract Documents. Each Certificate shall be stamped by a Professional Engineer licensed in the Province of Ontario. Where specified in the Contract documents, Certificates of Conformance shall be prepared by the Contractors Moveable Bridge Specialist Structural, Mechanical, Hydraulic, or Electrical Engineer or other Specialty Engineer.

.2 Non-conformances: materials or workmanship which have an attribute, property or characteristic that does not meet the requirements of the Contract Documents or shop drawings.

.3 Deficient Materials: means, for quality control purposes, materials which have an attribute, property or characteristic that does not meet the requirements of the Contract Documents or shop drawings.

.4 Deficient Workmanship: means, for quality control purposes, the final product does not meet the requirements of the Contract Documents or shop drawings due to the Contractor's construction activities including but not limited to incorrect elevations, dimensions, alignment, workmanship appearance and/or cross fall of individual elements, products and finished construction.

.5 General Conformance: means that, in the opinion of a Professional Engineer, the standard of construction work fulfills the essential requirements of the Contract Documents and has been done in accordance with normally accepted industry standards and will perform its intended function.

.6 Interim Inspection: an inspection confirming that the specified components of the Work are in General Conformance with the Contract Documents.

.7 Quality Control: a system or series of activities carried out by the Contractor to ensure that the final product and materials supplied meets the specified requirements.

.8 Quality Control Administrator (QCA): Contractor's one (1) identified representative responsible for monitoring and ensuring Quality Control compliance. The QCA shall be a direct employee of the Contractor and shall be someone other than the Contractor’s Project Manager, or Site Superintendent.

.9 Quality Engineer (QE): Professional Engineers licensed in the Provinces of Ontario to provide QE services specified in the Contract Documents. Each QE must be retained by the Contractor to certify that specified components of the work are in general conformance with the contract documents and issue Certificates of Conformance. Qualifications are part of the evaluation of the tender. Within 72 hours of Contract award, submit the following to the Departmental Representative: The names of the Quality Engineers and a summary of their relevant experience. The Moveable Bridge Specialist Structural Engineer, Mechanical Engineer, Hydraulics Engineer, Electrical Engineer, and Environmental Specialist shall be the same persons that were listed by the Contractor on the experience record that was included with the Contractor’s tender submission.

.10 Notification of Non-Conformance: means a formal notification by the Departmental Representative to the Contractor identifying aspects of the work which do not conform to the Contract requirements and which have not been adequately identified by the Contractor to the Departmental Representative.

.11 Non-Conformance Report: means a report issued by the Contractor to the Departmental Representative which identifies the Quality Control Performance Measure that was not met, will not be met, or may not be met. This report will include a proposal for corrective or mitigating action and must be approved by the Departmental Representative.

1.4 DECLARATION OF QUALIFICATIONS

.1 Within 72 hours of Contract award, submit the following to the Departmental Representative.

.1 The name of the QCA and a summary of their relevant experience;

.2 The names of all other quality control personnel and/or firms and a summary of their relevant experience and certifications. These should include other Quality Engineers identified in other sections of the specifications. This shall include, but not be limited to, the following activities:

.1 Micropile inspection installation.
.2 Steel fabrication.
.3 Welding.
.4 Coating.
.5 Asphalt design/placement.
.6 Steel erection.
.7 Other mechanical and electrical personnel and/or firms.

.2 Only the personnel/firms identified in the above submissions (Paragraph 1.2.1) shall be utilized for the indicated Certificates of Conformance, Interim Inspections, permissions to proceed and other quality control activities. Any revisions to the named personnel must be submitted in writing to the Departmental Representative for approval at least two (2) weeks prior to the activity for which the substituted personnel will be required.

.3 The Departmental Representative will be the sole judge of the qualifications of the quality control personnel. The Departmental Representative reserves the right to reject any quality control personnel who do not meet the mandatory qualifications.

.4 The Departmental Representative will respond in writing with an acknowledgement of receipt. Submissions that are incomplete or otherwise do not meet the requirements of the Contract Documents will be returned for re-submission at no additional cost and with no extension in time for interim or final completion dates.

.5 For audit purposes, submit supporting documentation demonstrating that the specified qualifications have been met for any Quality Engineer, quality control personnel or firm upon request at any time up to 30 calendar days after the date of certification of Completion of the Work. This must include detailed resume(s) and copies of certificates where applicable and must be submitted within 3 business days of the request.

1.5 QUALITY CONTROL PERFORMANCE MEASURES

.1 General

.1 The Contractor shall be responsible for the development, implementation and maintenance of a Quality Control program for all quality control activities in the Contract, and provide the staff and resources necessary to implement quality control processes that result in compliance to the quality control performance measures detailed in the contract documents. The program must include, but not be limited to, the following:

.1 Retaining the services of Quality Engineers as required.

.2 Assigning a Quality Control Administrator (QCA).

.3 Making available and submitting all QC documentation as per Section 01 33 00, as identified in other specifications, or upon request by the Departmental Representative.

.4 Ensuring all Interim Inspections are completed and Certificates of Conformance are submitted, where specified, prior to proceeding to the next stage of the Work.

.5 Retaining the services of all other specialty inspection firms, inspectors and Engineers.

.2 Quality Control Personnel/Firms

.1 Ensure that:

.1 Submissions of declarations for firms, the quality control personnel and Quality Engineers are accurate, complete and submitted in accordance with the timeframes as detailed in Contract Documents.

.2 Only the personnel/firms identified in the submitted declarations must be utilized for the indicated quality control activities.

.3 Personnel and firms meet the qualifications as specified in the Contract Documents and maintain these qualifications for the duration of their participation in the work.

.3 Submissions

.1 Ensure:

.1 All submissions have been reviewed by the Contractor prior to being submitted to the Departmental Representative.

.2 All submissions are signed by the QCA confirming that the submissions have been reviewed and meet the requirements for submissions identified in the Contract Documents.

.4 Sampling, Testing and Submission of Results

.1 Ensure that QC test results are recorded on the day on which the tests were performed, are submitted to the Departmental Representative under the signature of the QCA, and that each of the following is performed in accordance with the Contract Documents:

.1 Quality control material sampling, preparation, handling, delivery and storage.

.2 Quality control testing and the timing for the testing.

.3 Timing for the submission of results for all quality control testing.

.5 Non-Conformance due to Deficient Materials or Workmanship

.1 A non-conformance to a quality control performance measure occurs when the Contractor does not comply with that quality control performance measure.

.2 For each non-conformance occurrence due to deficient materials and/or workmanship:

.1 Immediately identify and notify the Departmental Representative of the non-conformance within one day of the identification of the non-conformance, prior to the Departmental Representative bringing it to the Contractor’s attention.

.2 Implement preventative measures prior to continuing with the operation and do not proceed with subsequent operations that would prevent or impede corrective work on the deficiency.

.3 Record a brief description of the deficiency in a daily diary immediately after identifying the deficiency and record the complete details within one business day of each occurrence.

.4 Within 3 business days, submit a Deficiency Report to the Departmental Representative containing the following:

.1 The cause and extent of the identified deficiency.

.2 A proposal for corrective work.

.3 For information purposes, a description of preventative measures to be undertaken that will effectively prevent reoccurrence of the event.

.4 A testing and/or inspection proposal for the written approval of the Departmental Representative and undertake the approved testing and/or inspection to demonstrate that the

corrective action has been effective, and the resulting material or elements of work are acceptable.

.5 Implement the corrective work, testing and/or inspection in accordance with the approved proposals.

1.6 INSPECTIONS

.1 Allow Departmental Representative access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.

.2 Give minimum seven (7) days' notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative.

.3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.

.4 Departmental Representative may order any part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Departmental Representative shall pay cost of examination and replacement.

1.7 INDEPENDENT INSPECTION AGENCIES

.1 Independent Inspection/Testing Agencies will be engaged by Departmental Representative for purpose of inspecting and/or testing portions of Work for QA purposes under Section 01 29 83, above and beyond those required of the Contractor. Cost of such services will be borne by Departmental Representative.

.2 Allocated costs: to Section 01 29 83.

.3 Provide equipment required for accessing and executing inspection and testing by appointed agencies.

.4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.

.5 If defects are revealed during inspection and/or testing, correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Contractor to pay costs for retesting and reinspection.

1.8 ACCESS TO WORK

.1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.

.2 Co-operate to provide reasonable facilities for such access.

1.9 PROCEDURES

.1 Notify appropriate agency and Departmental Representative in advance of requirement for tests, in order that attendance arrangements can be made.

.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in Work.

.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.10 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

.2 Make good other Contractor's work damaged by such removals or replacements promptly.

.3 If in opinion of Departmental Representative it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Departmental Representative may deduct from Contract Price the difference in value between Work performed and that called for by Contract Documents, amount of which shall be determined by Departmental Representative.

1.11 REPORTS

.1 Submit four (4) copies of inspection and test reports to Departmental Representative.

.2 Provide copies to Subcontractor of work being inspected or tested, manufacturer or fabricator of material being inspected or tested and.

1.12 TESTS AND MIX DESIGNS

.1 Furnish test results and mix designs as may be requested.

.2 The cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work shall be appraised by Departmental Representative and may be authorized as recoverable.

1.13 MOCK-UPS

.1 Not used.

1.14 MILL TESTS

.1 Submit mill test certificates as requested.

1.15 EQUIPMENT AND SYSTEMS

.1 Submit testing, adjusting and balancing reports for structural, mechanical, electrical and other systems identified in other sections of the Contract Documents.

.2 Submit Commissioning Documentation in accordance with Sections 01 91 00 and 01 91 13.

.3 Refer to other sections for definitive requirements.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Construction aids.

.2 Office and sheds.

.3 Parking.

.4 Project identification.

1.2 REFERENCES

.1 Canadian General Standards Board (CGSB)
- .1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.
- .2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA International)
- .1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
- .2 CSA 0121-17, Douglas Fir Plywood.
- .3 CSA Z797-09(R2014), Code of practice for Access Scaffold.
- .4 CAN/CSA-Z321-[96(R2006)], Signs and Symbols for the Occupational Environment, withdrawn but still available from CSA, CCOHS and Techstreet.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

1.4 INSTALLATION AND REMOVAL

.1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.

.2 Identify areas which have to be graveled to prevent tracking of mud, as approved by the Departmental Representative.

.3 Indicate use of supplemental or other staging area, as approved by the Departmental Representative.

.4 Provide construction facilities in order to execute work expeditiously, as approved by the Departmental Representative.

.5 Arrange for off-site storage and staging areas as required to complete the work and advise the Departmental Representative of any off-site storage or staging areas.

.6 Remove from site all such work after use.

1.5 SCAFFOLDING

.1 Scaffolding in accordance with CSA Z797.

.2 Provide and maintain scaffolding, ladders, platforms, and temporary stairs as required to complete the work.

1.6 HOISTING

.1 Provide, operate and maintain hoists, cranes and barges required for moving of workers, materials and equipment.

.2 Hoists, cranes and barges shall be operated by qualified operator.

.3 Equipment may not be placed or operated within 6m of the existing Severn River unless the Contractor provides a stamped letter by a Professional Engineer registered in the Province of Ontario. The stamped letter shall state that a review of the existing canal and abutments walls has been completed and that the proposed equipment will not negatively impact the immediate or long-term performance of the existing Severn River.

.4 A lift plan shall be prepared for all heavy lifts including, but not limited to, removal of the existing bridge, erection of new structural steel, and placement of mechanical equipment at the pivot pier. The lift plan shall clearly show the location of crane(s) and shall include a note that the surcharge loading from cranes will not adversely affect any permanent site works including, but not limited to, the existing canal walls, and the new abutments. The lift plan shall be stamped by a Professional Engineer registered in the Province of Ontario.

1.7 ELEVATORS

.1 Not used.

1.8 SITE STORAGE/LOADING

.1 Confine work and operations of employees to areas defined by Contract Documents. Do not unreasonably encumber premises with products.

.2 Do not load or permit to load any part of Work with a weight or force that will endanger the Work.

1.9 CONSTRUCTION PARKING

.1 Parking will be permitted on site provided it does not disrupt performance of Work, as approved by the Departmental Representative.

.2 Provide and maintain adequate access to project site, including Bridge Operator’s House.

.3 If authorized to use existing roads for access to project site, maintain such roads for duration of Contract and make good damage resulting from Contractors' use of roads.

1.10 SECURITY

.1 Pay for responsible security personnel to guard site and contents of site after working hours and during holidays.

1.11 OFFICES

.1 Provide office heated to 22°C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.

.2 Provide a clearly marked and fully stocked first-aid case in a readily available location.

.3 Subcontractors may provide their own offices as necessary. Direct location of these offices.

.4 Departmental Representative's Site office.

.1 Provide temporary office for Departmental Representative, one (1) week prior to the commencement of the work on site.
There is to be safe "off street" parking for two (2) vehicles for the Departmental Representative in use at the field office. The temporary office shall be located within the limits of the project site.

.2 Inside dimensions minimum 3.6 m long x 3 m wide x 2.4 m high, with floor 0.3 m above grade, complete with four (4) 50% opening windows and one lockable door.
The Departmental Representative temporary office shall be a 'stand-alone' facility. Providing a partitioned section of the Contractor's site trailer does not satisfy the requirements for providing a temporary office for the Departmental Representative.

.3 Insulate building and provide heating system to maintain 22° C inside temperature at -20° C outside temperature.

.4 Finish inside walls and ceiling with plywood, hardboard or wallboard. Finish floor with 19 mm thick plywood.

.5 Install electrical lighting system to provide min 750 lx using surface mounted, shielded commercial fixtures with 10% upward light component.

.6 Provide and maintain private washroom facilities adjacent to office complete with flush or chemical type toilet, lavatory and mirror and maintain supply of paper towels and toilet tissue. The washroom facility shall be insulated and heated during the winter months.

.7 Equip office with 1 x 2 m table, 4 chairs, 6 m of shelving 300 mm wide, one 3 drawer filing cabinet, one plan rack and one coat rack and shelf.

.8 Maintain in clean condition.

.9 The office shall be equipped with wireless internet access.

.10 Equip with a plain paper photocopier/scanner capable of producing 8½" x 11" and 8½" x 14" copies. Provide adequate supplies of toner cartridges and paper for the duration of the project for the photocopier/scanner. Restock paper and toner as required throughout the project.

.11 Provide cleaning services for the Departmental Representative's temporary office at least once per week and maintain the temporary office as needed through the project.

1.12 EQUIPMENT, TOOL AND MATERIALS STORAGE

.1 Provide and maintain, in a clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.

.2 Locate materials not required to be stored in weatherproof sheds on site in a manner to cause least interference with work activities.

1.13 SANITARY FACILITIES

.1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.

.2 Post notices and take such precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.14 CONSTRUCTION SIGNAGE

.1 Provide and erect, within three (3) weeks of signing Contract, two (2) project signs in English in two locations designated by Departmental Representative.

.2 Construction signs 1.2 x 2.4 m, of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.

Signage includes but is not limited to: the project signage described above, and the vehicular traffic closure signage.

.3 Indicate on sign, name of Owner, Consultant and Contractor of a design style established by Departmental Representative.

Signs shall also state the project title, address range, type of service, completion date, and contract number, as provided by Departmental Representative.

.4 No other signs or advertisements, other than warning signs, are permitted on site.

.5 Provide project identification site sign comprising foundation, framing, and one (1) 1200 x 2400 mm signboard as detailed and as described below.
.1 Foundations: 15 MPa concrete to CSA A23.1/A23.2 minimum 200 mm x 900 mm deep.
.2 Framework and battens: SPF, pressure treated minimum 89 x 89 mm.
.3 Signboard: 19 mm Medium Density Overlaid Douglas Fir Plywood to CSA O121.
.4 Paint: alkyd enamel to CAN/CGSB-1.59 over exterior alkyd primer to CAN/CGSB-1.189.
.5 Fasteners: hot-dip galvanized steel nails and carriage bolts.
.6 Vinyl sign face: printed project identification, self adhesive, vinyl film overlay, supplied by Departmental Representative.

.6 Locate project identification sign as directed by Departmental Representative and construct as follows:
.1 Build concrete foundation, erect framework, and attach signboard to framing.

.2 Paint all surfaces of signboard and framing with one coat primer and two coats enamel. Colour white on signboard face, black on other surfaces.
.3 Apply vinyl sign face overlay to painted signboard face in accordance with installation instruction supplied.

.7 Direct requests for approval to erect a Consultant/Contractor signboard to Departmental Representative. For consideration general appearance of Consultant/Contractor signboard must conform to project identification site sign. Wording shall be in both official languages.

.8 Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to CAN/CSA-Z321.

.9 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Departmental Representative.

1.13 CLEAN-UP

.1 Remove construction debris, waste materials, packaging material from work site daily.

.2 Clean dirt or mud tracked onto paved or surfaced roadways.

.3 Store materials resulting from demolition activities that are salvageable.

.4 Stack stored new or salvaged material.

1.14 MEASUREMENT AND PAYMENT

.1 There shall be no separate measurement for the work completed under this section.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Prepare, implement, monitor, and maintain an Erosion and Sediment Control Plan (ESCP) to provide water quality protection. The ESCP is to mitigate the potential for soil erosion and discharge of soil-bearing runoff or airborne dust resulting from the Contractor’s construction operations from entering all watercourses including drainage ditches, environmentally sensitive areas, and adjacent properties to the Working Area, according

to requirements of authorities having jurisdiction, sediment and erosion control plan, specific to site, that complies with requirements of authorities having jurisdiction. The ESCP is also to address turbidity control to prevent sediment migration from the Working Area while in-water work is being performed, and from temporary diversion works.

.2 Carry out construction operations that may impact upon water quality in a manner that strictly meets the requirements of all applicable legislation and regulations.

.3 Determine and conform to the requirements of the Department of Fisheries and Oceans (DFO), the Ontario Ministry of the Environment (MOE), the local municipality and/or Township, the area Conservation Authority and any other governmental regulatory agencies having jurisdiction in the working area or over any potentially impacted watercourses.
.1 It shall be the responsibility of the Contractor to obtain written approvals from DFO, MOE and the area Conservation Authority for the Contractor's proposed water quality protection schemes.

.4 Prior to commencing work, provide four (4) copies of a detailed Erosion and Sediment Control Plan for the Contractor's proposed water quality protection schemes bearing the seal and signature of a qualified Professional Engineer licensed to practice in the Province of Ontario. The ESCP will contain but is not limited to the following:
.1 Description of site condition, potential erosion and sediment issues at the site and associated risk.
.2 Description and details of environmental controls to be put in place.
.3 Phasing steps and coordination of environmental control measures installation with sequence of construction.
.4 Inspection, monitoring and maintenance program of all control measures during construction, work stoppage and post-construction, including additional inspections following large storm events and other periods of runoff.
.5 Monitoring plan of water quality at outlet of any construction site discharge at a receiving watercourse, and within the watercourse where in-water activities are taking place.
.6 Emergency contingency plan (provision of additional labour, equipment and materials to install additional control measures and detail an emergency response plan in case of an accidental event).
.7 Procedures and phasing of the removal and disposal of the control measures.
.8 Removal of all sediment and other materials contained by the temporary works.

.5 The designer of the ESCP is to visit the site prior, during and after construction to plan and evaluate the requirements for control measures, their installation and their effectiveness. The designer is to conduct a thorough inspection, as part of their site assessment and provide a risk assessment and mitigation plan to the Contractor and the Departmental Representative. The ESCP shall be revised, as required, as a result of their site assessment and monitoring.

.6 In the event of a work stoppage due to weather, seasonal work stoppage, contractual disputes, or direction by a regulatory agency, the Contractor is to continue monitoring and maintaining the erosion and sediment control measures.

.7 Guidelines for the development of an ESCP can be found in the 2007 Ministry of Transportation (Ontario), Environmental Guide for Erosion and Sediment Control during Construction of Highway Projects.

.8 It is the Contractor responsibility to develop and detail the ESCP to ensure that all regulatory requirements and environmental criteria for discharge to a water course are satisfactorily meet.

.9 Measures may include, but shall not be limited to, the following:
.1 Sediment ponds.
.2 Silt fences/barriers.
.3 Straw bales.
.4 Geotextiles.
.5 Check dams and/or berms.
.6 Biodegradable filter socks.
.7 Erosion mats.
.8 Vegetation.
.9 Interceptor ditch/scales.
.10 Mechanical equipment.
.11 Or other recognized technologies and methods available at the time of construction.

.10 Contractor shall supply and install additional or alternative measures, as directed by the Departmental Representative, if the installed control measures fail to perform adequately.

.11 Monitor weather forecasts and schedule the Work in order to minimize the risk of sediment-laden runoff entering any watercourse and other environmentally sensitive areas.

.12 The ESCP shall provide a contingency plan to include the provision of additional labour, equipment, or materials to install additional control measures and detail an emergency response plan in case of an accidental event.

.13 Ensure all workers, including sub-contractors, in the working areas are aware of the importance of the erosion and sediment control measures and informed of the consequences of the failure to comply with the requirements of the regulatory agencies and these specifications.

.14 Clean out accumulated sediment deposits periodically, as required at the sediment control devices, including those deposits that may originate from outside the construction area. Accumulated sediment shall be removed in such a manner that prevents the deposition of this material into any sewer or watercourse and avoids damage to the control measure. The sediment shall be removed from the site at the Contractor's expense and managed in compliance with the requirements for excess earth material, as specified elsewhere in the Contract.

.15 Immediately report to the Departmental Representative any accidental discharges of sediments material into either the watercourse or adjacent ditches. Appropriate response measures, including any repairs to existing control measures, or the implementation of additional control measures, shall be carried out by the Contractor without delay.

.16 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.17 Remove the sediment control measures when, in the opinion of the Departmental Representative, the measure(s) is no longer required. All sediment and erosion control measures shall be removed in a manner that avoids the entry of any equipment, other than hand—held equipment, into any watercourse and prevents the release of any sediment or debris into any sewer or watercourse within or downstream of the Working Areas.

.18 Restore and stabilize areas disturbed during removal of the sediment control measures.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF THE WORK

.1 This section covers the requirements for the installation of access to permit:

.1 All necessary field measurements and verifications for shop drawing preparation;

.2 Construction of the new bridge and removal of the existing bridge structure; and

.3 Inspection of all work by the Departmental Representative.

1.2 REFERENCES

.1 Province of Ontario

.1 Occupational Health and Safety Act, R.S.O.- Updated 2017.

.2 Canadian Standards Association (CSA International)

.1 CAN/CSA-A23.1, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

.2 CAN/CSA-A23.3, Design of Concrete Structures for Buildings.

.3 CAN/CSA-086, Engineering Design in Wood along with 086S1 Supplement No. 1 to CAN/CSA-086, Engineering Design in Wood.

.4 CSA 0121, Douglas Fir Plywood.

.5 CAN/CSA-0122, Structural Glued-Laminated Timber.

.6 CAN/CSA-S269.1, Falsework for Construction Purposes.

.7 CAN/CSA-S269.2, Access Scaffolding for Construction Purposes.

.8 CAN/CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel I Structural Quality Steels.

.9 CAN/CSA-8157, Strength Design in Aluminum.

1.3 DEFINITIONS

.1 Access to Work: any method used for access to carry out the work such as rigid framed scaffolding, mobile access buckets, cranes, ladders, work/suspended platforms, etc.

1.4 DESIGN REQUIREMENTS

.1 Design Access to Work components in accordance with CAN/CSA-S6, CAN/CSA-S269.1 and CAN/CSA-S269.2.

.2 Field welding to new or existing structural steel components will not be permitted.

.3 Drilling of holes or modifications to new structural steel components (that impair the structural capacity of the component), not shown as part of the work on the contract drawings, is not permitted.

.4 Where proprietary systems are used, the design to be in conformance with the manufacturer's recommendations.

.5 For the demolition of existing bridge, where the Contractor utilizes a platform, submit an evaluation of the structure confirming that the structure can safely support the load of the platform. This evaluation to be signed and sealed by a Professional Engineer licensed the Province of Ontario.

.6 Access to and from the Access to Work facilities must conform to all relevant occupational and health and safety regulations.

1.5 SHOP DRAWINGS

.1 Submit shop drawings in accordance with Section 01 33 00. For contracts where another authority is affected (such as navigable waters), two additional copies are required for each authority.

.2 Show the location, magnitude of all applied loads and safety factor on shop drawings bearing the seals and signatures of two Professional Engineers registered or licensed in the Province of Ontario.

.3 Access to Work shop drawings to include at least the following:

.1 Longitudinal, lateral, vertical, live, snow, impact and anticipated construction loads used in the design, including wind loads due to enclosures for debris containment.

.2 The grade and actual size of all structural materials.

.3 Posts, connections, bracing and welding to be in sufficient detail for analysis.

.4 Fully detailed frame shoring.

.5 Type and mass of equipment, moving or stationary, to be supported by the Access to Work platforms.

.6 All proprietary equipment and systems.

.7 Details and methods of maintaining rotational and lateral stability of existing structure sections.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Scaffolding, work platforms and other access materials is to be new or used materials in good condition.

.2 Scaffolding to be in accordance with CAN/CSA-S269.2 and CAN/CSA Z797 and requirements of Health and Safety of the Province of Ontario.

.3 Materials to be in accordance with relevant documents detailed in Section 1.2 References.

PART 3 - EXECUTION

3.1 MEANS OF ACCESS TO CARRY OUT THE WORK

.1 Provide and maintain all scaffolding, ramps, ladders, swing staging, platforms, temporary stairs, access lifting equipment, etc. as necessary to carry out the Work. All means of access to be approved by Departmental Representative and in accordance with the Occupational Health and Safety Act. Field measure ensuring proper fit of all works.

.2 Prior to commencement of work on any Access to Work facilities the Engineer for the access facilities is to complete an interim site inspection and issue a Certificate of Conformance, to be submitted to the Departmental Representative.

.3 Land based scaffolding to be erected on mud sills. Mud sills are to be of sufficient size ensuring no damage to existing features. Where the scaffolding is suspended from the newly erected superstructure steel, the methods of suspension must be such as to permit the execution of the work and also not adversely impact construction to the final geometry of the structure. All methods of suspension must be approved by the Departmental Representative.

.4 Where access is provided for Work over, in or adjacent to the waterway, ensure environmental protection is provided in accordance with Section 01 35 43 - Environmental Procedures. Where scaffolding access is provided for work on the pier, or platforms are provided to the underside of the superstructure, ensure all levels where work is being carried out have plastic sheeting or tarps to ensure that all debris and contaminated fluids are contained to those levels. Remove all debris and other contaminants in a safe manner, on a regular basis and, to the satisfaction of the Departmental Representative.

.5 For use of any lands beyond the federally-owned right-of-way, obtain written consent from the potentially affected private landowner(s) and consultation with the MNRF in the case of observations of provincial SAR. Ensure that all rules are adhered to and permits are acquired, as applicable.

.6 Do not damage the coating on steel components as a result of operations. Repair any coating damage resulting from the erection, use, or dismantling of scaffolding or work platforms in accordance with the Contract Documents at the Contractor's expense.

END OF SECTION

PART 1 – GENERAL

1.1 REFERENCES

.1 Ministry of Transportation Ontario (MTO)

.1 Ontario Traffic Manual (OTM) Book 7 - Temporary Conditions.

.2 Occupational Health and Safety Act (OHSA) and Regulations for Construction Projects, R.S.O. 1990 and R.R.O. 213/91.

.3 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.2 DESCRIPTION OF WORK

.1 The Contractor shall provide traffic control persons, signs, temporary traffic signs with platforms, TC-54 barrels, barricades and all other required traffic control devices on South Sparrow Lake Road, Canning road, Highway 11, and all other surrounding roads, waterways, and in all areas affected by the construction (pathways, sidewalks, parking lots and along the waterway) and as required to complete the work.

.2 The Contractor shall provide all requirements to carry out construction traffic control in accordance with OTM and OHSA.

.3 The Contractor shall provide traffic control persons, blocker trucks, and crash trucks, as required. The Contractor shall provide and maintain signs and barricades as detailed on the Contract drawings, as required by Book 7 (Temporary Conditions) of the Ontario Traffic Manual (OTM), and as directed by the Departmental Representative.

.4 The Contractor shall supply a mechanical sweeper to remove dirt or debris from the areas of the roadway which will be open to traffic as required based on the Contractor's construction procedures.

.5 Remove, salvage, and reinstate permanent signs as required to facilitate the work.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 The Contractor shall prepare a Traffic Control Plan (TCP) for vehicles, cyclists and pedestrians in accordance with MTO OTM's. The TCP is to be signed and sealed by a Professional Engineer registered in the Province of Ontario.

.3 In addition to the TCP, the Contractor shall also prepare a Navigation Control Plan that identifies measures that will be taken by the Contractor with respect to navigation at this site. At a minimum, the navigation control plan shall include a summary of all navigation restrictions listed in the Contract Documents and shall identify locations where advance warning notifications will be installed to advise boaters of the work at this project site. The Navigation Control Plan shall also identify any and all temporary measures that will be employed by the Contractor with respect to use of barges or any other temporary obstructions that would be placed in or over the waterway as part of the work.

.4 The Contractor shall have a copy of the location specific, traffic control plan for the protection of workers and the public on site at all times, as per the Ministry of Labour regulations.

.5 Submit the TCP and Navigation Control Plan to the Departmental Representative ten (10) days in advance of proposed changes to vehicle traffic or marine vessel management.

.6 Do not commence any works until Departmental Representative has reviewed the TCP and Navigation Control Plan and has returned both plans to the Contractor with no comments.

.7 Review of the TCP and the Navigation Control Plan by Departmental Representative makes no representation that document is accurate, complete or compliant with applicable legislation. Errors, omissions or deficiencies within TCP remain sole responsibility of Contractor. The Contractor shall have no claim for delay of the project or costs incurred as a result of an incomplete application.

.8 Review and modify TCP and the Navigation Control Plan for errors, omissions, deficiencies, or new hazards as the work progresses and resubmit these plans to the Departmental Representative for review each time an update has been made.

.9 Detail specific traffic control layout necessary for completion of work including vehicular, pedestrian and cyclist movement, required to allow the Contractor to fulfill conditions of the Contract taking into account organized, systematic safe conduct of the project and to meet Contract requirements. This includes, as applicable, detours, advanced project signs, staging sequences, work, public and emergency vehicles access and egress, public access and separation from hazardous areas, temporary barriers and fences, removal of existing pavement markings and selection of appropriate typical layouts and devices for traffic control.

.10 TCP to include, and not necessarily be limited to:
.1 Monitoring and repair.

.2 Traffic and pedestrian control signs (regulatory, warning and temporary).
.3 Traffic control delineation.
.4 Traffic control vehicles.
.5 Portable temporary traffic signals (PTTS) including timing.
.6 Contract specific work restrictions including operational constraints.
.7 Lane closures and detours.
.8 Night time requirements.
.9 Traffic staging and scheduling.
.10 Construction vehicle access and egress.
.11 Public access and egress.
.12 Pedestrian, cyclist and vehicular safety including barriers, temporary concrete barriers and barricades.
.13 Emergency Vehicle Access.
.14 Removal of existing and provision of temporary pavement markings.
.15 Any other traffic control measures.

1.4 PROTECTION OF PUBLIC TRAFFIC

.1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.

.2 When working on travelled way:
.1 Place equipment in position to present minimum of interference and hazard to travelling public.
.2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
.3 Do not leave equipment on travelled way overnight.

.3 Close lanes of road only after receipt of written approval from Departmental Representative.
.1 Before re-routing traffic erect suitable signs and devices in accordance with TCP.

.4 Keep travelled way free from potholes and of sufficient width for required number of lanes of traffic.
.1 Provide minimum traffic lane widths as indicated.

.5 Provide and maintain road access and egress to property fronting along Work under Contract and in other areas as indicated, unless another means of road access exists that meets approval of Departmental Representative.

1.5 INFORMATIONAL AND WARNING SIGNS

.1 Supply, install and maintain signs, flashing warning signs, and other devices required to indicate construction activities or temporary and unusual conditions resulting from Work which requires road user response.

.2 Supply and erect signs, delineators, barricades and miscellaneous warning devices in accordance with TCP and the Navigation Control Plan.

.3 Submit to the Departmental Representative prior to commencement of Work a list of required signs and other devices required for the TCP the Navigation Control Plan. If the situation on site changes, revise and resubmit TCP the Navigation Control Plan to Departmental Representative.

.4 On a frequency of not less than once per day during the entire Contract duration, the Contractor is required to complete inspections of all project signage and maintain an inspection log that indicates these inspections have occurred. The inspection log shall list all signs installed as part of this Contract including the four (4) Project Signboards, all traffic control signage, all navigation signage, any other signage installed by the Contractor. A copy of the signage inspection log shall be provided to the Departmental Representative on a weekly basis.

.5 Navigable Water

.1 During the Navigation Season, signs stating "Construction Ahead" shall be placed and maintained approximately 300 m east and 300 m west of the work on the Upper Severn River. The size of the signs should be 1.2 m high by 2.4 m wide and placed so that they are clearly visible to boaters.

.2 During the Non-Navigation Season (Winter Navigational Shut-down period), signs stating "Upper Severn River Closed to Navigation at the Hamlet Swing Bridge" shall be placed and maintained at the east and west limits of the Upper Severn River. The size of the signs should be 1.2 m high by 2.4 m wide and placed so that they are clearly visible to boaters.

.3 Any temporary works(s) that are on, over or across the waterway shall, during all periods of reduced visibility, be marked with yellow flashing lights located on each end of the work(s) and on other locations on the works so that the lights are spaced not more than 30 m apart.

.4 The Contractor must notify the Canadian Coast Guard Vessel Traffic Centre Noteship desk at 613-925-0666 at least 48 hours in advance of any event that may result in the bridge not being fully operational during the navigation season, and again once the new bridge has been commissioned and is in its full operating condition. The Contractor must provide the Departmental Representative of proof that this requirement has been fulfilled.

.6 Continually maintain traffic control devices.

.1 Check signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.

.2 Remove or cover signs which do not apply to conditions existing from day to day.

1.6 CONTROL OF PUBLIC TRAFFIC

.1 Provide competent flag persons, trained and properly equipped:

.1 When public traffic is required to pass working vehicles or equipment that block all or part of travelled roadway.

.2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
.3 Where temporary protection is required while other traffic control devices are being erected or taken down.
.4 For emergency protection when other traffic control devices are not readily available.
.5 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.

1.7 OPERATIONAL REQUIREMENTS

.1 Maintain existing conditions for traffic throughout period of contract except that, when required for construction under contract and when measures have been taken in accordance with TCP and as reviewed by Departmental Representative to protect and control public traffic.

1.8 MEASUREMENT AND PAYMENT

.1 There will be no measurement for payment for work within this section.
.2 The Contract Lump Sum Amount shall include all costs for traffic control persons, PTTS, signs, crash trucks, delineators and all detour signage and other traffic control devices to be used on the job for whatever purpose required by the terms of the contract and in accordance with the directions to be given to the Contractor by the Departmental Representative. Daily moving of these devices shall be the responsibility of the Contractor and no additional payment shall be made for these operations. The Contractor shall ensure that sufficient devices are readily available to satisfy all these requirements.
.3 Payment shall include all labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 NOT USED

PART 3 - EXECUTION

3.1 GENERAL

.1 The Contractor shall independently verify all traffic requirements indicated in the Contract Documents, such that they comply with OTM Book 7. The Contractor shall be responsible for all requirements in accordance with OTM Book 7, regardless of whether or not they are indicated in the Contract Documents.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Barriers.

.2 Environmental Controls.

.3 Traffic Controls.

.4 Fire Routes.

1.2 RELATED SECTIONS

.1 Section 01 52 00 - Construction Facilities.

1.3 REFERENCES

.1 Canadian General Standards Board (CGSB):
  .1 CAN/CGSB-1.189-2000, Exterior Alkyd Primer for Wood.
  .2 CAN/CGSB-1.59-97, Alkyd Exterior Gloss Enamel.

.2 Canadian Standards Association (CSA):
  .1 CSA O121-17, Douglas Fir Plywood.

1.4 INSTALLATION AND REMOVAL

.1 Provide temporary controls in order to execute Work expeditiously.

.2 Remove from site all such work after use.

1.5 HOARDING

.1 Not Used.

1.6 GUARD RAILS AND BARRICADES

.1 Provide secure, rigid guard rails and barricades around work areas such as, but not limited to, excavations, open stairways, openings due to removals or new work in progress, and work near the swing span when it is in its open position.

.2 Provide protection as required by governing authorities.

1.7 WEATHER ENCLOSURES

.1 Not Used.

1.8 DUST TIGHT SCREENS

.1 Not Used.

1.9 ACCESS TO SITE

.1 Provide and maintain access roads, sidewalk crossings, ramps and construction runways as may be required for access to Work.

1.10 PUBLIC TRAFFIC FLOW

.1 Provide and maintain competent signal flag operators, traffic signals, barricades and flares, lights, or lanterns as required to perform Work and protect the public.

1.11 FIRE ROUTES

.1 Maintain access to property including overhead clearances for use by emergency response vehicles.

1.12 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

.1 Protect surrounding private and public property from damage during performance of Work.

.2 Be responsible for damage incurred.

1.13 PROTECTION OF BUILDING FINISHES

.1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.

.2 Provide necessary screens, covers, and hoardings.

.3 Confirm with Departmental Representative locations and installation schedule three (3) days prior to installation.

.4 Be responsible for damage incurred due to lack of or improper protection.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Product quality, availability, storage, handling, protection, and transportation.

.2 Manufacturer's instructions.

.3 Quality of Work, coordination and fastenings.

.4 Existing facilities.

1.2 RELATED SECTIONS

.1 Section 01 45 00 – Quality Control.

1.3 REFERENCES

.1 Within text of each specification section, reference may be made to reference standards.

.2 Conform to these standards, in whole or in part as specifically requested in specifications.

.3 If it is not clear whether any product or system is in conformance with applicable standards, the Contractor shall demonstrate through third party testing by a qualified testing company that such products or systems are in conformance. This testing shall be paid for by the Contractor and the results shall be submitted to the Departmental Representative for review.

.4 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

.5 Conform to latest date of issue of referenced standards in effect on date of submission of Bids, except where specific date or issue is specifically noted.

.6 OPSS Ontario Provincial Standard Specifications and OPSD Ontario Provincial Standard Drawings quoted in these specifications are available online at http://www.raqsa.mto.gov.on.ca/techpubs/ ops.nsf/OPSHomepage.

1.4 QUALITY

.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in Work shall be new, not damaged or defective, and of best quality (compatible with specifications) for purpose intended. If requested, furnish evidence as to type, source and quality of Products provided.

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should any dispute arise as to quality or fitness of products, decision rests strictly with the Departmental Representative based upon the requirements of the Contract Documents.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout the bridges.

.5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.5 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 In event of failure to notify Departmental Representative at commencement of Work and should it subsequently appear that Work may be delayed for such reason, Departmental Representative reserves right to substitute more readily available products of similar character, at no increase in Contract Amount or Contract Time.

1.6 METRIC SIZED MATERIALS

.1 SI metric units of measurement are used exclusively on the drawings and in the specifications for this project.

.2 The Contractor is required to provide metric products in the sizes called for in the Contract Documents except where a valid claim can be made that a particular product is not available on the Canadian market.

.3 Claims for exemptions from use of metric sized products shall be in writing and fully substantiated with supportive documentation. Promptly submit application to Departmental Representative for consideration and ruling. Non-metric sized products may not be used unless Contractor's application has been approved in writing by the Departmental Representative.

.4 Difficulties caused by the Contractor's lack of planning and effort to obtain modular metric sized products which are available on the Canadian market will not be considered sufficient reasons for claiming that they cannot be provided.

.5 Claims for additional costs due to provision of specified modular metric sized products will not be considered.

1.6 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

.3 Store products subject to damage from weather in weatherproof enclosures.

.4 Store cementitious products clear of earth or concrete floors, and away from walls.

.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.6 Store sheet materials, lumber on flat, solid supports and keep clear of ground. Slope to shed moisture.

.7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.8 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.

.9 Touch-up damaged factory finished surfaces to Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.7 TRANSPORTATION

.1 Pay costs of transportation of products required in performance of Work.

1.8 MANUFACTURER'S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.

.2 Notify Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that Departmental Representative may establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Departmental Representative to require removal and re-installation at no increase in Contract Amount or Contract Time.

1.9 QUALITY OF WORK

.1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify the Departmental Representative if it is not practical to produce required results.

.2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves the right to require dismissal from site, workers deemed incompetent or careless.

.3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Departmental Representative, whose decision is final.

1.10 CO-ORDINATION

.1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.

.2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.11 REMEDIAL WORK

.1 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Coordinate adjacent affected Work as required.

.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.14 LOCATION OF FIXTURES

.1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.

.2 Inform Departmental Representative of conflicting installation. Install as directed.

1.15 FASTENINGS

.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.

.2 Prevent electrolytic action between dissimilar metals and materials.

.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.

.4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic

material plugs are not acceptable.

.5 Keep exposed fastenings to a minimum, space evenly and install neatly.

.6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.16 FASTENINGS - EQUIPMENT

.1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.

.2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No.304 stainless steel for exterior areas.

.3 Bolts may not project more than one diameter beyond nuts.

.4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.17 PROTECTION OF WORK IN PROGRESS

.1 Prevent overloading of any part of structure. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

1.18 EXISTING UTILITIES

.1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work.

.2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

1.15 MEASUREMENT AND PAYMENT

.1 There will be no measurement for work under this section.

.2 Payment will be deemed to be included as part of the Contract Lump Sum amount.

.3 Payment at the contract price shall be full compensation for all labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Field engineering survey services to measure and stake site.

.2 Recording of subsurface conditions found.

.3 List of geotechnical reports, and environmental studies undertaken for the project and available to the Contractor.

1.2 REFERENCES

.1 Owner's identification of existing survey control points and property limits.

1.3 QUALIFICATIONS OF SURVEYOR

.1 Qualified registered land surveyor, licensed to practice in Place of Work by the Association of Ontario Land Surveyors (AOLS).

1.4 SURVEY REFERENCE POINTS

.1 Existing base horizontal and vertical control points are designated on drawings.

.2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.

.3 Make no changes or relocations without prior written notice to Departmental Representative.

.4 Report to Departmental Representative when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.

.5 Require surveyor to replace control points in accordance with original survey control.

1.5 SURVEY REQUIREMENTS

.1 Establish two (2) permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents. Propose locations of these two (2) new bench marks to the Departmental Representative for review at least seven (7) prior to establishing the new bench marks. The new benchmarks shall meet the requirements of the AOLS and have an identification number.

.2 Establish lines and levels, locate and lay out, by instrumentation.

.3 Establish lines and levels for all site work including, but not limited to, road work, site grading, new kiosk, structural, mechanical and

electrical work.

1.6 EXISTING SERVICES

.1 Prior to commencing work and following locates by services/utilities, establish location and extent of service and utility lines in area of Work, and notify Departmental Representative of findings.

.2 Protect any line encountered during excavation work.

1.7 LOCATION OF EQUIPMENT AND FIXTURES

.1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.

.2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.

.3 Inform Departmental Representative of impending installation and obtain approval for actual location.

.4 Submit field drawings to indicate relative position of various services and equipment when required by Departmental Representative.

1.8 RECORDS

.1 Qualified land surveyor to prepare as-built record drawings, of the structure and ancillary works.

.1 As-built record documentation to also include a 3D Bridge Information Model (BrIM) in an electronic format native to Tekla Structures Software. The BrIM model is to be created using Industry Foundations Classes (IFC) in accordance to ISO 16739, ISO 29481, and ISO 12006-3 Standards, as well as with processes, specifications, and recommendations from BuildingSmart International (www.buildingsmart_tech.org).

.2 Maintain a complete, accurate log of control and survey work as it progresses.

.3 Prior to delivery of structural steel to site, submit to the Departmental Representative a certified survey showing dimensions, locations, angles and elevations of all new Work at the abutments, pivot pier, and east pier.

.4 After substantial completion has been obtained, and prior to final completion, provide a survey of the entire project site. The survey shall be completed by an Ontario Land Surveyor and shall include all new work and identify the property limits as well as the two (2) new benchmarks.

.5 Record locations of maintained, re-routed and abandoned service lines.

.6 Submit paper and electronic copies of record drawings (including BrIM model) in accordance with Section 01 78 00.

1.9 SUBMITTALS

.1 Submit name and address of Surveyor to Departmental Representative.

.2 On request of Departmental Representative, submit documentation to verify accuracy of field engineering work.

.3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform to Contract Documents.

1.10 SUBSURFACE CONDITIONS

.1 The geotechnical investigation report forms part of the package.

.2 In the event of disagreement between the Contract Documents and information provided in the geotechnical investigations, the Contract Documents will govern.

.3 Reference information is for general informational purposes only and is not guaranteed. Be responsible for ensuring the information is sufficient for the purposes of this Contract and for supplementing this information as necessary.

.4 Interpretation of the factual information is strictly the responsibility of the Contractor. The number of boreholes required to determine localized underground conditions between boreholes affecting construction costs, techniques, sequencing, equipment, scheduling, etc., may be greater than what has been carried out for design purposes. The Contractor shall decide on their own investigations as well as their own interpretations of factual borehole results, so that they may draw their own conclusions as to how the subsurface conditions may affect them.

.5 Identification of Reports:
.1 Foundation Investigation Report, Replacement of Hamlet Swing and Fixed Bridges, 1641 Muskoka District Road 49, Hamlet, Ontario; prepared by Golder Associates, dated January 19, 2018.

1.11 UNDERWATER INSPECTION REPORT

.1 The underwater inspection report forms part of the package.

.2 Identification of Reports:
.1 Underwater Inspection of the Hamlet Swing and Fixed Bridge; prepared by ASI Group, dated March 31st, 2017.

1.12 BASIC IMPACT ASSESSMENT

.1 Identification of Reports:
.1 Repair/Upgrade-Replacement of Hamlet Swing and Fixed Bridges Basic Impact Assessment (BIA), Amec Foster Wheeler, July 2018.

.2 The BIA report forms part of the package.

.3 In the event of disagreement between the Contract Documents and information provided in the BIA, the Contract Documents will govern.

1.13 ARCHIVE DRAWINGS

.1 The archive drawings form part of the package.

.2 In the event of disagreement between the Contract Documents and information provided in the archive drawings, the Contract Documents will govern.

.3 Reference information is for general informational purposes only and is not guaranteed. Be responsible for ensuring the information is sufficient for the purposes of this Contract and for supplementing this information as necessary.

1.14 WATER ELEVATIONS

.1 There are water elevations shown on the drawings taken at specific dates. These are not guaranteed to represent water levels at the time of bidding nor anticipated during construction.

.2 The Contractor should note that levels are affected by rainfall, lake levels and prevailing winds.

.3 The Contractor shall consider historic data, current conditions at time of bidding, long range weather projections when assessing dewatering or planning his means and methods of construction.

1.15 MEASUREMENT AND PAYMENT

.1 There shall be no separate measurement for payment for work under this section.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Progressive cleaning.

.2 Final cleaning.

1.2 PROJECT CLEANLINESS

.1 Maintain Work in tidy condition, free from accumulation of waste products and debris, other than that caused by Owner or other Contractors.

.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by Departmental Representative. Do not burn waste materials on site.

.3 Clear snow and ice from access to bridge site, and remove from site.

.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

.5 Provide on-site containers for collection of waste materials and debris.

.6 Provide and use clearly marked separate bins for recycling. Refer to Section 01 74 21.

.7 Remove waste material and debris from site at end of each working day.

.8 Dispose of waste materials and debris off site.

1.3 FINAL CLEANING

.1 When Work is Substantially Complete, remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.

.2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.

.3 Prior to final review, remove surplus products, tools, construction machinery and equipment.

.4 Remove waste products and debris other than that caused by Owner.

.5 Clean lighting reflectors, lenses, and other lighting surfaces.

.6 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.

.7 Remove dirt and other disfiguration from exterior surfaces.

.8 Sweep and wash clean paved areas.

1.3 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials in accordance with Section 01 74 21.

1.5 MEASUREMENT AND PAYMENT

.1 There will be no measurement for work under this section.

.2 Payment will be deemed to be included as part of the Contract Lump Sum amount.

.3 Payment at the contract price shall be full compensation for all labour, equipment and materials to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 WASTE MANAGEMENT GOALS

.1 Minimize amount of non-hazardous solid waste generated by the project and accomplish maximum source reduction, reuse and recycling of solid waste.

1.2 REFERENCES

.1 Ontario Ministry of Environment and Climate Change.
- .1 Ontario Environmental Protection Act (EPA)
  - .1 Regulation 102/94, Waste Audits and Waste Reduction Workplans.
  - .2 Regulation 103/94, Source Separation Programs.
- .2 Canadian Construction Association (CCA)
  - .1 CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.
- .4 Public Services and Procurement Canada (PSPC)
  - .1 2002 National Construction, Renovation and Demolition Non-Hazardous Solid Waste Management Protocol.
  - .2 CRD Waste Management Market Research Report (available from PSPC's Environmental Services).
  - .3 Sustainable Development Strategy 2007-2009: Target 2.1 Environmentally Sustainable Use of Natural Resources.
    - .1 Real Property projects over $1 million and in communities where industrial recycling is supported, implementation of CRD waste management practices will be completed, with waste materials being reused or recycled.
    - .2 Contractually ensure resources used in construction or maintenance are consumed and recovered in a sustainable manner.

1.3 DEFINITIONS

.1 Approved/Authorized Recycling Facility: waste recycler approved by applicable provincial authority or other users of material for recycling approved by the Departmental Representative.

.2 Class III: non-hazardous waste - construction renovation and demolition waste.

.3 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition, and/or renovation activities.

.4 Inert Fill: inert waste - exclusively asphalt and concrete.

.5 Waste Source Separation Program (WSSP): implementation and co-ordination of ongoing activities to ensure designated waste materials will be sorted into pre-defined categories and sent for recycling and reuse, maximizing diversion and potential to reduce disposal costs.

.6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.

.7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.

.8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.

.9 Reuse: Repeated use of product in same form but not necessarily for same purpose. Reuse includes:
.1 Salvaging reusable materials from re-modelling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.
.2 Returning reusable items including pallets or unused products to vendors.

.10 Salvage: Removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.11 Separate Condition: Refers to waste sorted into individual types.

.12 Source Separation: Acts of keeping different types of waste materials separate beginning from first time they became waste.

.13 Waste Audit (WA): Detailed inventory of estimated quantities of waste materials that will be generated during construction, demolition, deconstruction and/or renovation. Involves quantifying by volume/weight amounts of materials and wastes generated during construction, demolition, deconstruction, or renovation project. Indicates quantities of reuse, recycling and landfill.

.14 Waste Diversion Report: detailed report of final results, quantifying cumulative weights and percentages of waste materials reused, recycled and landfilled over course of project. Measures success against Waste Reduction Workplan (WRW) goals and identifies lessons learned.

.15 Waste Management Coordinator (WMC): Contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

.16 Waste Reduction Workplan (WRW): Written report which addresses opportunities for reduction, reuse, or recycling of materials generated by project. Specifies diversion goals, implementation and reporting procedures, anticipated results and responsibilities. Waste Reduction Workplan information acquired from Waste Audit.

1.4 ACTION AND INFORMATION SUBMITTALS

.1 Prepare and submit proof that all waste is being disposed of at a licensed landfill site or waste transfer site. A copy of the disposal waste transfer site’s license and a letter verifying that said landfill site will accept

the waste must be supplied to Departmental Representative prior to removal of waste from site.

.2 Develop all means and methods necessary to accomplish the removals, transportation and disposal to a suitable site of any impacted elements, including recognition of any and all regulatory requirements respecting hazardous materials. This may include but not be limited to:
.1 Lead-based coatings where found on portions of the existing steel.

1.5 DISPOSAL OF WASTES

.1 Do not bury rubbish or waste materials.

.2 Do not dispose of waste into waterways, storm, or sanitary sewers.

.3 Remove materials on-site as Work progresses.

1.6 SCHEDULING

.1 Co-ordinate Work with other activities at site to ensure timely and orderly progress of Work.

1.7 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 APPLICATION

.1 Handle waste materials not reused, salvaged, or recycled in accordance with appropriate regulations and codes.

3.2 DIVERSION OF MATERIALS

.1 On-site sale of salvaged materials is not permitted.

END OF SECTION

PART 1 - GENERAL

1.1 INSPECTION AND DECLARATION

.1 Acceptance of Work Procedures:

.1 Contractor's Inspection: Contractor to conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents. The Contractor’s Inspection shall include a final inspection by each of the Contractor’s Moveable Bridge Structural, Mechanical, Hydraulic, and Electrical Specialist Engineers.

.1 After the Contractor’s Inspection is complete, and all deficiencies have been corrected, provide a letter to the Departmental Representative advising that the work is complete and ready for the Departmental Representative’s Inspection. Included with the Contractor’s Inspection letter shall be stamped letters from each of the Contractor’s Moveable Bridge Structural, Mechanical, Hydraulic, and Electrical Specialist Engineers advising that they have completed their final inspections and find that the work has been completed in accordance with the Contract documents.

.2 Departmental Representative's Inspection:

.1 Departmental Representative and Contractor to inspect Work and identify defects or deficiencies.

.2 Contractor to correct Work as directed.

.3 Completion Tasks: submit written certificates in English that tasks have been performed as follows:

.1 Work: completed and inspected for compliance with Contract Documents.

.2 Defects: corrected and deficiencies completed.

.3 Equipment and systems: tested, adjusted and balanced, and are fully operational.

.4 Certificates required by Utility Companies: submitted.

.5 Operation of systems: demonstrated to Owner's personnel.

.6 Work: complete and ready for final inspection.

.4 Final Inspection:

.1 When completion tasks are done, request final inspection of Work by Departmental Representative and Contractor.

.2 When Work incomplete according to Departmental Representative, complete outstanding items and request re-inspection

1.2 FINAL CLEANING

.1 Clean in accordance with Section 01 74 11.

.1 Remove surplus materials, excess materials, rubbish, tools and equipment.

.2 Waste Management: in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 As-built, samples, and specifications.

.2 Equipment and systems.

.3 Product data, materials and finishes, and related information.

.4 Operation and maintenance data.

.5 Spare parts, special tools and maintenance materials.

.6 Warranties and bonds.

.7 Final site survey.

.8 Bridge Operation and Maintenance (O&M) Manual

1.2 RELATED SECTIONS

.1 Section 01 91 00 - Commissioning - General Requirements.

.2 Section 01 91 20 - Project Commissioning.

.3 Section 01 79 00 - Demonstration and Training.

1.3 SUBMISSION

.1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.

.2 A copy will be returned after final inspection, with Departmental Representative’s comments.

.3 Revise content of documents as required prior to final submittal.

.4 Two weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four (4) final copies of operating and maintenance manuals in English.

.5 Ensure spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.

.6 If requested, furnish evidence as to type, source and quality of products provided.

.7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

.8 Pay costs of transportation.

.9 Provide submittals in accordance with Section 01 33 00.

1.4 FORMAT

.1 Organize data in the form of an instructional manual.

.2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.

.3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

.4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.

.5 Arrange content by systems, under Section numbers and sequence of Table of Contents.

.6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.

.7 Text: Manufacturer's printed data, or typewritten data.

.8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

.9 Provide 1:1 scaled CAD files in dwg format. Forward pdf, NMSEdit Professional spp, MS Word, MS Excel, MS Project and Autocad dwg files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

1.5 CONTENTS - EACH VOLUME

.1 Table of Contents for Each Volume: provide title of project;
.1 Date of submission; names.
.2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
.3 Schedule of products and systems, indexed to content of volume.

.2 For each product or system:
.1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.

.3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.

.4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.

.5 Typewritten Text: as required to supplement product data. Provide logical

sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00.

.6 Training: Refer to Sections 01 79 00 and 01 91 00.

1.6 AS-BUILTS AND SAMPLES

.1 Maintain, at site for Departmental Representative one (1) record copy of:
- .1 Contract Drawings.
- .2 Specifications.
- .3 Amendments and addenda.
- .4 Change Orders and other modifications to the Contract.
- .5 Reviewed shop drawings, product data, and samples.
- .6 Field test records.
- .7 Inspection certificates.
- .8 Manufacturer's certificates.

.2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

.3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

.4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

.5 Keep record documents and samples available for inspection by Departmental Representative.

.6 Turn one set, paper copy and electronic copy, of AS-BUILT drawings and specifications over to Departmental Representative on completion of work. Submit files on USB compatible with PWGSC encryption requirements or through email or alternate electronic file sharing service such as ftp, as directed by Departmental Representative.

.7 If project is completed without significant deviations from Contract drawings and specifications submit to Departmental Representative one set of drawings and specifications marked "AS-BUILT".

1.7 RECORDING ACTUAL SITE CONDITIONS

.1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Departmental Representative.

.2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.

.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.

.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:

.1 Measured depths of elements of foundation in relation to finish first floor datum.
.2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
.3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
.4 Field changes of dimension and detail.
.5 Changes made by change orders.
.6 Details not on original Contract Drawings.
.7 References to related shop drawings and modifications.

.5 Specifications: legibly mark each item to record actual construction, including:
.1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
.2 Changes made by Amendments and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records, required by individual specifications sections.

.7 Provide digital photos, if requested, for site records.

.8 At completion of project, provide all recorded information on print drawings or alternatively transfer to CAD files in DWG format. Submit DWG files, also with electronic files in PDF format as part of the Closeout Submittals.

1.8 FINAL SURVEY

.1 Submit final site survey certificate in accordance with Section 01 71 00, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.

.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.

.3 Include installed colour coded wiring diagrams.

.4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.

.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and

alignment, adjusting, balancing, and checking instructions.

.6 Provide servicing and lubrication schedule, and list of lubricants required.

.7 Include manufacturer's printed operation and maintenance instructions.

.8 Include sequence of operation by controls manufacturer.

.9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.10 Provide installed control diagrams by controls manufacturer.

.11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.

.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

.13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

.14 Include test and balancing reports as specified in Sections 01 45 00 and 01 91 00.

.15 Additional requirements: As specified in individual specification sections.

1.10 MATERIALS AND FINISHES

.1 Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.

.2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

.4 Additional Requirements: as specified in individual specifications sections.

1.12 SPARE PARTS

.1 Provide spare parts, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.12 MAINTENANCE MATERIALS

.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.

.2 Provide items of same manufacture and quality as items in Work.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

.5 Obtain receipt for delivered products and submit prior to final payment.

1.13 SPECIAL TOOLS

.1 Provide special tools, in quantities specified in individual specification section.

.2 Provide items with tags identifying their associated function and equipment.

.3 Deliver to location as directed; place and store.

.4 Receive and catalogue all items. Submit inventory listing to Departmental Representative. Include approved listings in Maintenance Manual.

1.14 STORAGE, HANDLING AND PROTECTION

.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.

.2 Store in original and undamaged condition with manufacturer's seal and labels intact.

.3 Store components subject to damage from weather in weatherproof enclosures.

.4 Store paints and freezable materials in a heated and ventilated room.

.5 Remove and replace damaged products at own expense and for review by Departmental Representative.

1.15 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten (10) days after completion of the applicable item of work.

.4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Certificate of Substantial Performance is determined.

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

.6 Co-execute submittals when required.

.7 Retain warranties and bonds until time specified for submittal.

1.16 WARRANTY TAGS

.1 Tag, at time of installation, each warranted item. Provide durable, oil and water-resistant tag approved by Departmental Representative.

.2 Attach tags with copper wire and spray with waterproof silicone coating.

.3 Leave date of acceptance until project is accepted for occupancy.

.4 Indicate following information on tag:
- .1 Type of product/material.
- .2 Model number.
- .3 Serial number.
- .4 Contract number.
- .5 Warranty period.
- .6 Inspector's signature.
- .7 Construction Contractor.

1.17 PRICE AND PAYMENT PROCEDURES

.1 Payment for work associated with this section is included in the Lump Sum Price.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PAT 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Procedures for demonstration and instruction of equipment and systems to Owner's Operation and Maintenance (O&M) personnel.

.2 O&M personnel includes property facility manager, building operators, maintenance staff, security staff and technical specialists, as applicable.

1.2 RELATED SECTIONS

.1 Section 01 91 13 – General Commissioning (Cx).

.2 Section 29 05 00 – Mechanical Work.

.3 Section 26 05 00 – Common Woks Resulted from Electrical.

1.3 DESCRIPTION

.1 Demonstrate scheduled operation and maintenance of equipment and systems to Departmental Representative's personnel two weeks prior to date of final inspection.

.2 Departmental Representative will provide list of personnel to receive instructions and will coordinate their attendance at agreed-upon times.

1.4 QUALITY CONTROL

.1 When specified in individual Sections, require manufacturer to provide authorized representative to demonstrate operation of equipment and systems, instruct Departmental Representative’s personnel, and provide written report that demonstration and instructions have been completed.

.2 Submit training schedule of time and date for demonstration and training of each item of equipment and each system in accordance with the training plan four (4) weeks prior to designated dates, for Departmental Representative's approval.

.3 Submit reports within one (1) week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.

.4 Report shall give time and date of each demonstration and training, with list of persons present.

1.5 CONDITIONS FOR DEMONSTRATIONS

.1 Equipment has been inspected and put into operation in accordance with Section 01 91 13.

.2 Testing, adjusting, and balancing has been performed in accordance with Section 01 91 00 and equipment and systems are fully operational.

.3 Provide copies of completed operation and maintenance manuals for use in training, demonstrations and instructions. Provide a syllabus.

1.6 PREPARATION

.1 Verify that conditions for training, demonstration and instructions comply with requirements.

.2 Verify that designated O&M personnel are present.

1.7 DEMONSTRATION AND INSTRUCTIONS

.1 In accordance with Section 01 91 13.

.2 Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, and maintenance of each itemof equipment at scheduled time and at the equipment location.

.3 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

.4 Review contents of manual in detail to explain all aspects of operation and maintenance.

.5 Prepare and insert additional data in operations and maintenance manuals when the need for additional data becomes apparent during instructions.

1.8 TIME ALLOCATED FOR INSTRUCTIONS

.1 Minimum amount of time required for instruction of each item of equipment or system as follows:
- .1 Movable bridge mechanical equipment: 16 hours of instruction.
- .2 Movable bridge control equipment: 16 hours of instruction.
- .3 General Electrical Distribution System: 8 hours of instruction.
- .4 Traffic control gates and signals: 4 hours of instruction.
- .5 Navigation lights: 2 hours of instruction.
- .6 Mechanical and Hydraulic Systems: 16 hours of instruction.
- .7 Public Address System: 2 hours of instruction.

1.9 MEASUREMENT AND PAYEMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Includes general requirements for commissioning facilities and facility systems.

1.2 RELATED SECTIONS

.1 Section 01 91 13 – General Commissioning (CX).

.2 Section 01 91 20 – Project Commissioning.

1.3 QUALITY ASSURANCE

.1 Provide System Commissioning Administrator.

.2 Comply with applicable procedures and standards of the certification sponsoring association.

.3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.4 REFERENCES

.1 NETA Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems 2009.

1.5 SUBMITTALS

.1 Within fifteen (15) working days of Award of Contract, submit name of System Commissioning Administrator proposed to perform services who has managerial responsibilities for coordination of all commissioning activities.

.2 Submit documentation to confirm System Commissioning Administrator compliance with quality control provision.

.3 Submit three (3) preliminary specimen copies of each type of startup checklist, product information and performance verification report forms proposed for use.

.4 Submit completed report forms immediately after completion of each testing to Departmental Representative for review and verification.

.5 Fifteen (15) days prior to Substantial Performance, submit four (4) copies of final reports on applicable forms for functional performance verification.

.6 Submit post-commissioning reports of testing, adjusting, and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

.7 Submit all other commissioning documentation in accordance with Section 01 91 20.

1.6 REPORT FORMS

.1 System Commissioning Administrator shall make reports.

.2 Report forms shall include:
- .1 Startup Checklists.
- .2 Product Information (PI) Report forms.
- .3 Performance Verification (PV) Report forms.

.3 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.

.4 Submit signed form to Consultant for review and approval. After approval, immediately submit form bearing Consultant's signature to Departmental Representative.

.5 Submit signed form to Departmental Representative for review, approval and signature.

.6 Identify each instrument used for testing, adjusting and balancing and its latest date of calibration.

1.7 CONTRACTOR'S RESPONSIBILITIES

.1 Prepare each system for testing and balancing.

.2 Cooperate with testing organization and provide access to equipment and systems.

.3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.

.4 Notify testing organization and Departmental Representative seven (7) days prior to time project will be ready for testing, adjusting, and balancing.

.5 Accurately record data for each step.

.6 Report to Departmental Representative any deficiencies or defects noted during performance of services.

.7 Correct deficiencies identified in accordance with Departmental Representative's written instructions.

1.8 PREPARATION

.1 Provide instruments required for testing, adjusting, and balancing operations.

.2 Make instruments available to Departmental Representative to facilitate spot checks during testing and functional performance verification.

.3 Retain possession of instruments and remove at completion of services.

.4 Verify systems installation is complete and in continuous operation.

1.9 EXECUTION

.1 Test equipment, balance distribution systems, and adjust devices for bridge operating mechanical, hydraulic and electrical systems.

.2 Test equipment and adjust devices for bridge control system.

1.9 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.

.2 Acronyms:
.1 AFD - Alternate Forms of Delivery, service provider.
.2 Cx - Commissioning.
.3 EMCS - Energy Monitoring and Control Systems.
.4 O&M - Operation and Maintenance.
.5 PI - Product Information.
.6 PV - Performance Verification.
.7 TAB - Testing, Adjusting and Balancing.

1.2 GENERAL

.1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
.1 Verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent.
.2 Effectively train O&M staff.

.2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
.1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
.2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.

.3 Design Criteria: As per Departmental Representative requirements and to meet Project functional and operational requirements.

.4 AFD managed projects the term Departmental Representative in Cx specifications to be interpreted as AFD Service Provider.

1.3 COMMISSIONING OVERVIEW

.1 Section 01 91 31.

.2 For Cx responsibilities refer to Section 01 91 31.

.3 Cx to be included in the Contractor's lump sum cost breakdown.

.4 Cx activities supplement field quality and testing procedures described in relevant technical sections.

.5 Cx is conducted in concert with activities performed during stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the replacement swing bridge is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities includes transfer of critical knowledge to facility operational personnel.

.6 Departmental Representative will issue Certificate of Substantial Performance when:
.1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative.
.2 Equipment, components and systems have been commissioned.
.3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

.1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Departmental Representative, to ensure effective performance.

.2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

.1 Before Construction:
.1 Review contract documents, confirm by writing to Departmental Representative.
.1 Adequacy of provisions for Cx.
.2 Aspects of design and installation pertinent to success of Cx.

.2 During Construction:
.1 Co-ordinate provision, location and installation of provisions for Cx.

.3 Before start of Cx:
.1 Have completed Cx Plan up-to-date.
.2 Ensure installation of related components, equipment, sub-systems, systems is complete.
.3 Fully understand Cx requirements and procedures.
.4 Have Cx documentation shelf-ready.
.5 Understand completely design criteria and intent and special features.
.6 Submit complete start-up documentation to Departmental Representative.

.7 Have Cx schedules up-to-date.
.8 Ensure systems have been cleaned thoroughly.
.9 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
.10 Ensure "As-Built" system schematics are available.

.4 Inform Departmental Representative in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

.1 Report conflicts between requirements of this section and other sections to Departmental Representative before start-up and obtain clarification.

.2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 SUBMITTALS

.1 Submittals: in accordance with Section 01 33 00.
.1 Submit no later than four (4) weeks after award of Contract:
.1 Name of Contractor's Cx agent.
.2 Draft Cx documentation.
.3 Preliminary Cx schedule.
.2 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least eight (8) weeks prior to start of Cx.
.3 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least eight (8) weeks prior to start of Cx.
.4 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

.1 Refer to Section 01 91 33.

.2 Departmental Representative to review and approve Cx documentation.

.3 Provide completed and approved Cx documentation to Departmental Representative.

1.9 COMMISSIONING SCHEDULE

.1 Provide detailed Cx schedule as part of construction schedule in accordance with Section 01 32 16.06.

.2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
.1 Approval of Cx reports.
.2 Verification of reported results.
.3 Repairs, retesting, re-commissioning, re-verification.
.4 Training.

1.10 COMMISSIONING MEETINGS

.1 Convene Cx meetings following project meetings: Section 01 32 16.06 and as specified herein.

.2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.

.3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.

.4 At 60% construction completion stage. Section 01 32 16.06. Departmental Representative to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
.1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
.2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

.5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.

.6 Meeting will be chaired by Contractor’s Cx Agent, who will record and distribute minutes.

.7 Ensure subcontractors and relevant manufacturer representatives are present at 50%, 75% and 90% subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

.1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment and personnel.

1.12 WITNESSING OF STARTING AND TESTING

.1 Provide fourteen (14) days’ notice prior to commencement.

.2 Departmental Representative to witness of start-up and testing.

.3 Contractor's Cx Agent to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

.1 Factory testing: manufacturer to:
.1 Coordinate time and location of testing.
.2 Provide testing documentation for approval by Departmental Representative.
.3 Arrange for Departmental Representative to witness tests.
.4 Obtain written approval of test results and documentation from

Departmental Representative before delivery to site.

.2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative.
.1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
.2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.

.3 Integrity of warranties:
.1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
.2 Verify with manufacturer that testing as specified will not void warranties.

.4 Qualifications of manufacturer's personnel:
.1 Experienced in design, installation and operation of equipment and systems.
.2 Ability to interpret test results accurately.
.3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

.1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.

.2 Conduct start-up and testing in following distinct phases:
.1 Included in delivery and installation:
.1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
.2 Visual inspection of quality of installation.
.2 Start-up: follow accepted start-up procedures.
.3 Operational testing: document equipment performance.
.4 System PV: include repetition of tests after correcting deficiencies.
.5 Post-substantial performance verification: to include fine-tuning.

.3 Correct deficiencies and obtain approval from Departmental Representative after distinct phases have been completed and before commencing next phase.

.4 Document require tests on approved PV forms.

.5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Departmental Representative. If results reveal that equipment start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:
.1 Minor equipment/systems: implement corrective measures approved by Departmental Representative.
.2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Departmental Representative.
.3 If evaluation report concludes that major damage has occurred,

Departmental Representative shall reject equipment.

.1 Rejected equipment to be remove from site and replace with new.

.2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

.1 Assemble start-up documentation and submit to Departmental Representative for approval before commencement of commissioning.

.2 Start-up documentation to include:

.1 Factory and on-site test certificates for specified equipment.

.2 Pre-start-up inspection reports.

.3 Signed installation/start-up check lists.

.4 Start-up reports,

.5 Step-by-step description of complete start-up procedures, to permit Departmental Representative to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

.1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.

.2 With assistance of manufacturer develop written maintenance program and submit Departmental Representative for approval before implementation.

.3 Operate and maintain systems for length of time required for commissioning to be completed.

.4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

.1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.

.2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

.1 Notify Departmental Representative at least twenty-one (21) days prior to start of Cx.

.2 Start Cx after elements of construction affecting start-up and performance verification of systems have been completed.

1.19 INSTRUMENTS/EQUIPMENT

.1 Submit to Departmental Representative for review and approval:

.1 Complete list of instruments proposed to be used.

.2 Listed data including, serial number, current calibration

certificate, calibration date, calibration expiry date and calibration accuracy.

.2 Provide the following equipment as required:
.1 2-way radios.
.2 Ladders.
.3 Equipment as required to complete work.

1.20 COMMISSIONING PERFORMANCE VERIFICATION

.1 Carry out Cx:
.1 Under actual operating conditions, over entire operating range, in all modes.
.2 On independent systems and interacting systems.

.2 Cx procedures to be repeatable and reported results are to be verifiable.

.3 Follow equipment manufacturer's operating instructions.

.4 EMCS trending to be available as supporting documentation for performance verification.

1.21 WITNESSING COMMISSIONING

.1 Departmental Representative and Contractor’s Cx Agent to witness activities and verify results.

1.22 AUTHORITIES HAVING JURISDICTION

.1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.

.2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.

.3 Provide copies to Departmental Representative within five (5) days of test and with Cx report.

1.23 COMMISSIONING CONSTRAINTS

.1 Not used.

1.24 EXTRAPOLATION OF RESULTS

.1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Departmental Representative in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.25 EXTENT OF VERIFICATION

.1 Laboratory areas:
.1 Provide manpower and instrumentation to verify up to 100% of reported results.

.2 Elsewhere:
.1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.

.3 Number and location to be at discretion of Departmental Representative.

.4 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.

.5 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.

.6 Perform additional commissioning until results are acceptable to Departmental Representative.

1.26 REPEAT VERIFICATIONS

.1 Assume costs incurred by Departmental Representative for third and subsequent verifications where:
.1 Verification of reported results fail to receive Departmental Representative's approval.
.2 Repetition of second verification again fails to receive approval.
.3 Departmental Representative deems Contractor's request for second verification was premature.

1.27 SUNDRY CHECKS AND ADJUSTMENTS

.1 Make adjustments and changes which become apparent as Cx proceeds.

.2 Perform static and operational checks as applicable and as required.

1.28 DEFICIENCIES, FAULTS, DEFECTS

.1 Correct deficiencies found during start-up and Cx to satisfaction of Departmental Representative.

.2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified. Proceed with written approval from Departmental Representative.

1.29 COMPLETION OF COMMISSIONING

.1 Upon completion of Cx leave systems in normal operating mode.

.2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.

.3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Departmental Representative.

1.30 ACTIVITIES UPON COMPLETION OF COMMISSIONING

.1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.31 TRAINING

.1 Not Used.

1.32 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

.1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.33 OCCUPANCY

.1 Cooperate fully with Departmental Representative during stages of acceptance and occupancy of facility.

1.34 INSTALLED INSTRUMENTATION

.1 Use instruments installed under Contract for TAB and PV if:
.1 Accuracy complies with these specifications.
.2 Calibration certificates have been deposited with Departmental Representative.

.2 Calibrated EMCS sensors may be used to obtain performance data provided that sensor calibration has been completed and accepted.

1.35 PERFORMANCE VERIFICATION TOLERANCES

.1 Application tolerances:
.1 Specified range of acceptable deviations of measured values from specified values or specified design criteria. Except for special areas, to be within +/- 5% of specified values.

.2 Instrument accuracy tolerances:
.1 To be of higher order of magnitude than equipment or system being tested.

.3 Measurement tolerances during verification:
.1 Unless otherwise specified actual values to be within +/- 1% of recorded values.

1.36 OWNER'S PERFORMANCE TESTING

.1 Performance testing of equipment or system by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.

1.37 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 GENERAL EXCUTION

.1 The work under this item is to demonstrate that all the bridge electrical, hydraulic and mechanical system have been correctly installed and function properly.

.2 The Contractor shall provide all test equipment, safety equipment, personnel and monitoring devices necessary to show each piece of equipment has been installed, operates properly, is in proper operating condition, and integrated into the bridge power and control system. This work shall be coordinated with the control system vendor and the installing Contractor.

.3 The Contractor or the Contractor's Representative shall be present during all test operations.

3.2 STAGE 1 - CONTRACTOR’S FIELD TESTING

.1 The Contractor shall adjust, calibrate and test all equipment, place the integrated system in service, and test the integrated system using approved test procedures.

.2 The Contractor shall demonstrate that the completed system functions properly by performing at least ten (10) consecutive complete bridge operations without failure or any adjustments. A complete bridge operation shall be defined as starting with the automated 3 phase (green, yellow, red) traffic signals, operating all traffic control equipment to stop traffic, retracting the end locks, extending the end jacks, retracting the end lifts, retracting the end latch, bringing the span to the fully open limit switch, bringing the span to the fully closed position, extending the end latch, extending the end lifts, operating all traffic control equipment to allow traffic to proceed under automated 3 phase (green, yellow, red) traffic signal control. The Contractor shall deliver a report describing results of the Contractor's field tests, diagnostics, and calibrations including written certification to the Departmental Representative that the installed complete system has been calibrated,

tested, and is ready to begin Stage 2 - Conditional Acceptance Functional Checkout. The report shall also include a copy of the approved Stage 1 - Contractor's Field Testing procedure.

.3 Complete the demonstration of system functions in a way that will not interfere with use of the adjacent waterway.

3.3 STAGE 2 - CONDITIONAL ACCEPTANCE FUNCTIONAL CHECKOUT

.1 Upon successful completion of Stage 1 - Contractor's Field Testing and its acceptance by the Departmental Representative, the Contractor shall demonstrate that the completed bridge hydraulic operating/relay/programmable logic controller (PLC) system complies with the contract requirements. Using test procedures (submitted by the Contractor and approved by the Departmental Representative), all physical and functional requirements of the project shall be demonstrated. The conditional acceptance functional checkout test, as specified, shall not commence until receipt by the Contractor of written permission from the Departmental Representative, based on the Contractor's certification of successful completion of Stage 1 - Contractor's Field Testing, as specified above. The Departmental Representative may terminate this portion of the testing at any time when the system fails to perform as specified. If at any time the bridge is unable to function as intended without adjustments, repairs or other corrective actions this shall be regarded as a failure and shall result in termination of the Stage 2 Conditional Acceptance Functional Checkout Testing.

.2 Upon a failure resulting in termination of testing by the Departmental Representative or by the Contractor, the Contractor shall commence an assessment period. The Contractor shall identity all failures, determine causes of all failures, repair all failures, and deliver a written report to the Departmental Representative. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Departmental Representative. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the conditional acceptance functional checkout test. Based on the Contractor's report and the test review meeting, the Departmental Representative will determine the retest date.

.3 Upon successful completion of the conditional functional checkout testing, the Contractor shall deliver test reports and other documentation specified to the Departmental Representative for approval prior to commencing the

3.4 STAGE 3 - ENDURANCE TESTS

.1 The endurance test shall not be started until the Departmental Representative notifies the Contractor, in writing, that the Stage 2 - Conditional Functional Checkout Testing has been completed and correction of all outstanding deficiencies has been satisfactorily completed and the span has been opened to vehicular traffic.

.2 The Contractor shall commence Phase I (Testing) upon notification from the Departmental Representative. The Departmental Representative may terminate testing at any time the system fails to perform as specified. Upon termination of testing by the Departmental Representative or by the Contractor, the Contractor shall commence an assessment period as described for Phase II. Upon successful completion of the Endurance Test, the Contractor shall deliver test reports and other documentation specified to the Departmental Representative prior to acceptance of the system.

.3 During Phase I testing the bridge will be available for public use.

.4 Phase I (Contractor Testing): The testing shall be conducted 24 hours per day for 14 consecutive calendar days, including holidays, and the system shall operate as specified without fault or failure. The start date for the test and the opening times shall be as directed by the Departmental Representative. Each day the bridge shall be operated a minimum of three (3) times with the intent to perform the operations at or near the temperature extremes for that day (e.g. at 06:00 and 14:00). The Contractor shall make no repairs during this phase of testing unless authorized by the Departmental Representative in writing. If the system experiences no failures during Phase I testing, the Contractor may proceed directly to Phase III, after receipt of written permission from the Departmental Representative.

.5 Phase II (Failure Assessment): If Phase I is unsuccessful, the Contractor shall identify all failures, determine causes of all failures, repair all failures, and deliver a written report to the Departmental Representative. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Departmental Representative. As a part of this test review meeting, the Contractor shall demonstrate that all failures have been corrected by performing appropriate portions of the conditional acceptance functional checkout test. Based on the Contractor's report and the test review meeting, the Departmental Representative will determine the restart date for Phase I to be repeated. If the retest is completed without any failures, the Contractor may proceed directly to Phase III after receipt by the Contractor of written permission from the Departmental Representative.

.6 Phase III (Hand-Over): If Phase I is successful, the Contractor shall prepare a written report to the Departmental Representative. The report shall explain in detail the number of operations performed, results of each operation, and results of all tests performed. Based on the Contractor's report, the Departmental Representative will determine whether the work will be accepted by the Departmental Representative.

.7 Phase IV (Owner Operation): After Phase III (Hand Over), bridge operation will be ceded from the contractor to the Owner. The Owner will now operate the bridge with the contractor on-call should there be any system failure. Operation parameters will be the same as those for Phase I. During this period the contractor must provide the Departmental Representative with an emergency telephone number to be used for notifications in the case of

a failure during this period. The number must be in operation and be answered 24 hours a day, including weekends and holidays. In the case of a failure during Phase IV the Departmental Representative will contact the contractor at the contact number. The contractor must respond to the notification, by return telephone call to the Departmental Representative, within one hour of notification. The contractor must then have appropriate labour, equipment and materials on site and commence repairs within four (4) hours of the original notification. Following the original notification if the contractor does not respond to the original notification within one (1) hour, or if the contractor does not arrive on site within four (4) hours, then the Owner will mobilize their work crew to undertake any needed repairs. The Owner will then back charge the contractor for any costs incurred, even if the contractor subsequently responds and/or arrives on site and takes part in or completes the repairs, with the monies being taken against the Phase IV. Phase IV will be considered complete once the Owner has operated the bridge without failure for 14 consecutive days, including holidays. The contractor's warranty will remain in effect even if the Owner performs any work on the bridge as a result of the contractor's failure to respond to a notification.

.8 Phase V Seasonal Review: Prior to the navigational season opening the following spring a representative from the Contractor and Departmental Representative will assist the Owner to inspect and carry out maintenance work and systems check-out of the bridge.

3.5 OTHER TESTING AND INSPECTION REQUIREMENTS

.1 Perform hydraulic data acquisition to record all hydraulic pressures during operation of the span drive machinery in both directions of opening and all hydraulic machinery (swing cylinders, end lifts and end latch) during Stage 2 - Conditional Acceptance Functional Checkout Testing.

.2 Perform insulation resistance testing on all new electrical conductors installed under this contract. All insulation resistance testing is to be completed prior to the start of Stage 1 - Contractor's Field Testing.

.3 Take sample of hydraulic fluid from all reservoirs after flushing the system and provide a lab analysis of the fluid and a report.

END OF SECTION

PART 1 - GENERAL

1.1 SPECIAL WARNING

.1 This project requires a special enhanced commissioning.

.2 One of the commissioning requirements is that the General Contractor must engage a qualified independent System Commissioning Administrator (SCA) to coordinate and organize all Pre-Commissioning Testing, Commissioning Testing, and O&M Training. The SCA must complete the Contractor's Commissioning Documentation as specified in this Section.

.3 A total of 4% of the construction price will be held back by PSPC for unfinished commissioning work.

1.2 RELATED SECTIONS

.1 Section 01 91 00.

1.3 GENERAL

.1 The "Commissioning" for this project is defined as a planned program of activities which enhance quality management and information transfer that extends throughout all stages of project delivery.

.2 The commissioning activities shall include the standard activities and the enhanced activities which are traditionally not provided by the design and construction industry and which are defined in this document.

1.4 REFERENCE STANDARDS

.1 The most stringent requirements of the following commissioning standards and guidelines shall apply:
.1 NETA Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems 2009.

1.5 ROLES AND RESPONSIBILITIES

.1 The key members of the commissioning team include the Contractor and the Consultant.
.1 It is the Contractor's responsibility to engage a qualified independent System Commissioning Administrator (SCA) to represent the Contractor including the Sub-Contractors. The SCA shall be responsible for carrying out the Contractor's commissioning activities.
.2 The Departmental Representative will be assisted by the Consultant and other project team members for overview of the commissioning activities on behalf of the Departmental Representative. The Departmental Representative is the Commissioning Authority for this project.

.2 The Contractor is responsible for the following standard commissioning activities and enhanced commissioning activities during project construction, commissioning and operation phases.

.1 Construction Phase:
.1 Engage a qualified independent System Commissioning Administrator as single point of contact for all matters relating to commissioning (enhanced activity).
.2 Conduct separate commissioning meetings and prepare minutes of meeting.
.3 Submit shop drawings (standard activity).
.4 Conduct equipment installation and startup tests and submit test reports (standard activity).
.5 Perform TAB and submit TAB report (standard activity).
.6 Conduct System Startup Verification Testing and complete Startup Checklists and PI Report forms (enhanced activity).
.2 Commissioning Phase:
.1 Conduct separate commissioning meetings and prepare minutes of meeting.
.2 Conduct Functional Performance Testing and complete PV Report forms (enhanced activity).
.3 Demonstrate system operation (standard activity).
.4 Submit Operation and Maintenance Manuals (formerly called O&M Manuals) (standard activity).
.5 Submit "As-Built" drawings and specifications (standard activity).
.6 Conduct O&M training (standard activity).
.3 Operation Phase:
.1 Conduct separate commissioning meetings and prepare minutes of meeting.
.2 Conduct deferred Functional Performance Testing and complete PV Report forms (enhanced activity).
.3 Provide fine-tuning (standard activity).
.4 Provide specified inspection and maintenance services during warranty period (standard activity).

.3 The Departmental Representative will carry out the following commissioning activities related to the Contractor:
.1 Review and approve Contractor's Startup Checklists, PI and PV Report Forms and Functional Performance Test forms (enhanced activity).
.2 Review and approve Contractor's Standard Operation Procedures (SOP) Manual (formerly called Systems Manual) (enhanced activity).
.3 Review shop drawings (standard activity).
.4 Review and inspect installation and prepare construction deficiencies report (standard activity).
.5 Review and approve TAB report (standard activity).
.6 Direct and approve System Startup Verification Testing (enhanced activity).
.7 Direct and approve Functional Performance Testing (enhanced activity).
.8 Review and approve Maintenance Manuals (standard activity).
.9 Review and approve "As-Built" drawings and specifications (standard activity).
.10 Review O&M training (standard activity).
.11 Review and approve commissioning report (enhanced activity).
.12 Witness post-acceptance commissioning testing (enhanced activity).
.13 Direct and approve post-acceptance fine-tuning and review warranty

services (standard activity).
.14 Review and approve updated commissioning report (enhanced activity).

.4 The Departmental Representative (or its representative) will carry out the following commissioning activities related to the Contractor and the Consultant:
.1 Review and approve the qualifications of the System Commissioning Administrator (SCA) submitted by the Contractor.
.2 Review and approve Startup Checklists, PI and PV Report Forms prepared by the System Commissioning Administrator (SCA).
.3 Witness System Startup Verification Testing conducted by the Contractor and review test reports.
.4 Witness Functional Performance Testing conducted by the Contractor and review test reports.
.5 Review and approve O&M training conducted by the Contractor.
.6 Review commissioning documentation submitted by the Contractor.
.7 Review and approve commissioning report prepared by the System Administrator (SCA).
.8 Witness the post-acceptance commissioning testing conducted by the Contractor and review test reports.
.9 Review and approve updated commissioning report prepared by the System Administrator (SCA).

1.6 QUALIFICATIONS OF SYSTEM COMMISSIONING ADMINISTRATOR (SCA)

.1 The System Commissioning Administrator: An independent System Commissioning Administrator (SCA) retained by the Contractor for scheduling, coordination and supervision of Contractor's commissioning activities during construction, acceptance, and post-acceptance stages. The System Commissioning Administrator shall provide Contractor's Commissioning Documentation.

1.7 SCHEDULING

.1 Within fifteen (15) working days of contract award, the Contractor shall submit bar chart commissioning schedules indicating anticipated date of start, duration, and date of completion for the following key activities:
.1 Commissioning meetings.
.2 Shop drawings.
.3 Pre-startup installation inspections and tests.
.4 System and Equipment Startup and Verification.
.5 TAB.
.6 Functional Performance Test.
.7 Maintenance Manuals.
.8 "As-Built" drawings and specifications.
.9 O&M Training.
.10 O&M Training report.

.2 Bar chart commissioning schedule shall be prepared for each component, equipment, sub-system, system and integrated system to be commissioned as listed under paragraph 1.11.

.3 The Commissioning shall be carried out to meet the approved project schedule.

1.8 CONTRACTOR'S COMMISSIONING DOCUMENTATION

.1 The Contractor's Commissioning Documentation shall include the following:
- .1 Commissioning Schedule.
- .2 Minutes of Commissioning meetings.
- .3 Shop drawings and product data.
- .4 Installation inspection and test reports.
- .5 TAB reports.
- .6 Startup Checklists.
- .7 Product Information (PI) Report forms.
- .8 Performance Verification (PV) Report forms.
- .9 "As-Built" drawings and specifications.
- .10 Maintenance Manuals.
- .11 O&M Training Schedule
- .12 O&M Training Report.

1.9 PRE-COMMISSIONING TESTING - STARTUPS

.1 Requirements of Pre-commissioning Verification: a full range of checks and tests to determine that all components, equipment, systems, and interfaces between systems (e.g., emergency, fire, and life safety) operate in accordance with contact documents. This includes all operating modes, interlocks, control responses, and specific responses to abnormal or emergency conditions. Verification of the proper operation of the control system also includes verifying the interface of the control system with the mechanical and power components.

.2 The Startup Checklists and PI Report forms shall be completed by the Contractor and verified by the Consultant.

1.10 COMMISSIONING TESTING

.1 Commissioning Testing shall include System Operation Demonstration and Functional Performance Testing of all systems to be commissioned. Test each system independently and then in unison with integrated systems.

.2 Requirements of Functional Performance Testing (FPT): FPT shall determine if the systems are providing the required services in accordance with the finalized design intent. If FPT cannot be completed due to seasonal reasons, lack of occupancy, deficiencies beyond the scope of the electrical and mechanical work, or any other reason, this shall be noted along with an indication of when tests will be rescheduled. If any identified performance deficiencies need to be corrected, the tests shall be repeated after corrective work is carried out, and this process shall continue until acceptable performance is achieved.

.3 The PV Report forms shall be completed by the Contractor and verified by the Departmental representative.

1.11 EXTENT OF COMMISSIONING

.1 Systems to be commissioned with the comprehensive commissioning to include:

.1 Interface portion of the associated electrical and other bridge systems.
.2 Power Distribution Systems.
.3 Drive Systems.
.4 Mechanical Systems.
.5 Hydraulic Systems.
.6 Bridge Control System.
.7 Navigation, Pedestrian Signal and Traffic Control System.

1.12 O&M TRAINING

.1 The Contractor shall provide qualified training instructors to conduct O&M training.

.2 Four weeks prior to commencement of O&M training, the Contractor shall submit training schedule with course outline, agenda and a copy of training manual in accordance with the training plan for review by the Consultant and the PWGSC Commissioning Manager.

.3 Training shall include familiarization sessions, hands-on instruction, and classroom sessions.

.4 Classroom training shall include: review of Maintenance Manuals, Standard Operating Procedures (SOP) Manual, System Operational Procedures for all modes of operation, acceptable tolerances for system adjustments and procedures for dealing with abnormal and emergency situations.

1.13 UNFINISHED COMMISSIONING WORK

.1 Prior to the "Interim Certificate of Completion" a total of 4% of the construction price will be held back by PWGSC Project Manager until the acceptable Functional Performance Testing, O&M Training, and commissioning documentation have been completed.

1.14 COMMISSIONING REPORT AND POST-ACCEPTANCE COMMISSIONING

.1 When the acceptable Functional Performance Testing, O&M Training and commissioning documentation have been completed, the Consultant shall prepare a commissioning report. The report will identify the completed functional performance tests, the deferred functional performance tests, construction deficiencies, design deficiencies, user's changes of requirement and outstanding commissioning issues. The report will provide review comments on test results, O&M training and commissioning documentation and will recommend follow-up actions to be taken during post-acceptance commissioning.

.2 The Departmental Representative will not issue the "Interim Certificate of Completion" until the commissioning report, with a recommendation of acceptance, is submitted by the Departmental Representative.

1.15 ADDITIONAL COMMISSIONING REQUIREMENTS

.1 Refer to other specifications sections for additional commissioning

requirements.

1.15 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not used.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:
.1 Commissioning forms to be completed for equipment, system and integrated system.

1.2 INSTALLATION/START-UP CHECK LISTS

.1 Include the following data:
.1 Product manufacturer's installation instructions and recommended checks.
.2 Special procedures as specified in relevant technical sections.
.3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.

.2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary by Departmental Representative, supplemental additional data lists will be required for specific project conditions.

.3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.

.4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Departmental Representative. Check lists will be required during

.5 Use of check lists will not be considered part of commissioning process, but will be stringently used for equipment pre-start and start-up procedures.

1.3 PRODUCT INFORMATION (PI) REPORT FORMS

.1 Product Information (PI) forms compiles gathered data on items of equipment produced by equipment manufacturer, includes nameplate information, parts list, operating instructions, maintenance guidelines and pertinent technical data and recommended checks that is necessary to prepare for start-up and functional testing and used during operation and maintenance of equipment. This documentation is included in the Bridge O&M Manual at completion of project.

.2 Prior to Performance Verification (PV) of systems complete items on PI forms related to systems and obtain Departmental Representative's approval.

1.4 PERFORMANCE VERIFICATION (PV) FORMS

.1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiency and function independently and interactively with other systems as intended with project requirements.

.2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.

.3 Prior to PV of integrated system, complete PV forms of related systems and obtain Departmental Representative's approval.

1.5 SAMPLES OF COMMISSIONING FORMS

.1 System Commissioning Administrator (SCA)will develop and provide to Contractor required project-specific Commissioning forms in electronic format complete with specification data.
- .1 PI Forms.
- .2 PV Forms.
- .3 Installation/Startup Checklist.
- .4 Functional Performance Test.

.2 Revise items on Commissioning forms to suit project requirements.

1.6 CHANGES AND DEVELOPMENT OF NEW REPORT FORMS

.1 When additional forms are required, develop appropriate verification forms and submit to Departmental Representative for approval prior to use.
- .1 Additional commissioning forms to be in same format as other forms in use.

1.7 COMMISSIONING FORMS

.1 Use Commissioning forms to verify installation and record performance when starting equipment and systems.

.2 Strategy for Use:
- .1 System Commissioning Administrator (SCA) provides Contractor project-specific Commissioning forms with Specification data included.
- .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
- .3 Confirm operation as per design criteria and intent.
- .4 Identify variances between design and operation and reasons for variances.
- .5 Verify operation in specified normal and emergency modes and under specified load conditions.
- .6 Record analytical and substantiating data.
- .7 Verify reported results.
- .8 Form to bear signatures of recording technician.
- .9 Submit immediately after tests are performed to Departmental Representative for review.
- .10 Reported results in true measured Imperial unit values.
- .11 Provide Departmental Representative with originals of completed forms.
- .12 Maintain copy on site during start-up, testing and commissioning period.
- .13 Forms to be both hard copy and electronic format with typed written results in O&M Manual.

1.8 LANGUAGE

.1 To suit the language profile of the awarded contract.

1.9 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

.1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 This Section includes the requirements for balancing the swing span in both the longitudinal and transverse directions. Refer to Section 29 05 00 MECHANICAL WORK for additional information.

1.3 SUBMITTALS

.1 Shop Drawing Balance Report: The Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer shall prepare balance calculations to balance the swing span longitudinally and transversely about the centre bearing. Balance calculations shall be prepared prior to fabrication and construction based on approved shop drawings and material tests and shall be submitted to the Departmental Representative for review. The balance calculations and all supporting documentation shall be provided in the form of an engineered report. This report shall include detailed design of the steel counterweight by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer.

.2 'As-Fabricated' Balance Report: During fabrication of the structural steel the steel fabricator shall weight each component of the structural steel and report the 'as-fabricated' weights to the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer. Based on this information and the unit weight determined by weighing of the sample steel counterweight, the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer shall revise the design and detailing for the steel counterweight.

In addition to determining the quantity of steel counterweight, the 'As-Fabricated' Balance Report shall also identify the overall dead load of the bridge (without counterweight) and the location for the centre of gravity (without counterweight). This report shall also detail a procedure by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer for jacking the bridge to determine the 'As-Erected' bridge dead load and centre of gravity and comparing to calculated values per the Shop Drawing Balance Report. The 'As-Fabricated' Balance Report shall be submitted to the Departmental Representative for review.

.3 Refined Balance Report: As part of swing span balancing operation, the Contractor shall use jacks, temporary ballast or similar means to determine the 'As-Erected' bridge longitudinal and transverse imbalance moments. This information shall be used by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer to determine the number and location of steel balance plates that shall be installed.

.4 Balance Test Report: After final balancing of the bridge a final report shall be provided that includes all test data and details the final configuration of steel balance plates used to bring the bridge into

balance.

1.4 MEASUREMENT AND PAYMENT

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all design, labour, equipment and materials necessary to complete the work.

PART 2 - PRODUCTS

2.1 NOT USED

.1 Not Used.

PART 3 - EXECUTION

3.1 SPAN BALANCING AND REPORTS

.1 The balance calculations prepared by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer shall incorporate the distributions of span weight in the horizontal and transverse directions. All summary tables and back-up materials shall be submitted for review. Weights for new work shall be developed on the shop drawings for each component. The balance calculations and summary tables shall be updated by the Contractor throughout construction. It shall be the Contractor's responsibility to provide temporary bracing and supports and/or temporary balance material as required to stabilize the swing span during construction. Review of the balance calculations, counterweight details, and quantity and location of balance material does not relieve the Contractor from making such changes in the counterweights and balance material as deemed necessary to balance the span.

.2 The Contractor shall test the balance of the swing span to determine the dead load and centre of gravity at least once. A detailed balance testing procedure prepared by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer shall be provided to the Departmental Representative for review. A balance test report shall be prepared by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer at the following interim milestones:
.1 The 'As-Fabricated' Balance Report shall be submitted for review within two (2) weeks of completion of fabrication.

.3 The Contractor shall test the balance of the swing span to determine the longitudinal and transverse imbalance moment about the center bearing at least three (3) times. The initial span balance shall be performed after the span is set on the center bearing. The final span balance work shall be performed at the completion of the Contract work including installation of permanent steel balance plates and shall include operational testing of the span. A detailed balance testing

procedure prepared by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer shall be provided to the Departmental Representative for review. A balance test report shall be prepared by the Contractor's Moveable Bridge Structural or Mechanical Specialist Engineer at the following interim milestones:

.1 The Shop Drawing Balance Report shall be submitted for review within two (2) weeks of completion of shop drawings;

.2 The 'As-Fabricated' Balance Report shall be submitted for review within two (2) weeks of completion of fabrication;

.3 The Refined Balance Report shall be submitted for review within five (5) days of placing the steel counterweight.

.4 The Balance Test Report shall be submitted within two (2) weeks of final balancing.

3.2 SPAN BALANCE PERFORMANCE CRITERIA, CONSTRAINTS, AND REQUIREMENTS

.1 The transverse and longitudinal balance measurements are to demonstrate that the reaction due to imbalance at the balance wheels is 55 kN or less at all times during the construction. This is the limit during construction for imbalance.

.2 The Contractor shall not use the steel balance plate pockets at the end floor beams for setting transverse balance of the bridge. The Contractor shall only use steel balance plate pockets at intermediate (interior) floor beams for setting transverse balance of the bridge.

.3 Once the span can be operated an operational balance test shall then be performed which shall consist of observing the span during operation to determine if there is a tendency for the span to tilt in one direction for the range of movement. If this is the case, additional weight shall be added until the span does not tilt (i.e. there is only intermittent contact at the balance wheels). In the event that the centre bearing friction is small and it is difficult to obtain this condition it is also acceptable to demonstrate that a small amount of imbalance will cause the span to tilt in the opposite direction.

.4 Perform a final balance test after permanent weights are installed comprised of an operational test. Measurement of transverse and longitudinal imbalance may be performed as needed if additional adjustments to the permanent counterweight material is needed.

3.3 SPAN BALANCING PROCEDURE

.1 The Contractor is advised that the procedure offered below demonstrates a method of balancing swing bridges from previous projects but is not complete in all respects. The Contractor's procedure shall include a complete description of all equipment and methods to be employed. The Contractor may submit an alternate procedure for review. Alternate procedures will be reviewed and accepted or rejected at the sole discretion of the Departmental Representative. The procedure offered below does not replace the other requirements specified in this Section.

.1 Longitudinal Balance – Measurement

1. Allow the center bearing to be the sole support of the swing span by removing any blocking that is in place, withdrawing the end lifts and shimming the balance wheels and center pier live load supports so they are not in contact (if they have been installed).
2. Determine the distance between the balance wheels and the balance wheel track for each of the balance wheels (four total) closest to the longitudinal centerline of the bridge.
3. Jack the bridge using two 75-ton hydraulic jacks, equally spaced from the longitudinal centerline of the bridge, placed on the side of the center bearing which has the least clearance at the balance wheels. The jacks should be the same distance from the center bearing. Connect the two jacks so that the pressure to each jack is the same. Jacks shall be equipped with load cell indicators.
4. Jack the bridge until one of the balance wheels on the opposite side of the center bearing from the jacks just contacts the balance wheel track.
5. Release the pressure in the jacks and determine if the bridge remains in the jacked position or returns to the position prior to jacking.
6. If the bridge returns to the position prior to jacking, then the span is out of balance in the longitudinal direction. If the span does not return to its original position proceed to step 10.
7. Secure bridge for the purpose of adding weight to the bridge.
8. Add weight at the end of the bridge opposite from the jacks. Weights may be placed on the deck along the end floor beam.
9. Repeat steps 1 through 8 until the span does not return to its original position after jacking. Total weight shall be added permanently at that end of the bridge as directed by the Departmental Representative.
10. Jack the bridge from the low side (side with balance wheel in contact) with a dial indicator positioned to indicate movement of the pivot top casting on the opposite side of the center bearing from the jacks. Dial indicator to be on longitudinal centerline of the bridge. Determine the force required to initiate movement. Record this value as F_{east} or F_{west} accordingly.
11. Jack the bridge until the balance wheels opposite the jacks just contact the balance wheel track.
12. Jack the bridge from the opposite side with a dial indicator positioned to indicate movement of the pivot top casting of the opposite side of the center bearing from the jacks. Dial indicator to be on transverse centerline of the bridge. Determine the force required to initiate movement of the pivot top casting. Record this value as F_{north} or F_{south} accordingly.
13. Determine the imbalance force at the south side using the following equation:

$$F_{IS} = F_{NORTH} - \left(\frac{F_{SOUTH} - F_{NORTH}}{2}\right)$$

14. Determine the required weight at the south side of the bridge using the following equation:

$$W_{SOUTH} = \frac{F_{IS} \times d}{D}$$

Where,
F_{IS} = Imbalance force south (from Step 13).
d = Distance to jacks along transverse axis of bridge.
D = Distance to added weight along transverse of bridge.
W_{SOUTH} = Weight change at south side of bridge. If W_{SOUTH} is negative, remove weight from south side of bridge or add weight to north side of bridge. If W_{SOUTH} is positive, add weight to south side of bridge or remove weight from north side of bridge.

.2 Transverse Balance – Measurement

1. Allow the center bearing to be the sole supporter of the swing span by removing any blocking that is in place, withdrawing the end lifts and shimming the balance wheels and center pier live load supports so they are not in contact (if they have been installed).
2. Determine the distance between the balance wheels and the balance wheel track for each of the balance wheels (four total) closest to the transverse centerline of the bridge.
3. Jack the bridge using two 75 ton hydraulic jacks, equally spaced from the transverse centerline of the bridge, placed on the side of the center bearing which has the least clearance at the balance wheels. The jacks should be the same distance from the center bearing. Connect the two jacks so that the pressure to each jack is the same. Jacks shall be equipped with load cell indicators.
4. Jack the bridge until one of the balance wheels on the opposite side of the center bearing from the jacks just contacts the balance wheel track.
5. Release the pressure in the jacks and determine if the bridge remains in the jacked position or returns to the position prior to jacking.
6. If the bridge returns to the position prior to jacking, then the span is out of balance in the transverse direction. If the span does not return to its original position proceed to step 10.
7. Drive the end lifts or install blocking to secure bridge for the purpose of adding weight to the bridge.
8. Add weight at the side of the bridge opposite from the jacks. Weights may be placed on the deck in-line with the longitudinal girder.
9. Repeat steps 1 through 8 until the span does not return to its original position after jacking. Total weight shall be added permanently along that side of the bridge as directed by the Departmental Representative.
10. Jack the bridge from the low side (side with balance wheel in contact) with a dial indicator positioned to indicate movement of the pivot top casting on the opposite side of the center bearing from the jacks. Dial indicator to be on transverse centerline of the bridge. Determine the force

required to initiate movement. Record this value as F_{NORTH} or F_{SOUTH} accordingly.

11. Jack the bridge until the balance wheels opposite the jacks just contact the balance wheel track.

12. Jack the bridge from the opposite side with a dial indicator positioned to indicate movement of the pivot top casting of the opposite side of the center bearing from the jacks. Dial indicator to be on longitudinal centerline of the bridge. Determine the force required to initiate movement of the pivot top casting. Record this value as F_{EAST} or F_{WEST} accordingly.

13. Determine the imbalance force at the east side using the following equation:

$$F_{IE} = F_{WEST} - \left(\frac{F_{EAST} - F_{WEST}}{2}\right)$$

14. Determine the required weight change at the east side using the following equation:

$$W_{EAST} = \frac{F_{IE} \times d}{D}$$

Where,

F_{IE} = Imbalance force east (from Step 13).

d = Distance to jacks along transverse axis of bridge.

D = Distance to added weight along transverse of bridge.

W_{EAST} = Weight change at east side of bridge. If W_{EAST} is negative, remove weight from east side of bridge or add weight to west side of bridge. If W_{EAST} is positive, add weight to east side of bridge or remove weight from west side of bridge.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

.1 Codes and standards referenced are the latest versions at time of project tender.

.2 Ontario Provincial Standard Specifications (OPSS)/Ontario Ministry of Transportation (Access on-line as per Section 01 11 00:

.1 OPSS.PROV 180 November 2016, Management and Disposal of Excess Material

.2 OPSS.PROV 206 November 2014, Grading

.3 OPSS.PROV 209 November 2014, Embankments Over Swamps

.4 OPSS 301 November 2009, Restoring Unpaved Roadway Surfaces

.5 OPSS.MUNI 310 November 2017, Hot Mix Asphalt

.6 OPSS.PROV 330 November 2014, Construction Specification for In-Place Full Depth Reclamation of Bituminous Pavement And Underlying Granular

.7 OPSS.PROV 401 November 2015, Trenching, Backfilling, and Compacting

.8 OPSS.PROV 404 November 2017, Support Systems

.9 OPSS 407 November 2015, Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation

.10 OPSS.PROV 409 November 2017, Closed-Circuit Television (CCTV) Inspection of Pipelines

.11 OPSS.PROV 410 November 2015, Construction Specification for Pipe Sewer Installation in Open Cut

.12 OPSS.PROV 421 November 2015, Pipe Culvert Installation in Open Cut

.13 OPSS 422 November 2015, Construction Specification for Precast Reinforced Concrete Box Culverts in Open Cut

.14 OPSS 490 April 2016, Site Preparation for Pipelines, Utilities, and Associated Structures

.15 OPSS.PROV 491 November 2017, Preservation, Protection, and Reconstruction of Existing Facilities

.16 OPSS 492 November 2015, Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures

.17 OPSS.PROV 501 November 2014, Construction Specification for Compacting

.18 OPSS.PROV 510 November 2014, Construction Specification for Removal

.19 OPSS.PROV 517 November 2016, Dewatering of Pipeline, Utility, and Associated Structure Excavation

.20 OPSS.PROV 539 November 2014, Temporary Protection Systems

.21 OPSS 902 November 2010, Excavating and Backfilling – Structures

.22 OPSS 904 November 2014, Concrete Structures

.23 OPSS 905 November 2014, Steel Reinforcement for Concrete

.24 OPSS.PROV 1002 April 2018, Aggregates – Concrete
.25 OPSS.PROV 1004 November 2012, Aggregates - Miscellaneous
.26 OPSS.PROV 1010 April 2013, Aggregates - Base, Subbase, Select Subgrade, and Backfill Material
.27 OPSS 1150 November 2010, Hot Mix Asphalt
.28 OPSS.PROV 1151 November 2016, Superpave and Stone Mastic Asphalt Mixtures
.29 OPSS.PROV 1205 April 2015, Clay Seal
.30 OPSS 1301 November 2007, Cementing Materials
.31 OPSS 1302 September 1996, Water
.32 OPSS.PROV 1350 November 2016, Concrete - Materials and Production
.33 OPSS.PROV 1440 November 2014, Steel Reinforcement for Concrete
.34 OPSS.PROV 1801 April 2018, Corrugated Steel Pipe Products
.35 OPSS.PROV 1820 November 2014, Circular Concrete Pipe
.36 OPSS 1821 November 2015, Precast Reinforced Concrete Box Culverts
.37 OPSS 1840 November 2015, Non-Pressure Polyethylene Plastic Pipe Products
.38 OPSS 1841 November 2015, Non-Pressure Polyvinyl Chloride (PVC) Pipe Products
.39 OPSS.PROV 1843 April 2018, Non-Pressure Polypropylene (PP) Plastic Pipe Products
.40 OPSS.PROV 1860 April 2018, Geotextiles

.3 Canadian Standards Association (CSA):
.1 CAN/CSA S6-14, Canadian Highway Bridge Design Code.

.4 Department of Justice Canada (Jus)
.1 Canadian Environmental Assessment Act (CEAA)
.2 Canadian Environmental Protection Act, (CEPA)

.5 Ministry of Transportation (MTO)
.1 Designated Sources of Materials (DSM):
http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.2 DEFINITIONS

.1 Demolish: Detach items from existing construction and legally dispose of them off site, unless indicated to be removed and salvaged or removed and reinstalled.

.2 Existing to Remain: Existing items of construction that are not removed and that are not otherwise indicated as being removed, removed and salvaged, or removed and reinstalled.

.3 For the purpose of this specification, the following definitions apply:

.1 Bridge Structure means that portion of a bridge and associated wing and retaining walls above the bridge footing, excluding modular bridges

.2 Concrete Appurtenances mean as defined in OPSS 410, 421, and 422.

.3 Culvert means a single or multiple cell structure designed to provide an opening under a roadway, pedestrian way, railway, or side entrance for the passage of surface water, livestock, or pedestrians.

.4 Curb and Gutter means any combination of curb, gutter, curb with gutter, gutter setbacks, bullnoses, gutter outlets, and spillways.

.5 Engineer means a professional engineer licensed by the Professional Engineers Ontario to practice in the Province of Ontario.

.6 Pipe means any closed conduit originally designed to convey liquid or gas.

.7 Sundry Asphalt Pavements means paved islands, medians, boulevards, and walkways.

1.3 QUALITY ASSURANCE

.1 Regulatory Requirements: ensure Work is performed in compliance applicable Provincial/Territorial regulations.

.2 Comply with hauling and disposal regulations of Authority Having Jurisdiction.

1.4 SITE CONDITIONS

.1 Protect existing site features to remain or identified for salvage or re use; make repairs and restore to a similar condition to existing where damage to these items occurs as directed by the Departmental Representative and at no cost to Contract:

.1 Remove and store salvaged materials to prevent contamination.

.2 Store and protect salvaged materials as required for maximum preservation of material.

.3 Handle salvaged materials the same as new materials.

.2 Perform pavement removal work to prevent adverse effects to adjacent watercourses, groundwater and wildlife, and to prevent excess air and noise pollution:

.1 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers or onto adjacent properties.

.2 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with Authorities Having Jurisdiction.

.3 Protect existing site features and structures, trees, plants and foliage on site and adjacent properties.

PART 2 PRODUCTS

.1 NOT USED.

PART 3 EXECUTION

1.4 PREPARATION

.1 Verify extent and location of asphalt identified for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.1 Locate and protect utilities, preserve active utilities traversing site in operating condition.

.2 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

.3 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.4 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

.2 Prior to beginning removal operation, inspect and verify with Departmental Representative areas, depths and lines of asphalt pavement to be removed by pulverization.

.3 Protection: protect existing pavement not designated for removal, light units and structures from damage. In event of damage, immediately replace or make repairs to approval of Departmental Representative at no additional cost.

3.2 REMOVAL

.1 Pulverize existing asphalt pavement to lines and grades as indicated.

.2 Depth of pulverization to be minimum 150mm.

.1 100% of the mixed material by mass to pass the 50 mm sieve and 95% pass the 37.5 mm sieve.

.3 The bituminous pavement and underlying granular shall be reclaimed to the depth specified. The tolerance for the average depth of processing to be ± 15 mm from the depth noted above.

.4 Restore and reshape the surface utilizing suitable material obtained from the pulverization process.

.5 Imported material for grade raise, to consist of Granular A as indicated or other granular material approved by Departmental Representative.

.6 The in-place full depth reclamation including pulverizing, mixing, shaping, and compacting to final grade is to be completed across the full pavement width prior to closing down operations each day.

.7 Existing shoulders to be shaped and compacted to grade prior to closing down operations each day.

.8 Demolition of pavements, curbs and gutters:

.1 Square up adjacent surfaces to remain in place by saw cutting or other method acceptable to the Departmental Representative.

.2 Protect adjacent joints and load transfer devices.

.3 Protect underlying and adjacent granular materials where they are exposed and identified to remain.

.4 Prevent contamination with base course aggregates, when removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving.

.9 Use equipment and methods of removal and hauling which do not damage or disturb underlying pavement.

.10 Prevent contamination of removed asphalt pavement by topsoil, underlying gravel or other materials.

.11 Suppress dust generated by removal process.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Sweep remaining asphalt pavement surfaces clean of debris resulting from removal operations using rotary power brooms and hand brooming as required.

.4 Waste Management: separate waste materials for recycling in accordance with Section 01 74 20.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.2 Removed asphalt pavement which is to be recycled in hot mix asphalt concrete under this contract may be stockpiled at designated asphalt plant site.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

.1 Methods and procedures for demolition and removal of Hamlet Swing and Fixed Bridges Superstructures, east and west abutments and wingwalls, east pier, control house, and removal of septic tanks.

.2 Methods and procedures for partial removal of the pivot pier and rest piers.

1.2 REFERENCES

.1 Canadian Council of Ministers of the Environment (CCME)
.1 PN 1326-July 2005, Environmental Code of Practice for aboveground and underground tank systems containing petroleum products and allied petroleum products.

.2 Canadian Standards Association (CSA International)
.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.

.3 Ontario Provincial Standard Specification OPSS.MUNI 510, Construction Specification for Removal.

.4 Canadian Environmental Protection Act (CEPA) 1999.

.5 Canadian Environmental Assessment Act (CEAA), 1992 c37.

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.7 Transport Canada (TC)
.1 Transportation of Dangerous Goods Act, 1992 (TDGA), c. 34.

1.3 SUBMITTALS

.1 Provide submittals in accordance with Section 01 11 01 and Section 01 33 00.

.2 Shop Drawings:
.1 Provide shop drawings and product data in accordance with Section 01 33 00.
.2 Provide drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:
.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

1.5 SITE CONDITIONS

.1 Review designated substance report and take precautions to protect environment.

.2 Should material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify Departmental Representative immediately.
.1 Do not proceed until written instructions have been received from Departmental Representative.

.3 Notify Departmental Representative before disrupting items.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Leave equipment and machinery running only while in use, except where extreme temperatures prohibit shutting down.

.2 Demonstrate that tools and machinery are being used in manner which allows for salvage of materials in best condition possible.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Do Work in accordance with Section 01 35 29.

.2 Protection:
.1 Prevent movement, settlement, or damage to adjacent structures, utilities to remain in place. Provide bracing and shoring required.
.2 Keep noise, dust, vibration, and inconvenience to occupants to minimum.
.3 Protect services and equipment.
.4 Provide temporary dust screens, covers, railings, supports and other protection as required.

.3 Disconnect and re-route electrical, telephone and communication service lines. Post warning signs on electrical lines and equipment which must remain energized to serve other products during period of demolition.

.4 Locate and protect utility lines. Do not disrupt active or energized utilities designated to remain undisturbed.

.5 Disconnect and cap designated mechanical services.
.1 Natural gas supply lines: remove in accordance with utility company requirements.
.2 Sewer and water lines: remove in accordance with requirements of authority having jurisdiction.
.3 Other underground services: remove and dispose of as indicated on Contract Documents.

3.2 DEMOLITION SALVAGE AND DISPOSAL

.1 Refer to demolition drawings and specifications for items to be salvaged for reuse.

.2 Remove items to be reused, store as directed by Departmental Representative, and re-install under appropriate section of specification.

.3 Dispose of removed materials, to appropriate recycling facilities, and reuse facilities except where specified otherwise, in accordance with authority having jurisdiction.

3.3 STOCKPILING

.1 Label stockpiles, indicating material type and quantity.

.2 Designate appropriate security resources/measures to prevent vandalism, damage and theft.

.3 Locate stockpiled materials convenient for use in new construction. Eliminate double handling wherever possible.

.4 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

3.4 REMOVAL FROM SITE

.1 Transport material designated for alternate disposal in accordance with applicable regulations.

.2 Dispose of materials not designated for alternate disposal in accordance with applicable regulations.

3.5 CLEANING AND RESTORATION

.1 Keep site clean and organized throughout demolition procedure.

.2 Upon completion of project, reinstate areas affected by Work to condition which existed prior to beginning of Work.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREEMNTS

.1 Section 31 23 33.

1.2 WORK TO BE DEMOLISHED

.1 The Work to be demolished as part of this section is the existing Hamlet Swing and Fixed Bridges.

.2 The following is a description of the existing bridge to be demolished:
.1 The Hamlet Bridge, located at Canning Road, over the Trent Severn Waterway in Hamlet, Ontario. The structure consists of a swing bridge on the west side and a fixed bridge on the east side. The span lengths are 31 m and a 60 m for the fixed and swing span respectively. The width of the bridge from the center to center of the trusses is approximately 5.5 m. The bridge accommodates a single traffic lane.
.2 The bridge is a single lane steel through truss swing bridge with a nail laminated timber deck and wearing surface. The structural steel floor system consisted of deck grating support beams overlying longitudinal stringers supported on transverse floor beams.

1.3 REFERENCES

.1 Definitions:
.1 Alternate Disposal: reuse and recycling of materials by designated facility, user or receiving organization which has valid Certificate of Approval to operate. Alternative to landfill disposal.
.2 Deconstruction: systematic dismantling of structure in a manner that achieves safe removal/disposal of hazardous materials and maximum salvage/recycling of materials.
.1 Ultimate objective is to recover potentially valuable resources while diverting from landfill what has traditionally been significant portion of waste system.
.3 Demolition: rapid destruction of structure with or without prior removal of hazardous materials.
.4 Disassembly: physical detachment of materials from structure: prying, pulling, cutting, unscrewing.
.5 Hauler: company (possessing appropriate and valid Certificate of Approval) contracted to transport waste, reusable or recyclable materials off site to designated facility, user or receiving organization.
.6 Hazardous Materials: dangerous substances, dangerous goods, hazardous commodities and hazardous products, including but not limited to: corrosive agents, flammable substances, ammunition, explosives, radioactive substances, or other material that can endanger human health, wellbeing or environment if handled improperly.
.7 Processing: tasks which are subsequent to disassembly and may include: moving materials, denailing, cleaning, separating and stacking.
.8 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse by others.
.9 Recycle: process by which waste and recyclable materials are

transformed or collected for purpose of being transferred into new products.

.10 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form.

.1 Recycling does not include burning, incinerating, or thermally destroying waste.

.11 Reuse: repeated use of product in same form but not necessarily for same purpose. Reuse includes:

.1 Salvaging reusable materials from remodeling projects, before demolition stage, for resale, reuse on current project or for storage for use on future projects.

.2 Returning reusable items including pallets or unused products to vendors.

.12 Salvage: removal of structural and non-structural materials from deconstruction/disassembly projects for purpose of reuse or recycling.

.13 Source Separation: acts of keeping different types of waste materials separate, beginning from first time they became waste.

.14 Used Building Material Receipt: receipt issued at end destination for materials designated for alternate disposal.

.15 Waste Audit (WA): detailed inventory of materials in building. Involves quantifying (by volume or weight) amounts of materials and wastes generated during deconstruction. Indicates quantities of reuse, recycling and landfill.

.16 Waste Management Coordinator (WMC): contractor representative responsible for supervising waste management activities as well as coordinating related, required submittal and reporting requirements.

.17 Waste Reduction Workplan (WRW): written report which outlines actions to be taken to reduce, reuse and recycle materials during course of deconstruction. Actions based on finding of the Waste Audit (WA).

.18 Weigh Bill: receipt received from recycling facility indicating weight and content of each load/bin of material.

.2 Reference Standards:

.1 Canadian Council of Ministers of the Environment (CCME)

.1 PN 1326-2003, Environmental Code of Practice for Aboveground and Underground Tank Systems Containing Petroleum Products and Allied Petroleum Products.

.2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.3 CSA International

.1 CSA S350-[M1980(R2003)], Code of Practice for Safety in Demolition of Structures.

.4 Federal Legislation

.1 Canadian Environmental Assessment Act (CEAA), 2012.

.2 Canadian Environmental Protection Act (CEPA), 1999, c. 33.

.3 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.4 Motor Vehicle Safety Act 1993, c. 16 (MVSA).

.5 Navigable Waters Protection Act (NWPA), 1985, c.N-22.

.6 Fisheries Act, 1985, c.F-14.

.7 Species at Risk Act, S.C. 2002, c.29.

.5 Underwriter’s Laboratories of Canada (ULC)

.1 CAN/ULC-S660-08, Standard for Nonmetallic Underground Piping for Flammable and Combustible Liquids.
.2 CAN/ULC-S661-10, Standard for Overfill Protection Devices for Flammable and Combustible Liquid Storage Tanks.
.3 ULC/ORD C58.19 1992, Spill Containment Devices for Underground Flammable Liquid Storage Tanks.

1.4 PRICE AND PAYMENT PROCEDURES

.1 Measurement and Payment:
.1 There will be no measurement for work associated with the removal and disposal of the existing bridge.
.2 Payment for work associated with the removal and disposal of the existing bridge is included in the Lump Sum Price.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Deconstruction Meetings:
.1 Convene meeting 1 week prior to beginning Work of this Section and on-site installation, with Contractor’s Representative and Departmental Representative to:
.1 Verify project requirements.
.2 Verify existing site conditions adjacent to demolition works.
.3 Co-ordinate with other construction sub-trades

.2 Scheduling:
.1 Employ necessary means to meet project time lines without compromising specified minimum rates of material diversion. In event of unforeseen delay notify Departmental Representative.

1.6 PERFORMANCE REQUIREMENTS

.1 Separate materials from waste stream to obtain a minimum 75% diversion from landfill sites. Materials separation to include but not be limited to:
.1 Asphalt
.2 Concrete
.3 Metal
.4 Wood
.5 Aggregates & Soil
.6 Masonry stones
.7 Other

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Keep copies of submittals on file for minimum of five (5) years after completion of project.

.3 WMC is responsible for fulfillment of reporting requirements.

.4 Product Data: Submit WHMIS MSDS – Material Safety Data.

.5 Submit a work plan to the Departmental Representative at least 2 weeks prior to commencement of the demolition Work outlining the equipment used, dust and debris control and the sequence of removals.

.6 Prior to start of Work on site, submit detailed WA indicating descriptions of and anticipated quantities of materials to be reused, recycled and landfilled in accordance with Section 01 74 21.

.7 Prior to start of Work on site, submit pre-demolition audit and deconstruction/disassembly plan in accordance with Section 01 74 21.

.8 Based on findings of WA submit WRW indicating schedule of selective demolition, material descriptions and quantities to be salvaged, number and location of bins, anticipated frequency of tippage, and names and addresses of haulers, facilities or receiving organizations in accordance with Section 01 74 21.

.9 Waste Reduction Workplan: prior to beginning of Work on site submit detailed Waste Reduction Workplan in accordance with Section 01 74 21 and indicate:

.1 Descriptions of and anticipated quantities in percentages of materials to be salvaged, reused, recycled and landfilled.

.2 Schedule of selective demolition.

.3 Number and location of dumpsters.

.4 Anticipated frequency of tippage.

.5 Name and address of haulers, waste facilities and waste receiving organizations.

.10 Submit copies of certificates: weigh bills or bills of lading from authorized disposal sites and reuse and recycling facilities for material removed from site to Departmental Representative monthly.

.1 Written authorization from Departmental Representative is required to deviate from haulers, facilities or receiving organizations listed in WRW.

.2 Include following information:

.1 Time and date of removal.

.2 Description of materials(s).

.3 Quantity of material.

.4 Breakdown of reuse, recycling and landfill percentages.

.5 End of destination of material(s).

.11 Hazardous Materials:

.1 Submit description of Hazardous Materials and Notification of Filing with proper authorities prior to beginning of Work as required.

.12 Workers, haulers and subcontractors must possess current, applicable permits to remove, handle and dispose of wastes categorized Federally or Provincially as hazardous:

.1 Provide proof of compliance within twenty-four (24) hours upon written request of Departmental Representative.

1.8 DECONSTRUCTION DRAWINGS

.1 Submit for approval drawings, diagrams and details showing sequence of deconstruction work, materials designated for salvage and support of structures and underpinning.

.2 Submit drawings stamped and signed by qualified professional Departmental Representative registered or licensed in Province of Ontario, Canada.

1.9 QUALITY ASSURANCE

.1 A qualified Professional Engineer licensed in the Province of Ontario to oversee the deconstruction of the bridge to ensure the stability and integrity of the structure or any part of the structure at all times of the deconstruction.

.2 Qualifications: provide adequate workforce training through meetings and demonstrations. Have someone on site with deconsruction experience throughout project for consultation and supervision purposes.

.3 Regulatory Requirements:
.1 Ensure Work is performed in compliance with CEPA, CEAA, TDGA, MVSA and applicable Provincial regulations.

.4 Site Meetings:
.1 Arrange for site visit with Departmental Representative to examine existing site conditions adjacent to demolition work, prior to start of Work.
.2 Ensure key personnel, site supervisor, project manager, subcontractor representatives and WMC attend.

1.10 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00, Section 01 35 43, and Section 02 81 01 and with manufacturer's written instructions.

.2 Storage and Protection.
.1 Material designated for salvage is to remain the property of the Owner and be maintained in a reasonable condition and stored in a manner acceptable to the Departmental Representative.
.2 Protect existing items designated to remain and items designated for salvage. In event of damage to such items, immediately replace or make repairs to approval of Departmental Representative and at no cost to Departmental Representative.
.3 Remove and store materials to be salvaged, in manner to prevent damage.
.4 Store and protect in accordance with requirements for maximum preservation of material.
.5 Handle salvaged materials as new materials.

.3 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.4 Packaging Waste Management: remove for reuse and recycle materials as specified in the Construction Waste Management Plan in accordance with

Section 01 74 21.

1.11 ENVIRONMENTAL REQUIREMENTS

.1 Do Work in accordance with Section 01 35 43.

.2 Ensure deconstruction/selective demolition work does not adversely affect adjacent watercourses, groundwater and wildlife, or contribute to excess air noise pollution.

.3 Fires and burning of waste or materials is not permitted on site.

.4 Do not bury waste or materials on site.

.5 Do not dispose of waste or volatile materials, including but not limited to, mineral spirits, oil, petroleum-based lubricants, or toxic cleaning solutions into watercourses, including the Canal, or storm/sanitary sewers.
.1 Ensure proper disposal procedures in accordance with CEPA, TDGA applicable Provincial/Territorial regulations.

.6 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties in accordance with authorities having jurisdiction.

.7 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with authorities having jurisdiction and as directed by Departmental Representative.

.8 Protect trees, plants and foliage on site and adjacent properties where indicated.

.9 Prevent extraneous materials from contaminating air beyond deconstruction area, by providing temporary enclosures during Work.

.10 Cover or wet down dry materials and waste to prevent blowing dust and debris. Control dust on temporary roads.

.11 Erect temporary fencing to protect salvaged materials from vandalism, theft, adverse weather, or inadvertent damage by heavy machinery.

.12 Use natural lighting to do Work where possible.
.1 Shut off lighting except those required for security purposes at end of each day.

.13 Organize site and workers in manner which promotes efficient flow of materials through disassembly, processing, stockpiling, and removal.

1.12 SITE CONDITIONS

.1 Existing Conditions:
.1 Label and package component parts of mechanical and electrical material specified for salvage in accordance with Departmental Representative's instructions and as specified to prevent damage or loss.

.2 Structures to be deconstructed/demolished are:
.1 The existing Hamlet Swing and Fixed Bridges superstructure.
.2 the existing approach slabs.
.3 The existing east and west abutments and wingwalls including footings.
.4 The existing East Pier.
.5 Top portion of the existing Pivot Pier to limit shown on Contract Drawings.
.6 Electrical, mechanical and hydraulic equipment shown on the Contract Drawings.
.7 The existing Control House.

.3 List of items to be removed and reinstated, salvaged for reuse include, but not limited to:
.1 All the existing signs on the structure.
.2 All the existing traffic signs on the bridge and approaches.
.3 All the existing railings.
.4 The existing water, rain and Flow gages at the north rest pier.
.5 The existing stop bars.
.6 The existing traffic gates.
.7 The existing benchmark on the north rest pier.
.8 All the existing ladders.
.9 The existing trench cover plates on pivot girder.

.4 List of items to be removed and replaced include, but not limited to:
.1 The existing river level marker.
.2 The existing septic tank.
.3 remove and replace the existing 10 “km/h Max” speed sign on the east pier with “50 km/h Max” sign, or “4 Knots Max” sign.
.4 The existing navigation lights.

.5 Storage and Protection:
.1 Store materials salvaged for reuse and recycling as directed by the Departmental Representative.
.2 Maximum permitted duration of material storage on site determined in consultation with Departmental Representative after project completion.
.3 Prevent movement, settlement or damage of adjacent structures, services, paving, trees, walks and landscaping. Repair damage caused by deconstruction as directed by the Departmental Representative.
.4 Ensure adequate clearance considering wind between any cranes, rigging, payload and the adjacent structures. Provide bracing and shoring as required.
.5 Support affected structures and, if safety of structure being deconstructed, adjacent structures and services appear to be endangered, take preventative measures. Cease operations and immediately notify Departmental Representative.

PART 2 - PRODUCTS

2.1 EQUIPMENT

.1 Leave equipment and machinery running only while in use, except where extreme temperatures prohibit shutting down.

.2 Where possible use water efficient wetting equipment/trucks/attachments to minimize dust generation.

.3 Demonstrate that tools are being used in manner which allows for salvage of materials in a condition that allows reuse/recycling as identified in the WRW.

PART 3 - EXECUTION

3.1 OPERATIONAL CONSTRAINTS

.1 The canal navigation period is from May to October and the waterway must remain accessible for marine traffic throughout this period. Existing bridge removal cannot be completed during this period.

3.2 SITE VERIFICATION OF CONDITIONS

.1 Employ necessary means to assess site conditions and structure to determine quantity and locations of hazardous materials.

.2 Investigate site and structure[s] to determine dismantling, processing and storage logistics required prior to beginning of Work.

.3 Develop strategy for deconstruction to facilitate optimum salvage of reusable and recyclable materials.

3.3 PREPARATION

.1 Obtain necessary permits and approvals for demolition.
.1 Provide copies to Departmental Representative prior to start of Work on site.

.2 Inspect site with Departmental Representative and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

.3 Locate and protect utility lines. Preserve active utilities traversing site in operating condition.
.1 Notify and obtain approval of utility companies before starting demolition.
.2 Post warning signs on electrical lines and equipment which must remain energized to serve other properties during period of demolition.
.3 Disconnect electrical and telecommunication lines entering structures to be demolished.

.4 Temporary Erosion and Sedimentation Control:
.1 Inspect, repair, and maintain erosion and sedimentation control measures during deconstruction.
.2 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal after completion of deconstruction work.

.5 Protection of in-place conditions:
.1 Work in accordance with Section 01 35 43 – Environmental Procedures.

.6 Use adequate netting underneath deck to prevent any falling of debris into the river below during deck demolition/deconstruction.

.7 Provide a safe method of deconstruction (i.e. stable barges for cranes) as applicable.

.8 Do work in accordance with Section 01 35 29.

.9 Disconnect and cap designated mechanical and electrical services.
.1 Sewer and water lines: remove in accordance with requirements of authority having jurisdiction.
.2 Other underground services: remove and dispose of as directed by Departmental Representative

3.4 REMOVAL OF HAZARDOUS WASTES

.1 Prior to start of deconstruction work remove contaminated or hazardous materials as defined by authorities having jurisdiction from site and dispose of at designated disposal facilities in safe manner in accordance with TDGA and other applicable regulatory requirements, in accordance with Section 02 81 01.

3.5 DISASSEMBLY OF EXISTING BRIDGE

.1 Do not start any demolition/deconstruction before the review of demolition plan and shop drawings by the Department Representative.

.2 Blasting is not permitted for the construction or deconstruction/demolition of any component of the works.

.3 Chemical concrete demolition methods are not permitted for any component of the works.

.4 Materials removed from designated structure are property of Contractor.

.5 Throughout course of deconstruction pay close attention to connections and material assemblies. Employ workmanship procedures which maintain control of the deconstruction process.

.6 Ensure workers and subcontractors are trained to carry out work in accordance with appropriate deconstruction techniques.

.7 Project supervisor with previous deconstruction experience must be present on site throughout project.

.8 Deconstruct in accordance with CSA S350 or other applicable safety standards.

.9 Leave work site in safe and stable condition.

.10 At all times ensure the stability and integrity of the structure or any part of the structure at each stage of its deconstruction.

.11 Workers must utilize adequate fall protection at all times.

.12 Dismantle the existing bridge and remove the substructure to one meter below grade.

.13 Demolish to minimize dusting. Keep materials wetted as directed by Departmental Representative.

.14 Separate from waste stream, material designated for alternate disposal in condition suitable for reuse and/or recycling.

.15 Remove and store materials to be salvaged, in manner to prevent damage.
.1 Store and protect in accordance with requirements for maximum preservation of material.
.2 Handle salvaged materials as new materials.

.16 Remove materials that cannot be salvaged for reuse or recycling and dispose of in accordance with applicable codes at licensed facilities.

.17 Only dispose of material specified by selected alternative disposal option as directed by Departmental Representative.

.18 Ensure that these materials will not be disposed of in landfill or waste stream destined for landfill.

.19 Collect debris from debris netting on structure for disposal.

.20 Remove and dispose of demolished materials except where noted otherwise and in accordance with authorities having jurisdiction.

.21 Where existing materials are to be re-used in Work, use special care in removal, handling, storage and re-installation to assure proper function in completed work.

3.6 REMOVAL OPERATIONS

.1 Remove items as indicated on contract drawings.

.2 Do not disturb items designated to remain in place.

.3 Removal of Pavements: In accordance with Section 02 41 13.14.

.4 Obtain written approval of Departmental Representative prior to removal of trees. Grind, chip, or shred for mulching and composting.

.5 Stockpile topsoil for final grading and landscaping.

.6 Backfill.
.1 Backfill in areas as indicated and in accordance with Section 31 23 33.

3.7 PROCESSING

.1 Designate location for processing of materials which eliminates double handling and provides adequate space to maintain efficient material flow.

.2 Separate materials to ensure best possible condition of salvaged materials.

.3 Keep processing area clean and free of excess debris.

.4 Supply separate, marked disposal bins for categories of waste material. Do not remove bins from site until inspected and approved by Departmental Representative.

.5 Separate processed materials into organized piles for stockpiling. Provide collection area for materials designated for alternate disposal. Pile materials on pallets to facilitate transport off site or to identified short-term storage areas.

3.8 STOCKPILING

.1 Designate appropriate security resources/measures to prevent vandalism, damage and theft.

.2 Locate stockpiled materials convenient for use in new construction where appropriate. Eliminate double handling wherever possible.

.3 Stockpile materials designated for alternate disposal in location which facilitates removal from site and examination by potential end markets, and which does not impede disassembly, processing, or hauling procedures.

.4 Material designated for alternate disposal should be marketed to approved haulers, facilities or receiving organizations listed in Waste Reduction Workplan.

3.9 REMOVAL FROM SITE

.1 Transport material designated for alternate disposal to approved haulers, facilities or receiving organizations listed in Waste Reduction Workplan and in accordance with applicable regulations.
.1 Do not deviate from haulers, facilities or receiving organizations listed in Waste Reduction Workplan without prior written authorization from Departmental Representative.

.2 Dispose of materials not designated for alternate disposal in accordance with applicable regulations. Disposal facilities must be approved of and listed in Waste Reduction Workplan. Do not deviate from disposal facilities listed in Waste Reduction Workplan without prior written authorization from Departmental Representative.

3.10 CLEANING AND RESTORATION

.1 Keep site clean and organized throughout deconstruction.

.2 Upon completion of project, remove debris, trim surfaces and leave work

site clean.

.3 Upon completion of project, reinstate areas, walkways, light standards, affected by Work to match condition of adjacent, undisturbed areas.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 02 82 00.01 – Asbestos Abatement – Minimum Precautions

1.2 REFERENCES

.1 Definitions:
.1 Dangerous Goods: product, substance, or organism specifically listed or meets hazard criteria established in Transportation of Dangerous Goods Regulations.
.2 Hazardous Material: product, substance, or organism used for its original purpose; and is either dangerous goods or material that will cause adverse impact to environment or adversely affect health of persons, animals, or plant life when released into the environment.
.3 Hazardous Waste: hazardous material no longer used for its original purpose and that is intended for recycling, treatment or disposal.

.2 Reference Standards:
.1 Canadian Environmental Protection Act,1999 (CEPA 1999)
.1 Export and Import of Hazardous Waste and Hazardous Recyclable Material Regulations (SOR/2005-149).
.2 Department of Justice Canada (Jus)
.1 Transportation of Dangerous Goods Act, 1992 (TDG Act) 1992, (c. 34).
.2 Transportation of Dangerous Goods Regulations (T-19.01-SOR/2001-286).
.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).
.4 National Research Council Canada Institute for Research in Construction (NRC-IRC)
.1 National Fire Code of Canada 2015.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for hazardous materials and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29 and Section 01 35 43 to Departmental Representative for each hazardous material required prior to bringing hazardous material on site.
.3 Submit hazardous materials management plan to Departmental Representative that identifies hazardous materials, usage, location, personal protective equipment requirements, and disposal arrangements.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Transport hazardous materials and wastes in accordance with Transportation of Dangerous Goods Act, Transportation of Dangerous Goods Regulations, and applicable provincial regulations.

.4 Storage and Handling Requirements:

.1 Co-ordinate storage of hazardous materials with Departmental Representative and abide by internal requirements for labelling and storage of materials and wastes.

.2 Store and handle hazardous materials and wastes in accordance with applicable federal and provincial laws, regulations, codes, and guidelines.

.3 Store and handle flammable and combustible materials in accordance with National Fire Code of Canada requirements.

.4 Keep no more than 45 litres of flammable and combustible liquids such as gasoline, kerosene and naphtha for ready use.

.1 Store flammable and combustible liquids in approved safety cans bearing the Underwriters' Laboratory of Canada or Factory Mutual seal of approval.

.2 Storage of quantities of flammable and combustible liquids exceeding 45 litres for work purposes requires the written approval of the Departmental Representative.

.5 Transfer of flammable and combustible liquids is prohibited within buildings.

.6 Transfer flammable and combustible liquids away from open flames or heat-producing devices.

.7 Solvents or cleaning agents must be non-flammable or have flash point above 38 degrees C.

.8 Store flammable and combustible waste liquids for disposal in approved containers located in safe, ventilated area. Keep quantities to minimum.

.9 Observe smoking regulations, smoking is prohibited in areas where hazardous materials are stored, used, or handled.

.10 Storage requirements for quantities of hazardous materials and wastes in excess of 5 kg for solids, and 5 litres for liquids:

.1 Store hazardous materials and wastes in closed and sealed containers.

.2 Label containers of hazardous materials and wastes in accordance with WHMIS.

.3 Store hazardous materials and wastes in containers compatible with that material or waste.

.4 Segregate incompatible materials and wastes.

.5 Ensure that different hazardous materials or hazardous wastes are stored in separate containers.

.6 Store hazardous materials and wastes in secure storage area with controlled access.

.7 Maintain clear egress from storage area.

.8 Store hazardous materials and wastes in location that will prevent them from spilling into environment.

.9 Have appropriate emergency spill response equipment available near storage area, including personal protective equipment.
.10 Maintain inventory of hazardous materials and wastes, including product name, quantity, and date when storage began.
.11 Ensure personnel have been trained in accordance with Workplace Hazardous Materials Information System (WHMIS) requirements.
.12 Report spills or accidents immediately to Departmental Representative. Submit a written spill report to Departmental Representative within 24 hours of incident.

.5 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 35 21.

.6 Packaging Waste Management: remove for reuse as specified in Construction Waste Management Plan and Waste Reduction Workplan in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Description:
.1 Bring on site only quantities hazardous material required to perform Work.
.2 Maintain MSDS in proximity to where materials are being used. Communicate this location to personnel who may have contact with hazardous materials.

PART 3 - EXECUTION

3.1 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.
.1 Dispose of hazardous waste materials in accordance with applicable federal and provincial acts, regulations, and guidelines.
.2 Recycle hazardous wastes for which there is approved, cost effective recycling process available.
.3 Send hazardous wastes to authorized hazardous waste disposal or treatment facilities.
.4 Burning, diluting, or mixing hazardous wastes for purpose of disposal is prohibited.
.5 Disposal of hazardous materials in waterways, storm or sanitary sewers, or in municipal solid waste landfills is prohibited.
.6 Dispose of hazardous wastes in timely fashion in accordance with applicable provincial regulations.

.7 Minimize generation of hazardous waste to maximum extent practicable. Take necessary precautions to avoid mixing clean and contaminated wastes.

.8 Identify and evaluate recycling and reclamation options as alternatives to land disposal, such as:

.1 Hazardous wastes recycled in manner constituting disposal.

.2 Hazardous waste burned for energy recovery.

.3 Lead-acid battery recycling.

.4 Hazardous wastes with economically recoverable precious metals.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Comply with requirements of this Section when performing following work:
.1 Removing ceiling tiles that are asbestos-containing material, if the tiles cover an area less than 7.5 square metres and are installed/removed without being broken, cut, drilled, abraded, ground, sanded or vibrated.
.2 Removing non-friable asbestos-containing materials, other than ceiling tiles, if the material is installed or removed without being broken, cut, drilled, abraded, ground, sanded or vibrated at locations indicated on drawings.
.3 Break, cut, grind, sand, drill, scrape, vibrate or abrade non-friable asbestos containing materials using non-powered hand-held tools, and the material is wetted to control the spread of dust or fibres.

1.2 SECTION INCLUDES

.1 Requirements and procedures for asbestos abatement of non-friable asbestos-containing materials, ceiling tile removal of less than 7.5 square metres, and less than one square metre of drywall with asbestos containing joint compound.

1.3 REFERENCES

.1 Department of Justice Canada (JUS)
.1 Canadian Environmental Protection Act, 1999 (CEPA).

.2 Transport Canada (TC)
.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

.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 A Guide to the Regulations respecting Asbestos on Construction Projects and in Buildings and Repair Operations released in November 2007, http://www.labour.gov.on.ca/english/hs/ asbestos/index.html.

1.4 DEFINITIONS

.1 HEPA vacuum: High Efficiency Particulate Air filtered vacuum equipment with filter system capable of collecting and retaining fibres greater than 0.3 microns in any direction at 99.97% efficiency.

.2 Amended Water: water with nonionic surfactant wetting agent added to reduce water tension to allow thorough wetting of fibres.

.3 Asbestos-Containing Materials (ACMs): materials that contain 0.5 per cent or more asbestos by dry weight and are identified under Existing Conditions including fallen materials and settled dust.

.4 Asbestos Work Area: area where work takes place which will, or may, disturb ACMs.

.5 Authorized Visitors: Engineers, Consultants or designated representatives, and representatives of regulatory agencies.

.6 Competent worker person: in relation to specific work, means a worker who:
.1 Is qualified because of knowledge, training and experience to perform the work.
.2 Is familiar with the provincial and federal laws 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.

.7 Friable material: means material that:
.1 When dry, can be crumbled, pulverized or powdered by hand pressure, or
.2 is crumbled, pulverized or powdered.

.8 Non-Friable Material: material that when dry cannot be crumbled, pulverized or powdered by hand pressure.

.9 Occupied Area: any area of the building or work site that is outside Asbestos Work Area.

.10 Polyethylene: polyethylene sheeting or rip-proof polyethylene sheeting with tape along edges, around penetrating objects, over cuts and tears, and elsewhere as required to provide protection and isolation.

.11 Sprayer: garden reservoir type sprayer or airless spray equipment capable of producing mist or fine spray. Must have appropriate capacity for work.

1.5 SUBMITTALS

.1 Submittals in accordance with Section 01 33 00.

.2 Submit proof satisfactory to Departmental Representative that suitable arrangements have been made to dispose of asbestos-containing waste in accordance with requirements of authority having jurisdiction.

.3 Submit Provincial/Territorial and/or local requirements for Notice of Project Form.

.4 Submit proof of Contractor's Asbestos Liability Insurance.

.5 Submit to Departmental Representative necessary permits for transportation and disposal of asbestos-containing waste and proof that asbestos-containing waste has been received and properly disposed.

.6 Submit proof that all asbestos workers and/or supervisor have received appropriate training and education by a competent person in the hazards of asbestos exposure, good personal hygiene and work practices while working

in Asbestos Work Areas, and the use, cleaning and disposal of respirators and protective clothing.

.7 Submit proof satisfactory to Departmental Representative that employees have respirator fitting and testing. Workers must be fit tested (irritant smoke test) with respirator that is personally issued.

1.6 QUALITY ASSURANCE

.1 Regulatory Requirements: comply with Federal, Provincial/Territorial, and local requirements pertaining to asbestos, provided that in case of conflict among these requirements or with these specifications, more stringent requirement applies. Comply with regulations in effect at time Work is performed.

.2 Health and Safety:

.1 Perform construction occupational health and safety in accordance with Section 01 35 29.

.2 Safety Requirements: worker protection.

.1 Protective equipment and clothing to be worn by workers while in Asbestos Work Area include:

.1 Air purifying half-mask respirator with N-100, R-100 or P-100 particulate filter, personally issued to worker and marked as to efficiency and purpose, suitable for protection against asbestos and acceptable to Provincial Authority having jurisdiction. The respirator to be fitted so that there is an effective seal between the respirator and the worker's face, unless the respirator is equipped with a hood or helmet. The respirator to be cleaned, disinfected and inspected after use on each shift, or more often if necessary, when issued for the exclusive use of one worker, or after each use when used by more than one worker. The respirator to have damaged or deteriorated parts replaced prior to being used by a worker; and, when not in use, to be stored in a convenient, clean and sanitary location. The employer to establish written procedures regarding the selection, use and care of respirators, and a copy of the procedures to be provided to and reviewed with each worker who is required to wear a respirator. A worker not to be assigned to an operation requiring the use of a respirator unless he or she is physically able to perform the operation while using the respirator.

.2 Disposable-type protective clothing that does not readily retain or permit penetration of asbestos fibres. Protective clothing to be provided by the employer and worn by every worker who enters the work area, and the protective clothing shall consist of a head covering and full body covering that fits snugly at the ankles, wrists and neck, in order to prevent asbestos fibres from reaching the garments and skin under the protective clothing to include suitable footwear, and to be repaired or replaced if torn.

.2 Eating, drinking, chewing, and smoking are not permitted in Asbestos Work Area.

.3 Before leaving Asbestos Work Area, the worker can decontaminate

his or her protective clothing by using a vacuum equipped with a HEPA filter, or by damp wiping, before removing the protective clothing, or, if the protective clothing will not be reused, place it in a container for dust and waste. The container to be dust tight, suitable for asbestos waste, impervious to asbestos, identified as asbestos waste, cleaned with a damp cloth or a vacuum equipped with a HEPA filter immediately before removal from the work area, and removed from the work area frequently and at regular intervals.

.4 Facilities for washing hands and face shall be provided within or close to the Asbestos Work Area.

.5 Ensure workers wash hands and face when leaving Asbestos Work Area. Facilities for washing are located as provided by Contractor.

.6 Ensure that no person required to enter an Asbestos Work Area has facial hair that affects seal between respirator and face.

.3 Visitor Protection:

.1 Instruct Authorized Visitors procedures to be followed when entering and exiting work area during operations.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.2 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Separate for reuse and recycling and place in designated containers, steel, metal, and plastic waste in accordance with Waste Management Plan.

.5 Place materials defined as hazardous or toxic in designated containers.

.6 Handle and dispose of hazardous materials in accordance with the CEPA, TDGA, Regional and Municipal regulations.

.7 Fold up metal banding, flatten and place in designated area for recycling.

.8 Disposal of asbestos waste generated by removal activities must comply with Federal, Provincial, Territorial and Municipal regulations. Dispose of asbestos waste in sealed double thickness 0.15 mm thick (6 mil) bags or leak proof drums. Label containers with appropriate warning labels.

.9 Provide manifests describing and listing waste created. Transport containers by approved means to licensed landfill for burial.

1.8 EXISTING CONDITIONS

.1 Notify Departmental Representative of friable material discovered during Work and not apparent from drawings, specifications, or report pertaining to Work. Do not disturb such material pending instructions from Departmental

Representative.

1.9 SCHEDULING

.1 Not later than two (2) days before beginning Work that may disturb ACMs on this Project notify following in writing:
.1 Appropriate Regional or Zone Director of Medical Services Branch, Health Canada.
.2 Provincial Ministry of Labour.
.3 Disposal Authority.

.2 Provide Departmental Representative copy of notifications prior to start of Work.

1.10 OWNER'S INSTRUCTIONS

.1 Before beginning Work, provide Departmental Representative satisfactory proof that every worker has had instruction and training in hazards of asbestos exposure, in personal hygiene and work practices, and in use, cleaning, and disposal of respirators and protective clothing.

.2 Instruction and training related to respirators includes, following minimum requirements:
.1 Fitting of equipment.
.2 Inspection and maintenance of equipment.
.3 Disinfecting of equipment.
.4 Limitations of equipment.

.3 Instruction and training must be provided by a competent, qualified person.

.4 Supervisory personnel to complete required training.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Drop Sheets:
.1 Polyethylene: 0.15 mm thick.
.2 FR polyethylene: 0.15 mm thick woven fibre reinforced fabric bonded both sides with polyethylene.

.2 Wetting Agent: 50% polyoxyethylene ester and 50% polyoxyethylene ether mixed with water in a concentration to provide thorough wetting of asbestos-containing material.

.3 Waste Containers: contain waste in two separate containers.
.1 Inner container: 0.15 mm thick sealable polyethylene waste bag.
.2 Outer container: sealable metal or fibre type where there are sharp objects included in waste material; otherwise outer container may be sealable metal or fibre type or second 0.15 mm thick sealable polyethylene bag.
.3 Labelling requirements: affix pre-printed cautionary asbestos warning in both official languages that is visible when ready for removal

to disposal site.

.4 Slow-drying sealer: non-staining, clear, water-dispersible type that remains tacky on surface for at least 8 hours and designed for purpose of trapping residual asbestos fibres.

.5 Tape: fibreglass-reinforced duct tape suitable for sealing polyethylene under both dry conditions and wet conditions using amended water.

PART 3 - EXECUTION

3.1 PROCEDURES

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

.2 Before beginning Work, isolate Asbestos Work Area using, minimum, preprinted cautionary asbestos warning signs in both official languages that are visible at access routes to Asbestos Work Area.
.1 Remove visible dust from surfaces in the work area where dust is likely to be disturbed during course of work.
.2 Use HEPA vacuum or damp cloths where damp cleaning does not create a hazard and is otherwise appropriate.
.3 Do not use compressed air to clean up or remove dust from any surface.

.3 Prevent spread of dust from Asbestos Work Area using measures appropriate to work to be done.

.4 Wet materials containing asbestos to be cut, ground, abraded, scraped, drilled, or otherwise disturbed unless wetting creates hazard or causes damage.
.1 Use garden reservoir type low - velocity fine - mist sprayer.
.2 Perform Work to reduce dust creation to lowest levels practicable.
.3 Work will be subject to visual inspection and air monitoring.
.4 Contamination of surrounding areas indicated by visual inspection or air monitoring will require complete enclosure and clean-up of affected areas.

.5 Frequently and at regular intervals during Work and immediately on completion of work:
.1 Dust and waste to be cleaned up and removed using a vacuum equipped with a HEPA filter, or by damp mopping or wet sweeping, and placed in a waste container, and

.6 Cleanup:
.1 Place dust and asbestos containing waste in sealed dust-tight waste bags. Treat drop sheets and disposable protective clothing as asbestos waste; wet and fold these items to contain dust, and then place in plastic bags.
.2 Clean exterior of each waste-filled bag using damp cloths or HEPA vacuum and place in second clean waste bag immediately prior to removal from Asbestos Work Area.
.3 Seal waste bags and remove from site. Dispose of in accordance with

requirements of Provincial/Territorial and Federal Authority having jurisdiction. Supervise dumping and ensure that dump operator is fully aware of hazardous nature of material to be dumped and that the appropriate guidelines and regulations for asbestos disposal are followed.

.4 Perform final thorough clean-up of Work areas and adjacent areas affected by Work using HEPA vacuum.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 03 20 00 - Concrete Reinforcing.

.2 Section 03 30 00 - Cast-in-Place Concrete.

.3 Section 03 37 26 – Underwater Placed Concrete.

1.2 MEASUREMENT PROCEDURES

.1 No measurement will be made under this Section.

.2 Payment will be under the Contract Lump Sum amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.2 REFERENCES

.1 Canadian Standards Association (CSA)
- .1 CSA A23.1-14/A23.2-14, Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.
- .2 CSA O86-14, Engineering Design in Wood (Limit States Design).
- .3 CSA O121-17, Douglas Fir Plywood.
- .4 CSA O151-17, Canadian Softwood Plywood.
- .5 CSA S269.1-16, Falsework & Formwork.

.2 Council of Forest Industries of British Columbia (COFI)
- .1 COFI Exterior Plywood for Concrete Formwork.

1.3 SHOP DRAWINGS

.1 Submit shop drawings for formwork and falsework in accordance with Section 01 33 00.

.2 Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts. Comply with CSA S269.1 for falsework and formwork drawings.

.3 Indicate formwork design data, such as permissible rate of concrete placement, and temperature of concrete, in forms.

.4 Indicate sequence of erection and removal of formwork/falsework as directed by Departmental Representative.

.5 Each shop drawing submission shall bear stamp and signature of qualified professional engineer registered or licensed in Province of Ontario, Canada.

1.5 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21 and the Waste Reduction Workplan.

.2 Place materials defined as hazardous or toxic waste in designated containers.

.3 Ensure emptied containers are sealed and stored safely for disposal away from children.

.4 Use sealers, form release and stripping agents that are non-toxic, biodegradable and have zero or low VOC's.

PART 2 - PRODUCTS

2.1 MATERIALS

1 Formwork materials:
.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121 and CSA O86.
.2 For concrete with special architectural features, use formwork materials to CSA A23.1/A23.2.

.2 Form release agent: non-toxic, biodegradable, low VOC.

.3 Form stripping agent: colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between 70 and 110s Saybolt Universal 15 to 24 mm^2/s at 40°C, flashpoint minimum 150°C, open cup.

.4 Falsework materials: to CSA S269.1.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

.1 Verify lines, levels and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings and field measurements, especially in area of swing bridge.

.2 Obtain Departmental Representative's approval for use of earth forms framing openings not indicated on drawings.

.3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.

.4 Fabricate and erect formwork in accordance with CSA S269.1 and COFI Exterior Plywood for Concrete Formwork.

.5 Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.

.6 Align form joints and make watertight. Keep form joints to minimum.

.7 Use 25 mm chamfer strips on external corners and/or 25 mm fillets at interior corners, joints, unless specified otherwise.

.8 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.

.9 Build in anchors, sleeves, and other inserts required to accommodate Work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

.10 Clean formwork in accordance with CSA A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

.1 Leave formwork in place for following minimum periods of time after placing concrete.
   .1 7 days for walls.
   .2 7 days for footings and abutments.

.2 Remove formwork when concrete has reached 60% of its design strength of 35 MPa, or 20 MPa, or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

.3 Re-use formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.2 QUALITY OF FINISH

.1 Grinding of the surfaces to achieve proper alignment and tolerance will generally not be accepted and the work must conform to the lines and be smooth when the forms are removed.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

.1 This section covers the requirements for concrete reinforcing.

.2 This section also covers the requirements for reinforcing steel dowels installed using an epoxy grout.

.3 Installation of threaded rods into existing concrete using an epoxy grout is covered under this section.

.4 Field cutting or drilling holes in sheet piles is covered under this section.

1.2 RELATED SECTIONS

.1 Section 03 30 00 – Cast-in-Place Concrete.

1.3 PRICE AND PAYMENT PROCEDURES

.1 Measurement and Payment:
.1 There will be no measurement for this work.
.2 Payment will be under the Contract Lump Sum amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.4 REFERENCES

.1 CSA International
.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
.2 CSA A23.3-14, Design of Concrete Structures.
.3 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.
.4 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
.5 CSA W186-M1990(R2016), Welding of Reinforcing Bars in Reinforced Concrete Construction.

.2 Reinforcing Steel Institute of Canada (RSIC)
.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

.3 ASTM International
.1 ASTM A165/A615M -16, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
.1 Indicate placing of reinforcement and:
.1 Bar bending details.
.2 Lists.
.3 Quantities of reinforcement.
.4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Departmental Representative, with identifying code marks to permit correct placement without reference to structural drawings.
.5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

.2 Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated.
.1 Provide type B tension lap splices where indicated, unless otherwise indicated.

1.6 QUALITY ASSURANCE

.1 Submit in accordance with Section 01 45 00 and as described in PART 2 - SOURCE QUALITY CONTROL.
.1 Mill Test Report: provide Departmental Representative with certified copy of mill test report of reinforcing steel, minimum four (4) weeks prior to beginning reinforcing work.
.2 Submit in writing to Departmental Representative proposed source of reinforcement material to be supplied.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Departmental

Representative.

.2 Reinforcing steel shall be Grade 400W, as specified on the Contract Drawings, unless otherwise noted.

.3 Stainless steel reinforcing shall be type 316 LN or Duplex 2205 and have a minimum yield strength of 500 MPa, unless otherwise specified.

.4 Dowel adhesive for reinforcing steel bars to be selected from the Ministry of Transportation of Ontario Designated Sources of Material DSM#9.30.25.

.5 Dowel adhesive for installation of threaded rods to be selected from the Ministry of Transportation of Ontario Designated Sources of Material DSM#9.30.25.

.6 Chairs, bolters, bar supports, spacers: to CSA A23.1/A23.2.

.7 Mechanical splices: subject to approval of Departmental Representative.

.8 Tie rod: ASTM A615/A615M, Grade 75 ksi.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

.2 Obtain Departmental Representative's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Departmental Representative, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Provide Departmental Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four (4) weeks prior to beginning reinforcing work.

.2 Inform Departmental Representative of proposed source of material to be supplied.

PART 3 - EXECUTION

3.1 PREPARATION

.1 NOT USED.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Departmental Representative.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.3 PLACING REINFORCEMENT

.1 Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1/A23.2.

.2 Prior to placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

.3 Ensure cover to reinforcement is maintained during concrete pour.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

3.5 COLD WEATHER WORK

.1 The Contractor is advised that the work requires installation of epoxy anchors during the winter navigational shut-down period. The Contractor shall provide heating and hoarding as required to bring concrete and ambient temperatures up to the minimum temperatures recommended by the manufacturer of the epoxy adhesive. The Contractor shall also maintain these temperatures for the durations recommended by the manufacturer of the epoxy adhesive. If the manufacturer of the epoxy adhesive does not have specific recommendations for the cold weather installation, then the Contractor shall follow the requirements in Section 03 30 00 for the housing and heating.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

.1 The work of this section covers the requirements for the supply and placement of concrete and grout.

.2 As part of the work under this section, the Contractor shall apply an anti-graffiti coating. The Contractor shall also supply the Owner with 20 litres of the product required, in the future, for graffiti removal from the coated surfaces.

1.2 Related Sections

.1 Section 03 10 00 – Concrete Forming and Accessories.

.2 Section 03 20 00 – Concrete Reinforcing.

.3 Section 03 37 26 – Underwater Placed Concrete.

1.3 PRICE AND PAYMENT PROCEDURES

.1 Measurement and Payment:
.1 There shall be no separate measurement payment for the work under this Section.
.2 Payment will be under the Contract Lump Sum amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.4 REFERENCES

.1 CSA International
.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
.2 CSA A283-06(R2016), Qualification Code for Concrete Testing Laboratories.
.3 CAN/CSA-A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
.4 CSA G30.18-09(R2014), Carbon Steel Bars for Concrete Reinforcement.

.2 Abrasive blast cleaning of concrete to general method and cleanliness of SSPC-SP6, Commercial Blast Cleaning (NACE No. 3).

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings: convene pre-installation meeting one (1) week prior to beginning concrete works.
.1 Ensure Departmental Representative specialty contractor - finishing, forming.
.2 Verify project requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Shop Drawings:
.1 Submit placing drawings prepared in accordance with plans to clearly show size, shape, location and necessary details of reinforcing.
.2 Submit drawings showing formwork and falsework design to: CSA A23.1/A23.2.
.3 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.3 Provide testing results and reports for review by Departmental Representative and do not proceed without written approval when deviations from mix design or parameters are found.

.4 Concrete hauling time: provide for review by Departmental Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.7 QUALITY ASSURANCE

.1 Quality Assurance: in accordance with Section 01 45 00.

.2 Provide Departmental Representative, minimum four (4) weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
.1 Quality control Plan: provide written report to Departmental Representative verifying compliance that concrete in place meets performance requirements.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Delivery and Acceptance Requirements:
.1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
.1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
.2 Deviations to be submitted for review by Departmental Representative.
.2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
.3 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packing materials in accordance with Section 01 74 20.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

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

2.2 PERFORMANCE CRITERIA

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

2.3 MATERIALS

.1 Cement: CAN/CSA-A3001, Type GU.

.2 Supplementary cementing materials: to CAN/CSA-A3001.

.3 Water: to CSA A23.1/A23.2.

.4 Reinforcing bars: to CSA G30.18, Grade 400.

.5 Other concrete materials: to CSA A23.1/A23.2.

2.4 MIXES

.1 Alternative 1 - Performance Method for specifying concrete: to meet Departmental Representative performance criteria to CSA A23.1/A23.2.

.1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as described in PART 3 - VERIFICATION.

.2 Provide concrete mix to meet following plastic state requirements:

.1 Uniformity: no segregation. Concrete shall be tested for density, air content and slump to methods listed in CSA A23.1/A23.2 to confirm batch uniformity meets requirements of Table 13 of CSA A23.1/A23.2.

.2 Workability: free of surface blemishes, loss of mortar, colour variations, and segregation.

.3 Finishability: the amount of bleeding to satisfaction of the Departmental Representative.

.4 Set time: to conditions of pour and to acceptance of the Departmental Representative.

.3 Provide concrete mix to meet following hard state requirements:

.1 Durability and class of exposure: C-1.

.2 Compressive strength at 28 days age: 35 MPa minimum. No coarse aggregate in grouts.

.3 Intended application: includes but not limited to all footings, backwalls, abutment walls, wingwalls, East Pier, Pivot Pier modification, Rest Piers rehabilitation, approach slabs, concrete in site works, and all concrete items required to complete the work as specified on Contract Drawings.

.4 Aggregate size: 20 mm maximum.

.5 Volume stability: acceptable volume change range: less than 0.04% due to shrinkage, creep and freeze thaw cycle in

accordance with CSA A23.1/A23.2

.6 Pre-qualification: Concrete shall be prequalified by testing in accordance with CSA A23.1/A23.2-21C prior to first concrete placement.

.7 Maximum water to cementing materials ratio: 0.4.

.4 Concrete supplier’s certification.

.5 Provide quality management plan to ensure verification of concrete quality to specified performance.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Provide Departmental Representative 24 hours notice before each concrete pour.

.2 Place concrete reinforcing in accordance with Section 03 20 00.

.3 During concreting operations:

.1 Development of cold joints not allowed.

.2 Ensure concrete delivery and handling facilitates placing with minimum of re-handling, and without damage to existing structure or Work.

.4 Protect previous Work from staining.

.5 Clean and remove stains prior to application for concrete finishes.

3.2 INSTALLATION/APPLICATION

.1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.

.2 Sleeves and inserts:

.1 Cast in sleeves, ties, slots, anchors, reinforcement, frames, conduit, bolts, waterstops, joint fillers and other inserts required to be built-in.

.2 Sleeves and openings greater than 100 x 100 mm not indicated, must be reviewed by Departmental Representative.

3.3 FINISH

.1 Formed surfaces exposed to view: in accordance with CSA A23.1/A23.2.

.2 Equipment pads: provide smooth troweled surface.

.3 Pavements, walks, curbs and exposed site concrete:

.1 Screed to plane surfaces and use aluminum floats.

.2 Provide round edges and joint spacings using standard tools.

.3 Trowel smooth to provide lightly brushed non-slip finish.

3.3 CURING

.1 Use curing compounds compatible with applied finish on concrete surfaces free of bonding agents and to CSA A23.1/A23.2.

3.8 FIELD QUALITY CONTROL

.1 Concrete testing: to CSA A23.1/A23.2 by testing laboratory designated and paid for by Departmental Representative.

3.9 CLEANING

.1 Clean in accordance with Section 01 74 11.

.2 Use trigger operated spray nozzles for water hoses.

.3 Designate cleaning area for tools to limit water use and runoff.

.4 Cleaning of concrete equipment to be done in accordance with Section 01 35 43.

.5 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Codes and standards referenced shall be the latest issued at time of project tender.

.2 ASTM International
.1 ASTM C882/C882M-13a, Standard Test Method for Bond Strength of Epoxy Resin Systems Used with Concrete by Slant Shear.
.2 ASTM D695-15, Standard Test Method for Compressive Properties of Rigid Plastics.

.3 CSA International
.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
.2 CAN/CSA A23.3-14, Design of Concrete Structures.
.3 CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement.
.4 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.4 Reinforcing Steel Institute of Canada (RSIC)
.1 RSIC-2004, Reinforcing Steel Manual of Standard Practice.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by a Professional Engineer licensed in Ontario.
.1 Bar bending details.
.2 Lists.
.3 Quantities of reinforcement.
.4 Sizes, spacings, locations of dowels, with identifying code marks to permit correct placement without reference to structural drawings.

1.3 QUALITY ASSURANCE

.1 Submit in accordance with Section 01 45 00 and as described in PART 2 - SOURCE QUALITY CONTROL.
.1 Mill Test Report: provide Departmental Representative with certified copy of mill test report for reinforcing steel, minimum four (4) weeks prior to beginning reinforcing work.
.2 Representative proposed source of reinforcement material to be supplied.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Substitute different size bars only if permitted in writing by Departmental Representative.

.2 Reinforcing steel: Grade 400W, deformed bars to CSA G30.18, unless indicated otherwise.

.4 Plain round bars: to CSA G40.20/G40.21 Grade 400W.

.5 Zinc-rich paint:
.1 High-solids compound.
.2 Low VOC.
.3 Minimum 93% zinc in dry film.
.4 Minimum 97% pure zinc dust.

.6 Epoxy adhesive:
.1 Minimum bond strength according to ASTM C882 at 14 days: 20 MPa.
.2 Minimum compressive strength according to ASTM D695: 1800 MPa.

2.2 FABRICATION

.1 Substitute different size dowel bars only if permitted in writing by Departmental Representative.

.2 Ship bundles of dowel bars, clearly identified in accordance with bar bending details and lists.

.3 Contractor is responsible for providing proper dowel lengths for in-situ conditions. Because the depth of concrete removals may vary from the drawings, due to the condition of the for dowels fabricated to the wrong length.

2.3 SOURCE QUALITY CONTROL

.1 Provide Departmental Representative with certified copy of mill test report of dowel, showing physical and chemical analysis, minimum 4 weeks prior to beginning dowelling work.

.2 Inform Departmental Representative of proposed source of material to be supplied.

PART 3 – EXECUTION

3.1 PREPARATION

.1 Store, handle, mix, apply and cure proprietary products including epoxy adhesives in strict accordance with the manufacturer’s instructions.

.2 Clean drilled holes sufficiently to suit epoxy adhesive being used.

3.2 FIELD BENDING

.1 Do not field bend or field weld dowel except where indicated or authorized by the Departmental Representative.

.2 When field bending is authorized, bend without heat, applying slow and steady pressure.

.3 Replace any dowels which develop cracks or splits.

3.3 PLACING DOWELS

.1 Place dowels as indicated on placing drawings in accordance with CSA A23.1/A23.2.

.2 Prior to placing concrete, obtain Departmental Representative's approval of dowels.

.3 Holes for dowels shall be drilled into the concrete at the location and spacing as specified in the Contract Documents. They shall be installed in such a way as to not cause delamination or other damage to the surrounding concrete.

.5 Core drilling shall be used only if permitted according to the epoxy manufacturer’s instructions.

3.4 PULL TESTING

.1 Contractor is responsible for arranging and paying for pull testing of dowels.

.2 The Contractor shall provide documentation of equipment calibration to the Departmental Representative minimum of 10 Days prior to any pull testing of the dowels.

.3 The Contractor shall not install formwork or attach anything to the dowels such as steel reinforcement until the pull tests have been completed and the dowels are accepted into the work.

.4 A lot shall consist of dowels of the same dowel type installed on a given day, in a single stage. Where a given day's production is less than 50 dowels, the day's work may be combined with the next day's production to form a single lot. The adequacy of each lot shall be determined based on sampled testing.

.5 The Contractor shall conduct pull testing each lot within 3 Days of installation. The Departmental Representative shall be present during the testing procedure. The Departmental Representative shall randomly select 5% of the dowels in each lot, or 10 dowels, whichever is greater, for testing. The applicable pull test load as shown below must be sustained by the dowel, without displacement, for a time period of not less than one minute.

.6 Pull test loads:
.1 15M dowel: 60 kN.

.7 Dowels that fail the pull test by failure in the epoxy or in bond to the parent concrete shall be replaced by the Contractor at no extra cost by installing a new dowel in an adjacent location approved by the Departmental Representative. The hole shall be filled with proprietary patching material.
.1 If multiple dowels in a lot fail the pull test, additional dowels in that lot shall be tested until the adequacy of the lot can be determined, as decided by the Departmental Representative.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTION

.1 Section 03 10 00 – Concrete Forming and Accessories.

.2 Environmental regulations - Parks Canada Agency's Environmental Management Plan (EMP).

1.2 SECTION INCLUDES

.1 Materials and installation for concrete underwater by tremie, pumped concrete, bottom dump bucket, or bagged concrete method.

1.3 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this section.

.2 Payment will be under the Contract Lump Sum amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.4 REFERENCES

.1 CSA International
.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

1.5 DEFINITIONS

.1 Definitions:
.1 Tremie concrete: concrete placed underwater through tube called tremie pipe.
.2 Tremie pipe: pipe has hopper at upper end and may be open ended or may have foot valve, plug or travelling plug to control flow of concrete. Pipe has diameter of 200 mm minimum, constructed from sections with flange couplings fitted with gaskets.
.1 Concrete is placed in hopper and sufficient head of concrete is maintained in tremie pipe to provide desired rate of flow.
.3 Pumped concrete method: method of placing concrete underwater uses concrete pump with discharge line used in similar manner to tremie pipe.
.4 Bottom-dump bucket method: method of placing concrete underwater requires use of bucket designed to discharge from bottom after it has contacted foundation or surface of previously placed concrete.
.5 Bagged concrete method: method of placing underwater concrete consists of diver placing bags partially filled with dry concrete mix.

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Concrete pre-placement meeting; conduct pre-placement meeting two (2) weeks minimum before tremie operation.
.1 Ensure meeting includes as minimum attendees as follows:

.1 General contractor.
.2 Ready-mix concrete supplier.
.3 Admixture supplier.
.4 Placing/formwork sub-contractor.
.5 Reinforcing sub-contractor.
.6 Testing agency representative.
.7 Structural engineer.
.8 Owners representative.

.2 Distribute minutes to attendees including copies of concrete mix designs, aggregate physical properties, placing schedule, rate of delivery, testing program, and, contingency plan for delay and breakdown.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for concrete and include product characteristics, performance criteria, physical size, finish and limitations.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect concrete from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

1.9 WASTE MANAGEMENT AND DISPOSAL

.1 Develop Waste Reduction Workplan related to Work of this Section and in accordance with Section 01 74 21.

.2 Separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.3 Remove from site and dispose of packaging materials at appropriate recycling facilities.

.4 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.5 Divert unused concrete materials from landfill to local facility approved by Departmental Representative.

.6 Divert chemical additive materials from landfill to official hazardous material collections site approved by Departmental Representative.

.7 Do not dispose of unused chemical additive materials into sewer systems, into lakes, streams, onto ground or in any other location where it will pose health or environmental hazard.

.8 Fold up metal banding, flatten and place in designated area for recycling.

.9 Packaging Waste Management: remove for reuse and recycle of pallets, crates, padding, and packaging materials in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Concrete materials: to Section 03 30 00.

2.2 CONCRETE MIXES

.1 Portland Cement: to CSA-A3000, Type GU.

.2 Minimum compressive strength at 28 days: 35 MPa minimum unless noted otherwise.

.3 Class of exposure: C-1.

.4 Maximum water cement ratio by mass: 0.45.

.5 Nominal size of coarse aggregate: 20 mm.

.6 Cement content for mixtures: 385 kg/m³ minimum.

.7 Slump at point and time of discharge: 170 mm.

.8 Air dry density: 2400 kg/m³.

.9 Pre-qualification: Concrete shall be prequalified by testing in accordance with CSA A23.1/A23.2-21C prior to first concrete placement.

.10 Volume stability: acceptable volume change range: less than 0.04% due to shrinkage, creep and freeze thaw cycle in accordance with CSA A23.1/A23.2.

.11 Admixtures: as approved in writing by Departmental Representative. Use admixtures to correct deficiencies in mix or to improve placement of concrete.

.1 Departmental Representative may withdraw prior approval of admixture if conditions encountered during course of work indicate unsatisfactory results.

.2 Do not use calcium chloride or materials containing calcium chloride.

.3 Submit admixtures to produce self consolidating concrete to Departmental Representative for review.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete placement installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Where concrete must bond to existing surfaces, clean surfaces before starting concrete placement.
.1 Use water jets, mechanical scrapers or other means.

3.3 INSTALLATION

.1 Do concrete work in accordance with Section 03 30 00 and Section 03 20 00 and to CSA A23.1/A23.2. Testing for concrete to CSA A23.1/A23.2.

.2 Where concrete placement extends above water surface, protect concrete from direct contact with air at temperature below 5 degrees C for five (5) days.

.3 Place concrete in one continuous operation to full depth required.
.1 Supply complete equipment for every phase of operation.
.2 Provide sufficient supply of concrete to complete pour without interruption.

.4 Tremie method:
.1 Provide environmental mitigation measures for placement of tremie concrete in accordance with Section 01 35 43.
.2 Provide water-tight tremie pipe sized to allow free flow of concrete. Diameter of tremie pipe to be minimum 200 mm and minimum eight times maximum size of coarse aggregate.
.3 Provide hopper at top of tremie pipe and means to raise and lower tremie pipe.
.4 Provide plug or foot valve at bottom of tremie pipe to permit filling pipe with concrete initially.
.5 Provide minimum of one tremie pipe for every 30 m² of plan area and to maximum spacing of 6 m centre to centre. Do not move tremie pipes laterally through concrete.
.6 Start placement with tremie pipe full of concrete. Keep bottom of pipe buried minimum 900 mm in freshly placed concrete.
.7 If seal is lost, allowing water to enter pipe, withdraw pipe immediately. Refill pipe and continue placing as specified.

.8 If tremie operation is interrupted so that horizontal construction joint has to be made, cut surface laitance by jetting, within 24 to 36 hours and remove loose material by pumping or air lifting before placing next lift.

.9 Do not place concrete in flowing water when current exceeds 3 m/min. Do not vibrate, disturb or puddle concrete after placement.

.5 Pumped concrete method:

.1 Follow procedures as for tremie method in placing concrete using discharge line from concrete pump as tremie pipe.

.2 Pump discharge line diameter: 125 mm minimum.

.6 Bottom-dump bucket method:

.1 Fill bucket with concrete, cover top surface and lower slowly through water to prevent backwash.

.2 Discharge concrete only when bucket is in contact with surface on which concrete is to be deposited.

.3 Withdraw bucket until it is above concrete to maintain still water at point of discharge to approval of Departmental Representative.

.4 Do not place concrete in flowing water when current exceeds 3 m/min. Do not vibrate, disturb or puddle concrete after placement.

.7 Bagged concrete method:

.1 Use bags made of coarsely woven material to allow concrete to bond between bags.

.2 Fill bags with dry concrete mix not more than 80% full before placing.

.3 Place each concrete bag individually so that bag is stable and securely resting on foundation material or previously placed bags.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

.1 This Section covers the requirements for the supply, fabrication, delivery and erection of the structural steel for the bridge, including but not limited to, truss members, transverse floor beams, longitudinal stringers, lateral bracings, pivot girder assembly, balance wheel beams and plate attachments and all additional components that constitute the structural steel in the project and which are not covered elsewhere in the Contract Documents.

.2 The Provision of all shop drawings, erection drawings, procedures and other submittals identified in this Section.

.3 The delivery of all components identified under this Section to the site, including handling and storage (in a secure manner).

.4 The erection of all components which are part of this Section to constitute a balanced swing span bridge. This includes all welding and bolting of components. Calculations of all erection stresses/deformations to be submitted to the Departmental Representative.

.5 The balancing of the swing span is required. This will be achieved with individual steel plates. The supply of all steel plates and fasteners, as shown on the drawings, is part of the work under this Section. The undertaking of balance calculations during fabrication and erection, as well as supply and installation of the steel plate counterweight are included in separate sections.

.6 All testing, inspection and reporting (Quality Control) of the work, which is to be provided by the Contractor. This includes all Destructive Testing (DT) and Non-Destructive Testing (NDT), as are described in this Section or related references.

1.2 RELATED SECTIONS

.1 Section 05 50 00 – Metal Fabrication.

.2 Section 09 97 19 – Painting Exterior Metal Surfaces.

.3 Section 29 05 00 – Mechanical Work - General.

1.3 PRICE AND PAYMENT PROCEDURES

.1 There will be no measurement for work associated with Structural Steel for Bridges.

.2 Include materials and work required under this section in lump sum price bid for structural steel for swing and fixed bridges includes:
.1 Ensure lump sum price includes radiographic examination of optional shop splices and additional field splices.

.3 Structural steel will be paid for at the contract Lump Sum price for structural steel, which price is to include all labour, equipment and materials required to complete the work, which includes but is not limited to the supply, fabrication, loading, shipping, delivery, erection and erection Engineer of the complete steel superstructure in accordance with Contract Drawings and specifications.

.4 Shop and field inspection and testing is included in the lump sum price, including the supply of electric power, scaffolding, protection from the weather, and access for material testing and quality control inspection.

1.4 REFERENCES

.1 ASTM International (ASTM)
.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
.2 ASTM F3125/F3125M-15a, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.2 CSA International (CSA)
.1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
.2 CSA S6-14 Package, Canadian Highway Bridge Design Code.
.3 CSA S16-14, Design of Steel Structures.
.4 CSA S269.1-16, Falsework and Formwork.
.5 CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel.
.6 CSA W48-14, Filler Metals and Allied Materials for Metal Arc Welding.
.7 CSA W59-13, Welded Steel Construction, (Metal Arc Welding).
.8 CSA W178.2-14 – Certification of Welding Inspectors.

.3 Canadian Institute of Steel Construction:
.1 CISC Quality Guideline for Steel Bridges.

.4 Ontario Provincial Standard Specifications:
.1 OPSS 906 (November 2012) Construction Specifications for Structural Steel for Bridges.

.5 American Welding Society:
.1 AWS D1.5 Bridge Welding Code.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Pre-Installation Meetings:
.1 Convene pre-installation meeting two (2) weeks prior to beginning on-site installation (erection) of structural steel, with Contractor's Representative, Subcontractor’s Representative and Departmental Representative in accordance with Section 01 31 19 to:
.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordination with other building subtrades.

.4 Review manufacturer's written installation instructions and warranty requirements.

.2 Prior to start of Work arrange for site visit with Departmental Representative to examine existing site conditions adjacent to demolition work.

.3 Hold project meetings in accordance with Section 01 31 19.

.4 Ensure Contractor’s site supervisor, Contractor’s project manager and relevant subcontractor representatives attend.

.5 Departmental Representative will provide written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

.6 Site Meetings: as part of Manufacturer's Services described in PART 3 - FIELD QUALITY CONTROL, schedule site visits, to review Work.

.7 Prior to start of work in the field, convene meeting to discuss bolting, field welding and coating requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for structural steel and include product characteristics, performance criteria, physical size, finish and limitations.

.2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 29 and Section 01 35 43.

.3 Fabricator to submit verification of CSA W47.1 Division 1 or 2 certification at least 4 weeks prior to beginning fabrication.

.4 Contractor to submit verification that the structural steel fabricator for the bridges has CISC Steel Bridge Certification.

.5 Submit the general outline of the schedule for fabrication at least 4 weeks prior to beginning fabrication.

.6 Shop Drawings and Welding Procedures:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada at least 4 weeks prior to the start of fabrication.

.2 Indicate shop and erection details including shop splices, cuts, copes, connections, holes, bearing plates, threaded fasteners, rivets and welds. Indicate welds by CSA W59, welding symbols.

.3 Proposed welding procedures to be stamped by professional engineer registered or licensed in the Province of Ontario, Canada and approved by Canadian Welding Bureau. Submit proposed welding procedures 4 weeks prior to beginning fabrication.

.4 Submit description of methods, temporary bracing and strengthening, sequence of erection ad type of equipment proposed for use in erecting structural steel.

.5 Shop drawings to include the following:

.1 Full detail dimensions and sizes of all component parts of the structure for changes in shape due to weld shrinkage and any other effects that cause finished dimensions to differ from initial dimensions.

.2 Erection “piece” marks.

.3 All necessary specifications (mill test certifications and similar) for the materials to be used and shown on the shop drawings.

.4 Identification of areas requiring special surface treatment. such as, but not limited to, grinding, machining and other similar treatments.

.5 Identification of fracture-critical and primary tension members and component parts. Attachments having a length of more than 100 mm in the direction of tension and welded to the tension zone of a fracture-critical or primary tension member to be treated as part of that member.

.6 Bolt installation requirements, including number of “fit-up” bolts required at each connection and any oversize or slotted holes.

.7 Details of all welds, including but not limited to, symbols, finish, process and weld electrode grade.

.8 Identification of material and welds requiring non-destructive testing, including the limits of the weld undergoing testing and the frequency and type of testing (radiography, ultrasonic, visual).

.9 Temporary welds and whether temporary welds are to be incorporated into the final work.

.10 Location of shop and field splices.

.11 Indicate welds by CSA W59, welding symbols.

.6 Shop drawings requiring extensive correction will be sent back for revisions and resubmission.

.7 Do not commence fabrication until receiving reviewed (by Departmental Representative) drawings and welding procedures. Review will be noted by stamp and signature of Departmental Representative.

.8 Prior to beginning welding, submit valid Canadian Welding Bureau certification for each welder and welding operator for the positions and processes intended.

.9 Submit certification for all welding inspectors who will work on this project.

.10 The fabricator to have a copy of the shop detail drawings and welding procedures at the manufacturing plant during fabrication. The Contractor shall also have a complete set of paper shop drawings on site during construction.

.11 Shop drawing review by the Departmental Representative is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that the Departmental Representative approves the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting the shop drawings, and such review does not relieve the Contractor nor the Fabricator of the responsibility for meeting all requirements of the contract documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication

processes or construction and for the installation of the work.

.12 A detailed take-off and actual weights of the structural steel including all welds, connection plates, bolts, washers and nuts will be required for the balancing calculation.

.13 The qualifications of the fabrication inspection company to be retained by the Contractor. This firm shall be independent from the Contractor and the Fabricator and be certified by the Canadian Welding Bureau for the type of Destructive and Non-Destructive Testing/Inspection being performed.

.14 Inspector company to inspect all machined surfaces and provide written report, signed by Quality Engineer, that the surface machining meets the finish and tolerance indicated on the drawings.

.7 Erection Diagrams and Erection Procedures:

.1 Submit erection diagrams and erection procedure drawings and calculations, for information purposes only, signed and sealed by design and checking professional engineers registered or licensed in the Province of Ontario, Canada.

.2 Erection drawings and diagrams to include the following:

.1 Principal dimensions of the bridge.

.2 Erection piece marks, piece weights and sequence of erection.

.3 Size of all members.

.4 All field welds and field welding requirements, including identification of welds requiring non-destructive (show type of NDT to be performed) and visual testing.

.5 Size and type of bolts.

.6 Bolt installation requirements, including the number of “fit-up” bolts required at each connection and identification of oversize and slotted holes.

.7 Bracing during erection of structural steel and any temporary supports required to support the partially erected bridge.

.8 Treatment at faying surfaces for joints designed as slip critical.

.9 Balance details including the size/quantity of the steel counterweight.

.10 Locations for all cranes, lifting radius, maximum weight of components and details of outrigger supports.

.3 Do not commence erection until Contractor receives from the Departmental Representative reviewed erection diagrams, erection procedures, drawings and calculations.

.4 Maintain a paper copy of the erection diagrams and the erection procedure drawings and calculations at the site during erection.

.8 Mill Test Certificates:

.1 Submit the mill test certificates to the Departmental Representative confirming that all material is according to the contract documents.

.2 Copies of the mill test certificates for all material to be used in the fabrication are to be available for review at the fabricating plant during fabrication and submitted to the Departmental Representative. The certificates to show that the material is according to the contract documents. Copies of all mill test certificates shall be maintained onsite by the Contractor. They are to be reviewed by the Contractor’s fabrication testing company to verify the material is as per the project requirements.

.3 If the material cannot be identified by source test certificates, coupons are to be taken and tested and these test certificates are to be made available to the Departmental Representative.

.4 When mill test certificates originate from a mill outside of Canada or the United States of America, the Contractor is to have the information on the mill test certificate verified by testing at a Canadian laboratory. This laboratory is to be certified by an organization accredited by the Standards Council of Canada to comply with the requirements of ISO/IEC 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates are to be stamped with the name of the Canadian laboratory and appropriate wording stating that the material is according to the specified Contract requirements. The stamp is to include the appropriate material specification number, testing date (i.e., yyyy-mm-dd), and the signature of an authorized officer of the Canadian laboratory.

.5 All steel incorporated into the work shall be traceable to a specific mill test certificate associated with that steel component. This traceability is to be maintained by the Contractor’s fabrication inspection company and submitted to the Departmental Representative.

.9 Test Reports for Fasteners:

.1 Submit to the Departmental Representative, proof that the bolts, nuts, and washers meet the chemical composition, mechanical properties, dimensions, workmanship, and head burst as required by ASTM F3125/F3125M for ASTM A563/A563M, or ASTM F436/F436M and other structural high strength bolts as may be shown on the drawings.

.2 For bolts, nuts, and washers supplied from a manufacturer outside Canada or the United States of America, the above information will be verified by testing at a Canadian laboratory as outlined in the Mill Test Certificates clause.

.10 Submit a report documenting the results of the Shop Trial Assembly. Document any corrective work that was completed.

.11 Upon completion of fabrication of the components, and prior to delivery of the components to the site, the Departmental Representative will conduct an interim inspection of the work to verify that the fabrication of components has been carried out in general conformance with the shop drawings, welding procedures, submittals and contract documents and issue the fabricator written permission to proceed with the work.

.12 All quality control documents maintained by the Contractor’s fabrication inspection company, including but not limited to, weld test reports are to be submitted to the Departmental Representative upon completion of the component fabrication and prior to the Departmental Representative’s interim inspection and subsequent delivery to the site.

1.7 DELIVERY, STORAGE, AND HANDLING

.1 Deliver, store and handle in accordance with Section 01 61 00 and in accordance with manufacturer’s written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original

factory packaging, labelled with manufacturer's name and address.
.1 Ensure Departmental Representative has delivery schedules 14 days minimum prior to shipping.

.3 Storage and Handling Requirements:
.1 Provide protective blocking for lifting, transportation and storing.
.1 Exercise care during fabrication, transportation and erection of structural steel members.
.2 Do not notch edges of members.
.3 Do not cause excessive stresses.
.2 Mark mass on members weighing more than 3 tonnes.
.3 Protect unpainted weathering steel, before erection, with waterproof covering.
.4 Ensure that no portion of steel comes into contact with ground.
.1 Replace defective or damaged materials with new.
.5 Obtain the Departmental Representative agreement for all lifting log or other devices. Provide details for installation and removal.

.4 Perform all work necessary to ensure safe loading, delivery, unloading, and storage of structural steel. Comply with any load restrictions on shipment size and weight.

.5 Load structural steel for shipping in such a manner that it can be transported and unloaded at its destination without being excessively stressed, deformed, or otherwise damaged. Transport structural steel members with their webs in a vertical plane. When structural steel members cannot be shipped with their webs in the vertical plane, static and dynamic forces during handling, transportation, and storage are to be determined using a dynamic load allowance of 100%. Computed stresses are to be according to CSA-S6, Clause 10.10 and the maximum cyclic stress range is not to exceed the constant amplitude fatigue threshold for the appropriate fatigue categories specified in CSA-S6, Table 10.4. All the calculations and associated sketches, including reasons why the structural steel members cannot be shipped with the webs in the vertical plane, to be submitted by the Contractor to the Departmental Representative for review seven (7) days prior to shipping. All calculations and sketches for shipping, handling and erection are to be signed and sealed by an Engineer licensed in the province of Ontario.

.6 Submit Canadian Welding Bureau (CWB) accepted welding procedure specifications, data-sheets, and repair procedures for prequalification, signed and sealed by an Engineer licensed in the province of Ontario, for approval from the Departmental Representative at least 14 days prior to beginning the work.

.7 Advertising by means of removable signing is only permitted on elements while in transit to the specified site. Painting of advertisements directly on elements is not permitted.

.8 Develop Construction Waste Management Plan related to Work of this Section.

.9 Packaging Waste Management: remove for reuse and return by manufacture of

pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21.

1.8 QUALITY ASSURANCE

.1 Preconstruction Testing:
.1 Provide suitable facilities and cooperate with inspection organization and Departmental Representative in carrying out inspection and tests required.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Structural steel: to CSA G40.20/G40.21, grade and types 300WT Category 3, (with Charpy impact requirements, as shown on the Contract Drawings), unless otherwise indicated on the Contract Drawings.

.2 High strength bolts, nuts and washers: to ASTMF3125/F3125M A325M and galvanized, approved by Departmental Representative.

.3 Anchor bolts, washers and nuts: to CSA G40.20/G40.21, A193 Grade B7 grade and galvanized, as shown on the Contract Drawings.

.4 Bearings: See Section 29 05 00 and per Contract Drawings.

.5 Welding electrodes:
.1 Welding electrodes: to CSA W48 series.

.6 Stud shear connectors: to CSA W59, Clause 5.5.6 and Appendix H.

.7 Hot dip galvanizing: to ASTM A123/A123M, coating grade 85, minimum zinc coating of 600 g/m^2.

.8 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents. This is for grout that is not identified on the drawings to be epoxy.

.9 Substitution of other material for size and grade is not permitted unless approved by the Departmental Representative.

2.2 SOURCE QUALITY CONTROL

.1 Steel producer qualifications: certified in accordance with CSA G40.20/G40.21.

.2 Submit to Departmental Representative two (2) copies of certified mill test reports for Charpy V-notch test.

.3 Provide suitable facilities and co-operate with Departmental Representative in carrying out inspection and tests required.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for structural steel installation in accordance with manufacturer's written instructions.
.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Clean steel surfaces as directed by Departmental Representative when staining or defacing occurs.

.2 Verify location of substructure units, elevations of bearing seats and location of anchor bolts before erection of structural steel; report discrepancies to Departmental Representative.

.3 Work near river banks or embankments in accordance with written instructions from Departmental Representative.

.4 Restrict drifting during assembly to minimum required to bring parts into position without enlarging or distorting holes, and without distorting, kinking or sharply bending metal of any unit.
.1 Enlarge holes if necessary by reaming only after receipt of written approval from Departmental Representative.
.2 Ensure reamed holes are 2] mm maximum larger than bolt size used.

.5 Fabricate and install bearings as indicated.

.6 Place anchor bolts at elevations and locations indicated.
.1 Protect holes against entry of water and foreign material.
.2 Provide heating and protection as directed by Departmental Representative and completely fill space around anchor bolts with grout.

3.3 FABRICATION

.1 Steel fabricator must be certified to CISC’s latest Quality Guideline for Steel Bridges.

.2 Fabrication to be in accordance with CSA W59 except where modified by CSA S6 Clause A10.1.4 and A10.1.5. Where CSA W59 does not provide guidance, the requirements of AWS D1.5 shall apply.

.3 Do not begin fabrication until shop drawings, Contractor’s quality control procedure, welding procedures and orthotropic steel deck fabrication procedures have been reviewed by the Departmental Representative.

.4 Plate Edges:

.1 Plasma arc cutting of plates up to and including 20 mm in thickness is permitted. Plasma arc cutting of plates thicker than 20 mm is not permitted unless approved by the Departmental Representative. When permitted, use oxygen as the cutting gas for plasma arc cutting of plates. All edges to be free of dross.
.2 Inspect and repair planar discontinuities in accordance with CSA W59.
.3 Chamfer or radius all corners of all flanges, plates or other components 1.5 mm by grinding.

.5 Straightening Material:
.1 Material with sharp kinks will be rejected. Straighten bends in material using only mechanical means or by the application of controlled heating according to CSA W59. Details of the straightening procedure, including testing requirements, to be signed and sealed by an Engineer licensed in the Province of Ontario and submitted to the Departmental Representative prior to the straightening, for information purposes only.
.2 Straighten only in the presence of the Departmental Representative.
.3 If necessary, the Departmental Representative will specify additional testing to be performed by the Contractor. If evidence of damage is discovered; the material will be rejected and the cost of testing will be at the expense of the Contractor.
.4 Give the Departmental Representative 7 days' notice to arrange for the inspection.

.6 Welded Construction:
.1 To be in accordance with CSA W59 and CSA-S6 Clause A10.1.5.
.2 Do welding in shop unless otherwise permitted by Departmental Representative or as may be shown on the drawings.
.3 Weld only at locations indicated on the approved shop drawings.
4 Carry out welding by welders having a CSA W47.1 identification card valid for the type of welding to be done and for the duration of the welding work.
.5 The fabrication weld metal requirements, base metal repairs, and repairs of weld in fracture critical and primary tension members are to be according to CSA-S6 Clause 10.23.5.
.6 Any company undertaking welded fabrication or erection or both is to be certified according to CSA W47.1, Division 1.
.7 Weld profiles in accordance with W59.
.8 Peening is subject to approval by the Departmental Representative, where required.
.9 Record stress relief-heat treatment temperatures using thermo-couples or other methods acceptable to the Departmental Representative. Maintain a record showing temperature and time data of the heat-treating operation and make record available to the Departmental Representative upon request.
.10 Assembly for welding:
.1 In accordance with W59.
.2 Bearing stiffeners to be vertical under full dead load with the bridge in the closed position and the end lifts engaged.
.3 Intermediate stiffeners to be either true vertical or perpendicular to the horizontal work lines used to layout the girder.

.4 Bearing stiffeners fitted to bear to have a minimum bearing contact area of 75% and a maximum separation of 1 mm over the remaining area.

.5 Fitted intermediate stiffeners to have a minimum bearing contact area of 25% and a maximum separation of 2 mm.

.11 Temporary welds:

.1 Do not use on fracture-critical and primary tension members.

.2 Do not use on flange material in compression, unless approved by the Departmental Representative.

.12 Weld repairs and corrections:

.1 Preheat requirements for welding repairs to fracture-critical and primary tension members in accordance with CSA-S6 Table 10.14.

.2 Welding corrections and repairs to fracture-critical and primary tension members to be according to CSA S6, Clause 10.23.5.

.3 Any steel members subjected to heat for shape corrections or straightening is to be allowed to cool in still air.

.4 Welding corrections and repairs for fracture-critical and primary tension members:

.1 Submit repair procedures to the Departmental Representative at least 14 days prior to beginning the work.

.2 Approval for non-critical repairs:

.1 Non-critical repairs listed in CSA-S6, Clause 10.23.5.

.2 Submit repair procedures to Departmental Representative. Repair procedure to be designed and stamped by an Engineer licensed in the Province of Ontario and recognized or a Welding Engineer by the CWB.

.3 Submit repair procedures to Departmental Representative. Repair procedure to be designed and stamped by an Engineer licensed in the Province of Ontario and recognized or a Welding Engineer by the CWB. Do not begin work until receiving written notice of permission to proceed from the Departmental Representative;

.3 Approval for critical repairs:

.1 Critical repairs listed in CSA-S6, Clause 10.23.5;

.2 Critical repairs to be individually reviewed by the Departmental Representative before repair welding proceeds;

.4 Any section of weld that does not meet the acceptance standards is to be removed, re-welded, and re-examined;

.5 Non-destructive testing of fracture critical members: maintain documentation of all visual and non-destructive testing for review and confirmation by the Departmental Representative. Submit documentation to the Departmental Representative upon completion of the project.

.7 Bolted construction:

.1 In accordance with CSA-S6 Clause A10.1.6.

.2 Ensure bolts are sufficiently long to exclude threads from shear plane.

.3 Plasma arc cutting of holes: plasma arc cutting of holes shall only be permitted in plates up to and including 20 mm in thickness. Each member is to have an erection mark for identification. Erection mark is to be affixed

in an area not exposed to view in the finished structure. Plasma arc cut holes are to be produced by mechanically guided means and the diameter of the holes are to be greater than or equal to the thickness of the plate. When plasma arc cutting of holes is permitted, the cutting gas as well as the shielding gas are to be oxygen and the surface roughness is not to exceed 13 microns (500 micro-inches) as defined in ASME B46.1. Occasional gouges not more than 1.5 mm in depth are permitted. Thermally cut holes are to be 2 mm larger than the nominal diameter of the bolt and the taper is not exceed 0.5 degrees.

.4 Inspection as per CSA-S6 as required.

.8 A Shop Trial Assembly in accordance with CSA-S6 is mandatory.

.9 All interface surfaces between the structural and mechanical components to be machined as indicated on the Contract Drawings and Section 29 05 00. Machine surfaces to be protected as specified in Section 29 05 00.

.10 Tolerances: Dimensional and workmanship tolerances in accordance with CSA W59 and CSA-S6 Clause A10.1.7.

.11 Steel coating: Section 09 97 19.

.12 The Contractor shall complete a pressure test of all enclosed sections of the ribs/sidewalk. The pressure test shall consist of raising the pressure inside each section of rib/sidewalk to a selected gage pressure and measuring the pressure drop over a 30-minute interval. The rib/sidewalk sections shall be sealed at the conclusion of the test. The Contractors inspection company shall submit a report documenting the pressure test and certify that the enclosed rib/sidewalk sections are sealed consistent with industry practice.

.13 Unless indicated on the Contract Drawings, the Contractor shall not bolt attachments to the exterior stringers.

3.4 INSTALLATION

.1 Do falsework in accordance to CSA S269.1.

.2 Do fabrication and erection of structural steel in accordance with CSA S6 Canadian Highway Bridge Design Code.

.3 Do welding in accordance with CSA W59, except where specified otherwise.

.1 For CSA G40.20/G40.21, grade 350A steel, deposited weld metal to have Charpy V-Notch value not lower than that of steel.

.2 Do welding in shop unless otherwise permitted by Departmental Representative.

.3 Weld only at locations indicated.

.4 High strength bolting: in accordance with CSA S6 and CSA S16. Use 'turn-of-nut' tightening method.

.5 Finish: members true to line, free from twists, bends, open joints, sharp corners and sharp edges.

.6 Allowable tolerance for bolt holes:

.1 Matching holes for bolts to line up so that dowel 2 mm less in diameter than hole passes freely through assembled members at right angles to such members.

.2 Finish holes not more than 2 mm in diameter larger than diameter of rivet or bolt unless otherwise specified by Departmental Representative.

.3 Centre-to-centre distance between any two holes of group to vary by not more than 1 mm from dimensioned distance between such holes.

.4 Centre-to-centre distance between any two groups of holes to vary not more than maximum of the following:

Centre-to-Centre distance in metres	Tolerance in plus or minus mm
less than 10	1
10 to 20	2
20 to 30	3

.5 Correct mispunched or misdrilled members only as directed by Departmental Representative.

.7 Span length tolerances:

.1 Stringers, floor beams and girders: plus or minus 6 mm

.2 Centre-to-centre of bearing stiffeners and bearing plates: plus or minus 3 mm.

.8 Structural member support requirements:

.1 Support top and bottom flanges of ends of structural members and intermediate bearing locations of continuous structural members parallel to each other at 90 degrees to member web.

.2 Install flat and smooth except as otherwise indicated.

.3 Install bearing stiffeners after structural member support requirements have been met.

.4 Correct irregularities of flanges of structural members as permitted by Departmental Representative.

.9 Shop splices:

.1 Use complete joint penetration groove welds finished flush.

.2 Details of butt joints to CSA W59.

.3 Use only as approved by Departmental Representative.

.10 Camber:

.1 Camber tolerances for plate members to be to CSA W59.

.2 Record measurements of camber of each member, at points indicated.

.3 Fabricate field splices to conform to required camber.

.4 Submit diagram to Departmental Representative showing camber for each structural steel member fabricated.

.5 Advise Departmental Representative immediately when camber of fabricated structural steel member is greater than specified tolerances.

.6 Submit proposal for corrective measures.

.7 Undertake remedial measures as approved by Departmental Representative.

.11 Shop erection:

.1 Support each structural steel member on its bearing points and measure

and record deflection at same points indicated for measurement of camber.
.2 Measure deflections in plane of member web.
.3 Submit diagram to Departmental Representative showing deflection measurements for each structural steel member before delivery.
.4 Shop erection is not required for single span structural steel members with no field splices.

.12 Field splices: to approval of Departmental Representative.

.13 Mark members in accordance with CSA G40.20/G40.21.
.1 Do not use die stamping.
.2 Place marking at locations hidden when viewed from exterior after erection when steel is to be left in unpainted condition.

.14 Match marking: shop mark bearing assemblies and splices.

.15 Steel coating: Section 09 97 19.

.16 Additional temporary material may be provided to ensure that the member capacities are not exceeded during erection, if approved by the Departmental Representative. Show additional material on the erection diagram.

.17 Notify the Departmental Representative at least 14 days prior to beginning field operations.

.18 Do not use welding to fill misplaced holes.

.19 Only perform repairs to erected material upon receiving approval from the Departmental Representative.

.20 Hammering that can damage or distort the members is not permitted.

.21 Connections:
.1 Drill or sub-drill and ream holes made in the field.
.2 Report any error that prevents the proper assembly and fitting of parts and submit the proposed method of correction to the Departmental Representative. Corrective measures to not commence until the submitted proposal is accepted.
.3 Field welding to be completed to the same standards as all shop welding. This includes qualification of weld, welders, all testing/inspection.
.4 House (with heat) all area for all field welding.

.22 Upon completion of erection, the Contractor is to submit to the Departmental Representative a Certificate of Conformance bearing the sign and seal of the QC Engineer, licensed in the Province of Ontario. The Certificate is to state that the Work has been carried out in general conformance with the signed and sealed shop details, welding procedures, erection diagrams, erection procedure drawings, and contract documents.

3.5 FIELD QUALITY CONTROL

.1 Quality control to be in accordance with CSA-S6 Clause A10.1.8. The

acceptance standards of CSA W59 for dynamically loaded structures also apply.

.2 In addition to quality assurance measures instituted by the Departmental Representative, the Contractor is to be responsible for the quality control procedures specified herein.

.3 The Contractor is to retain an independent fabrication testing company certified by the CWB, to undertake the various inspections outlined in CSA W59 or this Section. Such inspection is required for all shop fabrications, field erection, field welding and bolting.

.4 The Contractor, in conjunction with the steel fabricator(s) and erection firm, shall submit a proposal for a Quality Control Program for the steel fabrication, delivery and erection under this Section. The following are the minimum requirements to be shown in the proposal. Sample documentation, which will be used to indicate the fulfillment of this Quality Control, is to be submitted at the time of the proposal. All submissions must be signed and stamped by a licensed Engineer (in the Province of Ontario), indicating that this Quality Engineer has reviewed all aspects of the fabrication testing company work and that the findings conform to the requirements of the contract.

.5 The independent fabrication testing company shall undertake the following inspection (on the truss):
.1 All requirements of OPSS 906 (Construction Specification for Structural Steel for Bridges), 906.07.04 “Quality Control”.
.2 100% of the fit up of the truss members.
.3 In the field and shop undertake 100% UT on all transverse complete joint penetration (CJP) welds and 50% UT on all longitudinal welds (CJP) in the built-up sections.
.4 In the field 100% UT on all other CJP welds.
.5 Verification of bolt installation by turn of the nut, as well as verification that the bolts supplied meet the requirements of the contract.
.6 Verification of the trial fit up in the shop for dimensional tolerance.

.6 Control of material: a record for each component is to be kept to identify the material as to heat number, corresponding mill test certificate, using colour coding or other identifying markings.

.7 The Contractor’s inspection firm is to carry out a full visual inspection of all welds, measurement of the flatness requirements of the deck panels, confirmation all fabrication is within tolerance of CSA W59 (and report all observations).

.8 Prior to commencement of welding, the Contractor is to make available to the Departmental Representative the Canadian Welding Bureau's transferable or non-transferable identification cards for each welder or welding operator to be employed on the work. Such identification cards are to be currently valid and indicate the welding processes and the welding positions at which the personnel are qualified to weld.

.9 Non-destructive testing:

.1 Carry out all non-destructive testing of the welds for bridge structures by using radiographic, ultrasonic, magnetic particle, and liquid penetrant test methods by an independent testing organization retained and paid for by the Contractor.

.2 The independent organization undertaking welding testing under this subsection is to be certified for testing bridges according to CSA W178.1. The certification is to encompass at least the following methods: radiographic, ultrasonic, dye penetrant and magnetic particle.

.3 The independent organization's non-destructive testing technician undertaking non-destructive testing of welds under this subsection is to be certified for testing bridges according to CSA W178.2-14. Certification is to be to either Level II or III for the methods used, as required by CAN/CGSB 48.9712/ISO 9712.

.4 Neither the technician nor the independent testing organization is to be changed without the approval of the Departmental Representative.

.5 Give at least 5 days' notice to the independent testing organization when the work is ready for testing. Include in the notice the type and quantity of work to be tested.

.6 Testing of welds:

.1 Carry out radiographic, ultrasonic, or magnetic particle testing using procedures according to OPSS 906.

.2 The amount and location of welding to be tested is not to be less than the following (except for built-up sections which is defined elsewhere):

.1 Visual inspection of all welds.

.2 Radiographic or ultrasonic inspection of groove welds in flanges and webs of fabricated components:

.1 Flange splices in tension or stress reversal zones: 100% of all welds;

.2 Flange splices in compression zones: 100% of the weld of 1 in 4 splices;

.3 Web splices for 1/2 the depth from the tension flange: 100% of the weld length for each weld;

.4 Web splices for 1/2 the depth from the compression flange: 100% of the weld length of 1 in 4 splices;

.5 When welds are tested by the ultrasonic method, spot radiography to be performed on 10% of those welds tested;

.6 If defects are found during testing of compression zones, two additional zones are to be tested for each zone exhibiting defects.

.3 Magnetic particle inspection of web-to-flange and web-to-deck plate fillet welds:

.1 Submerged-arc welds - 25% of length of each weld;

.2 Semi-automatic welds - 50% of length of each weld;

.3 Manual welds - 100% of length of each weld.

.4 Magnetic particle inspection of fillet welds in connection plates and stiffeners to which diaphragms or cross bracing are attached:

.1 For 1/2 the depth from the tension flange: 100% of weld length of each weld;

.2 Transverse welds on tension flanges: 100% of weld length of each weld.

.5 Arc strikes are to be lightly ground and checked for cracks by magnetic particle inspection.

.3 Radiographic and ultrasonic testing to be performed before assembly of the flanges or deck plates to the webs.

.4 Remove, re-weld, and re-examine the section of weld that does not meet the acceptance standards.

.7 Submit copies of all inspection reports completed by the Contractor's independent fabrication inspection company to the Departmental Representative on a weekly basis throughout fabrication. Inspection reports to be submitted under cover of a stamped and signed letter from the Contractor's Quality Engineer, licensed in the Province of Ontario, that all reports indicate general conformance with the drawings and specification.

3.6 QUALITY ASSURANCE

.1 Visual inspection, non-destructive testing, and sampling to be done in the fabricating shop and in the field by the Departmental Representative to confirm the material supplied, fabrication and erection has been done as specified in the contract documents and as a check (Quality Assurance) of the work done by the Contractor's inspection company.

.2 Supply electric power, scaffolding, protection from the weather, and free access for inspection and testing of material, to all aspects of the fabrication, delivery, and erection of the structural steel.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 05 12 33 – Structural Steel for Bridges.

.2 Section 09 97 20 – Painting Exterior Metal Surfaces.

1.2 PRICE AND PAYMENT PROCEDURES

.1 There will be no measurement for work associated and described in this section.

.2 All other work necessary for the completion of the work of this section will not be measured separately for payment, but will be considered incidental to the items in this section.

.3 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.3 REFERENCES

.1 ASTM International
- .1 ASTM A588/A588M-15, Standard Specification for High-strength Low-Alloy Structural Steel, up to 50 ksi [345 MPa] Minimum Yield Point, with Atmospheric Corrosion Resistance.
- .2 ASTM A572/A572M-18, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel.
- .3 ASTM F3125/F3125M-15, Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

.1 CSA International
- .1 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 CSA S16-14, Design of Steel Structures.
- .3 CSA W48-18, Filler Metals and Allied Materials for Metal Arc Welding.
- .4 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
- .5 CSA S6-14, Canadian Highway Bridge Design Code.

.2 Environmental Choice Program
- .1 CCD-047-98(R2005), Architectural Surface Coatings.
- .2 CCD-048-98(R2006), Surface Coatings - Recycled Water-borne.

.3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).

.4 The Master Painters Institute (MPI)
- .1 Architectural Painting Specification Manual - 2012.

.5 National Standards of Canada:
.1 CAN/CGSB-1.181-M92, Ready-Mixed Organic Zinc-Rich Coating.

.6 The Society for Protective Coatings (SSPC):
.1 SSPC-SP 1-82(R2004), Solvent Cleaning.
.2 SSPC-SP 11, Power Tool Cleaning to Bare Metal.

.7 Miscellaneous Sources:
.1 OPSS 911 (November 2014) Construction Specification for Coating Structural Steel Systems.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts, and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two copies of WHMIS MSDS.
.1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario.
.2 Indicate materials, core diameter, finishes, connections, joints, method of anchorage, number of anchors, anchor grade, anchor finish, supports, reinforcement, details, and accessories.
.3 Do not begin fabrication until receiving reviewed (stamped and signed) shop drawings from the Departmental Representative.
.4 Where multi-discipline engineering work is depicted on the same shop drawing and a single Engineer is unable to seal and sign the shop drawing for all aspects of the work, the drawing is to be sealed and signed by as many additional Engineers as necessary.
.5 Maintain a signed and sealed copy of the shop drawings on site prior to and during installation of all components covered by this section.

.4 Upon completion of fabrication, the Contractor’s Quality Engineer is to conduct an interim inspection of the various components of the work, to verify that the fabrication of all components, including railings and barriers, has been carried out according to the shop drawings and Contract Documents and issue written permission to proceed with the delivery to the site. This interim inspection of each component is to be acknowledge to the Departmental Representative by issuing a stamped and signed letter by the Quality Engineer indicating the component is satisfactory for shipment to the site.

.5 As built drawings:
.1 Prepare as built drawings as follows:
.1 For all work incorporated in the completed structure that required the submission of working drawings.
.2 For all changes from the original Contract requirements.

.2 The as built drawings are to be submitted to the Departmental Representative in a reproducible format such as a Mylar prior to final acceptance of the work.
.3 As built drawings to bear the seal and signature of an Engineer licensed in the Province of Ontario.

1.5 QUALITY ASSURANCE

.1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties. This may include mill test certificates or independent test results from a certified test facility.

.2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to work of this Section in accordance with Section 01 74 21.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel barrier/railing and posts: To CSA G40.20/G40.21 Grade 350WT, as specified on the Contract Drawings. Rail elements to meet specified Charpy requirements as are railing post components.

.2 Steel sections and plates: to CSA G40.20/G40.21, Grade 350WT, as specified on the Contract Drawings.

.3 All bolts and nuts are to be galvanized according to ASTM F3125 Grade A307 or Grade A325M, or as may be specified elsewhere on the contract drawings.

.4 Finished high-strength bolts shall meet the requirements of ASTM A449.

.5 Welding materials: to CSA W59.

.6 Welding electrodes: to CSA W48 Series.

.7 Setscrews and other threaded bolts to have zinc-nickel plating applied to a thickness of 10 µm. The plating to show no red rust after 1,000-hour exposure to salt spray according to ASTM B117.

.8 Grout: non-staining, non-shrink cement-based grout or non-staining, non-shrink epoxy-based grout and as specified on the drawings.

.9 Paint to be in accordance with Section 09 97 19.

.10 Galvanizing to be in accordance with ASTM A125M and this Section.

.11 Anti-seize compound to be in accordance with OPSS 1210.

.12 Injection hose system and epoxy grout to be from one of the expansion joint manufacturers on the Ministry of Transport Otario Designated Source List of Material.

.13 All mechanical grating clips/attachments shall be manufactured for Type 316 stainless steel.

.14 Anchorage assembly:

.1 Anchorage assemblies to be as specified on the Contract Drawings.

.2 The anchorage assembly to be supplied with the bolts installed in a template.

.15 Rolled steel sections to CSA G40.20/G40.21 Grade 350WT.

2.2 FABRICATION

.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured. Fabricate work in accordance with the Contract Documents and Shop Drawings.

.2 Where possible, fit and shop assemble work, ready for erection.

.3 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

.5 Grind or file exposed welds and steel sections smooth on barriers and railings and all other metal components which are used as railing and areas likely to come in contact with bridge maintenance crew’s hands.

.6 Shop fabricate components in sections as large and complete as practicable.

.7 Where welding is required, fabricator is to be certified according to Division 2.1 of CSA W47.1.

.8 Fabrication and welding to be as per Section 05 12 33.

.9 All flame cut edges to be as smooth and regular as those produced by edge planning and be free of slag. Grind all sharp edges to 1.5 mm bevel for all flame cut or sheared plates or a 1.5 mm radius.

2.3 FINISHES

.1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m^2, Coating Grade 85, to ASTM A123/A123M.

.2 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

.3 Shop coat primer: MPI- INT 5.1A in accordance with chemical component limits and restrictions requirements and VOC limits of GS-11.

.4 Zinc primer: zinc rich, ready mix to MPI-INT 5.2C in accordance with chemical component limits and restrictions requirements and VOC limits of GS-11.

.5 Painting: to be in accordance with Section 09 97 19.

2.5 SHOP PAINTING

.1 Primer: VOC limit 250 g/L maximum to GS-11

.2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.

.3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.

.4 Clean surfaces to be field welded; do not paint until field welding is complete.

.5 Painting of non-galvanized surfaces in accordance with Section 09 97 19.

.6 Unless noted otherwise on the contract drawings, all metal components (except galvanized steel components) covered by this Section shall be coated.

2.8 End Stop Bumper

.1 Steel bracket and assembly per details shown on mechanical contract drawings.

.2 Prime paint for both exterior and interior.
  .1 Primer: maximum VOC limit 250 g/L to GS-11 when applied onsite.

2.9 Trench Covers and Frames

.1 Steel fabricate from 9.5 mm thick plate set supported on galvanized angle 64 x 64 x 6.4 frame. Include anchors at 600 mm on centre for embedding in

concrete.

.2 Finish: galvanized.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

.1 Do welding work in accordance with CSA W59 unless specified otherwise.

.2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.3 Provide suitable means of anchorage acceptable to Departmental Representative such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.4 Exposed fastening devices to match finish and be compatible with material through which they pass.

.5 Supply components for work by other trades in accordance with shop drawings and schedule.

.6 Make field connections with the grade and type of bolts to CSA S16 or Weld field connection as specified on the Contract Drawings.

.7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.

.8 Touch-up field welds, bolts and burnt or scratched surfaces with primer after completion of:
.1 Primer: maximum VOC limit 250 g/L to GS-11.

.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.
.1 Primer: maximum VOC limit 250 g/L to GS-11.

3.4 END STOP BUMPERS

.1 Install end stop bumpers at locations as indicated on the Contract Drawings.

3.6 TRENCH COVERS

.1 Install trench covers in locations as indicated.

3.7 CHANNEL FRAMES

.1 Install steel channel frames to openings as indicated.

3.8 ANCHORAGES

.1 Anchorage assemblies shall be installed as specified in the Contract Documents.

.2 Anchorages installed before concrete placement:

.1 When specified in the Contract Documents, anchorage components are to be installed prior to placing concrete and be securely tied to reinforcing steel. Anchorage assemblies to be positioned with templates and installed securely in the formwork to maintain the position of the anchors during placement of concrete.

.3 Anchorages installed after concrete placement:

.1 When specified in the Contract Document, anchorages are to be installed after concrete placement. Holes are to be core drilled or galvanized grout cans installed as indicated on the Contract Drawings, anchoring grout placed, and anchors properly positioned at locations specified. The placement of the anchoring agent and the anchors are to be according to the manufacturer's recommendations, except as modified herein. The holes are to be free of dust and debris immediately prior to placement of the anchoring agent. When the anchoring agent fails to fill the hole after insertion of the anchor, additional anchoring agent is to be immediately added to fill the hole.

.2 When a cement based grout is used as the anchoring agent, the holes are to be pre-dampened for a period of 1 hour and any free water is to be removed prior to the application of the cement based grout.

.3 When an epoxy grout is specified as the anchoring agent, the inside surface of the holes is to be roughened and dry prior to the application of the epoxy grout.

.4 Where anchors are inserted into horizontal or inclined holes in a vertical face, the anchors are to be maintained in position during the setting of the anchoring agent. Prevent loss of anchoring agent from the holes.

3.9 GALVANIZED COATING REPAIR

.1 When the galvanized surface of a component is damaged or uncoated, the exposed steel is to be repaired if the cumulative total of the damaged and

uncoated areas does not exceed 2% of the total area of each component or 0.02 m2, whichever is less. Where the cumulative area exceeds these amounts, the damaged coating is to be stripped and the component re-galvanized according to ASTM A123/A123M.

.2 Damaged and uncoated areas to be cleaned of all rust and other contaminants and repaired using one of the following methods:

.1 Soldering method using zinc-tin-copper-solder:

.1 The surface preparation of damaged and uncoated areas and the application of the flux and zinc-tin-copper solder to be according to ASTM A78O/A780M and the manufacturer’s recommendations;

.2 The finished thickness of the metal coating in the repaired area is to be a minimum of 9O µm. The repaired surface is to be ground flush with the surrounding galvanized coating.

3.10 QUALITY CONTROL

.1 A completed Certificate of Conformance to be submitted to the Departmental Representative upon completion of the work, signed and sealed by the Contractor’s Quality Engineer licensed in the Province of Ontario, confirming that the following for each component listed in paragraph 1.2 are in general conformance with the requirements of the Contract Documents:

.1 Materials.

.2 Fabrication.

.3 Coating.

.4 Installation and adjustments.

3.11 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.12 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 ASTM International
.1 ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

.2 American Wood Preservers' Association (AWPA)
.1 AWPA A2-15, Standard Methods for Analysis of Water-borne Preservatives and Fire Retardant Formulations.
.2 AWPA A3-15, Standard Methods for Determining Penetration of Preservatives and Fire Retardants.

.3 CSA International
.1 CSA B111-74(R2003), Wire Nails, Spikes and Staples.
.2 CSA O80 Series-15, Wood Preservation.
.3 CSA O86-14, Engineering Design in Wood.
.4 CSA G40.20-13/G40.21-13, General Requirement for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
.5 CAN/CSA-Z809-16, Sustainable Forest Management.

.4 Forest Stewardship Council (FSC)
.1 FSC-STD-01-001-2015, FSC Principle and Criteria for Forest Stewardship V5-2.
.2 FSC-STD-20-002-9, Structure and Content of Forest Stewardship Standards V3-0.
.3 FSC Accredited Certified Bodies.

.5 Green Seal Environmental Standards (GS)
.1 GS-36-2013, Commercial Adhesives.

.6 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.7 National Lumber Grades Authority (NLGA)
.1 NLGA Standard Grading Rules for Canadian Lumber GR 2017.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for wood decking and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two (2) copies of WHMIS MSDS.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.4 Samples:
.1 Submit for review and acceptance of each unit.
.2 Samples will be returned for inclusion into work.
.3 Submit two (2) 300 x 300 mm samples of each type.

.5 Certifications: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.

1.3 QUALITY ASSURANCE

.1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect wood decking from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Wood decking: to NLGA standard Grading Rules for Canadian Lumber select structural grade Western Hemlock.

.2 Wood running board: select structural grade Western Hemlock.

.3 Timber support block: shall be select structural grade Western Hemlock.

.4 Timber curbs: shall be select structural grade Western Hemlock.

.5 Wood decking shall be kiln dry to 15% maximum moisture content. CAN/CSA-Z809, SFI or Forestry Stewardship Council (FSC) certified.

.6 Decking lengths: as indicated on the Contract Drawings.

.7 Nails: to CSA B111, hot dipped galvanized finish; sizes to CSA O86. Supply 200 mm spiral spikes for lateral nailing.

.8 Hold down steel nailing clips: manufactured from 2 mm thick steel sheets, Grade 300 W, conforming to CSA G40.20/G40.21. Nailing clips shall be galvanized after fabrication. Holes in clips to be sufficiently sized to receive hot dipped galvanized nails.

.9 Wood preservative: odourless chemical type to CSA 080 for natural finish.

.10 Preservative: to CAN/CSA-O80 Series and shall be Chromated Copper Arsenate (CCA) according to AWPA P5.

.11 Fire retardant: to CSA O80.20, to provide:
.1 Flame Spread Classification: FSC 25.
.2 Smoke developed of not more than: 25.

.12 Adhesive and Sealants: as recommended by decking manufacturer.

.13 Fasteners and hardware: shall be protected after manufacture by hot dip galvanizing according to ASTM A123/A123M Coating Grade 85.

.14 Bolts, rods, and lag screws: shall be according to ASTM A307 or CSA G40.20/G40.21.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for wood decking installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Do wood deck work to CSA O86 except where specified otherwise.

.2 Install decking to CSA O86, as indicated on the Contract Drawings.

.3 Supply minimum of 1 bearing support for each plank.

.4 Stagger end joints in adjacent planks minimum of 0.5 m.
.1 Separate joints in same area by at least 2 intervening courses.
.2 Avoid joints in first fifth of end spans.
.3 Minimize joints in middle third of span.

.5 Install wood running boards to CSA 086, as indicated on the Contract Drawings.

.6 Apply preservative to end cuts of pressure treated lumber.

.7 Laminated deck boards shall be spliced only over sleepers, only one splice per line, and splices shall be staggered by at least 700 mm.

3.3 FIELD QUALITY CONTROL

.1 Testing:

.1 Testing moisture content of delivered material will be performed by testing laboratory designated by Departmental Representative.

.2 Departmental Representative will pay for costs of testing in accordance with Section 01 29 83.

.3 Testing moisture content of delivered material will be by testing laboratory designated by Departmental Representative.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by wood decking installation.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

.1 This section covers the requirements for the painting of all steelwork that is included in the Contract Drawings.

.2 All other painting of Metal Fabrications as identified on the Drawings or in Section 05 50 00. This includes all new structural steel and metals of any kind. This does not include nosing angles on the abutments, deck or the stainless steel bird screen and drain system. This may include galvanized or bare metal surfaces, as identified on the drawing.

.3 This section also includes a description of the Contractor's requirement for quality control and verification procedures.

.4 Included with this Section is all work required to undertake coating in both the shop and the field.

.5 Coating of mechanical and electrical equipment as noted in Sections 26 05 00 and 29 05 00 is to be complete in accordance with this section.

.6 Warranty inspection of the paint surface and repair of any defect by the Contractor.

.7 All metal surfaces that are not sealed from the environment, covered with asphalt and/or waterproofing, or otherwise indicated on the drawings not be coated, shall be either metalized and coated, galvanized and coated, galvanized or painted.

1.2 RELATED SECTIONS

.1 Section 01 33 00 – Submittal Procedures.

.2 Section 01 35 43 – Environmental Procedure.

.3 Section 05 12 33 – Structural Steel for Bridges.

.4 Section 05 50 00 – Metal Fabrication.

.5 Section 09 97 20 – Metalizing Structural Steel

1.3 PRICE AND PAYMENT PROCEDURES

.1 No measurement for payment will be made for the work covered by this section.

.2 All other work necessary to the completion of the work to achieve a system consistent with the intent of this specification and the provision of this section will not be measured separately for payment but will be considered incidental to the work of this section.

.3 Payment will be under the Contract Lump Sum Amount and such payment shall

be full compensation of all labour, equipment and materials necessary to complete the work.

.4 Painting of metal components shall be considered to be paid under the item for the fabrication and installation of said component, if there is a separate pay item for that component. Where no separate item exists for the metal components, then coating of these components will be deemed to be included in the Contract Lump Sum Amount.

1.4 REFERENCES

.1 American Society for Testing and Materials (ASTM):
- .1 ASTM D610-08(2012), Standard Test Method for Evaluating Degree of Rusting on Painted Steel Surfaces.
- .2 ASTM D2369-10(2015) e1, Standard Test Method for Volatile Content of Coatings.
- .3 ASTM D2832-92(2016), Standard Guide for Determining Volatile and Nonvolatile Content of Paint and Related Coatings.

.2 Canadian General Standards Board (CGSB):
- .1 CAN/CGSB-1.177-M91, Two-Component Polyurethane Coating, Resistant to Chalking and Yellowing.
- .2 CAN/CGSB-1.183-99, Zinc-Rich Epoxy Coating.
- .3 CAN/CGSB-1.193-99, High-Build Epoxy Marine Coating.
- .4 CAN/CGSB-1.207-98, Low Temperature Curing Epoxy Coating.
- .5 CAN/CGSB-1.212-2004, Heavy Duty Free Marine Primer for Steel and Light Alloy Surfaces.

.3 Federal Standard (FS):
- .1 FS-595B-98, Paint Colours.

.4 SAE Aerospace Material Specification AMS Standard
- .1 SAE AMS-STD-595

.5 Society for Protective Coatings (Formerly known as the Steel Structures Painting Council abbreviated SSPC):
- .1 SSPC-SP-1-04, Solvent Cleaning.
- .2 SSPC-SP-6/NACE No 3-07 Commercial Blast Cleaning.
- .3 SSPC-SP-7/NACE No 4-07, Brush-off Blast Cleaning.
- .4 SSPC-SP-10/NACE No 2-07 Near White Blast Cleaning.
- .5 SSPC-Vis-1-89, Abrasive Cleaning.

.6 OPSS - Ontario Provincial Standard - 1704 “Material Specification for Paint Coating Systems for Structural” Steel (April 2010).

.7 Ministry of Transportation Designated Sources List DSM # 9.20.39; 9.20.65; 9.20.60.

.8 All manufacturer's current product data sheets must be used in conjunction with, and form part of, this Section. Where contradictions occur, the most stringent requirement that will produce the best quality and durability of the coating system as judged by the Departmental Representative shall be used.

1.5 DEFINITIONS

.1 The terms paint, painting and coating are used interchangeably with and without the term system throughout the documents and drawings. On bare metal surfaces, the terms shall refer to the full coating system with all primer, mid-coat and top coats applied on a fully prepared and blast cleaned surface to SSPC- SP10 Near White Metal Standards. This treatment is to be applied to all surfaces of the bridge and all metal on site, except as may be noted on the drawings or within other Sections. Stainless steel does not need to be protected by coating.

.2 For galvanized surfaces, the terms paint, painting or coating, shall refer to the surface preparation noted herein, or as may be required by the coating system manufacturer and include tie-coat and top-coat for galvanized components.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit the following in accordance with Section 01 33 00:
- .1 All purchase orders, invoices and other documents that prove the materials to be used meet the requirements of specification.
- .2 Paint colour chips.
- .3 Copies of manufacturer's instructions for mixing, straining, thinning, application temperature window, dew point, cure time to recoat and applying coatings.
- .4 Manufacturer's recommendations for tip size, air pressure, paint guns and air supply.
- .5 Include worker protection measures for cleaning and painting in the Site Specific Safety Plan in accordance with Section 01 35 29.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for painting exterior metal surfaces and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two (2) copies of WHMIS MSDS.

.3 Samples:
- .1 Submit samples for review and acceptance of each unit in accordance with Section 01 33 00.
- .2 Samples will be returned for inclusion into work.
- .3 Upon request, Departmental Representative will furnish qualified products list of paints.
- .4 Paints that do not appear on MPI Approved Products List must be approved by Departmental Representative before use on project. When it is proposed to use non-qualified paint, submit one (2) L sample of paint to Departmental Representative at least two (2) weeks prior to commencement of painting for analysis and acceptance. Mark samples with name of project, its location, paint manufacturer's name and address, name of paint, MPI standard number and manufacturers paint code number.
- .5 Enable Departmental Representative to take one (2) L samples of each paint delivered to site, one sample from manufacturer's containers and one

sample from painters' pot.

.2 Submit copies of Inspection Sheets for the quality control program showing confirmation of surface preparation/cleaning, pre-coat cleanliness and all aspects of the painting system including thickness and function of each coat. Sheets to be submitted in accordance with Section 01 33 00.

.3 Submit Material Data Sheet for each coating system. Each coating system is to have manufacture defined application temperatures, dew points, cure time (for range of temperatures) and re-coat times clearly indicated for shop and field application.

.4 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

.5 Test Reports:
.1 Submit test reports showing compliance with specified performance characteristics and physical properties and in accordance with Section 01 45 00.

1.7 QUALITY ASSURANCE

.1 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Paint Materials – Over Bare Mild Carbon Steel
.1 All surfaces are to be prepared as noted elsewhere. The number noted in "()" indicates the acceptable minimum dry film thickness (DFT) for the product to be used on this project.
.2 Primer: System: Epoxy Zinc:
.1 Epoxy Zinc – with a minimum of 85% minimum zinc content in the dry film and to all other requirements of CAN/CGSB- 1.183-99. Acceptable products include:
.1 Carbozinc 858 by Carboline (90 µm);
.2 Amercoat 68HS by PPG Canada (90 µm);
.3 ZincClad III HS by Sherwin-Williams (90 µm);
.4 Interzinc 315B by International Paint (90 µm);
.3 Intermediate Coat:

.1 High – Solids Epoxy to the requirements of CAN/CGSB-1.193-99. Acceptable products include:
.1 Carboguard 893 by Carboline (100 µm);
.2 Amercoat 385 by PPG Canada (100 µm);
.3 Macropoxy 646 by Sherwin-Williams (125 µm);
.4 Interguard 475HS by International Paint (100 µm);

.4 Top Coat:
.1 Polyurethane to the requirements of CAN/CGSB-1.177-M91. Acceptable products include:
.1 Carbothane 134HG by Carboline (50 µm);
.2 Amercoat 450H by PPG Canada (50 µm);
.3 Acrolon 218 HS by Sherwin-Williams (75 µm);
.4 Interthan 870UHS by International Paint (75 µm);

.2 Paint Materials – For Seal Coat / Top coat over Metalizing
.1 All surfaces are to be prepared as noted elsewhere. The number noted in the "()" indicates the acceptable minimum dry film thickness (DFT) for the product to be used on this project.
.2 Acceptable products include:
.1 Carbothane 134HG by Carboline (100 µm).
.2 Amercoat PSX 700FD by PPG Canada (100 µm).
.3 MC-Prepbond by Wasser Canada (25 µm) Plus 2nd Coat of MCFerrox A by Wasser Canada (75 µm).

.3 Paint Materials – For Coating over Galvanized Surfaces
.1 All surfaces are to be prepared as noted elsewhere. The number noted in "()" indicates the acceptable minimum dry film thickness (DFT) for the product to be used on this project.
.2 First Coat to the requirements of CAN/CGSB-1.193-99:
.1 Carbomastic 15FC (125 µm) by Carboline;
.2 Amercoat 385 (100 µm) by PPG Canada;
.3 Top Coat to the requirements of CAN/CGSB-1.177-M91:
.1 Carbomastic 13Y4G (50 µm) by Carboline;
.2 Amercoat 450H (75 µm) by PPG Canada;

.4 Compatibility
.1 Paint materials for each coated area must be the products of a single manufacturer and be approved by that manufacturer for use together as one painting system in the environment considered (immersion, splash zone, or atmospheric exposure) and for that particular substrate. Alternatives for paint system require the submission for evaluation of the information requested in OPSS 1704 Material Specification for Paint Coating Systems for Structural Steel, April 2010, as well as meeting all requirements of this specification.
.2 Alternatives will not be considered during the tender period.

.5 Colour of Top Coat
.1 The colour code is: SAE AMS-STD-595A color #15052.

.6 Caulking/Sealant
.1 Caulking/sealant shall be paintable silicone caulking.
.2 The caulking shall be UV resistant and compatible with the paint system being used.

.3 The manufacturers indicated service life for the caulking material shall be at a minimum 20 years.
.4 Caulking shall have excellent adhesion to the prepared surface prior to top coating and be placed prior to the installation of the top coat.

PART 3 - EXECTION

3.1 PAINTING AFTER CLEANING

.1 It is recognized that rusting of the cleaned members occurs quickly and that priming must follow the cleaning operation shortly after cleaning is complete. Coordinate work and inspection to allow verification of the prepared surfaces cleanliness and profile.

3.2 EXAMINATION

.1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for painting exterior metal surfaces installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Carry out tests to determine existence of lead base paint on existing exterior metal surfaces.
.3 If lead exists stop work and report findings to Departmental Representative.
.4 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.5 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.3 SURFACE PREPARATION

.1 This surface preparation is applicable to all metal surfaces, except metalized and galvanized surfaces.

.2 Solvent clean to SSPC-SP1.

.3 Blast Cleaning to SSPC- SP10.

.4 All surfaces are to be cleaned with abrasive blast cleaning; to be equivalent to SSPC-SP10 Near-White Blast Cleaning when compared with SSPC-Vis-1 Visual standard.

.5 Solvent cleaning shall be used to remove grease and oil prior to blasting.

.6 Very lightly hand-sand the surface to roughen in readiness for the new coatings. The sanding process must not damage the steel. Therefore, in the presence of the Departmental Representative, prepare a separate mock-up area of sanding for each of the different substrate surfaces. Upon Departmental Representative's approval of mock-up, proceed with light sanding the rest of the surfaces.

.7 All surfaces are to be abrasive blast cleaned to SSPC-SP10 to create surface profile and to reach an acceptable level of surface profile for paint adhesion.

3.4 PROTECTION OF CLEANED SURFACES

.1 Apply primer as soon as possible after surface has been cleaned and inspected by Departmental Representative and before deterioration of surface occurs.

.2 Fully clean surfaces again to conform to preparation standards if flash rust or rusting, or, other degradation occurs after completion of surface preparation.

.3 Prevent contamination of cleaned surfaces before prime coat is applied and between applications of remaining coats of paint.

3.5 COATING SYSTEMS

.1 Each surface shall receive an appropriate thickness of coating as per manufacturer’s recommendations or this Section (whichever is greater). The approval of the Departmental Representative is required to vary from the thickness identified in this section for a given product.

.1 All materials must be applied in a climate controlled environment which is in accordance with manufacturer's recommendations and this specification. The heating to achieve working temperature requirements of this specification are more stringent than some manufacturers require and shall be adhered to unless it would cause an adverse effect in the product.

.2 All primer must have an unlimited recoat time to allow areas to be painted in stages. All primers must satisfy the requirements for slip resistance of a Class B coating. The primer must be exposed on all faying surfaces to be bolted, with no intermediate or top coat on the primer on the faying surface.

3.6 PREPARING COATINGS FOR APPLICATION

.1 Follow manufacturer's instructions for mixing, straining, and thinning paint. In addition to the manufacturer's instructions.

.1 Do not dilute or thin paint for brush application: use as received from manufacturer without written permission from Departmental Representative.

.2 Do not mix or keep paint in suspension by means of air bubbling through paint.

.3 Record all additives and the amount of any thinning products. All additives and thinning products to be confirmed for use in writing by the manufacturer.

3.7 SEAL COATING

.1 Unless directed otherwise by the coating manufacturer, thin the seal coat approximately 25% and apply as a mist coat to the prepared metalized surface. When the mist coat has penetrated the metalizing, follow with the full coat (with proper thinning) to obtain the specified minimum dry film thickness.

3.8 QUALITY CONTROL

.1 Site Tests, Inspections:
.1 Upon completion of the painting procedures test for dry film reading and evaluate the results as per SSPC-PA 2.

.2 The Contractor shall retain the services of an independent NACE Coating Inspector Level 3. This individual may not be a full time employee of the Contractor nor any Subcontractor nor Supplier. The Contractor shall submit the name, registration number and resume of previous experience for the NACE Inspector.

.3 The NACE Level 3 Inspector shall prepare an outline of all inspection activities, such as inspecting the condition of the steel before cleaning, the blast cleaned surface, profile, cleanliness, mixing of coatings, application, recording of the DFT and all other inspections that will be complete. This outline will be submitted to the Departmental Representative for review, along with samples of all documentation (forms, photographs, other). Once approved, this shall constitute the required documentation for the coating inspection, whether done in the shop or in the field.

.4 The Contractor's NACE Inspector and the Departmental Representative will check the degree of cleanliness of surfaces. Do not apply paint until prepared surfaces have been accepted by Departmental Representative.

.5 The Contractor shall be responsible for monitoring the wet film thickness and confirming and recording the dry film thickness of each layer of paint on each member.

.6 The Contractor shall record the thicknesses of coating of each layer for each member and provide a written record of all measurements taken.

.7 Each coat of paint serves a function. Before applying the next coat, the layer before must be successfully applied. This is particularly important for such functions as the previous coat's function of sealing and building over gaps and joints in the steel and paint below. Review with the Departmental Representative that the prior coat has sealed and created a continuous thicker film over connections where plates touch filling the gaps and raw edges between plates before applying any top coat.

.8 Work with the manufacturer's representative to obtain the results intended from the products specified. Report all adjustments and additives to the paint or thinning of the paint. Never thin the paint more than the specified amount and record the amount of thinner used by the Contractor’s NACE Inspector. Record and provide records of any direction given by the manufacturer's representative. If the direction contradicts the written instructions on the product sheets in any way or approaches the product limits, specifically notify the Departmental Representative of the issues in writing before applying any coating.

.9 The Contractor’s NACE Inspector will note areas requiring correction due to low thickness and areas which have other defects such as runs, drips

and errors and, propose remediation.

.10 Proper and sufficient lighting is required to prepare, paint and inspect the bridge. Provide proper and sufficient lighting to the requirements of the Departmental Representative. Lighting shall be area lighting and not merely spot lighting.

.11 The Departmental Representative will be provided access and an opportunity to spot check dry film thickness of each layer and application of paint after it is applied and before the next is applied, as they see fit.

.12 At the time of inspection, the Contractor's NACE Inspector and Departmental Representative will also check for gross defects such as (but not limited to) mudcracking and holidays.
.1 The Contractor shall pay the cost of rectifying defects. This may include, when so directed by Departmental Representative, the removal of all defective areas as well as adjacent areas, as well as all under coats, re-cleaning of surfaces, and re-painting in accordance with these specifications.
.2 For each coat, do not apply subsequent coats until the dry painted surface has been accepted by Contractor's NACE Inspector and Departmental Representative.

.13 At the conclusion of all shop coating, the Contractor's Quality Engineer shall review all reports from the Contractor's NACE Inspector and provide an interim Certificate of Conformance for each component (bridge, railing, etc.), complete with all NACE Report's, prior to shipping any steel components to the site.

.14 After the erection of all steel on site and the completion of coating (including repairs of all damaged areas), the Contractor's Quality Engineer shall review all NACE Inspection Reports and provide a final Certificate of Conformance for the coating on the complete structure.

3.9 HOUSE HEATING AND/OR SHOP CONDITIONS

.1 Ensure no water, including condensation water, can drip onto surfaces during the cleaning and painting operations.

.2 Protect, shelter, or heat surface and surrounding air to comply with the following temperature and relative humidity conditions.
.1 Ensure ambient air temperature is above 10°C at time of painting and at all times afterwards until paint has fully cured and dried.
.2 Ensure metal surface temperature is between 10°C and 50°C at time of coating application.
.3 Ensure relative humidity is below 85% at time of coating application and at all times afterwards until paint has fully cured and dried. Note that this may require heating above the minimum temperature requirement if this is necessary to ensure relative humidity requirement is met. Adjustments in humidity to allow better curing can be submitted in writing for review by the Departmental Representative.
.4 Temperature and humidity restrictions may be reduced based on the coating manufacture's written recommendations.

.5 On site, containment of the work area where coating or surface prepared is occurring, must restrict the escape of dust and coating spray.

3.10 PROTECTION

.1 Protect painted surfaces from damage during construction.

.2 Protection of surfaces:
.1 Protect surfaces not to receive paint.
.2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of paint. Remove contaminants from surface and apply paint immediately.
.3 Protect cleaned and freshly painted surfaces from dust to approval of Departmental Representative.

.3 Repair damage to adjacent materials caused by painting exterior surface application installation.

3.11 APPLICATION

.1 Manufacturer's Instructions: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

.2 Apply paint by spraying, brushing, or combination of both. Use sheepskins or daubers when no other method is practical in places of difficult access.

.3 If airless equipment is used, provide and maintain airless spray equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.4 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.

.5 Keep paint ingredients properly mixed in spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary to keep solids suspended and mixed.

.6 Use dipping or roller coating method of application when specifically authorized by Departmental Representative in writing.

.7 Caulk open seams at contact surfaces of built up members with material approved by Departmental Representative, before second undercoat of primer is applied.

.8 Where surface to be painted is not under cover, do not apply paint when:
.1 Air temperature is below 5°C or when temperature is expected to drop to 0°C before paint has dried.
.2 Temperature of surface is over 50°C unless paint is specifically formulated for application at high temperatures.
.3 Fog or mist occur at site; it is raining or snowing; there is danger

of rain or snow; relative humidity is above 85%.
.4 Surface to be painted is wet, damp or frosted.
.5 Previous coat is not dry.
Note that these provisions set the minimum standards for extreme temperature and humidity regardless if manufacturer's documentation allows application under more extreme conditions. Where the provisions of SSPC-SP10, Near White Blast cleaning, or the Contract Documents are more stringent, then in all cases, the more stringent requirement shall apply.

.9 Supply cover when paint must be applied in damp or cold weather. Supply, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions specified. Protect until paint is dry or until weather conditions are suitable.

.10 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

.11 Provide cover at all times and especially when paint must be applied in damp or cold weather. Protect, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions specified. Protect until paint is cured in accordance with the curing requirements of this specification or until weather conditions are suitable.

.12 Apply each coat of paint as continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied. If products do not allow recoating, fully remove paint and prepare the surface in accordance with the blast cleaning and preparation requirements of this specification and then re-apply the full coating system.

.13 If any layer of coating is too thick, it will be reviewed by the Departmental Representative and, if rejected, the area of concern will be fully removed and the surface prepared in accordance with the blast cleaning and preparation requirements of this specification and then re-apply the full coating system.

.14 Brush application:
.1 Work paint into cracks, crevices and corners and paint surfaces not accessible to brushes by spray, daubers or sheepskins.
.2 Brush out runs and sags.
.3 Remove runs, sags and brush marks from finished work and repaint.
.4 Brush apply additional coat of paint to all bolts (strip coat) prior to applying final spray coat.

.15 Spray application:
.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
.2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.
.3 Keep paint ingredients properly mixed in spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
.4 Apply paint in uniform layer, with overlapping at edges of spray

pattern.
.5 Brush out immediately runs and sags.
.6 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray. In areas not accessible to spray gun, use brushes, daubers or sheepskins.
.7 Remove runs, sags and brush marks from finished work and repaint.

.16 Shop painting:
.1 Do shop painting after fabrication and before damage to surface occurs from weather or other exposure.
.2 Spray paint contact surfaces of field assembled, bolted, friction type joints with primer coat only. Do not brush primer after spraying.
.3 Do not paint metal surfaces which are to be embedded in concrete.
.4 Paint metal surfaces to be in contact with wood with either full paint coats specified or three shop coats of specified primer.
.5 Do not paint metal within 50 mm of edge to be welded. Give unprotected steel one coat of approved protective coating after shop fabrication is completed.
.6 Remove weld spatter before painting. Remove weld slag and flux by methods as specified in paragraph 3.2.3 Metal Surfaces to be Repainted.
.7 Protect machine finished or similar surfaces that are not to be painted but that do require protection, with coating of rust inhibitive petroleum, molybdenum disulphide, or other coating approved by Departmental Representative.
.8 Copy previous erection marks and weight marks on areas that have been shop painted.

.17 Field painting:
.1 Paint steel structures as soon as practical after erection.
.2 Touch up metal which has been shop coated with same type of paint and to same thickness as shop coat. This touch-up to include cleaning and painting of field connections, welds, nuts, washers, bolts, and damaged or defective paint and rusted areas.
.3 Field paint surfaces (other than joint contact surfaces) which are accessible before erection but which are not to be accessible after erection.
.4 Apply final coat of paint after concrete work is completed or as directed by Departmental Representative. If concreting or other operations damage paint, clean and repaint damaged area. Remove concrete spatter and droppings before paint is applied.
.5 Where painting does not meet with requirements of specifications, and when so directed by Departmental Representative, remove defective paint, thoroughly clean affected surfaces and repaint in accordance with these specifications.

.18 Handling painted metal:
.1 Handle painted metal after paint has dried, or when necessary for handling for painting or stacking for drying.
.2 Scrape off and touch up paint which is damaged in handling, with same number of coats and kinds of paint as were previously applied to metal.

.19 All bolts, nuts and washers shall be given a prime coat, mid coat and finish coat, by brush striping, in addition to the spray application. The seal coat and finish coat over metalized surfaces shall be brush applied prior

to spray application of each coat. Proper preparation of the galvanized fasteners is required.

3.12 JOINTS IN PAINTING SYSTEMS

.1 At joints where the system must be left incomplete, an exposed section of primer and each coat must be left to allow the primer and each coat to be lapped on respective coats without lapping other coats.

.2 The band of primer left exposed must be wide enough to allow cleaning of adjacent steel and a transition to mid-coat and finish coat and still allow primer to be applied to cleaned metal and the surface or, exposed primer before the transition to midcoat.

.3 When cleaning near transitions, protect finished areas from blasting and select transition locations such that the transitions can be made.

3.13 INACCESSIBLE AREAS

.1 All areas and surfaces of the bridge are to be prepared and painted, including all metal except where specifically directed not to be painted.

.2 There are areas where spraying access is tight. Review all areas and work with the Departmental Representative to devise methods of applying a continuous coating system to these areas and undertaking inspection.

3.14 LIMITS OF PAINTING

.1 Painting shall include all steel surfaces, as noted on the drawings. Three (3) exceptions shall be:

.1 All metalized steel components.

.2 All galvanized steel components.

.3 Nosing Angles.

.2 Unless the connection in the steel components is noted as a slip critical connection, all such faying surfaces shall be cleaned and primed.

.3 All interior and exterior surfaces of all the members will be painted.

.4 For metalized surfaces, the faying surface shall receive a coating of metalizing, as noted in Section 09 97 20.

3.15 REPAIRS TO PAINT SYSTEM

.1 Touch up any painted surface that has been damaged, marred or does not meet the intent and details of this specification using the procedures listed below. Apply paint to the specified thickness of each coating layer of the painting system.

.2 Any area left for field connections where the Contractor has been allowed to apply the full painting system before installation, shall have touch-up painting as follows. In general, the full system will not be applied prior to field assembly on the field connections as this will not provide the mid-coat seal. This is to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint.

.3 Repair procedure for coating system.

.1 The Contractor, in conjunction with his NACE Inspector, Painting Subcontractor and Paint Manufacturer, shall develop a coating repair procedure for all coated surfaces, for review and approval of the Departmental Representative.

.2 All dry film thickness measurements to be adjusted as per manufacturer's recommendations and Departmental Representatives approval.

3.16 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

.1 This Section covers the requirements for the following work:
- .1 Surface preparation and metalizing of structural steel as required to do the work as shown on the Contract Drawings.
- .2 Quality control and verification of the work by the Contractor.
- .3 Warranty inspection and repair of any defect by the Contractor.

1.2 PRICE AND PAYMENT PROCEDURES

.1 There will be no measurement for work associated with the metalizing and coating application (work described by this section).

.2 Metalizing (including the application of the seal coat) will be paid for at the contract lump sum bid price.

.3 Shop and field work are both included, including the supply of all power, scaffolding/access, protection from weather and material testing and inspection.

.4 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.3 RELATED REQUIREMENTS

.1 Section 01 35 43 – Environmental Procedures.

.2 Section 05 12 33 – Structural Steel for Bridges.

.3 Section 05 50 00 – Metal Fabrications.

.4 Section 09 97 19 – Painting Exterior Metal Surfaces

1.4 REFERENCES

.1 ASTM International
- .1 ASTM B 833-13, Standard Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metalizing) for the Corrosion Protection of Steel.

.2 SSPC, American Welding Society (AWS) and NACE Joint Publications
- .1 SSPC-CS 23.00 / AWS C2.23M / NACE No.12-2003, Application of Thermal Spray Coatings (Metalizing) of Aluminum, Zinc, and Their Alloys and Composites for Corrosion Protection of Steel.

.3 OPSS 911 (November 2014) Construction Specification for Coating Structural Steel Systems.

.4 ASTM International

.1 ASTM B833-13, Standard Specification for Zinc and Zinc Alloy Wire for Thermal Spraying (Metalizing) for the Corrosion Protection of Steel.
.2 ASTM D4285-83 (2012), Standard Test Method for Indicating Oil or Water in Compressed Air.
.3 ASTM D4417-11, Standard Test Methods for Field Measurement of Surface Profile of Blast Cleaned Steel.
.4 ASTM D4541-09, Standard Test Method for Pull-Off Strength of Coatings Using Portable Adhesion Testers.

.5 The Society for Protective Coatings (SSPC) Good Painting Practice, SSPC Painting Manual Vol. 1, 4th Edition, 2002
.1 AB 1, April 2013, Mineral and Slag Abrasives.
.2 PA 1, November 2004, Shop, Field and Maintenance Painting of Steel.
.3 PA 2, May 2012, Procedure for Determining Conformance to Dry Coating Thickness Requirements.
.4 SP 1, November 2004, Solvent Cleaning.
.5 SP 8, November 2004, Pickling.
.6 SP 11, July 2012, Power Tool Cleaning to Bare Metal.
.7 VIS 1-02, Visual Standard for Abrasive Blast Cleaned Steel.
.8 VIS 3-04, Visual Standard for Power-and Hand-Tool Cleaned Steel.

.6 The Society for Protective Coatings (SSPC)
.1 SSPC-SP 5/NACE No. 1-07, White Metal Blast Cleaning.
.2 SSPC-SP 6/NACE No. 3-07, Commercial Blast Cleaning.
.3 SSPC-SP 10/NACE No. 2-07, Near-White Blast Cleaning.

.7 SSPC, American Welding Society (AWS) and NACE Joint Publications
.1 SSPC-CS 23.00 / AWS C2.23M/NACE No.12-03, Application of Thermal Spray Coatings (Metalizing) of Aluminum, Zinc and Their Alloys and Composites for Corrosion Protection of Steel.

.8 American National Standards Institute/American Welding Standard (ANSI (AWS))
.1 ANSI/AWS A5.33 – Specification for Solid and Ceramic Wires and Ceramic Rods for Thermal Spraying.

.9 Federal Standard (FS)
.1 FED-STD-595C-17 Colours Used in Government Procurement.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Written Notices
.1 Details of the methods, procedures, and sequence of operations to be employed to complete the work, including schedules. This includes one procedure for shop metalizing and a separate procedure for field metalizing.
.2 Details of surface preparation and coating of areas that are difficult to access and the method of application.
.3 Contractor’s inspection and quality control of the metalizing and seal coat, as per Section 09 97 20, paragraph 3.7, Quality Control, to be complete by the Contractor retained NACE Level 2 Inspector.

.4 The metalizing work shall be completed by a Sub-Contractor or manufacturer with at least two years of experience performing the metalizing of structural steel. Submit descriptions of at least three (3) previous metalizing projects.

.5 Each spray operator shall be qualified to metalize according to ANSI/AWS C2.23M, with documentation submitted to the Departmental Representative identifying the names and qualifications of each spray operator.

.3 Material Certification:

.1 Before commencement of the coating application, the Departmental Representative shall be supplied with written certification from the metalizing and seal coat manufacturers stating that all materials supplied are as specified in the Contract Documents and the manufacturer's current product data sheets.

.2 The coating manufacturer shall certify the coating/procedure is suitable to apply to metalized surfaces.

1.6 QUALITY CONTROL

.1 Each phase of the work shall be inspected by the Contractor retained independent NACE Inspector (Level 1) and the Departmental Representative and approved before work is to commence on to the next phase.

.2 Acceptability of the surface preparation by the Contractor’s NACE Inspector shall be based on the applicable SSPC surface preparation specifications and pictorial standards given in SSPC-VIS 1 and SSPC-VIS 3.

.3 Surface profile measurements shall be made by the Contractor’s NACE Inspector on a random basis using an electronic paint coating thickness measurement gauge and an extra coarse pressure sensitive replica tape according to ASTM D 4417, Method C.

.4 The work shall be randomly tested by the Contractor’s NACE Inspector for cleanliness to determine contamination of surfaces by the presence of visible dust, oils, grease, or other foreign matter.

.5 During thermal metal spraying, the Contractor’s NACE Inspector shall perform random adhesion tests according to ASTM D 4541 using either Type III or Type V self alignment tester. The minimum acceptable adhesion strength shall be 4.8 MPa. All nonconforming areas and areas damaged by the test shall be reblasted and re-sprayed to conform to the requirements as specified in the Contract Documents. Adhesion measurements on repaired areas may be made on a random basis according to the above method.

.6 The Contractor shall submit all NACE Inspection Reports prior to any component being shipped from the shop.

.7 Equivalent quality control procedures shall be performed for all metalizing completed in the field.

.8 The Contractor Quality Engineer shall review all shop metalizing and field metalizing reports from the NACE inspector. The Quality Engineer shall

prepare a Certificate of Conformance that the metalizing (and coating) applied in the shop meets the general conformance of the specifications. This shall be provided to the Departmental Representative before any steel is shipped to the site. similarly, following completion of field metalizing (and coating) of field welded areas, as well as damaged components, the Quality Engineer shall review all NACE Inspection Reports on the field metalizing and provide the Certificate of Conformance to the Departmental Representative for the metalizing works.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Thermal Sprayed Metal Coatings: Thermal sprayed metal coatings shall be according to SSPC-CS 23.00/AWS C2.23M/NACE No.12. The metalizing wire (thermal spray feedstock) shall be an alloy consisting of 85% zinc and 15% aluminum that conforms to the requirements of ASTM B 833 or 99.99% zinc, at the choice of the Contractor.

.2 Abrasive Media: Blast abrasive media used for the surface preparation for thermal spray metal coating application shall be sufficiently hard and sharp to produce an angular surface profile on to the steel substrate such that the subsequent metal coating shall meet the bond strength requirements specified.

.3 Abrasives shall conform to the following
- .1 SSPC AB1 for mineral slag abrasive.
- .2 SSPC AB2 for recycled ferrous metal abrasives.
- .3 SSPC AB3 for new steel abrasives.

PART 3 - EXECTION

3.1 GENERAL

.1 The extent of work, cleaning requirements, surface preparation, environmental protection requirements, and type of coating system shall be as specified in the Contract Documents.

.2 Where there is a conflict between the manufacturer's recommendations and the Contract Documents, the more stringent requirements shall apply as determined by the Departmental Representative.

.3 All components coated in the shop shall be protected from handling or shipping damage by using padded slings, separators, and tie downs or other similar devices. Loading procedures shall be designed to protect coated surfaces from any possible damage to the coating.

.4 All bare metal to be metalized in the field after welding or bolting, shall be protected from rust staining of adjacent component, concrete components and coated surfaces.

3.2 SURFACE PREPARATION

.1 Fins, slivers, burred, or sharp edges, weld spatter or slag shall be removed by power grinding prior to the surface preparation and coating application.

.2 All corners and edges shall be rounded to 1.5 mm radius or 1.5 mm chamfer.

.3 Faying surfaces of structural steel components to be connected by bolts shall be cleaned to the surface preparation standard required for the coating system specified and metalized (or protected from coating by masking as noted on the drawings).

.4 Flame cut edges shall be ground over their entire surface, such that any hardened surface layer is removed and subsequent abrasive blast cleaning produces the specified surface profile depth.

.5 Structural steel surfaces specified to receive a thermal sprayed metal coating shall be abrasive blast cleaned to the requirements of SSPC-SP 5/NACE No.1. The abrasive blast cleaning shall provide a surface profile height of a minimum of 50 µm and a maximum of 100 µm when measured in accordance with ASTM D4417.

.6 Do not conduct final surface preparation with exposed bare steel under damp environmental conditions or when the surface temperature is less than 3^{0}C greater than the dew point temperature of the surrounding air.

3.3 APPLICATION OF COATING

.1 Written notice shall be given to the Departmental Representative 48 hours in advance of Contractor’s intention to carry out surface preparation and thermal metal spray coating application in either the shop of in the field.

.2 The application of thermal sprayed metal coating shall be according to SSPC-CS 23.00/AWS C2.23M/NACE No.12 to provide a coating thickness of minimum 200 µm. No single pass shall deposit more than 100 µm. Thermal sprayed metal coating shall have a bond strength of minimum 4.8 MPa to the steel substrate when tested according to ASTM D 4541 using either Type III or Type V self-alignment tester.

.3 Measurements of adhesion shall be taken every 50 m^2.

.4 Immediately prior to metalizing, all prepared surfaces shall be cleaned by vacuuming to remove dust, debris, and other surface contaminants. At least one layer of thermal sprayed metal coating shall be applied within 4 hours of blast cleaning or before flash rusting occurs, whichever is sooner. This layer shall cover the peaks of the surface profile. Prior to applying additional sprayed metal to the specified thickness, the first layer of coating shall be visually inspected to verify that the coating surface has not become contaminated. Any contamination shall be removed according to the manufacturer's instructions before any additional material is applied. The coating shall be sprayed to obtain the specified thickness, as soon as possible.

.5 Before starting the work, a 200 x 300 x 3 mm steel sample plate similar in composition and thickness to the steel to be coated shall be submitted to the Departmental Representative. This plate shall be cleaned and sprayed according to the Contract Documents. The metal coating on the sample plate shall be checked by the Departmental Representative for compliance with the Contract Documents. This plate, when accepted by the Departmental Representative, shall be used as the visual standard to determine the acceptability of the thermal spray metal coating for the entire work. A second plate with the seal and top coat shall also be submitted to the Departmental Representative.

.6 All thermal metal spray applicators shall demonstrate proficiency in applying the thermal sprayed metal coating on a test patch to the satisfaction of the Contractor’s NACE Inspector prior to commencing full-scale application. The first 600 mm square block pattern application shall be used for this evaluation by the Contractor’s NACE Inspector and the Departmental Representative.

.7 Spray parameters should be set for spraying the submitted feedstock and at a minimum, be validated by passing a bend test as follows.

.1 Spray five carbon steel coupons with approximate dimensions 50 mm x 150 mm x 1.25 mm. The surface of the coupons should be prepared to the same degree as specified for the project. Bolt, bracket or otherwise fasten the coupons to larger pieces of stock during the blast cleaning and metalizing operations.

.2 Spray metalizing 200 µm thick in a right angle cross hatch spray passes, laying down approximately 100 µm per pass.

.3 Bend coupons 180 degrees around a 12.5 mm diameter mandrel.

1. Bend test passes if there is no cracking or only minor cracking visually observed on the bend-radius.
2. Bend test fails if the coating cracks and lifts from the substrate.

.8 The equipment shall be operated according to the manufacturer's latest written instructions, including air pressure, gun distance to work surface, and gun angle relative to the work surface.

.9 Thermal metal spraying shall be done in a block pattern, typically 600 mm square. The sprayed metal shall overlap 50% on each pass to ensure uniform coverage. The required coating thickness shall be obtained in multiple layers. Each layer shall be applied at right angles to the previous layer. The semimolten or molten particles of metalizing wire shall be firmly adhered to the substrate; free from lumps, chips, blisters, or loosely adhering particles; and have a fine-sprayed texture.

.10 Metalizing to be completed in the field (including the touch-up of damaged components), shall be completed after all welding is complete and all bolts are fully tensioned.

.11 The shop where metalizing is complete shall be fully enclosed with outside walls to grade and a roof.

.12 Proper spray equipment setup, calibration and operating procedures shall be verified by passing the bend test (noted in this Section) at the beginning of each work shift that metalizing is to be applied.

3.4 SEAL COATING OF THERMAL SPRAYED METAL COATINGS

.1 All thermal sprayed metal coated surfaces shall be seal coated within six (6) hours after application of thermal sprayed metal coating according to SSPC-PA 1.

.2 Contamination on thermal sprayed metal coated surfaces, including dust and moisture, shall be removed to the satisfaction of the Contractor’s Independent NACE Inspector and the Departmental Representative prior to the application of the seal coat. The seal coat materials shall be mixed and applied according to the manufacturer's instructions. Thinning shall not be done, unless approved in writing by the manufacturer and by the Departmental Representative.

.3 For the requirement of the seal coat see Section 09 97 19.

.4 The minimum dry film thickness shall be 100 µm for the seal coat (normally applied as a two-coat application process or as recommended by the coating manufacturer).

3.5 REPAIR OF THERMAL SPRAYED METAL COATINGS AND SEAL COAT

.1 The Departmental Representative shall be notified 24 hours in advance of their intention to carry out the repair of damaged coatings.

.2 Damaged metal coating and uncoated areas of structural steel surfaces shall be cleaned of all rust and other contaminants and repaired by thermal metal spraying according to SSPC-CS 23.00/AWS C2.23M/NACE No.12 to provide a thickness of minimum 200 µm, applied in two separate coats. The surfaces shall be brought to the original surface preparation standard specified prior to thermal metal spraying.

.3 For repair of seal coated metalized surfaces, the seal coating on and around the metalized surfaces that are to be repaired shall be removed by sanding to a sufficient distance from the repair area to prevent damage to seal coating during the metal coating repair process. The repaired area shall then be coated with the specified seal coating system according to the Seal Coating of Thermal Sprayed Metal Coatings clause.

3.6 METALIC COATING MATERIALS

.1 A 1.0 m long metalizing wire from the same batch used in the work shall be submitted to the Departmental Representative.

.2 The Contractor’s NACE inspector shall prepare and sign a letter that indicates that the sample(s) of wire enclosed with the letter was taken from the same batch as the metal wire used in the remainder of the metalizing.

.3 The Contractor shall provide a certificate of chemical composition of the thermal spray feedstock from a single manufacturer for all materials used on the project.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Codes and standards referenced are the latest versions at time of project tender.

.2 Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals, (5th Edition).

.3 ASTM International

.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A276/A276M-17, Standard Specification for Stainless Steel Bars and Shapes.

.3 ASTM B209M-14, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate Metric.

.4 ASTM B210M-12, Standard Specification for Aluminum-Alloy Drawn Seamless Tubes Metric.

.5 ASTM B211M-12e1, Standard Specification for Aluminum and Aluminum-Alloy Bar, Rod and Wire Metric.

.6 ASTM A153/A153M-16a, Zinc Coating (Hot Dip) on Iron and Steel Hardware

.7 ASTM A780/A780M-09(2015), Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings.

.4 Canadian General Standards Board (CGSB)

.1 CGSB 62-GP-9M, Prefabricated Markings, Positionable, Exterior, for Aircraft Ground Equipment and Facilities.

.2 CGSB 62-GP-11M, Marking Material, Retroreflective, Enclosed Lens, Adhesive Backing and Amendment.

.5 CSA International

.1 CSA G40.20-13/G40.21-13 (R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.2 CAN/CSA-O80 SERIES-15, Wood Preservation.

.3 CSA O121-17, Douglas Fir Plywood.

.4 CSA W47.2-11 (R2015), Certification of Companies for Fusion Welding of Aluminum.

.5 CAN/CSA-Z809-16, Sustainable Forest Management.

.6 CSA O141-05 (R2014), Softwood Lumber

.6 Forest Stewardship Council (FSC)

.1 FSC-STD-01-001, FSC Principle and Criteria for Forest Stewardship.

.7 Green Seal Environmental Standards (GS)

.1 GS-11-2015, Paints and Coatings.

.8 The Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual - September 2012.

.9 Ontario Provincial Standard Specifications (OPSS)/Ontario Ministry of Transportation: Access on-line as per Section 01 11 00):

.1 OPSS 2001 November 2014, Metal Sign Blanks

.10 Ministry of Transportation (MTO)
.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.2 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for traffic signage, including product characteristics, performance criteria, physical size, finish and limitations.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Meet or exceed specified provincial standards using only materials that at approved for use in Ministry of Transportation Ontario (MTO) construction projects

.2 Sign supports:

.1 Steel posts: to CSA G40.21-13 (R2018), 4 m long, flanged "U" shaped in cross section, measuring 65 mm wide x 30 mm deep. Metal thickness: 4.5 mm. Hot dipped galvanized: to ASTM A123/A123M, Coating Grade 85.

.2 Standard tubular supports for small signs: to ASTM B210M.

.3 Timber posts:

.1 Posts to be in dressed sizes and pressure treated with wood preservative.

.2 Tolerance on the cross-sectional dimensions of all wooden posts is ± 2 mm.

.3 Wood preservative to be according to CAN/CSA O80 SERIES-15, Use Category UC 4.1.

.4 Wood posts to be stamped for wood preservative treatment using a certification mark authorized by the Canadian Wood Preservers Bureau (CWPB). The wood preservative stamp shall will be visible after installation and located at least 1.8 m from the bottom of the post.

.4 Vertical tubular supports and connecting diagonal members: to ASTM B210M.

.5 Truss members: to ASTM B210M.

.6 Aluminum tubular members: belt ground satin finish.

.7 Base plates for ground mounted signs: to ASTM B209M. Base plates for overhead supports: to ASTM B209M.

.8 Tubular support caps for ground mounted signs: to ASTM B210M or fabricated from aluminum plate as specified in ASTM B209M. Castings for overhead signs: to ASTM B211M.

.9 Aluminum flanges: to ASTM B211M.

.10 Anchor and connecting bolts, 'U' clamps and miscellaneous hardware for overhead sign installations: fabricate from 304 stainless steel as specified in ASTM A276/A276M-17.

.11 Sign hardware for ground mounted signs to be hot dip galvanized according to ASTM A153/A153M-16a.

.3 Signboards:

.1 Plywood: to CSA O121, 19 mm thick. Overlaid Douglas Fir, Medium Density CAN/CSA-Z809 or FSC or SFI certified, overlaid one side only with fibre or plastic sheet surfacing material.

.1 Plywood blanks not will not deviate more than 4 mm from the specified size in any dimension, except thickness.

.2 Aluminum sheet: to ASTM B209M, precut to required dimensions.

.1 Thickness for signboards up to 750 mm wide: 2.1 mm minimum.

.2 Thickness for signboards 750-1200 mm wide: 2.1 mm minimum.

.3 Thickness for refurbishing existing sign panels: 1.0 mm minimum.

.4 Aluminum sign blanks are not to deviate more than 3 mm from the specified size in any dimension, except thickness.

.3 Aluminum extrusions: to ASTM B211M, 150 mm or 300 mm panels suitable for bolting together.

.4 T-shape stiffeners for signboards: to ASTM B210M.

.5 Connecting straps and brackets: to ASTM B209M.

.6 Aluminum materials: to ASTM B209M.

.7 Xylene thinner: to CAN/CGSB-1.94.

.8 Chemical conversion coating for aluminum:

.9 Primer for aluminum: to MPI # 8, VOC limit of GS-11.

.10 Screen print ink and Coatings:

.1 Transparent or opaque colours per OTM Book 2.

.11 Reflective sheeting and tape: to ASTM D 4956.

.12 Transparent tape: flexible, smooth-surfaced, moisture resistant tape with pressure sensitive adhesive.

2.2 FABRICATION

.1 Supports:

.1 Connect aluminum support members by welding in accordance with CSA W47.2. Work to be performed by Canadian Welding Bureau qualified members only. Flame cutting of members not permitted.

.2 Welds to be of same strength as adjacent member or casting.

.3 Reinforce in area of electrical hand holes to equal strength of full section member.

.4 Remove sharp edges and burrs.

.2 Signboards:

.1 Plywood blanks:

.1 Cut plywood blanks to required shapes and dimensions. Fill edges with wood filler suitable for outdoor use and sand smooth.

.2 Lightly sand surfaces, wipe clean with xylene thinner and allow to dry for 8 hours.

.3 Spray signboard back and edges with one prime coat and two white finish coats in the same colour as the sign face.

.2 Aluminum blanks:

.1 Degrease, etch and bonderize with chemical conversion coating.

.2 Clean surfaces with xylene thinner. Dry.

.3 For non-reflective signs, spray face with one coat vinyl pretreatment coating and two finish coats of required colour.

.4 For aluminum signboards that are to be painted before installation, spray and bake face of signboards with two coats of enamel in accordance with MPI-EXT 5.4A.

.3 Reflective background sheeting and lettering:

.1 Cut and apply in accordance with manufacturer's instructions.

.2 Apply adhesive coated material with heat lamp vacuum applicator or by squeeze roll application method. Apply pressure sensitive material with roller or squeegee.

.3 Edge wrap sheeting on each extrusion prior to bolting extrusions. Match pieces of sheeting from different rolls for each signboard to ensure uniform appearance and brilliance by day and night.

.4 Reflective signboard faces may be prepared using silk screen transparent ink.

.4 Non-reflective lettering and symbols: cut from vinyl film as specified in CGSB 62-GP-9M, or paint using required colour of finish paint or silk screen transparent ink.

.5 Clean signboards completely and apply transparent tape over top edge and extending 25 mm minimum down back and front of signboard.

.6 Protect finished signboard faces with one coat of clear.

.3 Sign identification:

.1 Apply sign number and date of installation with 25 mm high stencil painted black letters on lower left back face of each signboard.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Sign bridge:

.1 Erect sign bridge as indicated. Permissible tolerance: 12 mm maximum departure from vertical.

.2 Sign support:

.1 Erect supports as indicated. Permissible tolerance: 50 mm maximum departure from vertical for direct buried supports. Where separate concrete footings have been placed, erect posts with base plates resting on levelling nuts and restrained with nuts and washers. Permissible tolerance: 12 mm maximum departure from vertical.

.2 Coat underside of base plate with corrosion protective paint before installation.
Connect shoe base to shaft with inside and outside fillet welds.

.3 Close open aluminum tubes and posts with aluminum cap. Cut oblong holes in shoe bases to drain condensation. Install aluminum bolt cover on each base plate restraining nut.

.4 Erect posts plumb and square to details as indicated.

.5 Single channel steel posts:

.1 Drive to required depth without damage to posts.

.2 If rock or concrete is encountered, drill hole to required depth and set post in sand.

.3 In finished concrete surfaces, backfill with concrete or grout. Protect from adverse conditions until cured.

.6 Wooden post installation:

.1 Excavate post holes to required diameter. Compact bottom of hole to provide firm foundation. Set post and backfill in 150 mm layers with excavated material. Compact each layer before placing each subsequent layer.

.2 Leave or make depression, approximately 150 mm deep, around posts until paint is dry, then backfill and compact with excavated material to ground elevation.

.7 Join truss sections with wrought aluminum flanges welded to chords with inside and outside fillet welds. Build in camber to truss and monotube bridge supports to allow for deflection due to dead load of sign support, signboards, appurtenances; and an additional 1:300 camber.

.3 Signboard:

.1 Fasten signboards to supporting posts and brackets as indicated.

.2 Fasten lane markers to signboard. Use T-shape aluminum stiffeners to join portions of sign panel on site. Cover face of T-stiffener with material identical to face of sign panel.

3.2 REPAIR/ RESTORATION

.1 Prepare new message on 1.0 minimum mm aluminum sheet.

.2 Install new message on existing signboard in place, or remove existing signboard and install new message before re-erection.

.3 Rivet new message to existing using 3 mm blind rivets at 300 mm centre to centre maximum around each portion of sheeting and with four, 6 mm diameter stainless steel bolts at corners.

3.3 CORRECTING DEFECTS

.1 Correct defects, identified by Departmental Representative, in sign message, consistency of reflectivity, colour or illumination. Correct angle of signboard and adjust luminaire aiming angle for optimum performance during night conditions to approval of Departmental Representative.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for recycling in

accordance with Section 01 74 20.

.1 Carefully dismantle and salvage wood, aluminum and steel materials for recycling.

.2 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.3 Deliver salvaged materials to location identified by Departmental Representative.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by traffic signage installation and salvage operations.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

.1 Design, supply, installation and commissioning of an electrical room and storage facility including all services. Building to consist of concrete or masonry block walls and may be prefabricated or cast-in-place.

.2 Design, supply and installation of prefabricated wood roof trusses.

.3 Construction of building foundations as per Contract Drawings.

.4 Design, supply and installation of all interior and exterior finishes.

1.2 RELATED REQUIREMENTS

.1 Section 03 10 00 - Concrete Forming and Accessories.

.2 Section 03 20 00 – Concrete Reinforcing.

.3 Section 03 30 00.01 – Cast-in-Place Concrete.

1.3 PRICE AND PAYMENT PROCEDURES

.1 Measurement and Payment:
- .1 In accordance with Section 01 22 01, there will be no measurement for work associated with the Control House.
- .2 In accordance with Section 01 22 01, payment for work associated with the Control House is included in the Lump Sum Price.

1.4 REFERENCES

.1 American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc. (ASHRAE)
- .1 ASHRAE 90.1-2016 (SI Edition), Energy Standard for Buildings Except Low-Rise Residential Buildings.

.2 American Society for Testing and Materials (ASTM)
- .1 ASTM C36/C36M-01, Specification for Gypsum Wallboard.
- .2 ASTM C553-13, Specification for Mineral Fibre Blanket Thermal Insulation for Commercial and Industrial Applications.
- .3 ASTM C665-17, Specification for Mineral-Fibre Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.

.3 Canadian Standards Association (CSA International)
- .1 CSA A23.3-14, Design of Concrete Structures.
- .2 CSA A23.4-16, Precast Concrete – Materials and Construction.
- .3 CSA A123.3-05 (R2015), Asphalt Saturated Organic Roofing Felt.
- .4 CSA A165 Series-04 (R2014), CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
- .5 CSA G30.18-09 (R2014), Carbon steel bars for concrete reinforcement.

.6 CSA O141-05(R2014) – Softwood Lumber.
.7 CSA O118.1(R2013) – Western Red Cedar Shakes and Shingles.
.8 CSA O118.2(R2013) – Eastern White Cedar Shingles.

.4 Standard Council of Canada
.1 CAN/CGSB-12.2-M91 (R2017), Flat, Clear Sheet Glass.
.2 CAN/CGSB-75.1-M88, Tile, Ceramic.
.3 CAN/ULC-S101-07, Standard Methods of Fire Endurance Tests of Building Construction and Materials.
.4 CAN/ULC-S102-10, Standard Methods of Test for Surface Burning Characteristics of Building Materials and Assemblies.
.5 CAN/ULC-S702-14, Standard for Mineral Fibre Thermal Insulation for Buildings.
.6 CAN/ULC-S705.1-15, Standard for Thermal Insulation - Spray Applied Rigid Polyurethane Foam, Medium Density - Material Third Edition.
.7 CAN/ULC-S705.2-04, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density - Installer's Responsibilities - Specification.

.5 National Building Code of Canada, NBC 2015.

.6 National Research Council (NRC)/Institute for Research in Construction (IRC)
.1 Construction Technology Update No. 9-1997, Evolution of Wall Design for Controlling Rains Penetration.
.2 Construction Technology Update No. 17-1998, Pressure Equalization in Rainscreen Wall systems.
.3 Construction Technology Update No. 34-1999, Designing Exterior Walls According to the Rainscreen Principle.

.7 Department of Justice Canada (Jus)
.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
.2 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.8 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
.1 Material Safety Data Sheets (MSDS).

.9 Geotechnical Investigation Report Repair/Upgrade-Replacement of Hamlet Swing and Fixed Bridges, Hamlet, Ontario”, by Golder Associates, dated January 19, 2018.

1.5 ADMINISTRATIVE REQUIREMENTS

.1 Pre-installation Meetings:
.1 Convene pre-installation meeting one (1) week prior to beginning work of this Section and on-site installation, with contractor's representative and Departmental Representative in accordance with Section 01 31 19 to:
.1 Verify project requirements.
.2 Review installation and substrate conditions.
.3 Co-ordination with other building construction subtrades.
.4 Review manufacturer's written installation instructions and warranty requirements.
.2 Arrange for site visit with Departmental Representative prior to start

of Work to examine existing site conditions adjacent to demolition work.
.3 Hold project meetings every week.
.4 Ensure key personnel, contractor's site supervisor, subcontractor representatives attend.
.5 Departmental Representative will submit written notification of change to meeting schedule established upon contract award 24 hours prior to scheduled meeting.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for sealants, insulation, and building materials and include product characteristics, performance criteria, physical size, finish and limitations.
.2 Submit two (2) copies of WHMIS MSDS in accordance with Section 01 35 29 and Section 01 35 43, for the following.
.1 Sealants.
.2 Tape.
.3 Proprietary joints.

.3 Shop Drawings:
.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
.1 Submit drawings for the prefabricated or cast-in-place building.
.2 Submit shop drawings for the prefabricated roof trusses.
.3 Submit drawings for fabricator designed assemblies, components and connections. Stipulation to this effect may appear on submitted drawings.

.4 Delegated Design Submittals:
.1 Indicate plans and grid lines, structural members and connection details, bearing and anchorage details of roof cladding, wall cladding, framed openings, accessories, schedule of materials and finishes, camber and loadings, fasteners and welds.
.2 Indicate detailed description of mechanical, electrical and other systems in Work.
.3 Describe requirements of other systems of components related to this Work but provided by others.
.1 Obtain necessary information required to detail this Work including methods of integration and securing.
.4 Submit erection drawings to Departmental Representative for approval, before construction.
.5 Indicate erection dimensions and methods.

.5 Manufacturer's Instructions: submit application instructions for caulking, tape, and sealant.

.6 Manufacturer's Field Reports: submit to Departmental Representative manufacturer's written report, within three (30) days of review, verifying

compliance of Work, as described in PART 3 - FIELD QUALITY CONTROL.

.7 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect components and equipment from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 35 29.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21.

.6 Place materials defined as hazardous or toxic in designated containers.

.7 Handle and dispose of hazardous materials in accordance with CEPA, TDGA, and Regional and Municipal regulations.

.8 Ensure emptied containers are sealed and stored safely.

.9 Unused sealant materials must not be disposed of into sewer system, into streams, lakes, onto ground or in other location where it will pose health or environmental hazard.

1.8 WARRANTY

.1 Contractor warrants Work of this section for five (5) years.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Building materials: The prefabricated or cast-in-place building structure is to consist of concrete or masonry block walls. The roof is to consist of prefabricated wood trusses.
.1 Concrete: to CSA A23.1/CSA A23.2 and CSA A23.4.
.2 Masonry block: to CSA A165 Series.

.3 Reinforcing steel to: CSA G30.18.
.4 Lumber for roof trusses: to CSA-O141.

.2 Foundation walls, footings and slab on grade:
.1 To be in accordance with Section 03 10 00, Section 03 20 00 and Section 03 30 00.

.3 Roofing:
.1 Asphalt shingles to CSA A123.1/A123.5.
.2 Type, colour and texture to be approved by Departmental Representative.

.4 Siding:
.1 Cedar shingles to CSA O118.1 or O118.2.
.2 Shingles to be fire-retardant treated.
.3 Size and pattern to be approved by Departmental Representative.

.5 Glass and glazing materials:
.1 Glass: to CAN/CGSB-12.2.
.2 Glass to be double glazed windows.
.3 Glass and glazing to be approved by Departmental Representative.

.6 Vapour retarders:
.1 Polyethylene film: to CAN/CGSB-51.34, 0.152 mm thick, heavy duty.
.2 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
.3 Sealant: compatible with vapour retarder materials, recommended by vapour retarder manufacturer.
.4 Staples: minimum 6 mm leg.

.7 Sealants:
.1 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
.2 When low toxicity caulks are not possible, confine usage to areas which offgas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize offgas time.
.3 Where sealants are qualified with primers use only these primers.
.4 Sealants to be approved by Departmental Representative.

.8 Thermal Insulation:
.1 Batt and blanket mineral fibre: type RSI 2.11 to ASTM C553, ASTM C665 and CAN/ULC S702.
.2 Sprayed Insulation: to CAN/ULC S101, CAN/ULC S102, CAN/ULC S705.1, CAN/ULC S705.2.
.3 Insulation to be approved by Departmental Representative.

.9 Exterior Door:
.1 1.34 mm (16 gauge) thermally broken frame
.2 1.06 mm (18 gauge) insulated embossed metal door.
.3 Door hardware to include: heavy duty lockset, ball bearing hinges and dead bolt, closure, weatherstrip and overhead stop.
.4 Door, frame and hardware to be approved by Departmental

Representative.

.10 Interior Door:
- .1 Solid core wood door.
- .2 1.34 mm (16 gauge) metal frame.
- .3 Door hardware to include: Heavy duty ball bearing hinges, heavy duty lockset and floor stop.

.11 Interior walls and ceilings:
- .1 Gypsum board: to ASTM C36/C36M regular, 13 mm thick and 1200 mm wide x maximum practical length, ends square cut, edges bevelled, as indicated.

.12 Floor tile:
- .1 Ceramic tile: to CAN/CGSB-75.1.
- .2 Colour, pattern and size to be approved by Departmental Representative.

.13 Paint:
- .1 Provide paint materials for paint systems from single manufacturer.
- .2 Conform to latest MPI requirements for interior painting work including preparation and priming.
- .3 Materials (primers, paints, coatings, fillers, thinners, solvents, etc.) in accordance with MPI Architectural Painting Specification Manual "Approved Product" listing. Use MPI listed materials having E2 rating where indoor air quality requirements exist. Primer: VOC limit 100g/L maximum. Paint: VOC limit 100 g/L maximum.
- .4 Colours and finish to be approved by Departmental Representative.

2.2 SYSTEM DESCRIPTION

.1 Provide building structure and enclosure to physical dimensions as indicated.

.2 Building occupancy as defined by National Building Code of Canada is Group D or F, as determined by the Regulatory Authority and with all applicable health and safety.

.3 Generally, building is intended to enclose machinery, electrical equipment and bridge operators.

.4 The building us to be fireproof, weatherproof, and climate controlled.

2.3 DESIGN CRITERIA

.1 Design of building and prefabricated trusses to be in accordance with NBCC 2015.
- .1 Design members to withstand, within acceptable deflection limitations, all the applicable loads indicated in the NBCC 2010.
- .2 For site specific loads such as wind, snow and seismic loads, use the climatic data from the NBCC 2015 nearest to Hamlet, Ontario.
- .3 Allow for ceiling, piping, conduit and other interior dead loads imposed on this structure.

.2 Maintain heat transfer to maximum 'U' value of 0.6 as calculated by ASHRAE 90.1 zone method or by rational analysis based on tests.

.3 Design building to allow for thermal movement of component materials caused by ambient temperature range of 46 degrees C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

.4 Ensure total absence of condensation on interior surfaces.

.5 Building watertight construction.

.6 Provide for positive drainage of condensation occurring within wall construction and water entering at joints, to exterior face of wall in accordance with "Rain Screen Principles", as described by NRC/IRC.

.7 Vapour seal building enclosure to withstand, without failure, design RH at design ambient temperature condition, maintained against interior atmospheric pressure of 250 Pa.

.8 Design building enclosure elements to accommodate, by means of expansion joints, movement in wall and structural movements without permanent distortion, damage to infills, racking of joints, breakage of seals, water penetration or glass breakage.

.9 Design, assemble and secure building elements to building frame to ensure stresses in sealants and seals are within sealant manufacturer's recommended maximum.

.10 Design building assembly to permit easy replacement and disassembly of components.

.11 Contractor to design connections between foundation walls and building.

.12 Building interior environment: heated and cooled to maintain temperature of 20 degrees C minimum to 25degrees C maximum with relative humidity of 25% to 50%.

.13 Building lighting: maintain measured lighting level of 10 lx at 1500mm above finished floor, after building finishes and painting complete.

.14 Access units, doors, and windows to sizes and locations indicated.

.15 Locations of housekeeping pads for equipment as indicated on Contract Drawings.

2.4 PERFORMANCE CRITERIA

.1 Maximum deflection for roofing under full specified live load: 1/360 of clear span.

.2 Maximum deflection for exterior cladding under full specified exterior wind induced loads: 1/180 of clear span.

.3 Maintain following tolerances for building structure and enclosure elements.
.1 Maximum variation from plane or location shown on shop drawings: 1 mm/1 m of length and up to 1 mm/5 m maximum.
.2 Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75 mm.

2.5 FABRICATION

.1 Maintain air and vapour and thermal barrier throughout building enclosure elements.

.2 Locate vapour barrier on warm side of thermal insulation.

.3 Locate air barrier as detailed.

.4 Complete enclosure assembly with exterior skin, glass units, access units, doors, inner air/vapour seal membrane, thermal insulation and interior finish.

.5 Accurately fit and rigidly frame together joints, corners and mitres.
.1 Match components carefully to produce continuity of line and design.
.2 Make joints and connections toward exterior weathertight.
.3 Provide hairline joints for materials in contact.
.4 Co-ordinate location of visible joints.

2.6 FINISHES

.1 Not used.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for prefabricated building erection installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 ERECTION

.1 Erect building structure and enclosure elements.

3.3 FIELD QUALITY CONTROL

.1 Manufacturer's Field Services:
.1 Obtain written report from manufacturer's verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
.2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
.3 Ensure manufacturer's representative is present before and during critical periods of installation.
.4 Schedule site visits:
.1 After delivery and storage of products, and when preparatory Work is complete but before installation begins.
.2 Upon completion of Work, after cleaning is carried out.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.
.1 Remove excess sealant by moderate use of low VOC mineral spirits or other solvent as directed by sealant manufacturer.
.2 Clean surfaces.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 PROTECTION

.1 Protect finished surfaces with strippable coatings, strippable wrappers, plywood or sheet materials as required before acceptance of Work.

.2 Protect installed products and components from damage during construction.

.3 Repair damage to adjacent materials caused by sealants, insulation, and building materials installation.

END OF SECTION

PART 1 - GENERAL

1.1 MANUFACTURE OF HYDRAULIC EQUIPMENT

.1 The supply of new components of the hydraulic system shall be the responsibility of one company only. This company shall be a recognized manufacturer of high pressure oil-hydraulic systems and shall be acceptable as such to the Departmental Representative. The supplier of the hydraulic system shall be the same supplier responsible for manufacture of the Hydraulic Power Unit Control Panel (HPUCP), defined in specification sections 24 05 01 and 40 25 00.

.2 The hydraulic system shall be constructed as shown on the drawings and designed for low maintenance requirements and to facilitate easy troubleshooting.

.3 The Contractor shall be responsible for the coordination of the hydraulic work with all other work items as necessary to produce completed systems which meet the requirements of the Contract Documents. The coordination effort shall be overseen by the Moveable Bridge Specialist Hydraulic Engineer.

1.2 LIMITS OF WORK

.1 The limits of work included for this section are as indicated on the Contract Drawings, supply of the hydraulic cylinders as indicated on the Contract Drawings, and as specified herein.

1.3 SUPPLIER QUALIFICATIONS

.1 Fabrication of the Hydraulic Power Unit (HPU) and associated Hydraulic Power Unit Control Panel (HPUCP) shall be done in a qualified shop with a minimum of 10 years of experience in the design and manufacture of hydraulic systems for the movable bridge industry.

.2 Supplier shall engage the services of a Movable Bridge Specialist Hydraulic Engineer, meeting the qualifications described in Section 01 45 00. Design review, calculations, preparations of shop drawings, fabrication, shop testing and field testing must be supervised by a Professional Engineer (Movable Bridge Specialist Hydraulic Engineer) who has been responsible for the design of at least three hydraulic systems for movable bridges. In addition, it will be the responsibility of the Professional Engineer to coordinate all aspects of the electrical interface with the hydraulic system.

The Professional Engineer must: make and sign and submit all calculations, check, seal and sign all shop drawings; witness all shop tests, inspect at the installation site installed hydraulic systems and accessories to ensure that they were properly installed, have all required components, are mechanically sound, and are safe to operate. The certificate must be provided to the Departmental Representative on completion of Commissioning Stage 1 – Contractors Field Testing.

.3 Piping, flushing, installation and adjustment of hydraulic components shall be done under the direction of a Certified Fluid Power Technician, Certified Fluid Power Specialist, or Certified Fluid Power Engineer with a minimum of 5 years and 3 prior jobs experience within the movable bridge field.

1.4 STANDARDS

.1 All new hydraulic components must meet the requirements of the National Standard of Canada CAN/CSA-S6-14 Canadian Highway Bridge Design Code, hereinafter referred to as CHBDC.

.2 Record as-built changes in accordance with National Fluid Power Association Standard Section 7.4.3.

.3 Standards referred to in the Contract Documents are published by the following organizations and are directly applicable to the material and workmanship required by this item.

.1 ASTM – American Society for Testing and Materials
.2 ANSI – American National Standards Institute
.3 CSA – Canadian Standards Association
.4 AWS – American Welding Society
.5 SSPC – The Society for Protective Coatings
.6 NFPA – National Fluid Power Association
.7 DNV – Det Norske Veritas
.8 DIN - Deutsches Institut für Normung (German Institute for Standardization)
.9 ISO – International Standards Organization

1.5 SUBSTITUTIONS

.1 Items specified by manufacturer name or part number on the Contract Plans may be replaced by an equivalent item by another manufacturer, subject to approval by the Departmental Representative, with the understanding that all changes required by the substitution are made at no additional cost. Item equivalency shall be determined at the sole discretion of the Departmental Representative and may be based on one or more of the following: quality, function, ease of maintenance, physical size, reliability, value, load capacity (static and dynamic), durability, availability and other criteria as deemed appropriate by the Departmental Representative.

1.6 PERFORMANCE

.1 The hydraulic schematic and schedule provided in the Plans are provided, in combination with the requirements of the Specifications, to show the design intent for the hydraulic system for tendering purposes. The hydraulic system supplier is responsible for final sizing and selection of all components. Even if no changes to the circuit are made, the hydraulic system supplier shall be responsible for the design and ensuring that the system will meet the performance

requirements herein. If, in the opinion of the hydraulic system supplier, significant modifications are necessary to meet any of the requirements, this shall be brought to the attention of the Departmental Representative 10 days prior to the tender closing. Any troubleshooting, including materials and labor to modify the circuit during field start up, which is necessary to achieve acceptable performance of the completed system, shall be performed at no additional cost.

.2 The performance requirements of the hydraulic system are as follows:

.1 Swing Circuit:

.1 Provide for two speed (creep and normal) operation to start, smoothly accelerate (continuous linear acceleration from zero speed to constant speed) the swing span, run at constant speed, smoothly decelerate (continuous linear deceleration from normal speed to creep speed) the swing span to creep speed and stop and hold the span against a bumper at reduced force.

.2 Creep and normal speed & pressure shall be independently field adjustable in both directions.

.3 Once set, speed of operation shall be constant independent of changes in external loading on the swing span (e.g. wind, ice or friction).

.4 Time of operation for a 75 degree swing shall be 105 seconds including ramp time of 10 seconds ramp up, and 10 seconds ramp down.

.5 System working pressure, which may not be exceeded during a normal operation, is 19 MPa.

.6 System maximum pressure, which may not be exceeded during any operational condition including during an emergency stop, is 20.7 MPa.

.7 When stopped, the hydraulic system shall prevent the span from drifting excessively when subjected to external loading.

.8 During normal operation, cushions shall not be utilized in the span drive cylinders to assist in decelerating the span.

.9 In a scenario of creep speed limit switch failure, cushions shall be designed such that the bridge is decelerated to 15-20% of full speed within 5 seconds. Cushion deceleration should be less than normal deceleration to warn bridge tender of limit switch failure.

.10 During emergency stop an accumulator shall be used to mitigate shock loading and provide a short ramp time of 3-5 seconds.

.2 End Lift Circuit:

.1 The hydraulic system shall be capable of operating the end lift system in 10 seconds.

.2 The end lift system shall be hydraulically synchronized by use of a rotary flow divider/combiner.

.3 The hydraulic system shall be capable of retracting the end lift system at a controlled rate with an overhauling load applied to the hydraulic cylinder.

.4 The end lift system shall be capable of holding the position of the end lift cylinders without the presence of hydraulic pressure in the system.

.5 The end lift system shall be configured and adjusted to drive the end lift cylinders to the end of their physical limits of travel in each direction.

.3 Locking Pin Circuit:

.1 The hydraulic system shall be capable of operating the locking pin circuit at a reduced pressure.

.2 The time of operation for the locking pin shall be 5 seconds.

1.7 AVAILABILITY

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work. The following items are anticipated to require long lead times: Span drive hydraulic cylinders, end lift hydraulic cylinders, pumps, manifolds, electric motors, proportional valves and hose duct. It is recommended that shop drawings for procurement of these items be expedited to allow for early ordering of raw materials.

1.8 ADMINISTRATIVE

.1 Submit to the Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples and mock ups in SI Metric units.

.4 Where items or information is not produced in SI Metric units converted values are acceptable.

.5 Review submittals prior to submission to the Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work is coordinated.

.8 It is the responsibility of the hydraulics subcontractor to make the necessary arrangement and sizing of components for the proper functioning of the hydraulic system. Specification data provided in this document are only guidelines for the hydraulics subcontractor. The contract plans show estimated pressure drops and flows for components required to meet opening times & loads for the horsepower chosen. The contractor must confirm in their submittal these values are correct with supporting documentation of the selected components and calculations.

.9 Contractor's responsibility for errors and omissions in submission is not relieved by the Departmental Representative's review of submittals.

.10 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by the Departmental Representative's review.

.11 Keep one reviewed copy of each submission on site.

1.9 DIMENSIONS/CERTIFIED DRAWINGS

.1 Dimensions indicated on the Contract Drawings are nominal and intended for information. Many of the dimensions indicated on the Contract Drawings have been obtained from existing drawings or from information provided by various machinery manufacturers. The dimensions have not been field verified or obtained from certified drawings from the various manufacturers. All dimensions indicated on the Contract Drawings must be verified in the field or from certified drawings from the various machinery manufacturers by the Contractor. Notify the Departmental Representative of any dimensional deviations found during the verification. Make all required field measurements and obtain certified dimensions for all manufactured products necessary before shop drawings, fabrication, and installation may proceed. The Contractor is solely responsible for converting dimensions from metric to Imperial units, or vice versa, as required.

1.10 SUBMITTALS

.1 Shop drawings, erection drawings, machinery installation procedures, final record drawings, and other required submittals specified herein, shall be submitted in accordance with the requirements of the Contract.

.2 Submit complete drawing packages for all hydraulic system submittals including all HPUCP electrical submittals. Any submittals that do not contain all documents required for the manufacture, assembly and erection of the machinery system will be returned without review.

.3 Due to the important relation between the cushions and the swing span hydraulic cylinder mounting location, the contractor responsible for the concrete work, machinery installation, and hydraulic system supplier shall submit a coordinated erection plan with installation procedures to ensure proper functioning of the cushion feature of these cylinders. It is critical to install the cylinders such that 95% of the working cushion length is utilized. Drawing details and calculations shall be submitted to demonstrate proper coordination.

.4 Submit calculation for the hydraulic accumulator function showing pre-charge pressure, deceleration time, accumulator volume, accumulator flow rate diagram for normal operation and emergency stop operation in both direction of swing span operation.

.5 Submit calculations for hydraulic system operation showing each system flow, horsepower, and pressure for breakaway friction, acceleration forces, and normal operation forces. Show estimates for pressure drop of all elements in the system based on cold temperature (8 deg. C) and warm (32 deg. C) temperature operation. It is important to choose component sizes such that the horsepower losses due to pressure drops & flow for opening & closing are adequate to achieve the operating objectives.

.6 Submit span drive hydraulic cylinder cushion calculations as well as cushion shop and field test procedure. Cushion shop and field testing must include chart recording of cylinder stroke (velocity) verses pressure including internal cushion pressure. Calculations are to be based on a working cushion length as shown on the mechanical drawings at each end with a 5 second cushion deceleration. Cushions shall utilize a dual-stage valve design with internal cushion relief valve that is capable of external adjustment for fine tuning. Calculations for proper sizing of the external adjustment valves shall be included and shall confirm that the valves chosen will provide good adjustability. Calculations must take into account cushion dissipation of the flow and pressure energy due to the pumps compensator setting in addition to the inertia imposed by the span itself. Pressure drop for all elements in the system shall be taken into account for all calculations. Submit complete drawings of proposed span drive cylinder cushions showing all dimensions and internal cushion tolerances for approval.

.7 Provide complete engineering calculation details for proposed span drive cylinders showing the cylinders ability to operate safely within the given application and pressure requirements. Detailed calculations shall be submitted prior to any cylinder manufacturing to show at minimum the cylinders buckling strength, tube yield strength, rod eye tear out yield, mid-trunnion mount tear out yield, piston pull out strength. Rod end connection strength, and any other strength calculations deemed pertinent by the Engineer. Calculations shall demonstrate that the cylinders conform to CHBDC requirements.

.8 Submit calculations for pressure filter and return filter showing estimate of flow and pressure drop capacity utilized during normal operation, cold oil conditions, and warm oil conditions.

.9 Include efficiency data for the hydraulic pump from the pump manufacturer at the normal operating condition. Provide a certified drawing for the hydraulic pump.

.10 Submit an HPU shop test procedure for approval with the submittal package. A comprehensive test of HPU, manifolds, and HPUCP all connected together as a system will be performed prior to shipment to the field. Shop testing shall demonstrate and chart record, normal operation and creep speed in both directions as well as all auxiliary functions using a simulated load induced into the hydraulic system via proportional relief valves connected in place of the cylinders. Use these external proportional relief valves to induce a stepped response as well as other ramped responses to prove the combined electrical and hydraulic system will respond appropriately (i.e. counterbalance valve adjustments, ramp times, horsepower limiters, etc.).

.11 Submit a main span cylinder shop test procedure for approval with the submittal package. Shop test each main span cylinder/manifold actuator assembly to demonstrate ability to hold both low and high pressure (1Mpa & 20Mpa respectively) with less than 3cc/min leakage. Typical test would hold pressure locked inside cylinder for 5 minutes with less than 10% loss of starting pressure. Provide velocity vs pressure chart recordings of each main span cylinder/manifold actuator assembly’s cushion performance under normal operation cylinder speeds and failed creep speed limit switch scenario. Demonstrate that cushions do not interfere with normal operational speed and will provide specified cushioning speed under the failed limit switch scenario.

.12 Submit field test procedures for a comprehensive test of power unit, cylinders and HPU control panel. Provide chart recordings to demonstrate proper operation per the plans under normal operation, normal stop, E-stop for each pump operating. In addition provide chart recordings that verify cylinder cushion operation at normal speed and failed creep speed limit switch scenario. Demonstrate that cushions do not interfere with normal operational speed and will provide specified cushioning speed under the failed limit switch scenario.

.13 Submit a start-up and flushing procedure. Include requirements for testing the incoming hydraulic fluid for cleanliness as well as performing final fluid testing upon the completion of all functional testing.

.14 Submit detailed plans for the layout and configuration of the HPU room. Provide elevation views for all walls of the HPU room. Provide a floor and reflected ceiling plan. Show all components, including mechanical, structural, electrical, and hydraulic. Show all mounting details. Identify working clearances.

.15 Submit Hose & Hose duct drawings as defined below.

.16 Submit layout drawings for all hydraulic tubing. Show all structural, mechanical, and electrical components in sufficient detail to identify and prevent all conflicts. Show mounting details for all tubing. Provide isometric views where required to convey details.

1.11 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Submit drawings stamped and signed by a professional engineer registered or licensed in Ontario, Canada.

.3 Provide a detailed shop drawing submittal schedule to the Departmental Representative within 30 days of the "Notice to Proceed".

.4 Draw all shop drawings to scale (hydraulic schematic drawings excluded) and provide the scale on the drawings. Ensure that details of a given part are clearly visible at the scale selected for that part with the exception that enlarged views of small details within a part may be used to improve clarity and prevent excessively large drawings.

.5 Indicate materials, methods of construction and attachment or anchorage, connections, schedules for fabrication, shop assembly procedures, diagrams showing sequence and details for erection, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.6 Identify conflicts between manufacturers' instructions and Contract Documents and submit resolution for review and approval.

.7 Identify variations between Contract Documents and product or system limitations that may be detrimental to the successful performance of the completed work.

.8 Submit copies of producer or manufacturer data. This includes specifications, tests and installation instructions for the following items, but not excluding other items or materials not specifically mentioned.

- .1 Mill reports and physical tests of all metals
- .2 Bolts, nuts, washers and other fasteners
- .3 Paint
- .4 Lubricants
- .5 Standard stocked items

.9 Allow 30 days for the Departmental Representative's review of each submission.

.10 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Departmental Representative prior to proceeding with Work.

.11 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.12 Accompany submissions with transmittal letter containing:
.1 Date.
.2 Project title and number.
.3 Contractor's name and address.
.4 Identification and quantity of each shop drawing, product data and sample.
.5 A sequential number. Number resubmittals with the original submittal number and an alphabetic suffix.
.6 Other pertinent data.

.13 Submissions include
.1 Date and revision dates.
.2 Project title and number.
.3 Name and address of:
.1 Subcontractor.
.2 Supplier.
.3 Manufacturer.
.4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
.5 A complete shop bill of materials for all machinery parts.
.6 Details of appropriate portions of Work as applicable:
.1 Fabrication.
.2 Layout, showing dimensions, including identified field dimensions, and clearances.
.3 Setting or erection details.
.4 Capacities.
.5 Performance characteristics.
.6 Standards.
.7 Operating weight.
.8 Wiring diagrams.
.9 Single line and schematic diagrams.
.10 Relationship to adjacent work.
.11 Instructions for painting the machinery.
.12 All appropriate weld symbols along with stress relieving process for weldments.
.13 The surface finish of machined surfaces and tolerances for each dimension for which a specific fit is required. Fit and finish per CHBDC section 13.7.5.

.14 Dimension parts to ensure that components of a common purpose that are fabricated from the same detail are interchangeable.
.15 Tolerances for all drawing dimensions, either directly or via a standard title block, as necessary to obtain proper fit and function of assembled components.
.16 The required tension method of tightening and all other pertinent information for all machinery connection bolts.

.7 Proprietary parts shown in outline on the drawings with sufficient dimensions and data to determine the clearances required for installation and operation.

.8 Certified dimension prints from equipment manufacturers stating pertinent ratings of the equipment, and indicating, when applicable, provisions for adding, draining, and checking the lubricant, method of lubrication, amount and type of lubricant required and type of fittings, the location of inspection openings and the location and type of venting devices.

.9 Complete assembly and erection drawings shall be furnished. These drawings shall be given identifying marks and essential dimensions for locating each part or assembled unit with respect to the bridge or equipment foundation. Every part shall be cross referenced to the sheet on which it is detailed. Contract Plans shall not be submitted as a substitute for assembly or erection drawings.

.10 Indicate on the shop drawings, for review by the Departmental Representative, the type of tightening, type of wrench and the value of torque or other pertinent information of all connection bolts for all items and machinery.

.14 After the Departmental Representative's review, distribute copies.

.15 Submit electronic copies of product data sheets or brochures for requirements requested in the specifications where shop drawings will not be prepared due to standardized manufacture of product.

.16 Submit electronic copies of test reports for requirements requested in the specifications and as requested by the Departmental Representative.

.1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.2 Testing must have been within 3 years of date of contract award for project.

.17 Submit electronic copies of certificates for requirements requested in the specifications and as requested by the Departmental Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.18 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by the Departmental Representative.
.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.19 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by the Departmental Representative.

.20 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.

.21 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by the Departmental Representative.

.22 Delete information not applicable to project.

.23 Supplement standard information to provide details applicable to project.

.24 If upon review by the Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, approved electronic documents will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.12 SYSTEM REQUIREMENTS

.1 Identify, in accordance with National Fluid Power Association Standards, all components including those located within manifolds, mounting plates, pads or fittings. Design the system so that all components are easily installed, adjusted, inspected, and maintained.

.2 Environmental Protection: Design system so that all parts, motors, pumps, etc. are mounted over a stainless steel drip pan to contain a minimum of 50 liters of fluid.

.3 System Controls: System controls shall conform to National Fluid Power Association Standards. Provide starting and stopping functions for the prime mover and shifting functions for the proportional and directional control valving.

1.13 INSTALLATION PROCEDURE

.1 Prepare a detailed written installation procedure for the installation of all hydraulic machinery. Include sequence of installation start-up

& flushing procedure, bolt tightening methods and required tension values for all bolts. Include resumes for all Certified Fluid Power Technicians, Specialists or Engineers who will be responsible for the work with the written installation procedure.

.2 Demonstrate to the Departmental Representative that the Contractor has full knowledge of hydraulic procedures and that the work will be performed by qualified Certified Fluid Power Technicians.

.3 Begin installation of the system after the procedures and resumes have been submitted by the Contractor and they are satisfactory in the sole opinion of the Departmental Representative. Correct and resubmit the procedure and/or submit resumes for alternate personnel as necessary to the satisfaction of the Departmental Representative. This resubmission procedure, if required, is not cause for delay.

.4 Ship machinery items to the job site after the Contractor has submitted a satisfactory installation procedure.

1.14 SHIPPING AND HANDLING

.1 Power units, valve stands, and cylinder assemblies shall be shipped to the site fully assembled. Prior to shipment, securely seal hydraulic equipment fluid ports. Prior to installation, store units fully assembled indoors in a clean, dry, dust-free environment.

1.15 FINAL RECORD DRAWINGS AND SPECIFICATION (“AS BUILT DRAWINGS”)

.1 Submit reproducible drawings for all materials as fabricated following fabrication. Clearly indicate any deviations from the approved shop drawings. Make reproducible drawings using the Department’s standard title block. Stamp these drawings “As Built”, immediately above the title block. Coordinate these submissions with the requirements of Sections 01 77 00 and 01 78 00.

1.16 MAINTENANCE MANUAL

.1 Contents of Manual:

.1 Table of contents, in the following order.

.2 Manufacturer’s literature describing each piece of equipment and giving manufacturer’s model number and drawing number.

.3 Copies of all warranties on equipment supplied to the project. For each item of work defined in this specification, provide a warranty of two (2) years of both materials and workmanship for all failures, repair.

.4 Copies of all approved installation procedures.

.5 Copies of all assembly, erection and shop drawings. These drawings to be included “as built” in the final version of the manual.

.6 Steps for cursory inspection that should be carried out annually.

.7 Steps for semi-in-depth inspection that should be carried out every 3 years.

.8 Steps for in-depth inspection that should be carried out every 6 years.
.9 List of nearest local suppliers of all equipment parts.
.10 List of parts and supplies that are to be furnished as part of the Contract.
.11 Name, address, and telephone number of the local manufacturer's representative and of the service company for each piece of equipment so that prices or spare parts can easily be obtained.
.12 Copies of hydraulic cylinder pressure strip chart recordings made during start up testing.
.13 Cushion setup and adjustment procedure.
.14 Accumulator setup and adjustment procedure.
.15 Normal operating procedures.
.16 Emergency operating procedures.

.2 Submit six preliminary copies of the manual prior to shipment of machinery to the site. Complete the preliminary manual in all respects with regard to material content, organization and legibility for review by the Departmental Representative. Preliminary copies need not comply with presentation requirements including page size, paper weight, paper reinforcement and protection including oil, moisture and wear resistant covers, and copy method.

.3 Preliminary copies will be reviewed and the changes made will be incorporated in to the final manual. Submit six final copies of the manual after the machinery is in operation. Incorporate into the final manual the Departmental Representative’s comments on the preliminary manual and all field changes made during construction and installation. Ensure permanence of the manuals by complying with all presentation requirements.

.4 Provide an electronic copy of the final manual in Portable Document Format (PDF).

.5 Furnish manufacturer's operating and maintenance manuals giving complete instructions relative to assembly, installation, operation, adjustment, lubrication, maintenance, and carrying complete parts lists for every item of equipment furnished by the Contractor.

.6 Manuals may be manufacturer's standard publications provided that they comply with specified requirements relative to quantity and quality of information and data.

.7 Neatly imprint the covers and title page with a descriptive title and that contain the name of the bridge, owner, and location. Include on the title page the names of the Departmental Representative, the Contractor, and the date of issue. Separate the various sections which comprise the manual with divider pages. All parts information must be correct for the equipment provided under this Contract. Modify standard parts drawings to be suitable and block out irrelevant material. Modify all general information used as necessary to show pertinence to the equipment furnished under this Contract, and remove irrelevant

material. Submit the arrangement of the manual, method of binding, including material and text to the Departmental Representative for approval.

.8 Illustrations must be clear. Printed matter, including dimensions and lettering on drawings, must be easily legible. If reduced drawings are incorporated into the manuals, darken the original lines and letters if necessary to retain their legibility after reduction. Larger drawings may be folded into manuals to page size. Reproduce diagrams and prints used in the manual to a size less than 279 mm by 432 mm. Include diagrams on white paper and vacuum seal in transparent plastic material impervious to moisture and oil, and resistant to abrasion. Other formats which are equal in clarity, sharpness, durability and permanence will be considered.

.9 Prepare the manuals from the following materials:
.1 Tear, water, and grease resistant paper.
.2 Page size, 216 mm by 279 mm.
.3 Fold out diagrams and illustrations.
.4 Reproducible by dry copy xerography method.
.5 Oil, moisture and wear resistant hard or flexible plastic covers.

.10 Furnish a minimum of one hydraulic schematic for the system. Produce the schematic on stainless steel, with the information laser engraved on the schematic. Schematic shall include mark numbers for individual components, manufacturer’s part numbers, as well as the design ISO 4406 filtration value for the hydraulic fluid, the hydraulic fluid type, and the pressure set points of all relief and pressure regulating valves. Stainless steel shall be minimum 1.6mm thick. Schematic shall be minimum 432mm wide by 280mm high. Submit the schematic to the Departmental Representative for approval prior to fabrication. Mount the schematic to the face of the hydraulic reservoir.

1.17 COORDINATION AND QUALITY CONTROL

.1 The Contractor shall engage a Movable Bridge Specialist Hydraulic Engineer, meeting the qualifications described in Section 01 45 00, who shall be responsible for monitoring and ensuring Quality Control compliance for the Hydraulic Work. The work performed by the Moveable Bridge Specialist Hydraulic Engineer shall include as a minimum, but not be limited to the following:
.1 Development and/or review of the construction schedule for the hydraulic work, identifying all long lead items requiring expedited shop drawing reviews.
.2 Development and/or review of a detailed shop drawing submittal schedule.
.3 Participation in progress meetings with the Departmental Representative via telephone as needed to maintain schedule.
.4 Preparation of all required calculations as described herein.
.5 Ensure that the hydraulic work is coordinated as required with the mechanical, electrical and structural work to mitigate the risk of

conflicts during installation as part of the preparation of shop, assembly and installation drawings.

.6 Review of all required shop and field procedures as described herein.

.7 Provide oversight of the shop QC process including review of any non-conformance reports (NCR's) from the shop.

.8 Witness shop testing work (required items are defined in 3.10 SHOP TESTING). Prepare and submit shop inspection reports to document and certify satisfactory completion of all tests prior to shipping.

.9 Witness field testing work (required items are defined in 3.11 START UP AND FIELD TESTING). Prepare and submit field inspection reports to document and certify satisfactory completion of all tests and satisfactory performance of the installed, integrated system.

1.18 MEASUREMENT AND PAYMENT

.1 Shop Drawings; HPU Assembly; Swing Cylinders; End Lift and Centering Cylinders; Controls; Piping, Installation and Other Miscellaneous Items; Shop and Field Commissioning Hydraulic Components; Hose and Hose duct:

.1 No measurement for payment will be made for work under these items.

.2 Payment shall be by lump sum for each item.

.3 Payment at the Contract price for these tender items shall be full compensation for all labour, equipment, supplies and material to do the work.

.2 Basis of Payment:

Milestone	Payment	Requirements
Shop Drawings Approved	5%	Departmental Representative's approval of shop drawings
Procedures Approved	5%	Departmental Representative's approval of shop and field testing procedures
Completion of Shop Testing	5%	Departmental Representative's approval of shop test report
Components on Site	Direct Component Cost (DC)	Components on site, stored as required by specifications. Provide invoices for direct cost of components.
Installation	65% - DC	Departmental Representative's approval of Field Testing Reports
Completion of Functional Testing	12%	Successful completion of functional testing as defined under Commissioning
Operation, Maintenance and Lubrication Manuals Approved	3%	Departmental Representative's approval of O&M manuals
Completion of Endurance Testing	5%	Successful completion of endurance testing as defined under Commissioning, no outstanding requirements from Contract Documents
Total	100%	

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND WORKMANSHIP

.1 All materials shall be new and conform to NFPA standards and other standards listed in these Specifications and on the Contract Plans, unless noted otherwise.

.2 Supply materials from manufacturers who have manufactured similar materials for similar applications for a period of not less than ten years.

.3 Do not fabricate, machine, weld, cast or forge items without sufficient advance notification to the Departmental Representative to permit scheduling of required inspection. Furnish all facilities and provide for free access at the plant or shop for the inspection of materials and workmanship, and to witness shop tests. The inspector has the authority to recommend to the Departmental Representative rejection of material or workmanship that does not meet the requirements of the Contract Documents. The Departmental Representative shall make the final decision for rejection.

2.2 FASTENERS

.1 Bolts smaller than 1 1/2 in. (38 mm): high strength heavy hex bolts made from material equal to ASTM A325M unless otherwise specified on the Contract Drawings.

.2 Bolts greater than 1 1/2in. (38 mm): made from material equal to ASTM A449-14.

.3 All bolts: conform to the Unified Thread Standards, coarse thread series, for threads on bolts, nuts, and cap screws with a Class 2A tolerance for bolts and Class 2B tolerance for nuts, in accordance with ANSI/ASME B1.1_2003, unless otherwise specified. Bolt head and nut bearing surfaces must be flat and square with the axis of the bolt holes. Spot face as necessary to produce no less than 80% contact between mating surfaces.

.4 Hex socket head cap screws: ASTM A574-17.

.5 Hex socket flat countersunk head cap screws: ASTM F835-13.

.6 Stainless steel hex cap screws: ASTM F593-17.

.7 Hex cap screws: ASTM A449-14.

.8 Lock washers: ASME B18.21.1-2009

.9 Brass hex socket flat countersunk head cap screws: ASTM F468-16.

.10 Furnish positive type lock nuts and hardened washers for all bolts and for all flat countersunk head cap screws used as bolts. Double heavy hex nuts conforming to ASTM A563-15 are required unless indicated otherwise on the Contract Drawings. Submit alternate locking methods to the Departmental Representative for approval. All hardened steel washers: in accordance with ASTM F436-09.

.11 Tighten fasteners to provide a tension of 50% of the bolt's ultimate tensile strength unless otherwise specified on the drawings. Provide the method of tightening and of verifying the tension in all bolts on the Shop Drawings for approval by the Departmental Representative.

2.3 HYDRAULIC POWER UNIT & COMPONENT SPECIFICATIONS

.1 General - HPU and tank assembly shall be capable of fitting through the dimensional constraints shown on the plans. All fasteners, brackets, supports, and mounting bolts shall be stainless steel.

.2 Reservoir Group - R1

.1 Reservoir, 225 l oil capacity, total physical capacity shall be a minimum of 10% greater than oil capacity, with suitable baffle. Provide a minimum of two removable clean out covers on the front face of the reservoir. Fabricate reservoir and supporting structure of ASTM A276 Type 316 stainless steel. Provide plugged drain valve mounted at lowest point in reservoir. Provide 300mm sight glass. Provide ports as required for all components and accessories, as well as two extra 25mm SAE ports with down pipes. Provide appropriate brackets for supporting all field wiring, tubing, and accessories.

.2 In-Tank Magnet - for a stainless steel reservoir sized such that the magnetic unit extends from 25 mm off the floor of the reservoir to the top of the oil level. Magnet shall be serviceable within the space constraints of the HPU room.

.3 In-Tank Heater (H1) – sized as required to maintain appropriate reservoir temperature. Heaters shall be mounted such that they are serviceable without moving or disturbing the reservoir, multiple heaters may be required to accomplish this. Provide thermostats and necessary electrical controls for the heater(s). Operation of the heater(s) shall be interlocked with the “low-low” level switch and the “high-high” temperature switch.

.4 Vent/Breather (B1) – which creates a moisture barrier between the reservoir and the external atmosphere.

.5 Temp Level Switch - dual function temperature/level switch with two switch points each for temperature and level.

.6 Thermometer - bimetal type, 127 mm stainless steel case, range - 20 - 120 degrees C, accuracy +/- 1.0% full scale.

.7 Sight Level Gauge - O-ring seals, Pyrex glass tube, aluminum body.

.8 Filler Cap - Non-breathing cap with coarse strainer for direct filling of reservoir.

.3 Pump Motor Group – P1

.1 Pump : Variable Volume Remote Pressure Compensated Piston Pump with horsepower limiter control, 85 cc/rev minimum, with adjustable maximum volume stop, 31 MPa continuous pressure rating.
.2 Prime Mover : Standard TEFC/NEMA foot mounted "C" faced chemical duty rated squirrel cage induction motor coupled with a "C" faced adaptor bracket rated for 30 hp @ 1800 rpm . Refer to section 24 05 01 for electrical requirements related to the motor.
.3 Coupling : Flexible with less than 0.127mm misalignment and coupling setscrews secured with Loctite.
.4 Adaptor Bracket : Standard aluminum adaptor bracket with access hatch for coupling inspection and maintenance. Provide drilled hole in bottom of adaptor bracket to drain any pump input shaft seal leakage.
.5 Vibration Isolation Mount – Sized as required to reduce transmission of pump vibration to surrounding components.

.4 Hydraulic Fluid
.1 Hydraulic fluid shall be Greenplus Hydraulic Fluid ES biodegradable oil.
.2 Hydraulic fluid shall be dyed red with a dye provided by the manufacturer or certified compatible with the fluid by the fluid manufacturer.
.3 Contractor is responsible for ensuring all components selected are compatible with specified fluid.

.5 Valve Stands - Valve stands for the mounting of manifolds, valves and gauges shall be integral parts of the hydraulic power units and shall be fabricated from ASTM A276/A276M Type 304 or 316.

.6 Drip Tray - Drip tray for catching any spill of fluid from the reservoir assembly. ASTM A276/A276M type 304 or 316 Stainless steel construction, 19 mm NPT drain and plug. Drip tray to overhang all components 100mm. Edges of drip tray shall be the highest component on drip trays, mounting bars for other components shall not be configured to allow oil to run over edges of drip trays. Provide drip tray for pump and manifold group and separate drip tray for reservoir.

.7 Manifold Blocks
.1 MB1 - Hydraulic Manifold – made of steel, nickel plated after machining, rated for 31 MPa working pressure.
.2 MB2 - Hydraulic Manifold – made of steel, nickel plated after machining, rated for 31 MPa working pressure. Manifold shall be mounted to span drive cylinder. All ports, plugs, and other fittings shall be stainless steel.
.3 MB3 - Hydraulic Manifold – made of steel, nickel plated after machining, rated for 31 MPa working pressure. Manifold shall be mounted to end lift cylinder. All ports, plugs, and other fittings shall be stainless steel.
.4 Arrange all components on manifold blocks such that maintenance activities (installation/removal of tubing or hoses, adjustment of components) can be performed without removing or otherwise disturbing adjacent components.

.5 Manifolds shall be engraved with component mark numbers or plain English descriptions adjacent to each component.

.6 Manifolds shall be computer designed and analyzed. Analysis shall be performed with an industry accepted software package. Calculate minimum wall thickness within manifold. Provide detailed drawings showing all drillings, ports, internal passages for review. Provide an assembly drawing showing all internal and external plugs.

.8 Check Valves

.1 CV1 – Cartridge type check valve.

.2 CV2 – Cartridge type check valve.

.3 CV3 – Cartridge type pilot to open check valve. Valve to be equipped with external drain/vent. 0.07 cc/min max leakage. External components constructed of passivated stainless steel.

.4 CV4 – Cartridge type check valve, 75 l/min capacity, 0.07 cc/min max leakage. 0.03 MPa cracking pressure. External components constructed of passivated stainless steel.

.5 CV5 - Cartridge type pilot to open check valve. Valve to be equipped with external drain/vent. 0.07 cc/min max leakage. External components constructed of passivated stainless steel. Provide manual load release or provide separate needle valves connecting cylinder ports to tank.

.6 CV6 - Cartridge type pilot to open check valve. 0.07 cc/min max leakage.

.9 Relief / Reducing Valves

.1 RV1 – Relief Valve, Main System. Cartridge type relief valve set at 21.3 MPa. 380 l/min minimum capacity. Provide cap and lockwire seal for adjustment.

.2 RV2 – Relief Valve, Proportional. Cartridge type proportional relief valve. Pilot flow capacity, matched to selected pumps. Provide manual override. Provide coil & amplifier card as required to interface with the HPU control system.

.3 RV3 – Relief Valve, Emergency Close Circuit. Direct acting adjustable relief valve for use in emergency closing circuit. Pilot flow capacity matched to selected pumps. Provide cap and lockwire seal for adjustment.

.4 RV4 – Relief Valve, Span Drive Cylinder, Rod End. Valve shall be direct acting cartridge type with exposed portions of valve constructed of passivated stainless steel. Valve shall be factory set at cracking pressure specified on the drawings. Valve shall be provided with test certificate from factory setting procedure. Valve shall be engraved with setting pressure and shall be equipped with a capped and lockwired cover to prevent future tampering or adjustment.

.5 RV5 – Relief Valve, Span Drive Cylinder, Blind End. Valve shall be direct acting cartridge type with exposed portions of valve constructed of passivated stainless steel. Valve shall be factory set at cracking pressure specified on the drawings. Valve shall be provided with test certificate from factory setting procedure. Valve shall be engraved with setting pressure and shall be equipped with a capped and lockwired cover to prevent future tampering or adjustment.

.6 RV6 – Relief Valve, End Lift Cylinder, Blind End. Valve shall be direct acting cartridge type with exposed portions of valve constructed of passivated stainless steel. Valve shall be factory set at cracking pressure specified on the drawings. Valve shall be provided with test certificate from factory setting procedure. Valve shall be engraved with setting pressure and shall be equipped with a capped and lockwired cover to prevent future tampering or adjustment.

.7 RV7 – Relief Valve, End Lift Cylinder, Rod End. Valve shall be direct acting cartridge type with exposed portions of valve constructed of passivated stainless steel. Valve shall be factory set at cracking pressure specified on the drawings. Valve shall be provided with test certificate from factory setting procedure. Valve shall be engraved with setting pressure and shall be equipped with a capped and lockwired cover to prevent future tampering or adjustment.

.8 RV8 – Pressure Reducing Valve, Locking Pin Circuit. Cartridge type, 20 l/min capacity, 0.3 – 10.3 MPa adjustment range.

.9 RV9 – Pressure Relief Valve, Locking Pin Circuit. 20 l/min capacity. Provide cap and lock wire seal for adjustment.

.10 Counterbalance Valves

.1 CB1 - Cartridge, 3:1 pilot ratio, 110 L/min capacity, 0.3 cc/min max leakage. Load holding type valve that brakes the span should the Proportional Directional Control Valve (DV1) lose power when the swing bridge is operating. This valve modulates hydraulic flow to the span drive cylinders during the swing cycle and is controlled by pilot pressure from the opposite ends of the cylinders. Should the bridge try to "runaway" due to inertia or and overhauling external load (e.g. wind) the pilot pressure is lost and the counterbalance modulates to a more closed position thereby preventing the cylinders from extending or retracting too rapidly. Proper sizing of the counterbalance valves for smooth span operation is the responsibility of the hydraulic system supplier. The valves shall be sized and selected to operate smoothly with the main proportional directional control valve. Span oscillation will be cause for rejection and new valves or manifolds to achieve smooth operation will be at the expense of the hydraulic system supplier.

.2 CB2 - Cartridge, 3:1 pilot ratio, 220 L/min capacity, 0.3 cc/min max leakage. Load holding valve that prevents runaway of end lifts during extension of cylinder.

.11 Filters

.1 F1 – Pressure Filter Operating pressure 21 MPa, equipped with a mechanical/electrical clogging indicator with thermal trip sensor to prevent cold oil start nuisance indications. Filter element shall be rated at 5 micron with a minimum efficiency rating of Beta (10) = 200.

.2 F2 – Return Filter - Operating pressure 7 MPa, equipped with a mechanical/electrical clogging indicator with thermal trip sensor to prevent cold oil start nuisance indications. Filter element shall be rated at 5 micron with a minimum efficiency rating of Beta (10) = 200. Provide checked connection and quick disconnect coupling for connection to a filter cart for filling the reservoir with filtered oil although insuring that filter cart backpressure will not affect the working

hydraulics circuitry. Quick disconnect coupling shall be stainless steel.

.12 Flow Controls

.1 FC1 – Cartridge type, pressure compensated adjustable flow control. Selected and set to limit span closing speed to 10-20% of full speed when emergency close circuit is used. Valve maximum setting shall not exceed 8 l/min. Provide cap and lockwire seal for adjustment.

.2 FC2 – Cartridge type flow control valve.

.3 FC3 – Cartridge type needle valve, provide hand knob for positive draining of accumulator. Normally closed.

.4 FC4 – Cartridge type flow control, to allow controlled depressurization of accumulator when SV2 is deenergized.

.5 FC5 – 45 l/min capacity cartridge type needle valve, normally closed. External components of valve shall be constructed of passivated stainless steel. Provide hand wheel or knob for operation.

.6 FC6 – Cartridge type pressure compensated adjustable flow control valve. Provide cap and lockwire seal for adjustment.

.13 Solenoid Valves

.1 SV1 – Cartridge type 3 way directional solenoid valve. Valve shall have positive overlap while shifting. Provide manual override for valve. Coil voltage shall be compatible with emergency closing control system.

.2 SV2 – Cartridge type 2 way directional solenoid valve. Provide manual override for valve. Coil voltage shall be compatible with emergency closing control system.

.3 SV3 – Cartridge type 2 way directional solenoid valve. Poppet style construction. Maximum leakage 0.7 cc/min. Provide manual override for valve. Coil voltage shall be compatible with emergency closing control system.

.4 SV4 – Cartridge type 2 way directional solenoid valve. Poppet style construction. Maximum leakage 0.7 cc/min. Provide manual override for valve. Coil voltage shall be compatible with emergency closing control system.

.14 Directional Valves

.1 DV1 - Proportional Directional Control Valve Sub plate mounted Three Position, Spring Offset, 65 L/min min capacity. The hydraulic system supplier shall decide whether it is appropriate to use a 2:1 spool for this application, and shall coordinate the appropriate amplifier card for use with this valve. Provide provision for manual operation of control valve. When manual override is used to actuate the span cylinder directional control valve, speed shall be restricted to 20% of full speed.

.2 DV2 – Directional Control Valve, End Lifts. Sub plate mounted three position, spring offset, 160 l/min minimum capacity. Provide soft shift functionality to decrease fluid hammer on end lift components. Provide manual override.

.3 DV3 – Directional Control Valve, Locking Pin. Sub plate mounted three position, spring offset, 4 l/min minimum capacity. Provide soft

shift functionality to decrease fluid hammer on locking pin components. Provide manual override.

.15 Field Wiring - All Field wiring to all electrical hydraulic components shall be performed with pre-moulded cable assemblies. Field terminated cable assemblies shall not be used. All valve connectors to non-proportional solenoids shall be equipped with a LED indicator and MOV surge suppressor.

.16 Flow Divider

.1 FD1 – Rotary gear type flow divider, 4:1 ratio. Flow divider to be sized to match flow requirements of the end lift circuit. Flow divider shall be equipped with anti-cavitation check valves. 2.0% divisional accuracy or better. Provide pressure test ports at each outlet of the flow divider.

.17 Pressure Gauge

.1 PG1 - 0 - 21 MPa, Bourdon tube type, liquid filled, stainless steel case, 63 mm dia. face.

.2 Provide gauge snubbers, stainless steel, rated for 31MPa, for all pressure gauges.

.18 Flow Meter

.1 FM1 - In line unit mounted in a readily visible location. Rated at 160 L/min capacity.

.19 Accumulator

.1 AC1 - Provide a piston type accumulator 16 liter capacity to provide emergency fluid as specified and rated for 21 MPa, nitrogen filled, SAE flange port. Design of the accumulator shall comply with the requirements of NFPA T2.24.1 R1-2007. Provide appropriate safety placards. Multiple accumulators may be required due to the space constraints of the hydraulic power unit room. Provide stainless steel mounting hardware from same manufacturer as the accumulator.

.20 Ball Valves

.1 BV1 – Pump suction line ball valve. Provide 50mm nominal size ball valve with factory installed and mounted limit switch that indicates whenever the valve is not fully open. Construction shall be 316 stainless steel.

.2 All other ball valves shall be sized appropriately for the circuit to which they are connected. SAE code 61/62 ports shall be used for all span drive and end lift cylinder ball valves. Valves of other port types may be considered with prior approval of the Departmental Representative.

.3 Use full port valves in all locations.

.21 Pressure Switch

.1 PS1 - Pressure Switch -rated for 21 MPa with adjustable set point set at 10 MPa rising, repeatability 3% of setting.

.22 Test Ports

.1 TP1 - Test port connection fittings shall be of the checked female type, be provided with a metal cap that is tethered to the fitting with an M16x2.0 thread. Fitting, cap and tether type 316 stainless steel. Only one style of test port shall be provided.

2.4 VALVES(GENERAL)

.1 All system valving shall be rated for its intended flow and pressure with a minimum pressure rating of 31 MPa on all pressure valves. Use ANSI standard sub plate mounted valves for ease of servicing, wherever possible. Provide full port valves for all ball valves.

2.5 PIPING, FITTINGS AND MANIFOLDS

.1 Piping includes all pipe, tubing and flexible hose. Piping, fittings, manifolds and the piping system shall conform to CSA Standards, except as otherwise noted. All rigid plumbing, field or local to HPUs, shall be seamless type 316 stainless steel tubing or pipe. All fittings shall be 37 degree O-ring seal, face seal, or flange type 316 stainless steel. Use SAE Code 61/62 connections wherever possible. Pipe threads shall not be permitted on the hydraulic system without prior written permission from the Departmental Representative. Do not permit installed piping to come into direct contact with metal or concrete structures and protect piping from abrasion. Use vibration damping clamps suitable for piping under 20.7 MPa pressure with type 316 stainless steel hardware and plates to support piping. All clamps shall conform to DIN 3015 part 2.

.2 Flexible hose and Fittings shall be SAE rated for intended working pressures with a minimum working pressure rating of 20.7 MPa with a minimum safety factor of 4. Hose ends 12.5mm and larger shall be SAE Code 61 flange type manufactured from type 316 stainless steel and shall be crimped. Hose ends smaller than 12.5mm shall be 37 degree JIC or face seal type manufactured from type 316 stainless steel and shall be crimped. Use of flexible hoses should be at an absolute minimum except on cylinder connections and anywhere on the HPU where vibration may unreasonably reduce the working life of rigid plumbing connections. Protective sleeves shall be used to protect hoses from abrasion due to contact with hose supports, the structure, other hoses or adjacent equipment. The material to be used shall be submitted for approval.

.3 All manifolds shall conform to CSA Standards.

.4 Test port connection fittings shall be of the checked female type, be provided with a metal cap that is tethered to the fitting with an M16x2.0 thread. Fitting, cap and tether type 316 stainless steel. Only one style of test port shall be provided.

2.6 HYDRAULIC CYLINDERS

.1 Mill type hydraulic cylinders shall meet all applicable standards. Cylinders shall have bore, stroke, and rod diameter as indicated on the

Plans. The service pressure rating and maximum pressure rating of all cylinders shall be as shown on the Plans.

.2 Span drive cylinders shall conform to all requirements of CAN/CSA-S6-14 13.8.16.3.1 Cylinders for span operation.

.3 Cylinder Dimensions: Outline dimensions for span drive cylinders and end lift cylinders are provided in the Plans. These are the assumed dimensions for cylinders that meet all technical requirements of the project. If desired to provide cylinders with different outline dimensions, adjust the details of mating components as needed at no additional cost.

.4 Provision shall be made for grease lubrication of the rod end spherical bearings and the trunnion mount bushings (for the span drive cylinders) and the rod end and blind end spherical bearings (for the end lift cylinders) via lubrication passage, annular distribution groove, and lubrication fitting. Provide orientation of ports and fittings as shown on the Plans.

.5 Cylinder Heads shall be steel welded/bolted construction (not threaded type) using stainless steel bolts. Cylinder heads shall contain an appropriate rod scraper to limit intrusion of foreign materials into the hydraulic oil. Cylinder heads for swing span cylinders shall contain a collar reservoir system to contain small rod seal leaks. Collar reservoir shall be provided with clear reservoir to collect and measure fluid, and a petcock to allow drainage by maintenance personnel.

.6 Piston Rods: Piston rods for end lift cylinders shall be made of 17-4 PH stainless steel and chrome plated.

.7 Provide rods with spanner wrench flats or other approved means to secure the piston rod in place while assembling or removing the rod end.

.8 Cylinder Rod Ends: Provide spherical bearing housings for the rod end of the cylinders that conforms to the dimensions shown on the Plans. Provide a positive means to retain the bearing housing on the end of the piston rod. Design of the rod end shall meet the requirements of CSA-S6-14 pertaining to design of machinery.

.9 Cylinder manifolds: Span Drive Cylinder Manifold: Provide a hydraulic manifold meeting the following requirements:

.1 Cylinder manifold shall be rigidly mounted to each cylinder & piped using 316SS welded pipe.

.2 Cylinder manifold pilot operated check valves shall have external drain to prevent oscillation, and shall be selected for zero leak holding.

.3 Cylinder manifold relief valves shall be fast acting and shall be selected for zero leakage.

.4 Cylinder manifold anti-cavitation check valves shall be zero leakage.

.5 Cylinder manifold shall be provided with manual release needle valves to allow for maintenance or emergency operation of the cylinder. Manual release valves shall allow for variable flow adjustment.

.6 Provide stamped or engraved stainless steel name plates at each component and port on the cylinder manifold that includes both the mark number of the component from the approved shop drawing as well as a description of the function of the component.

.7 Provide end lift cylinders with manifolds to contain the valves shown on the contract plans but otherwise meet the requirements for span drive cylinders.

.10 Cylinder Spherical Plain Bearing: Provide spherical plain bearings as shown on the Plans. Provide fits and finishes on mating components in accordance with the manufacturer’s recommendations. Provide spherical plain bearings with load ratings in accordance with those shown on the Plans.

.11 Seals: Seal material shall be compatible with the hydraulic fluid in use. An appropriate rod wiper shall be provided. The manufacturer shall produce evidence that all dynamic seals are suitable for both frequent and infrequent operation and are capable of not less than 500,000 cycles of operation. Seals should be chosen for near zero leak operation. Seals and internal bearings should be designed such that the cylinder does not vibrate during operation due to excessive friction.

End lift cylinder seals shall be suitable for load holding applications.

.12 Cylinder Ports: Span drive and end lift cylinder ports shall be SAE code 62 flange type. Locking pin cylinder ports shall be SAE O-ring type.

.13 Provide air bleed ports as required to facilitate proper bleeding of the cylinders without removal or manipulation of the cylinders from their normal operating locations.

.14 Cushions: Span drive cylinders shall be provided with cushions at both ends to assist in safely decelerating the bridge in case of limit switch failure. Cushions shall have working length as indicated on the mechanical drawings and shall be externally adjustable with a dual-stage valve design with internal relief protection. Cushions shall be calculated and designed by the contractor such that at least 5 seconds of deceleration is provided in both directions. Include a method of reading pressure at the internal cushion at each end via a pressure gauge. Provide cushions for the end lift cylinders to reduce impact loading at limits of travel. All cushion adjustment valves shall be recessed into the cylinders and be covered with sealed plugs or flanges that will protect the adjustment valves from corrosion in a marine environment. External portions of cushion adjuster valves shall be constructed of stainless steel. Span drive cylinder cushion adjusters

shall be clearly labeled to indicate which stage is adjusted with which valve.

.15 End lift cylinders shall be provided with cushions to reduce the speed of travel of the end lifts as they approach the ends of travel in either direction. The bridge weight also provides a force to retract the end lift cylinder at the end of travel in the raised position(cylinder retracted)and shall be considered when sizing the cushion.

.16 Cylinders shall be painted using the manufacturer's special paint for corrosive marine environments.

.17 Provide stamped or engraved stainless steel name plates on all cylinders indicating model number, manufacturer, pressure rating, bore and rod diameter, stroke length, cushion information, test pressure, and details of any other nonstandard features. Locate name plates in prominently visible locations unobstructed by hoses or other machinery items. Laser etched name plates will be rejected.

.18 Testing: In addition to other tests listed above, the main span drive hydraulic cylinders shall be hydrostatically tested at 10 MPa and 31 MPa for 5 minutes in both directions. After the test, the cylinder shall be inspected for deformation, seal leakage or other failures. Subsequent to the hydrostatic test, the cylinder shall be fully extended and retracted for a minimum of 25 cycles. Cylinder motion must be smooth and no leakage is permitted. If corrective action is necessary, the testing sequence shall be performed again. Use the above specified hydraulic fluid for all testing.

.19 Locking Pin Cylinder

.1 Locking pin cylinder shall be a tie rod cylinder. Dimensions shall be as shown on the mechanical drawings. Cylinder shall be constructed in accordance with ISO 6020/2 with the following options:

.2 Mounting arrangement shall be MS2 side lug (foot) mount.

.3 Piston rod shall be 17-4 PH stainless steel, chrome plated.

2.7 HYDRAULIC HOSE DUCT

.1 Provide a hydraulic hose duct (hereinafter referred to as “hose duct”) as shown on the contract drawings. All ancillary devices required for function of the hose duct are incidental to this item.

.2 Hose ducts shall be provided at west abutment corbels as shown on the contract drawings.

.3 The hose ducts between the West pier and the pivot pier shall consist of PVC conduit. Three 75mm ducts shall run from the end of the trench near the West abutment

.1 The hose duct shall follow the river bottom and rise nearly vertically at the pivot pier.

.2 Clamps shall be provided to secure the individual hydraulic hoses. The clamps shall be of a two piece bolt together type construction, similar in construction to hydraulic tubing clamps as per DIN 3015 part 2.

.3 Secure the hose duct to the river bottom using the details shown on the electrical plans for the securing the electrical conduits.

.4 Detail, furnish and install a hose duct support mounted to the outside of the pivot pier to support the hose duct. The hose duct support shall be constructed of structural steel and be hot dip galvanized. Galvanize the component in accordance with Specification Section 29 05 00 Mechanical Work. Mount the hose duct support to the pivot pier with appropriately sized stainless steel field installed anchors. Hose duct support shelf shall be fabricated from minimum 9.5mm thick steel plate. Anchor bolts shall be minimum Ø12.7mm. Hose duct support shall be capable of withstanding a 120kg point load at any location without permanent deformation.

.5

.6 Do not proceed with installation of the hose duct until the following have been performed:

.1 Complete erection and assembly drawings are provided for the hose duct. Information provided shall include the following at a minimum:

.1 Assembly views. .2 Elevation, plan, and section views of the hose duct system installed on the pivot pier. Show all working clearances to all structural, mechanical, and electrical components.

.2 .3 Shop drawings for the hydraulic hoses & fittings have been submitted & reviewed. Refer elsewhere in this specification for detailed requirements.

2.8 SPARE PARTS

.1 All spare parts shall be new. Spare parts shall be provided in sturdy storage containers suitable for long term storage. Small spare parts shall be provided in cases with divided compartments for each size or type of component and shall be labeled. Caps or protective plugs shall be provided for all open fittings or ports to prevent contamination. All manufacturer’s recommended long term storage procedures shall be performed on all spare parts. Heavy items, including but not limited to cylinders and pumps shall be provided in heavy wooden crates.

.1 (2) seal and bearing kits for each cylinder type
.2 (6) reservoir breathers
.3 (2) filter elements for each filter type
.4 (20) gallons hydraulic fluid
.5 (2) Spare inserts for hydraulic pump to motor couplings.
.6 (1) Main Proportional directional control valve
.7 (1) End lift directional control valve
.8 (1) Proportional Amplifier card for each type provided
.9 (3) Spare flexible hose for each size and length provided.
.10 (1) Spare ball valve for each size and style provided.
.11 (2) Spare solenoid coils for each type provided.

.12 (2) Spare solenoid valve connector cables for each type provided.
.13 (1) Spare parts kit containing minimum (6) of each size and style of o-ring or other replaceable seals gaskets, fasteners, etc. required for routine maintenance and servicing of the system.
.14 (1) Spare pressure gauge for each type provided
.15 (4) Spare test port connectors
.16 (2) Pressure gauges, rated 0-34 MPa, with max pressure tell-tales, equipped with mating test port connectors. Provide rubber over moulded bumper for test gauges. Provide jumper hoses if required to ensure pressure gauges can be installed at any test port on the hydraulic system during operation to measure operating pressures. Provide plugs or caps for test connectors when not in use. Provide a sturdy case to store the pressure gauges at the site.
.17 (1) Test port connector equipped with valve and short length of tubing, to be used for sampling hydraulic oil from any test port in the system.
.18 (1) Spanner wrench for each size cylinder rod.
.19 (1) Accumulator charging and servicing kit provided in a sturdy case. Charging kit to be provided by the manufacturer of the accumulator.
.20 (1) Accumulator charging extension hose, 15m length. Hose is to enable charging of the accumulator from a nitrogen source on the roadway. Provide hose end fittings compatible with PCA requirements to be provided by the Departmental Representative during construction.
.21 (1) Spare end lift hydraulic cylinder.
.22 (1) Spare locking pin hydraulic cylinder.
.23 (4) Spare lever actuated limit switches for the end lift hydraulic cylinders and (2) spare lever actuated limit switches for the locking pin.

PART 3 - EXECUTION

3.1 DIMENSIONAL VERIFICATION

.1 Prior to fabricating new machinery components, review the Plans and/or field survey and measure the structure, as required to ensure that the components as designed and detailed in the drawings will fit into the structure as intended. Perform all such reviews and measurements before preparation of the shop drawings or working drawings and before performing work at the bridge.

3.2 CONSTRUCTION DETAILS

.1 Supply all apparatus, tools, devices, materials and labour to manufacture, ship, install, erect, align, adjust, lubricate, test, and paint, to complete machinery as provided in the Contract Documents. Furnish any apparatus, tools, devices, materials and labour incidental to the work, but not specifically stated or included at no additional cost.

3.3 QUALITY

.1 Products, materials, equipment and articles incorporated in Work shall be new (unless specified otherwise in the contract documents), not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.

.3 Should disputes arise as to quality or fitness of products, decision rests strictly with the Departmental Representative based upon requirements of Contract Documents.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout.

3.4 INSPECTION

.1 The Departmental Representative reserves the right to inspect all machinery at the factory, prior to shipping. Provide the Departmental Representative with full access to the manufacturer’s fabrication facility for such inspections.

.2 Inspections are based on the requirements of the Specifications and Contract Drawings, referenced codes or standards, and the Contractor's approved submittal documents. The Departmental Representative has the authority to stop fabrication or shipment of any material, component, or assembly that does not comply with specified requirements. Replace or repair to the satisfaction of the Departmental Representative any such rejected item. All such replacements or repairs are made at the Contractor's expense.

.3 The Departmental Representative will make inspections of equipment throughout the construction period. Correct defects, deficiencies, or deviations from the Contract Drawings or Specifications discovered during such inspections at no additional cost. Shop approval of machinery does not relieve the Contractor from making such repairs as directed by the Departmental Representative.

3.5 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by the Departmental Representative as failing to conform to Contract Documents. Replace or re execute in accordance with Contract Documents.

3.6 STORAGE, HANDLING AND PROTECTION

.1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.2 Coat finished metal surfaces and unpainted metal surfaces that would be damaged by corrosion, as soon as practical after finishing with a corrosion inhibitor. Remove this coating from all surfaces prior to lubrication for operation and from all surfaces prior to painting after erection.

.3 Mount assembled units on skids or otherwise crate for protection from weather, dirt and all other injurious conditions during shipment and storage as approved by the machinery manufacturer. Submit in advance information as to methods and materials which will be used for protection for approval by the Departmental Representative.

.4 Store machinery items as to permit easy access for inspection and identification. No outdoor storage of machinery components is permitted regardless of the methods of protection provided.

.5 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

.6 Store products subject to damage from weather in weatherproof enclosures.

.7 Store cementitious products clear of earth or concrete floors, and away from walls.

.8 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.9 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.10 Correct damage that occurs to the machinery components as a result of improper protection during shipment or storage by the Contractor to the satisfaction of the Departmental Representative at no additional cost.

.11 Touch up damaged factory finished surfaces to the Departmental Representative's satisfaction. Use touch up materials to match original. Do not paint over name plates.

3.7 MANUFACTURER’S INSTRUCTIONS

.1 Unless otherwise indicated in specifications, install, assemble or erect products in accordance with manufacturer's instructions.

.2 Notify the Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that the Departmental Representative will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and re installation at no increase in Contract Price or Contract Time.

3.8 INSTALLATION

.1 Commence demolition of existing and installation of new components after all required components have been manufactured and approved for installation, preparations by others where required have been satisfactorily completed and installation procedure have been approved.

.2 All hydraulic connections, system flushing and start up shall be performed under the direction of a Certified Fluid Power Technician whose certification number shall be listed on the resume submitted for approval. The system flushing procedure must be submitted for approval.

.3 Due to the important relation between the cushions and the swing span hydraulic cylinder mounting location, the contractor responsible for the concrete work, machinery installation, and hydraulic system supplier shall submit a coordinated erection plan and installation procedure to ensure proper functioning of the cushion feature of these cylinders. It is critical to install the cylinders such that 95%of the working cushion length is utilized.

3.9 FILLING AND FLUSHING OF HYDRAULIC SYSTEMS

.1 Prior to connecting piping or flexible hoses to any system component, clean with a pneumatically powered projectile cleaning system repeating until a fresh clean projectile exists with no visible debris.

.2 After completion of work on any hydraulic system, the system shall be topped off with new hydraulic fluid. Any fluid that is drained from the system in order to perform the work shall be removed and properly disposed of in accordance with all applicable local, provincial and federal laws.

.3 Any hydraulic fluid that is added to the system shall be pumped into the reservoir through a 5 micron filter.

.4 All components of the affected systems (pumps, valves, manifolds, supply and return lines, reservoirs, etc.) shall be thoroughly flushed by looping hoses at the cylinders. The main pump may be used for flushing. All system filter elements shall be replaced as required during flushing and new filter elements shall be installed at the conclusion of the flushing. A suitable portable filtration unit may also be used. Flushing for all systems shall be continued until a

particle count below 17/15/12 per ISO 4406 is achieved for two consecutive contamination tests. A certified laboratory fluid analysis/report shall confirm that the required range has been achieved and that there is an acceptable level of water in each system. Copies of the certified laboratory reports shall be submitted to the Departmental Representative. Flushing shall be performed under the direction of a Certified Fluid Power Technician.

.5 The hydraulic cylinders should be filled with fluid while in a horizontal position to ensure all air is removed before connection to the system.

3.10 SHOP TESTING

.1 The Contractor shall test and perform shop adjustments to the hydraulic system prior to delivery of the components to the jobsite. Test shall be structured to isolate each system and verify that the hydraulic power unit, all cylinders, hydraulic circuitry and interface to the control system operate as intended. A shop test procedure shall be prepared and submitted to document in detail all of the steps needed to adjust system pressures and flows as needed to obtain the system performance as specified. All design pressure and flow values shall be independently verified by the Engineer responsible for the design of the system and preparation of the test procedure who shall witness the tests, prepare and submit a shop test report for review by the Departmental Representative. Minimum test requirements are as follows:

.1 Carry out static pressure tests at 31 MPa to demonstrate that the system (including cylinders) is free of leaks, and that the cylinder manifold valves perform leak free load holding capability.

.2 Adjust and verify all pressure relief valve settings.

.3 Adjust and verify flow rates for all circuits for extend and retract to obtain the desired operating times. This includes acceleration rates and creep speed for the span drive circuit.

.4 Perform cushioning tests for all cylinders equipped with cushions. Verify the rod position that the cushion engages, and rates of deceleration. Use an electronic chart recorder to record the position and pressure at the cylinder ports, and internal cushion pressure. Record at full cylinder velocity and design value pump relief settings in both directions. Measure the cushioning pressure and outlet pressure. Measure the cushioning time during the cushioning stroke in both directions. Check if the cylinder is decelerating.

.5 Record electric motor current during cushion testing.

.6 Simultaneously record rod and blind end cylinder pressures for each pair of cylinders during normal operation. Record pressures dynamically at a 50 Hz sample rate. Provide strip chart recordings of the pressure readings identifying when the cylinder starts, stops and direction of travel for 3 cycles in both directions of operation. Perform an emergency stop test and verify that maximum cylinder pressures are not exceeded. Record electric motor current and pump pressure during the entire test.

3.11 START UP AND FIELD TESTING

.1 The Contractor shall test and perform field adjustments to the hydraulic system prior to operating the swing bridge. A detailed procedure sealed by a Professional Engineer licensed in Ontario, Canada, shall be submitted to the Departmental Representative for review at least 6 weeks prior to testing the system. Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or forces. Minimum test requirements are as follows:

.1 Carry out static pressure tests at 31 MPa to demonstrate that the system (including cylinders) is free of leaks.

.2 Use an electronic chart recorder to record the following system parameters during all tests: electric motor voltage and current, cylinder rod position, cylinder pressure at the cylinder ports, and internal cushion pressure where applicable.

.3 Repeat all shop test procedures to verify that system pressures, flows and speeds have not been altered since the shop test.

.4 Perform a cushion test at full open and full closed. To mitigate the risk of damage, perform multiple tests gradually increasing the speed of the span until it is demonstrated that with the span reaching the cushions moving at full speed the cushions will decelerate the span as intended.

.5 Perform an emergency stop test with the span moving at full speed in both directions and verify that maximum cylinder pressures are not exceeded.

.6 After all adjustments and other testing is complete, perform a final record test of as-built system performance as follows: Simultaneously record rod and blind end cylinder pressures for each set of cylinders during normal operation. Record pressures dynamically at a 50 Hz sample rate. Provide strip chart recordings of the pressure readings identifying when the cylinder starts, stops and direction of travel for 3 cycles in both directions of operation. Include documentation of these test results as part of the O&M manuals.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

.1 This section covers electrical and control requirements for the Hydraulic Power Unit (HPU) include Control Panel, Operator Control Console, and Bridge Control Cabinet (BCC) to be supplied by a single vendor as part of the HPU package.

.2 Provide electrical equipment for the hydraulic power systems as indicated and as specified. The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

.3 Refer to the following specification sections for related scope of work requirements:

Section 24 05 00 – Hydraulic Work - General;
Section 40 25 00 - Programmable Logic Controller (PLC);
Section 26 24 22 - Field Instrumentation Devices; and
Section 40 20 00 - Bridge Control Sequence of Operation

1.2 REFERENCES

.1 The Automation Systems that will be provided for the movable bridge control system shall comply with the latest revised applicable codes, specifications and standards here below listed:

.2 CSA Group
- .1 CSA C22.1-2018, Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .2 CAN/CSA-Z462-18, Workplace Electrical Safety.
- .3 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards – Guidelines for Selection and Use.

.3 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.4 Electronic Industry Association (EIA) 232-D: Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

.5 National Electrical Manufacturer’s Association (NEMA):
- .1 AB-1: Molded Case Circuit Breakers
- .2 ICS-1: General Standards for Industrial Control and Systems
- .3 ICS-2: Standards for Industrial Control Devices, Controllers and Assemblies
- .4 ICS-4: Terminal Blocks for Industrial Use
- .5 ICS-6: Enclosures for Industrial Controls and Systems

.6 ANSI/NEMA MG 1-2011, Motor and Generators.

.6 International Society of Automation (ISA):
- .1 ANSI/ISA-50.00.01: Compatibility of Analog Signals for Electronic Industrial Process Instruments
- .2 ANSI/ISA-51.1: Process Instrumentation Terminology
- .3 ANSI/ISA -18.2 – Management of Alarm Systems for the process Industries (Article 11 – HMI Design for Alarm Systems)

.7 International Electrotechnical Commission (IEC)
- .1 IEC 61131 Program languages for PLC based systems
- .2 IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety - related Systems
- .3 IEC 61000 series Electro Magnetic Compatibility (EMC)

.8 ANSI/IEEE Standards
- .1 ANSI/IEEE C37.90.1: Standard Surge Withstand Capability (SWC) Tests for Protection Relay Systems.
- .2 ANSI/IEEE C37.90.2: Trial Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Trans-receivers.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Detailed Bill of Materials for all control panel hardware, and associated materials and components, listing: manufacturer's name, quantity, description, size, and catalog/part number.

.3 Shop Drawings:
- .1 Complete documentation for all control panel equipment and associated components, including: manufacturer's product literature, specifications, performance capabilities, features and accessories, dimensions and weights, illustrations, and data in sufficient detail to demonstrate compliance with Specification requirements. Manufacturer’s literature and data shall be marked to clearly delineate all applicable information and crossing out all inapplicable information.
- .2 Control panel fabrication drawings (plan view, and interior and exterior elevation views) with all equipment and components clearly shown, dimensioned, and labeled. Drawings

shall show the equipment, component assembly, terminal blocks, wire-ways, clearances, and locations for conduits/conductors and anchor bolts. Devices shall be identified with the same marking as used on the schematic diagrams. The drawings shall include a detailed layout of all door mounted pilot devices and instruments.

.3 Enclosure construction, NEMA Type 4X, and type and gauge of materials.

.4 Detailed descriptions of control panel equipment, equipment installation requirements, and heat dissipations.

.5 System configuration with power circuit single line diagrams, grounding circuits, circuit breakers, and fuses.

.6 Control schematics, sequence of operation, ladder diagrams, and interconnection drawings.

.7 Nameplate data including the nameplate material, heights of letter and inscriptions.

.8 Spare parts list as specified in this Section.

.9 Manufacturer's installation instructions including receiving, handling, and storage requirements.

.4 Control and Schematic Diagram:

.1 Schematic diagrams shall show the equipment serial number, the purchaser's drawing number, purchase order number, or similar identification which will indicate the particular equipment to which the diagrams apply.

.2 Diagrams shall show all equipment and components in the electrical system including internal wiring of subassemblies. Diagrams shall clearly identify internal and external devices, and all remote contacts and signals. Show all interconnections between power sources and device elements of a particular system or equipment, and all interlocks with other equipment/systems in a manner that fully indicates the circuit function and operation. Show all panel terminal block identification numbers and all wire numbers. Show all intermediate terminations between field elements and panels. Diagrams of subassemblies may be furnished on separate sheets.

.3 Identify each device by a unique number or number-letter combination.

.4 Conductor Identification: Identify each conductor by a unique number, letter, or number-letter combination. Consecutive numbering is preferred. Each conductor shall have the same identification at all terminals and tie points. All conductors connected to the same terminal or tie point shall have the same identification. Where multi conductor cable is used, a color code may be used to supplement the above identification. Where color coded multi conductor cable is used for wiring identical components, such as limit switches,

the color code used shall be consistent and charted on related diagrams.

.5 Provide a schematic diagram for each electrical system. The schematic diagram shall be drawn between vertical lines which represent the source of control power. Show control devices between these lines. Show actuating coils of control devices on the right-hand side. Show contacts between the coils and the left vertical line.

.6 Where the internal wiring diagrams of subassemblies are furnished on separate sheets, they shall be clearly identified and cross-referenced to the separate sheets of the control circuit.

.7 For clarity, show control device symbols in the order in which the controls are positioned on the diagram.

.8 Use a cross-referencing system in conjunction with each relay coil so that associated contacts may be readily located on the diagram. Where a relay contact appears on a sheet separate from the one on which the coil is shown, describe the purpose of the contact on the same sheet. Show all spare contacts.

.9 Show limit, pressure, level, flow, temperature, and similar switch symbols on the schematic diagram with all utilities turned off (electric power, air, gas, oil, water, lubrication, etc.) and with the equipment at its normal starting position.

.10 Show contacts of multiple contact devices (e.g., selector switches and pushbuttons) on the line of the schematic diagram where they are connected in a circuit. Indicate a mechanical connection between the multiple contacts by a dotted line or arrow.

.11 Additional charts or diagrams may be used to indicate the position of multiple contact devices such as limit, pressure, level, and selector switches.

.12 Show the purpose or function of all switches adjacent to the symbols.

.13 Show the purpose or function of controls such as relays, starters, contactors, solenoids, subassemblies, and timers on the diagram adjacent to their respective symbols. Show the number of positions of the solenoid valve adjacent to the valve solenoid symbol.

.5 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures and maintenance information.

.6 Factory Acceptance Test (FAT) Procedures

.7 Site Acceptance Test (SAT) procedures

.8 Test Report

.9 Certificates

.10 Application programs (i.e. all the program source files) software developed for the application shall be provided to the Department.

.11 Electrical Content for Operation and Maintenance Manual:

.1 Contractor shall submit a detailed Operation and Maintenance (O&M) Manual for all custom control panels specified herein and shown on the Drawings. The O&M Manual shall be provided in accordance with the general requirements of the specification and as specified herein.

.2 The O&M Manual shall include, but not be limited to, the following:

.3 Manufacturer's product literature, specifications, performance capabilities, features and accessories, and illustrations.

.4 Detailed Bill of Materials for all control panel equipment and components, listing: manufacturer's name, quantity, description, size, range, and model/part number.

.5 Manufacturer’s data and drawings showing dimensions, physical configurations, installation and mounting details, and wiring schematics.

.6 Control ladder diagrams and wiring schematics. Loop diagrams for each monitoring and/or control loop.

.7 Complete, detailed installation and operation instructions for all control panel equipment and components.

.8 Service and maintenance data shall include all information and instructions required by District's personnel to keep the control panel and all associated components functioning properly under the full range of operating conditions.

.9 Explanation with illustrations as necessary for each service and maintenance task.

.10 Recommended schedule of service and maintenance tasks including troubleshooting instructions, list of maintenance tools and equipment, recommended spare parts list, and names, addresses and phone numbers of all manufacturers and manufacturer's local service representatives

.11 Final O&M Manual - In addition to the O&M Manual requirements specified above, the Final O&M Manual shall be supplemented with the as-built drawings (including all field changes) for all control panel wiring and loop diagrams after a successful completion of start-up and initial operation,

.12 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

.2 Recycled Content:

.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

1.4 QUALITY ASSURANCE

.1 All materials shall be new and conform to CSA standards and/or other standards listed in these Specifications and on the Contract Plans, unless noted otherwise.

.2 Supply materials from manufacturers who have manufactured similar materials for similar applications for a period of not less than ten years.

.3 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect equipment from damage.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 HPU CONTROL PANEL, OPERATOR CONTROL CONSOLE, AND BRIDGE CONTROL CABINET

.1 Contractor shall provide HPU Control Panel, Operator Control Console, and Bridge Control Cabinet designed to operate as an integrated system for the operation of the movable bridge.

.2 The HPU shall be provided with an integrated electrical power and control panel with a lockable, mechanical latch disconnect switch. Power shall be removed whenever the door to the electrical enclosure is open (the switch is in the off position). However, incoming power lines to the switch are live unless power is removed externally. In addition, the HPU control panel shall provide means to disconnect and lockout each HPU pump motor.

.3 HPU control panel enclosure rating/ ingress protection shall be NEMA 4X. The control switches, alarm indications, and other panel mounted devices shall have and maintain the same level of ingress protection of the HPU control panel. The HPU control panel enclosure shall have double front panel covers. Exterior cover to access control switches, display and indications; interior cover for access to electrical components and for protection from live parts. The physical dimension of the HPU control panel shall be no larger in any dimension than 450mm x 1000mm x 1500 mm (depth x width x height).

.4 The Operator Control Console and Bridge Control Cabinet shall be fabricated from No.10 gauge 302 stainless steel sheet properly formed and reinforced to provide adequate strength. The control console and control cabinet shall be neatly fitted up with close joints; all rough edges or corners shall be ground off smoothly, and all projecting edges rounded off. All metal hardware shall be of substantial construction, and shall have a satin chrome plate finish. All equipment mounting screws and bolts shall be stainless steel. The Operator Control Console and Bridge Control Cabinet shall be fully custom fabricated or it may consist of custom modules using standardized components where available to meet the dimensional and functional characteristics shown on the design drawings and as specified. Secure doors and/or access panels in place using captive, spring-loaded, self-locking spring nuts and hardened sheet metal screws. Use stainless steel screws and nuts. Secure access panels with spring-loaded, quarter-turn fasteners with studs held captive in the removable panel. Provide adequate ventilation to dissipate the heat generated within the cabinet enclosure(s). Provide special equipment supports and guides as required to support the equipment and other components within the Operator Control Console and Bridge Control Cabinet.

.5 The wiring within the control cabinet(s) shall be flame-retardant, ethylene-propylene insulated, switchboard wire, Type SIS. The wiring shall be arranged systematically so that all circuits can be readily traced. All conductors shall be terminated on easily accessible terminal blocks mounted inside at the rear or as appropriately determined by the control systems vendor. Spare terminals that total at least 20 percent of those actually used shall be provided. All circuit wirings shall be clearly identified and correspond to the shop drawing circuit wiring diagrams.

.6 Provide control switches, indication lights, displays, relay devices, terminal blocks, wire management, and miscellaneous hardware as required to perform the control functions as indicated on drawings and as specified. Furnish standard catalog electrical components items under regular manufacture with pre-existing catalog ratings equal to or better than the requirements of the contract drawings and specifications. Accompany request for approval of equipment other than as specified or as indicated by technical and descriptive data and specifications sufficient for the Department’s Representative to determine its adequacy. Unless otherwise specified or indicated, electrical materials and equipment shall meet the standards, specifications, and tests referenced. Submit data specifications and assembly drawings showing sizes, ratings, parts and material lists, overall dimensions, and mounting dimensions with the product data.

.7 Control panel shall have a flange mounted disconnecting circuit breaker operable from the control panel front and interlocked with the enclosure door, to be used to isolate the control panel from the power supply. The panel shall have a nameplate identifying the circuit breaker feeding the panel. Warning labels shall be provided identifying sources of foreign power to be disconnected prior to accessing the control panel.

.8 The control voltage within the control panel controls shall be 120 VAC. Provide control power transformers, overcurrent protection, and power supplies to convert supply voltage to utilization voltage as required.

.9 The control panel shall be the source of power for all 120 VAC devices interconnected with the control panel including, but not limited to solenoid valves, instruments, and transmitters both mounted in the control panel and remotely connected to the control panel.

.10 The PLC and control devices including control valves shall be sourced from HPU control panel and be power from UPS control power supply source.

.11 Provide uninterruptable power supply (UPS) size to provide backup and to condition of AC control power against surge, sags, or brief line power losses. The UPS shall have the capacity to allow control valves to ramp open or close to its final stop position.

.12 Provide marshalling terminal blocks dedicated for the following:
- .1 Field devices external to the HPU skid;
- .2 Interface wiring between HPU Control Panel and the Bridge Control Cabinet
- .3 Interface wiring between HPU Control Panel and the Operator Control Console
- .4 Interface wiring between the Bridge Control Cabinet and the Operator Control Console

.13 Provide nameplates for each device on the HPU control panel, valve panels, and gauge panels. Nameplates shall clearly indicate the function of each device and, in the case of manually operated controls, indicate the condition established for each position of the control. Instruction plates shall clearly indicate the proper procedures and sequences of operations to activate the system, to operate the system, and to secure the system after completion of operation. Machine engrave lettering on nameplates on steel plate. Mount instruction plates on a rigid backing and covered with clear, rigid plastic sheeting. Mount instruction plates in a location easily visible to an operator stationed at the console or panel.

.14 Provide security provisions on the control panel to prevent unauthorized or accidental operation of the system.

.15 Provide plastic coated rigid metal conduits. The conduit shall be hot-dip galvanized including the threads. The galvanized conduit shall conform to ANSI C80.1 and UL 6. The plastic coating shall be factory applied by the same manufacturer who produces the hot-dip galvanized conduit. The plastic coating shall have a minimum thickness of 0.040 mm for the full length of the pipe except for the threads. The plastic coating shall have a tensile strength of 3500 psi. Furnish a coupling loose with each length of the conduit. The bond between metal and plastic shall be equal to or greater than the tensile strength of the plastic coating. The coated conduit shall conform to NEMA RN 1, Type A.

.16 Conduit fittings shall be galvanized, high test, gray iron castings. The fittings shall be plastic coated in the same manner as outlined above for the conduit. Furnish gaskets for all covers.

.17 Provide support for conduits and cabinets as required by IEEE C57.12.70. The supports shall be galvanized and plastic coated in the same manner as outlined above for the conduit.

.18 Cabinets and Boxes Cabinets and boxes shall be watertight, stainless steel, NEMA 4X housings sized as required. The cabinet and box hubs shall be consistent Control Consoles.

.19 Provide the subassemblies with adequate protective pads, supports, and blocking and securely restrained to prevent distortion or damage to the painted surfaces in transit. Any loss or damage during shipment, including damage to the painted surfaces, is the Contractor's responsibility; replace or repair without additional cost to the Contract price. Pack all accessories and spare parts separately in containers plainly marked "ACCESSORIES ONLY," or "SPARE PARTS ONLY." Place a packing list, listing the contents of each container, in a moisture-proof envelope and securely fasten to the outside of the container. Standard commercial packaging in accordance with ASTM D3951 will be acceptable except where a different method or standard of packaging is specified.

.20 Provide ground lugs/bus for electrical grounding connections.

2.2 CONTROL FUNCTIONS AND FEATURES

.1 The HPU control panel shall include programmable logic controller (PLC). The PLC shall comply with the requirements of the Specification Section 40 25 00 PROGRAMMABLE LOGIC CONTROLLER (PLC).

.2 The HPU shall be controlled locally using the front panel controls switch and/or HMI, and remotely by the bridge control system. The HPU control system shall include as a minimum the following:

- .1 Power on indication - The Power indicator lights indicate that electrical power is applied to the HPU.
- .2 Bridge Control/Local Control Switch - In the Local Control position, you can operate the HPU with the front panel controls. If it is in the Bridge Control position, the bridge control system is use to operate the HPU.
- .3 An Enable Switch and High Pressure Switch - ensures that the system starts in low pressure, and permits quick selection of low or high pressure.
- .4 HPU Stop Switch – to disable HPU control system.
- .5 Span Stop Switch - When Stop is pressed (in either Local Control and Bridge Control), provide a normal stop function intended to provide a smooth method of stopping the span without the undesirably high machinery stresses typically experienced with an emergency stop.
- .6 Emergency Stop Switch - This switch operates in both local and remote control and is used during emergency situations

only. When pressed, it immediately shuts down the HPU and Bridge Control System. The emergency stop shall be wired to directly remove power from the operating coils of HPU pump motor starters and bridge machinery motor starters.

.7 Emergency Off/Close Switch - The "Emergency Off/Close" selector switch located on the Operator Control Console and on the HPU Control Panel, in "Close" position, will allow the operator to bypass the bridge control relay interlocks and PLC control to close the bridge. The emergency close contact shall send signal directly to the selected HPU pump motor starter to starter the pump motor and open the bridge emergency close control valve to close the bridge at reduced speed.

.8 Low Fluid Level indicator lights – to indicate the hydraulic fluid level has dropped below a preset value.

.9 Fluid Over-Temperature indicator lights - to indicate when the hydraulic fluid temperature has exceeded a preset value.

.10 Dirty filter indicator lights to indicate when the filter needs replacement. A dirty filter signal will not shut the unit down, but it will prevent the unit from starting.

.11 Interlocks protect the HPU against low hydraulic fluid level, over-temperature, and dirty filters.

.12 Reset Switch - This switch resets the interlock circuit if the condition causing the interlock has been corrected.

.13 Pump 1 Select Switch and Pump 2 Select Switch – The switches allow manual selection for the HPU to operate on hydraulic Pump 1 or Pump 2.

.14 Pump 1 and Pump 2 manual START/STOP control; only function in when Local Control Switch is in local control position.

.15 Fluid level gage This gage indicates the level of hydraulic fluid in the reservoir.

.16 Temperature gage This gage indicates the temperature of the hydraulic fluid in the HPU reservoir

.17 An hour meter - to indicates the total operating hours of the pump to help you determine maintenance intervals.

.18 Reduced voltage motor starter(s) to reduces the initial motor inrush current when electrical service to the HPU is turned on.

.19 Thermal overloads protect the HPU from excessive current draw.

.20 Hydraulic fluid tank heater power and control circuits with thermostat control source from the HPU Control Panel. Heater shall be included with low-low fluid level.

.21 Bridge span angular position display on the local control panel HMI utilizing 4-20 mA signal from the span position sensor. Provide 4-20 mA signal splitter in the HPU control panel to allow 4-20 mA signal connection to the digital display located on the Operator Control Console. The 4-20 mA

signal to the digital display located on the Operator Control Console shall not be from the PLC output.

.3 Control Interlocks:

.1 The HPU contains interlock circuitry to shut down the HPU when various conditions occur such as low level hydraulic fluid, over-temperature, low pressure, dirty filters and motor overload.

.2 Reset when the interlock condition has been corrected and the HPU is restarted; the Reset switch must be pressed to reset the interlock circuitry.

.3 Hydraulic fluid Low-level condition – Whenever the level of hydraulic fluid in the HPU reservoir drops below a preset limit, control switch opens to turn off the pump motor. The HPU control system generates the Low Fluid Level alarm indication on the HPU front panel, provide alarm output and permissive interlock signal to bridge control system to prevent bridge operation.

.4 Fluid over-temperature condition - Whenever the temperature of the hydraulic fluid in the HPU reservoir exceeds a preset limit, control switch opens to turn off the HPU pump motor. The HPU control system generates the Fluid over-temperature alarm indication on the HPU front panel, provide alarm output and permissive interlock signal to bridge control system to prevent bridge operation.

.5 Dirty filter - The low-pressure fine filter is monitored by differential pressure switch. When a dirty filter creates excessive differential pressure across the filter, the control switch opens. The HPU control system generates the Dirty Filter alarm indication on the HPU front panel, and provide alarm output signal to bridge control system but does not prevent bridge operation. If the indicator is active when the HPU shutdowns. Reset must be pressed (after the filter is replaced) to restart the HPU.

.6 Motor overload - Thermal overload sensors detect excessive current and open the normally closed contacts connected to the motor starter coil. Motor overload relay contacts open to turn off the HPU if the pump motor(s) draws excessive current. When an overload condition occurs, the reset button on the motor overload relay must be pressed.

.4 Alarm and Indications:

Provide the following alarm indications and control signals:	HPU HMI Panel on HPU Skid	Output Indication on the Bridge Control Panel
HPU Enabled/Disabled	X	

Bridge Control/Local	X	
Proportional Directional Control Valve (Open/Close)	X	
Start/low pressure selected	X	
High pressure selected	X	
Pump motor 1 is running	X	
Pump motor 2 is running	X	
Stop switch is pressed	X	
E-Stop switch(s) is pressed	X	
Hydraulic fluid Low-level warning alarm	X	
Hydraulic fluid Low-level shutdown condition	X	
Fluid over-temperature warning alarm condition	X	
Fluid over-temperature shutdown condition	X	
Pressure Filter Differential Pressure indicator - Caution	X	
Return Filter Differential Pressure indicator - Caution	X	
Motor(s) overload for each individual motor	X	
HPU Common Trouble Alarm	X	X
HPU Common Trip (System Shutdown)	X	X
Alarm Reset switch is pressed	X	
Span Position Indication	X	X

.5 Control Devices and Wiring:

.1 Provide manual or automatic control protective or signal devices required for the specified operation and all control wiring for these controls and devices whether indicated or not. Electrical control devices shall have minimum current and voltage ratings in accordance with the requirements of NEMA ICS 2 contact rating designation A 300, as applicable, unless larger ratings are indicated or are required. Provide control devices with the number and arrangement of contacts

required to perform the specified control functions. Provide devices with or installed in NEMA 4X enclosures.

.2 Pressure Switches Pressure switches shall have a minimum pressure rating of as required. Enclose the switches in watertight, stainless steel, NEMA 4X housings. Provide the switches with a normally open, normally closed contact having a minimum rating of 5 amps, 125/250 volts AC.

.3 Relays used in control circuits shall be industrial magnetic control relays conforming to NEMA ICS 2 contact rating designation A 300, except where other ratings are indicated. Apply relays in control circuits in such a manner that proper control functions are obtained regardless of whether the contacts are overlapping or non-overlapping.

.4 Indicating light assemblies shall be LED, switchboard type, insulated for 120 Volt AC service, with appropriate colored as indicated and integrally mounted resistors for 120 Volt AC service. LED lamps shall be replaceable from the front of the panel.

.6 Bridge Operation Control Interface

.1 Provide control command signals, control and safety interlock signals, indication signals, system configuration and programming, and associated circuit wirings between system components as specified and as indicated on the design drawings.

.2 The control system integration shall include all the inputs, outputs, controls, alarms, and indication between the HPU control panel, bridge control relay cabinet, operator control console; hydraulic pump motors; main hydraulic cylinder swing circuit; end lift circuit; latch pin circuit; control valves; span position indicator; limit switches, and other associated field devices.

.3 The control system shall be integrated to perform functions as described in the Specification Section 40 20 00 BRIDGE CONTROL SEQUENCE OF OPERATION.

2.3 PUMP MOTORS AND STARTERS

.1 The pump motors shall conform to the applicable requirements of NEMA MG 1, except as hereinafter specified, and designed to withstand full voltage starting. Motor shall be rated for severe duty motors for indoor or outdoor harsh environment installation. Provide additional customized features as required to accommodate machinery interface and system integration.

.2 Provide Totally Enclosed Fan Cooled (TEFC), NEMA Design B. Windings shall be copper and the winding insulation shall be of Class H.

.3 Provide electronic soft-starter for each pump motor. The soft starter shall be integrated with the HPU control system for start/stop control functions and monitoring operating parameters. The electronic soft-starter shall be properly sized and be appropriate rated for the driven motor(s).

.4 Design the motor to operate continuously without exceeding the temperature rise permitted by the applicable NEMA standards for the class of insulation and frame construction used.

.5 The motors shall operate on 600 volts, 60 Hz, 3-phase power and sized (30hp, 1800 rpm) to operate the corresponding pump. The motor torque characteristics in relation to the speed and starting current, shall conform to the motor design classification. The motor size and torque characteristics of the motor motors shall be as required to accommodate the performance requirement of the driven equipment without damage to the motor or the equipment at any voltage from 90% to 110% of motor nameplate voltage.

.6 Provide a stainless steel, drain-breather similar and equal to Crouse-Hinds type "ECD Universal" and locate so that any water present can be drained from inside the motor.

.7 Provide winding insulation of either class H with special moisture, fungus, and oil-proof treatment. Provide winding insulation of the type designed and constructed to withstand the severe moisture conditions and the wide range in ambient temperature to which the motors will be subjected. The motor windings shall be encapsulated.

.8 Install a heater or heaters in the motor frame or end bells or wrapped around the winding end turns. The heater shall be automatically turned on when the motor is not running. The heater shall be capable of withstanding the same temperature extremes as the motor. Provide heaters that when energized the temperature of the motor winding will be held approximately 10 degrees C (18 degrees F) above ambient. Design them for 120 volts AC continuous operation. The heaters shall withstand 10 percent overvoltage continuously. Terminals of the heaters, including the leads, shall be watertight. Terminate the leads in the motor lead terminal box.

.9 Motor terminal leads shall have insulation equivalent to that of the motor winding, and terminate in a two-piece, four-position, watertight, stainless steel, NEMA 4X, terminal box secured rigidly to the motor frame. Position and seal the leads where they pass through the frame with a water-resistant seal of a synthetic rubber material or else with a synthetic rubber gasket. Thread conduit entrances to the terminal box.

.10 Motors and motor's terminal boxes arrangement on the HPU skid shall allow accessibility to cable terminations and allow removal of motor(s) of off the skid for service.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 The electrical installation work shall be installed as indicated on the Contract Drawings and in accordance with approved shop drawings and manufacturer's recommendations.

.2 All associated construction and installation work shall be installed using good installation judgement and in accordance with all prevailing national and local codes and ordinances.

3.2 TESTS, INSPECTIONS, AND VERIFICATIONS

.1 The Contractor shall be responsible for all the necessary tests of the HPU's electrical and control system, both Factory Acceptance Test (FAT) and the Site Acceptance Test (SAT). Testing shall include both hardware and software items included in its scope of supply.

.2 Testing shall include all system hardware, communications, back-up and redundancy operations, 100% of I/O points (including spares) with simulated inputs and outputs (hardware I/O simulator with real tag numbers shall be arranged before testing), local panel (if any), and any other external device communications interface. Testing shall also include complete integrated testing of the interfaces including field devices, relay panel(s), machinery control equipment, and operator control console.

.3 Testing shall include functional tests and all associated interfaces with the operator console and graphic displays.

.4 Contractor shall provide all necessary test equipment and software including any special software or hardware required for a complete functional test of the system.

.5 Contractor shall clear and shall re-test and approve all punch list items before the HPU equipment may be released for shipping. In presence of any pending punch list, the advanced shipping may be authorized by the Departmental Representative.

.6 The Contractor shall provide the necessary assistance to co-ordinate the field tests, to supervise the commissioning and start-up activities, to perform the training activities applicable for the package.

.7 Departmental Representative and Contractor may attend all of the tests. Any limitation on time required for the tests is not accepted: any test is considered ended if and only if completed in every part.

3.3 FACTORY ACCEPATANCE TEST (FAT)

.1 The FAT will concern all the equipment and developed software within Contractor scope of supply, as well as the integration with another subsystem supplied by sub-contractor(s).

.2 Schedule and testing procedures shall be submitted to the Contractor/Departmental Representative as early in the design as possible, but not less than 30 days prior to test. After schedule approval, at least 2 weeks prior to the start of testing, the Contractor shall provide the FAT procedures. FAT procedures and required test report forms shall be made available during the test.

.3 The FAT test report shall be provided no later than 2 weeks after FAT completion.

.4 The Departmental Representative may ask to postpone the starting date of FAT if any material omissions or relevant errors in the documentation are met.

.5 Prior to the FAT all the necessary equipment shall be fully assembled, wired and connected in order to test all the functionality of the supply. The Contractor shall provide test documentation for all electronic devices and for the cards before system assembling.

.6 The Contractor shall organize the testing activities and make available all the assistance and equipment necessary so that the testing activity proceeds as quickly as possible. Location, staff and equipment to perform the test are completely at Contractor charge.

.7 The control system shall be installed in its final configuration and mainly the following items shall be tested:

- .1 Hardware components and power supply
- .2 Visual check in order to verify the equipment quantities and conformity to drawings and contractual characteristics, identification tags, safety coverings, cable run, interconnection between panels, etc.
- .3 Project documentation check
- .4 Insulation resistance and dielectric test of components
- .5 Redundancy systems test
- .6 Test of all I/O’s

.7 Test of loss of power and subsequent power up
.8 Application software
.9 HMI Graphics
.10 Communication

.8 As general statement, 100% of hardware (spares included) and application software shall be tested. In order to facilitate the tests, the Contractor shall provide all the needed equipment to simulate digital/analogue inputs, to check the status of digital/analogue outputs and to simulate serial link communication.

.9 All the application software will be tested by simulation of all I/Os (software simulating the field is accepted).

.10 After the completion of the hardwired FAT, testing procedure shall foresee a complete integrated testing of the bridge control interfaces (System Integration Test). All the necessary hardware components and software application necessary to perform the test will be provided by the Contractor.

.11 Since the Software FAT may be performed after the delivery of the hardware at site, the Contractor shall foresee all the necessary equipment in order to proceed with software test without any additional cost charged to the Departmental Representative.

.12 All the anomalies, defections or changes will be reported and corrected by the Contractor before the end of testing or, at least with the Contractor approval, before shipment.

.13 A check list shall be issued during the FAT. Detailed check list shall be prepared by the Contractor and included in the FAT procedure. Other tests can be required according to the project needs and will be defined during detailed engineering.

.14 Positive result in the test does not release the Contractor from his responsibilities to provide a system completely working and to perform all the modification, which could be necessary to assure system correct working in the field.

.15 After successful completion of the FAT, the FAT completion report shall be signed by the equipment vendor and by the Contractor.

.16 A final report shall be issued at the end of FAT, highlighting possible reservation as far the Departmental Representative are concerned; shipment authorization will be generally issued by the Contractor only after the complete solution for the pending reservation.

3.4 SITE ACCEPTANCE TEST (SAT)AND COMMISSIONING ASSISTANCE

.1 The Site Acceptance Test is intended to verify that the system, as accepted at FAT completion, will still perform on site as per specification after the shipment. This test will be performed after erection and wiring completion but jointly with the loop tests on each individual loop.

.2 It shall fully cover all the functionalities of the system that could have been degraded by dismounting, packing, shipping and installing the system on site (i.e. I/O cables connections, power supply connections, hardware integrity, etc).

.3 The other checks shall be repeated as “Sample”, with an extent suitable to demonstrate that the system has been properly restarted and the configuration correctly reloaded.

.4 Contractor shall have equipment manufacturer's technicians be on site during field test to perform the test and solve any problem that could arise as part of the contract.

.5 Before performing the test, the Contractor is asked to issue and submit for the Department or Department’s Representative approval, a Site Acceptance Test Procedure complete with check-lists identifying each test to be performed.

.6 The tests, start up and commissioning activities at construction site in charge to the Contractor shall at minimum include:

- .1 Test without auxiliary voltage and insertion of auxiliary voltage
- .2 Check of installed equipment (quantity, quality)
- .3 Check of insulation of cables and equipment electric materials
- .4 Check of cables for continuity and conformity to drawings
- .5 Switch on operating voltage to equipment after checking protection settings
- .6 Switch on control system into service
- .7 White test (without power voltage)
- .8 Calibration of all adjustable monitoring equipment (limit switches, position transducers, level transducers, thermostats, level switches, pressure switches, etc.)
- .9 Calibration and proper operation checkout of all field equipment: controls, local commands indicators, actuators both electric and electro-pneumatic
- .10 Check of the interface equipment to control system by checking the corresponding readings (alarms, indicators, measurement readings, etc.)
- .11 No load tests (with the machines energized)
- .12 Check of direction of rotation of the machines

.13 Check of machine power consumption and protection settings

.14 Calibration and check the proper operation of the electrical and hydraulic machine controls, which are possible only when the machine is running

.15 Test of the entire software with all I/O connected in their final configuration; all the controls, sequences, interlocks and specific functions of the program shall be tested locally from the panel interface (if any) and remotely from the main control room.

.7 The Contractor shall have at their disposal all the necessary equipment for testing and put the system into service.

.8 The commissioning and system tests include the download of the final hardware/software configuration.

.9 Any software programming change required by Contractor on site and implemented by the equipment vendor personnel shall be considered part of the Site Acceptance Test scope of work.

3.5 WARRANTY

.1 Warranty period: refer to Commercial documentation.

3.6 TRAINING

.1 Contractor shall provide on construction site training course to instruct the operator and maintenance personnel on the main operation and maintenance acknowledgments for HPU control system.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 MEASUREMENT AND PAYMENT PROCEDURES

.1 Lump Sum Amount. No measurement will be made for this item.

.2 Payment at the Contract price for this tender item shall be full compensation for all labor, equipment, supplies and material to

do the work, including the cost for the associated work applicable to this tender item per the requirements of the following specification sections:

01 91 13 - General Commissioning
01 79 00 - Demonstration and Training
26 05 00 - Common Work Results for Electrical
26 05 21 - Wires and Cables (0-1000 V)
26 05 26 - Grounding and Bonding for Electrical Systems
26 24 22 - Field Instrumentation Devices
26 60 13 - Low-Voltage Motors
40 20 00 - Bridge Control Sequence of Operation
40 25 00 - Programmable Logic Controller (PLC)

.3 Basis of payment shall be as follow:

Milestone	**Payment**	**Requirements**
Shop drawings approved	5%	Department Representative's approval of shop drawings
Completion of Factory Acceptance Test (FAT)	15%	Department Representative's approval of FAT Report
Substantial completion of electrical installation	50%	Department Representative's approval of Final Field Inspection Report
Completion of Electrical Tests	15%	Department Representative's approval of Field Electrical Report
Completion of Final Testing and Commissioning	15%	Department Representative's approval of the Final Testing and Commissioning Report
TOTAL	100%	

END OF SECTION

PART 1 - GENERAL

1.1 ELECTRICAL WORK DESCRIPTION

.1 This section includes general requirements for supply, service, delivery, storage, installation, testing and commissioning of electrical equipment, apparatus, appliances, materials, and accessories necessary to complete the work under the scope of the contract.

.2 Provide supervision, labor, and assistance to manufacturer's field representative and/or technical directors for equipment to be installed as a part of this Contract. Follow specified procedures and instructions provided by the departmental representatives. Representatives will not be present at all times.

.3 The prime mover of the bridge span(s) shall be by packaged hydraulic power unit(s) with integrated control system. The integrated control system shall consists of programmable logic controller (PLC) system, software and hardware, monitoring and control logic programming, input/output device, human-machine-interface (HMI), communication device, field instrumentations and control devices, hydraulic power unit(s), hydraulic cylinder(s), machinery drive motor(s), traffic control interface equipment, warning system, circuit wiring, and miscellaneous electrical devices integrated to form a functional and operational system.

.4 The Contractor shall provide service of qualified system integration company to develop and produce substantially completed electrical installation shop drawings as integrated system for Departmental Representative review and approval. The substantially completed installation shop drawings shall be developed based on the final shop drawings of the actual equipment procured. The substantially completed installation shop drawings shall include layout/assembly/installation drawings of equipment, components terminal boxes and terminations drawings, schematic diagrams, point-to-point interconnection wirings with cable tags and termination identification for field installation. The Contractor shall coordinate all activities required to produce the substantially completed installation shop drawings.

1.2 RELATED REQUIREMENTS

.1 All section 26 specifications defined for the electrical work.

1.3 REFERENCES

.1 Definitions:

.1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

.2 Electrical systems shall be engineered, manufactured and installed in accordance with the National Electrical Codes. The design and engineering of the electrical installation shall satisfy all statutory requirements of the national and/or local authorities of the country in which the electrical installation will be located. The electrical installation shall be suitable for the site conditions as specified. Where necessary, special attention shall be paid to the selection and installation of electrical equipment suitable for seismic conditions. Where relevant, the specific publications are referenced herein.

.3 The following reference standards documents form part of the specification to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the work.

.2 Reference Standards:

.1 CSA Group

.1 CSA C22.1,2018 Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.

.2 CAN/CSA-C22.2 NO. 0-10 (R2015) - General requirements - Canadian electrical code, part II

.3 CSA C22.2 NO. 47-13 - Air-cooled transformers (dry type)

.4 CSA C22.2 NO. 52-17 - Underground secondary and service-entrance cables

.5 CSA C22.2 NO. 227.2.1-14 - Liquid-tight flexible non-metallic conduit (Bi-national standard with UL 1660)

.6 CSA C22.2 NO. 0.3-09 (R2014) - Test methods for electrical wires and cables

.7 CSA C22.2 NO. 2420-09 (R2014) - Belowground reinforced thermosetting resin conduit (RTRC) and fittings (Bi-national standard, with UL 2420)

.8 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.

.9 CSC C22.2 NO. 248.8-11 (R2016) - Low-voltage fuses - Part 8: Class J fuses (Tri-national standard, with UL 248-8 and NMX-J-009/248/8-ANCE)

.10 CSA C22.3 No.7-06, Underground Systems, except where otherwise specified.

.11 CAN/CSA-S6-14, Canadian Highway Bridge Design Code

.12 CAN/CSA-S6.1-14 - Commentary on CAN/CSA-S6-14, Canadian Highway Bridge Design Code.

.13 CAN/CSA-Z462-18, Workplace Electrical Safety.

.2 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)

.1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

.3 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)

.1 EEMAC 2y-11958 and amendment thereto, Light Gray Colour for Indoor Switchgear.

.4 Heath Canada/ Workplace Hazardous materials Information System (WHMIS).

.1 Material Safety Data Sheets (MSDS).

.5 American Society for Testing and Materials (ASTM)

.1 ASTM D149 - 09(2013) -Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

.6 National Electrical Contractor Association (NECA)

.1 NECA 1-2015 - Standard Practice of Good Workmanship in Electrical Contracting.

.7 National Fire Protection Agency (NFPA)

.1 NFPA 79-2018 – Electrical Standard for Industrial Machinery.

.8 The Ontario Electrical Safety Code 2012, and all bulletins (Ontario)

.9 Ontario provincial Standard Specifications

.1 OPSS 106 – General Specification for Electrical Work

.2 OPSS 602(Nov 2017) – Construction Specification for Installation of Electrical Chambers

.3 OPSS 603 (Nov 2017)- Construction Specification for Installation of Duct

.4 OPSS 604(Nov 2017) - Construction Specification for Installation of Cable

.5 OPSS 609(Nov 2012) – Construction Specification for Grounding

.6 OPSS 610(Nov 2016) – Removal of Electrical Equipment

.7 OPSS 614(Nov 2012) – Construction Specification for Installation of Power Supply Equipment

.8 OPSS 615(Nov 2017) – Construction Specification for Pole Erection.

.9 OPSS 616(Nov 2012) – Construction Specification for Footings & Pads for Electrical Equipment.

.10 OPSS 617(Nov 2013) - Construction Specification for Roadway Luminaires and Brackets

.11 OPSS 620(Nov 2017) - Construction Specification for Traffic Signal Equipment

.12 OPSS 621(Nov 2017) - Construction Specification for Electrical Traffic Control Device.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Preconstruction Submittals:

.1 Health and safety plan

.2 Work plan

.3 Quality Control(QC) plan

.4 Schedule of submittal items with dates

.3 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for all items described in these specifications and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Submit for review single line electrical diagrams under plexiglass and locate as indicated.

.1 Electrical distribution system in the electrical equipment room.

.5 Shop drawings:

.1 The Contractor shall submit copies of vendor, producer or manufacturer data for materials, devices and subsystems or standard or proprietary products. These shall include design and installation shop drawings, catalog cuts, specifications, testing requirements, and installation instructions for the following items, but not excluding other items or materials not specifically mentioned herein.

.2 System integration and/or engineered system shop drawings shall be stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada. Equipment shop drawings are not required to be stamped and signed by professional engineer, but must have applicable CSA certification for the equipment and material.

.3 A number of electrical equipment items specified as part of the electrical work are to be provided for mechanical installation, followed by electrical installation under the herein specified electrical work. The dimensions of these items are critical for their installation and integration into the bridge mechanical machinery system. Their dimensions

are indicated on the mechanical Contract Drawings and have been obtained from information provided by various equipment manufacturers. The dimensions have not been obtained from manufacturer's certified drawings (certified drawings are drawings certified by the manufacturer to be dimensionally accurate and which contain sufficient detail to determine if the requirements of the Contract Documents have been satisfied). The Contractor shall, as part of its procurement process, obtain certified drawings for these items from the manufacturers and provide them to those responsible for the mechanical work in the preparation of the Shop and Erection Drawings for the bridge machinery. The certified drawings shall be submitted in support of the developed Shop Drawings. The Contractor shall notify the Departmental Representative of any dimension of any specified item that deviates from the Contract Drawings. These items shall consist of the following:

.1 Packaged Hydraulic Power Units (HPU)
.2 HPU Control Panels/PLC
.3 Bridge Control Cabinet (BCC)
.4 Operator Control Console
.5 Span Position Indication
.6 Mechanical Limit switches
.7 Magnetic Limit Switches
.8 Geared Rotary Cam Limit Switches
.9 Switchboards and Panelboards
.10 Distribution Transformers
.11 Disconnect Switches
.12 Limit Switches
.13 Traffic Control Gates
.14 Navigation Lights
.15 Bridge Operator's Control Console
.16 Uninterruptible Power Supply (UPS)

.4 Under no circumstance shall any of the proposed electrical power or control systems be fabricated, assembled, or wired directly from the Contract Drawings. The Contractor shall prepare and submit installation shop drawings substantially completed as integrated system for Departmental Representative review and approval. The substantially completed installation shop drawings shall include layout/assembly/installation drawings of equipment, components terminal boxes and terminations drawings, schematic diagrams, point-to-point interconnection wirings with cable tags and termination identification for field installation.

.5 The Contractor shall identify any constructability issues or conflicts between manufacturers' shop drawings and contract documents (drawings and specification) during the Contractor shop drawing review and installation drawing development

process. The Contractor shall also identify variations between Contract Documents and product or system limitations or functionality that may be detrimental to the successful performance or operation of the completed work. The Contractor shall submit proposed resolutions for review and approval by the Departmental Representative.

.6 Comprehensive shop Bills of Material shall be included for each of the proposed major items of equipment and systems and sub-systems including electric service switchgear, motor control center, Packaged HPU, HPU Control Panel/PLC, Bridge Control Cabinet, Operator Control Console, etc. The computed shipping and operating weights of each piece of electrical equipment shall be stated on the Shop Drawings upon which it is detailed.

.7 Complete assembly and installation drawings shall be furnished. These drawings shall clearly indicate how the work is to be performed in the field including foundation requirements, equipment clearances required for operation and maintenance access and as required by applicable codes.

.8 Assembly and installation drawings shall be given identifying marks and essential dimensions for locating each piece of equipment or assembled unit with respect to the bridge and its required equipment foundation. Each unit shall be cross-referenced to the Shop Drawing on which it is detailed or indicated in physical and functional terms.

.9 The Contractor shall submit electronic copies of all required shop drawings, unless otherwise directed, that include shop, assembly, installation, schematic and wiring Drawings. Drawings shall be prepared for all electrical power and control systems and sub systems proposed for the bridge and shall describe in physical, functional, schematic and wiring terminologies the proposed systems. The configuration of the power and control system shall be clearly described as well as the logic associated with the system and the required interfaces with the overall traffic control operating systems. All Installation Drawings shall conform to the following:

.1 Manufacturer’s Literatures – The submittal information shall have annotation of project’s equipment identification (name and/or tags) on their respective sheets. Where equipment vendor’s standard product data sheets and/or drawings are furnished which cover a number of variations of the general class of equipment, the information shall be annotated to indicate exactly which equipment, parts, and/or accessories are being furnished. Technical data such as equipment ratings, operation parameters, performance data shall be provided for each specific piece of electrical equipment as specified.

.2 General Arrangement Drawings - The general arrangement (GA) drawings shall indicate at a minimum 3 perspective views: plan view, elevation view, and side view. Additional views or sections shall be provided as required to clearly indicate the extents and features of the subject. The GA drawings shall locate all equipment and shall include equipment centerlines, equipment access and maintenance space. The Contractor shall indicate any areas that require more than 3 feet of clearance around their equipment boundary on the GA drawings for access or maintenance requirements. Information regarding the location of access doors or view port to allow access platform & walkway design shall be provided. The Contractor is responsible for consolidation of all information from their suppliers onto their GA drawings.

.3 Physical Dimensioned Drawings – Provide physical dimensioned drawings for electric service equipment including but not limited to: motor control center, switchboards, panelboards, hydraulic power and control system, control panels, motors, brakes, bridge operator control console, rotary cam limit switches, span seated limit switches, cabling systems, etc. shall be drawn to scale. Outline drawings shall depict graphically and dimensionally the configurations, profile, and limitations of parts and assemblies. Perspectives and reference points shall be indicated clearly for each view. All details of given devices or components shall be clearly visible at the scale selected for that part, assembly or sub-assembly with the exception of enlarged views drawn to capture small details within a part, such as those that may be used to improve clarity and prevent excessively large drawings. Separate details shall be provided for all opposite hand span drive motors, brakes and span position rotary cam limit switches and shall be in accordance with the mechanical machinery layout.

.4 Equipment Foundation and Mounting - Anchor bolt drawings shall provide templating dimensions in sufficient detail to facilitate the preparation of foundation design drawings and to determine the sizes and types of fasteners and other installation devices required. Foundation plans shall provide sufficient dimensional and configuration details to facilitate foundation design and installation planning by the Contractor. The drawings shall also include the supplier’s recommendations for installation methods and materials.

.5 Wiring Diagrams – Provide applicable one-line, three-line and schematic diagrams to shows wirings, connections and interconnections of the electrical

system installation, equipment or its component devices and parts. Drawings shall provide such detail as is necessary to be able to trace the electrical circuits and connections involved. The drawings must include cable numbers, conductor colors, pair/triad numbers, terminal source and designation identifications. If cables are shielded, the shields shall be shown on the drawings. All spare conductors shall be shown on the drawings.

.10 Submit six (6) copies of 600 x 600 mm minimum size drawings and product data to authority having jurisdiction.

.11 If changes are required, notify Departmental Representative of these changes before they are made.

.12 Conduct field surveys to verify existing dimensions shown on the plans, prior to development of submittals. Identify field verified dimensions on submittals. Conduct field measurements and surveys as required to supplement the information provided in the plans and to provide a complete and satisfactory fitting and operational installation.

.6 Engineering Data:

.1 Provide Substantially Completed Installation Shop Drawings

.2 Provide Electrical System Protection Coordination and Device Settings

.3 Provide Arc flash study and warning label information

.7 Certificates:

.1 Provide CSA certified equipment and material.

.2 Where CSA certified equipment and/or material is not available, submit such equipment and/or material to authority having jurisdiction for special approval before delivery to site.

.3 Submit test results of installed electrical systems and instrumentation.

.4 Permits and fees: in accordance with General Conditions of contract.

.5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative.

.8 Startup and Commissioning Plan and Report

.1 Provide Startup and Commissioning Plan

.2 Startup and Commissioning Report

.9 Test Reports:

.1 Provide Factory Acceptance Test

.2 Provide Electrical Construction Field Testing and Commissioning Report

.10 Manufacturer's Field Reports: Submit to Departmental Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and electrical power and control testing, as described in PART 3 - EXECUTION.

.11 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
  - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
- .2 Building Energy Consumption: submit Measurement and Verification Plan following IPMVP for monitoring end-uses as follows:
  - .1 Lighting systems and controls.
  - .2 Constant and variable motor loads.
- .3 Recycled Content:
  - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.
- .4 Regional Materials: submit evidence that project incorporates required percentage 50% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for electrical equipment and installations for incorporation into manual.
- .1 The Contractor shall provide Operation and Maintenance Manuals to be contained in one or more volumes for all electrical power and control systems and sub systems and interfaces with the communications network provided under this contract. The Departmental Representative will review preliminary copies of the O&M Manuals and the Contractor will incorporate the changes made into the final manual. Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:

.1 System description, equipment and functional descriptions, bridge control sequence of operation and step-by-step operating procedures.
.2 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
.3 Start up and shutdown procedures including proper adjustment, operation, lubrication, state of equipment during shutdown, winterize protection of equipment.
.4 Safety precautions.
.5 Procedures to be followed in event of equipment failure.
.6 Warranty information.
.7 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Final “As-Built” Drawings shall be submitted for review and approval at the completion of the project. Any field modification during construction and/or deviations from the approved Shop Drawings shall be clearly indicated. Reproducible drawings shall be made on sheets using the Project standard title block. These drawings shall be stamped "As Built", immediately above the title block.

.4 Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures. Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.6 QUALITY ASSURANCE

.1 System Integrator – Contractor shall designate an individual (such as the Control System Supplier) to act as the Project's Control. Systems Integrator and to serve as sole representative for the detail design, development, coordination, and testing of the drives, MCC, PLC system (including programming), relay control, system, and Human-Machine Interface (Including programming). Ensure the Control Systems Integrator is qualified in developing and coordinating these types of specialty items, and the System Integrator is approved by the Departmental Representative. The System Integrator will serve as a single point of contact prior to, during, and after construction, and must be available for consultation during all phases of the project, including shop drawing submittal and review. All shop drawings shall be reviewed by the Control Systems Integrator prior to distribution to the Departmental Representative for his review. The Control Systems Integrator shall stamp the reviewed shop drawings with an appropriate stamp indicating that he has reviewed and accepted the

drawing before distribution. Ensure the Control Systems Integrator is present at all shop testing and is on site and directing all testing and commissioning of the bridge operating equipment and systems. Process any approved changes associated with the bridge electrical system through the Control Systems Integrator. He shall maintain the responsibility for coordination of the work. The contractor shall submit the pre-qualification submittal of the Control Systems Integrator to the Departmental Representative for approval at the time of the Pre-Construction Conference. The written acceptance of the Control Systems Integrator by the Departmental Representative shall occur prior to preparing detailed design drawings and specifications. Include with the pre-qualification submittal documents that substantiate the qualifications of the proposed individual having a minimum the following qualifications:

.1 Licensed Professional Electrical Engineer.

.2 Past experience integrating similar projects on movable bridges within the past ten (10) years.

.3 Ten (10) years' experience as the control system integrator that includes a minimum of three (3) years electrical design experience for moveable bridges.

The Departmental Representative will review the pre-qualification submittal of the Control Systems Integrator, and will be the sole judge of the adequacy of the information submitted. Inadequate proof of this ability and experience, or insufficient details, shall be cause for disqualification of the Control Systems Integrator.

.2 Contractor Review and Acceptance of Shop Drawings
The Contractor shall provide a Quality Assurance process for all shop drawings and calculations that are submitted. The review shall indicate completeness of the submittal and compliance with the design. Provide a cover sheet listing the preparer(s) and checker(s) name, initials, and content responsibility. The preparer and checker shall initial each sheet to establish their content responsibility. The preparer and checker shall not be the same individual. An Registered Professional Engineer shall review, approve, sign and seal the shop drawing cover letter or submittal letter to affirm that the shop drawings meet the intent of the contract.

.3 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety

Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Electrical work shall be performed by qualified personnel. Installer shall be skilled in trade and shall have thorough knowledge of products and equipment specified to perform equipment and system installation in a safe professional manner.

.6 All partially outdoor or outdoor electrical equipment enclosure construction, material and protective treatment shall be listed as suitable for installation in humid, salt-laden air environment.

.7 Electrical components, equipment and systems shall satisfactorily pass all applicable factory and field tests in accordance with the relevant industry standards. Copies of all test certificates and supporting documentation shall be supplied to the Department as part of submittal requirements or as requested by the Departmental Representative.

.8 Manufacturer of equipment specified shall be recognized in industry for normally supplying this type of equipment. Manufacturer shall be ISO certified.

.9 Materials and equipment furnished for permanent installation shall be new, unused, and undamaged. Provide the standard cataloged materials and equipment of manufacturers regularly engaged in the manufacture of the products. For material, equipment, and fixture lists submittals, show manufacturer's style or catalog numbers, specification and drawing reference numbers, warranty information, and fabrication site. All equipment and materials shall be in accordance with the technical specification and other relevant industry standards.

.10 Service conditions: Provide equipment and material suitable for intended service and installation at location indicated.

.11 Parts shall be manufactured to industry standard sizes to facilitate maintenance and interchangeability.

.12 Contractor shall develop detailed, step by step, testing and commissioning plan for placement of electrical equipment, apparatus, and completed electrical system in service. Contractor shall execute the plan, and document the performance and test results. Contractor shall take corrective actions necessary to bring the failed and/or noncompliance test results into conformance.

.13 Acceptance testing of electrical distribution system and equipment under scope of project shall conform to the specification,

equipment manufacturer recommended testing and commissioning requirements, and to the latest revision of the ANSI/NETA Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems (ANSI/NETA ATS).

.14 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality conformed to the requirement of Specification Section 01 45 00.

1.7 DESIGN ANALYSIS AND DOCUMENTATION

.1 Contractor shall perform supplemental studies and/or designs per the requirements of the specification. Contractor shall submit drawings and engineering data in accordance with the submittal requirements and schedule to assure compliance with the project requirements, overall construction schedule, and the project in service date. During the design submittal process, the Contractor shall provide required design analysis.

.2 Contractor’s design shall give consideration to economics, safety of operation, acceptable performance, reliability, interchangeability of parts, O&M familiarity, and other benefits.

1.8 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Provide temporary electrical connections to equipment heaters, or provide temporary heaters, as required to prevent damage from moisture and as required in other Sections of these Specifications.

.2 Provide climate controlled environment for the storage for control equipment/ assemblies during construction. Thoroughly dry out and put through special dielectric test as directed by the Departmental Representative or replace if not tested to the satisfaction of the Departmental Representative, any apparatus that has been subjected to possible injury by water or dampness (including the interiors of motor control equipment or any other electrical devices).

Store and protect equipment from damage from mishandling, dropping or impact. Do not install damaged equipment.

.3 Replace defective or damaged materials with new at no cost to the Departmental Representative.

.4 Develop Construction Waste Management Plan related to the Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 DESIGN REQUIREMENTS

.1 Operating voltages: to CAN3-C235.

.2 Motors, electric heating, control, lighting and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.

.1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

.3 Language operating requirements: provide identification nameplates and labels for control items in English and French.

.4 Use one nameplate or label for each language.

2.2 MATERIALS AND EQUIPMENT

.1 Provide material and equipment in accordance with Section 01 61 00.

.2 Substitution: Electrical material and equipment specified constitute the basis of design material and equipment. The Contractor may provide product that meet or exceed the quality, functions and performance specified from reputable and qualified manufacturers with the understanding that all design and/or method of installation changes required by the substitution shall be made by the Contractor at no additional cost to the contract. Product acceptability shall be determined at the sole discretion of the Departmental Representative and may be based on one or more of the following: quality, function, ease of maintenance, physical size, reliability, value, electrical load capacity, durability, standardized components, availability and other criteria as deemed appropriate by the Departmental Representative.

.3 Material and equipment to be CSA certified. Where CSA certified material and equipment are not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

.4 Factory assemble control panels and component assemblies.

2.3 CONDUIT RACEWAY

.1 Provide conduit raceways as indicated on drawings and/or as specified. Where conduit size is not indicated, provide minimum conduit size in accordance with requirements of CEC.

.2 Provide conduit type per the applicable locations:

- .1 Indoor Applications:
  - .1 Exposed non-corrosive environment: Rigid Galvanized Steel Conduit (RGS)
  - .2 Exposed corrosive environment: Reinforced Thermosetting Resin Conduit (RTRC) or Fiberglass Conduit
  - .3 Above grade and concealed inside wall: IMC or RGS Conduit
  - .4 Embedded in concrete: PVC Schedule 40 PVC
  - .5 Connection to electrical equipment subject to vibrations: Liquid-tight Flexible Metallic Conduit
  - .6 Conduit stub-up: Rigid Galvanized Steel Conduit (RGS)
- .2 Partially Exposed to Outdoor or Outdoor Applications:
  - .1 Exposed non-corrosive environment: Rigid Galvanized Steel Conduit (RGS)
  - .2 Exposed corrosive environment (petrochemical, wastewater, chemical, pulp and paper, bridges, tunnels, docks, piers, and cooling tower and vicinity): PVC Coated- Rigid Galvanized Steel Conduit (PVC-RGS). Installer shall be certified by manufacturer to install PVC coated conduit.
  - .3 Direct Buried: PVC Schedule 80
  - .4 Embedded in concrete: PVC Schedule 40 PVC
  - .5 Under Roadway: Steel Reinforced, concrete encased duct bank, PVC Schedule 40 PVC ducts
  - .6 Conduit stub-up: Rigid Galvanized Steel Conduit (RGS)
- .3 Submersible Applications:
  - .1 Flexible fiberglass composite underwater duct with design pressure strength of three time the pressure of the installed water depth minimum.

.3 Rigid Metal Conduit

- .1 Rigid metal conduit shall be construct of mild steel tube with continuous welded seam in accordance with ANSI C80.1, and UL 6.

.2 Exterior and Interior of conduit shall have protective coating consisting of Metallic zinc applied by hot-dip galvanizing or electro- galvanizing with a final coat of transparent zinc chromate to exterior. Exterior and interior coatings applied to conduit shall afford sufficient flexibility to permit field bending without cracking or flaking.

.3 Thread pitch shall conform to ANSI/ASME B1.20.1. Taper shall be 3/4”/ft. (62.5 mm/m).

.4 Each length of conduit shall have UL listing label.

.5 Couplings, unions, and fittings: Threaded-type, galvanized steel. Covers shall have solid gaskets and captive screw fasteners.

.6 Size of conduits shall be as indicated on construction drawing or as specified herein. Where size is not indicated, it shall be in accordance with the fill requirements as defined in the CEC. Unless otherwise indicated, the minimum size conduit shall be 3/4 mm.

.7 The RGS conduits shall be hot dipped galvanized inside and out with hot dipped galvanized threads.

.8 Each underground joint shall be sealed and made liquid-tight.

.9 Stainless steel screws shall be furnished and used to attach the covers to the conduit fittings. All coated material shall be installed, patched according to the manufacturer’s latest printed recommended installation and patching instructions, and as approved by the Departmental Representative.

.10 All conduits shall be secured to outlet boxes, junction boxes or cabinets.

.11 All conduit terminations shall be equipped with insulating bushings.

.12 Couplings, connectors and fittings used for the installation shall be of a type specifically designed and manufactured for use with the supplied plastic coated conduit. Flexible liquid-tight conduit and connectors shall be used where final connection to equipment with rigid conduit is not practicable, such as to equipment with adjustable mountings or subject to vibration as specified above. Where used the flexible conduit runs shall be no less than 500mm in length or as approved by the Departmental Representative.

.13 Use solid gaskets. Ensure conduit fittings with blank covers have gaskets, except in clean, dry areas or at the lowest point of a conduit run where drainage is required.

.4 PVC-Coated Rigid Galvanized Steel Conduit

.1 PVC-coated raceway shall be installed as a system, which means the fittings, conduit bodies, straps, hangers, boxes, etc., are also coated.

.2 Exterior coating shall be a minimum of 40-mil, polyvinyl chloride (PVC) coating over exterior and apply urethane

coating uniform and consistent to interior of conduit. Internal coating shall be nominal 2 mil thickness. Conduit threads shall be protected by urethane coating.

.3 Use manufacturer acceptable method when threading the PVC coated conduit.

.4 The integrity of PVC coating shall be maintained at the threaded connection.

.5 Reinforced Thermosetting Resin Conduit (RTRC)

.1 Reinforced Thermosetting Resin Conduit shall be an epoxy-based resin system using anhydride-curing agent. RTRC shall be meets CSA C22.2 NO. 2420-09 (R2014) standards.

.2 Conduit shall consist of continuous E-glass roving. Additives for increasing flame spread and lowering smoke density shall be halogen free.

.3 The conduit shall be rounded and shall be free from all defects including indentations, delamination, pinholes, foreign inclusions, and resin-starved areas. The bore of the conduit shall be smooth and uniform.

.4 Carbon black shall be used as ultraviolet inhibitor to protect conduit and fittings.

.5 Dielectric strength shall exceed 400 volts/mil when tested in accordance with ASTM D149.

.6 All elbows and fittings shall be manufactured from the same process, methods and chemicals as the conduit. Fittings, elbows, joints and accessories shall be as recommended by manufacturer to maintain UL listing of components and system.

.7 Conduit bodies shall be manufactured using compression molding process using vinylester resin with reinforcement glass. Bodies shall be fire resistant in accordance with CSA C22.2 NO. 2420-09 (R2014)and be halogen free.

.8 Minimum wall thickness of 0.09 mm for normal size 50mm - 100mm (2”-4”) for general application. Extra heavy wall with minimum wall thickness of 0.25 mm for normal size 76mm - 203mm (3”-8”) for heavy loading, long span, and/or under water crossing applications.

.6 Liquid tight Flexible Metallic Conduit (LFMC)

.1 Conduits to motors and other electrical vibrating equipment shall terminate in conduit fittings on the motors and equipment, the final connection being made with liquid-tight flexible conduit and suitable liquid-tight connectors.

.2 Flexible conduit shall be as short as possible and in no case shall not exceed a conduit run of 2m.

.3 Provide liquid-tight flexible metallic conduit with a protective jacket of PVC extruded over a flexible interlocked galvanized steel core to protect wiring against moisture, oil, chemicals, and corrosive fumes.

.4 All fittings used for flexible metallic conduit shall be specifically designed for such conduit.

.5 Liquid-tight unions shall be installed where standard threaded couplings cannot be used.

.7 Rigid Nonmetallic Conduit

.1 Ensure rigid nonmetallic conduit complies with NEMA TC 2 and NEMA TC 3 with wall thickness not less than Schedule 40.

.8 Deflection/Expansion Fitting

.1 Provide deflection/expansion conduit fittings at conduit crossing between two structures at location with deflection, vibration from vehicular traffic and/or expansion. Deflection/expansion conduit fittings shall be UL listed and CSA Certified.

2.4 ENCLOSURE, JUNCTION BOXES, AND TERMINAL CABINETS

.1 In general, all electrical equipment and instrumentation shall be in enclosures. Enclosures, junction boxes, and terminal cabinets located in exposed or semi-exposed locations shall be NEMA 4X (or IEC type IP56 rated) as a minimum.

.2 Enclosures, boxes, and cabinets in wet locations or subject to condensation shall include a minimum 6 mm drain hole at the low point of the enclosure.

.3 General purpose enclosures, boxes, and cabinets installed indoors in unconditioned space shall be NEMA 12 rated.

.4 Enclosures, boxes, and cabinets in dry, environmentally controlled areas and that are exceptionally clean may be NEMA 1 rated.

.5 Junction boxes pull boxes and electrical enclosures larger than 4” (100 mm) trade size in any dimension shall be of adequate strength to support mounted components without deflection during shipment and installation.

.6 Underground boxes shall be specifically design and construct for intended installed location, and be either pre-formed concrete or high strength fiberglass. Body and Cover shall be capable of withstanding, without failure, type of traffic in general area.

.7 Electrical enclosures located in outdoor, wet, or hose down areas shall be provided with space heaters, adjustable thermostat with set point temperature indicator, and miniature circuit breaker protective device. Space heater capacity shall maintain enclosure internal temperature above dew point under specified service conditions.

.8 Outdoor electrical enclosures with ventilating openings shall be provided with fine mesh filters and stainless steel bug screens.

2.5 HARDWARE

.1 Provide hardware including, but not limited to, anchor bolts, nuts, washers, expansion anchors, wire nuts needed for installation.

.2 Provide corrosive resistance hardware suitable for the environment and compatible with the electrical equipment construction and degree of environment and ingress protection.

.3 For outdoor installation of electrical equipment, provide stainless steel hardware such as, but not limited to, anchors, bolts, braces, boxes, bodies, clamps, fittings, guards, nuts, pins, rods, shims, thimbles, washers, and miscellaneous hardware.

.4 Hardware smaller than 3/4” (19 mm) shall match NEMA standard size bolt holes on motors and electrical equipment.

2.6 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

.1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated.

.2 Control wiring and conduit: in accordance with Section 26 29 03 - Control Devices except for conduit, wiring and connections below 50 V.

2.7 AUXILIARY TRANSFORMERS

.1 Provide separately mounted transformers as shown on Drawings. Transformers shall be encapsulated, dry-type with copper winding, self-air-cooled, capable of wall- or floor-mounting, and enclosed for wiring connection by conduit.

.2 Enclosures shall be made of sheet steel with corrosion-resistant finish and manufacturer’s standard color. Ingress protection rating shall be suitable for the environment and in accordance with requirements of this Specification.

.3 Provide at least 2 full kVA capacity voltage taps above and 2 full kVA capacity taps below nominal rating. Each tap shall be 2.5% step.

.4 Transformer shall be capable of at least 150°C rise above rated site maximum ambient without degrading transformer life.

.5 Transformers shall comply with CAN/CSA-C22.2 No. 47.

2.8 FUSES

.1 Fuses shall comply with CAN/CSA-C22.2 No.248.8

2.9 SAFETY DISCONNECT SWITCHES

.1 Provide electrical equipment with heavy-duty, quick-make, quick-break type isolation switches. The isolation switches ratings shall be as indicated on the construction drawings. If not indicated and required by local authority, provide safety isolation switch rating suitable the application operating voltage, current rating, number of poles, and installed environment.

.2 Switch construction is such that the operating handle shall be integral part of enclosure base and when the switch handle in the "ON" position, the cover or door cannot be opened.

.3 Provide provisions to lock the handle in the "OFF" position and not capable of being locked in the "ON" position.

.4 Provide two (2) auxiliary contacts rated at 15A to be use for space heater circuit and for disconnect position status.

.5 Disconnect switches shall comply with CAN/CSA-C22.2 No. 0.

2.10 WARNING SIGNS

.1 Warning Signs: in accordance with requirements of the electrical codes.

.2 Porcelain enamel signs, minimum size 175 x 250 mm.

.3 Electrical equipment Arc Flash and Short Circuit Current to CSA C22.1.

2.11 WIRING TERMINATIONS

.1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.12 EQUIPMENT IDENTIFICATION

.1 Identify electrical equipment with nameplates labels as follows:

.1 Nameplates: plastic laminate 3 mm thick plastic engraving sheet, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.

.2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

.2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.

.3 Wording on nameplates labels to be approved by Departmental Representative prior to manufacture.

.4 Allow for minimum of twenty-five (25) letters per nameplate or label.

.5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.

.6 Identify equipment with Size 3 labels engraved "ASSET INVENTORY NO. XXXX" as directed by Departmental Representative.

.7 Disconnects, starters and contactors: indicate equipment being controlled and voltage.

.8 Terminal cabinets and pull boxes: indicate system and voltage.

.9 Transformers: indicate capacity, primary and secondary voltages.

2.13 WIRING IDENTIFICATION

.1 Identify wiring with permanent indelible identifying markings, numbered coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

.2 Maintain phase sequence and colour coding throughout.

.3 Colour coding: to CSA C22.1.

.4 Use colour coded wires in communication cables, matched throughout system.

2.14 CONDUIT AND CABLE IDENTIFICATION

.1 Colour code conduits, boxes and metallic sheathed cables.

.2 Cover with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.

.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

Prime	Auxiliary	
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 5 kV	Yellow	Blue
up to 15 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Fire Alarm	Red	
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.15 FINISHES

.1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.1 Paint outdoor electrical equipment "equipment green" finish.

.2 Paint indoor switchgear and distribution enclosures light gray to EEMAC 2Y-1.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for electrical installation in accordance with manufacturer's written instructions.

.1 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.

.2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where otherwise specified.

3.3 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.4 CONDUIT AND CABLE INSTALLATION

.1 Install conduit and sleeves prior to pouring of concrete.

.2 Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.

.3 During the construction phase, all open ends of the conduit termination shall be plugged with approved conduit stopping plugs to prevent ingress of moisture, water, and construction debris and/or aggregate.

.4 Conduits shall be installed in practical alignment with the structure, with uniform pitch draining toward boxes with properly formed bends and securely attached to the bridge structure.

.5 Provide deflection/expansion conduit fittings at conduit crossing between two structures at location with deflection, vibration from vehicular traffic and/or expansion. Install deflection/expansion conduit fittings per manufacturer instruction and recommendation.

.6 Surface mounted shall be supported throughout the entire route at regular intervals. The spacing between adjacent support points shall not exceed the manufacturer recommendation for their respective conduit sizes.

.7 Where rigid steel conduit crosses an expansion joint or where significant temperature differentials are anticipated (such as outdoor raceway spans between structurers, attached to bridges, on rooftops, etc.) expansion fittings shall be provided to allow relative movement to occur on either side of the expansion joint. A separate circuit protective conductor shall be installed to maintain an effective electrical continuity across the expansion joint. Provide factory installed packing ring, designed to prevent the entrance of moisture, and a pressure ring. Include a Grounding ring or a Grounding conductor for metallic expansion couplings.

.8 An adequate number of suitably sized electrical pull boxes/junction boxes shall be provided in all conduit runs to facilitate circuit wiring installation without damage. electrical pull boxes/junction boxes shall be provided immediately after

every two bends, or after a bend plus a maximum straight run of 10m, or after a maximum straight run of 15m.

.9 Provide required penetrations in floors, walls, or roofs. Penetrations shall be as small as possible, and installed in neat manner. Repair of the surrounding surfaces damaged during installation of penetrations shall be included as part of this work. Where a conduit passes through fire resistant structural elements, such as walls and floors designated as fire barriers, the penetration openings shall be properly sealed according to the appropriate degree of fire resistance of the penetrated wall and/or floor to prevent the spread of fire and smoke from one area migrating into another. In addition, where a conduit is installed in a channel, duct, ducting or shaft which pass through such elements, suitable fire-resistant barriers shall also be provided to prevent the spread of fire.

.10 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

.11 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

3.5 LOCATION OF OUTLETS

.1 Locate outlets in accordance with Section 26 05 32 - Outlet Boxes, Conduit Boxes and Fittings.

.2 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes.

.3 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.

.4 Locate light switches on latch side of doors.

.1 Locate disconnect devices in mechanical and elevator machine rooms on latch side of floor.

3.6 MOUNTING HEIGHTS

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 Install electrical equipment at following heights unless indicated otherwise.
 .1 Local switches: 1400 mm.
 .2 Wall receptacles:
  .1 General: 300 mm.
  .2 In pivot pier vaulted hydraulic equipment room: 1400 mm.
 .3 Panelboards: as required by Code or as indicated.

3.7 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.8 FIELD QUALITY CONTROL

.1 General Electrical Test Requirements
 .1 Inspection and testing shall be performed on all new installations and alterations to an existing installation in accordance with the requirements of this Section. The International Electrical Testing Association (NETA) shall be referred and adopted where appropriate. In the event of any test indicating failure to comply, that test and those preceding, the results of which may have been influenced by the fault indicated, shall be repeated after the fault has been rectified. Provide all necessary test equipment, labor, and personnel to perform the tests, as herein specified. The following tests shall be performed.

.2 Testing of Electrical Installation. The testing of the electrical installation shall be carried out during and following complete installation of the electrical items.
 .1 General.
 Electrical testing shall be performed during equipment manufacture and procurement, the electrical installation process and following completion of the installation. The electrical testing shall consist of the following:
  .1 Factory Testing
  .2 Field Testing
  .3 Adjustments
  .4 Performance Acceptance Testing
  .5 Endurance Testing
  .6 Training
  .7 Supervision of Operations
 .2 Factory Testing.
 The electrical testing shall consist of factory testing of the major items of electrical equipment procured for installation at the bridge. The major items of electrical equipment shall include the integrated bridge power and

control system to prove the operating and functionality and control logic. These tests shall be conducted by the equipment manufacturer and witnessed by the Departmental Representative as specified herein. The manufacturer shall submit test certificates and supporting data corroborating that the testing was performed and successfully completed in accordance with this specification. The Contractor shall submit test procedure to the Departmental Representative for approval prior to conducting the tests that would constitute acceptance of the manufactured equipment.

.1 The following items of equipment shall be factory tested in the presence of the Departmental Representative:

.1 The integrated testing of motor control center, PLC control system, bridge operator control console and limit switches

.2 In the absence of the hydraulic system, operation of the system shall be performed by simulating the integrated functionality of the operation of the hydraulic system with the electrical control system.

.2 The factory testing of each system described above shall consist of completely wiring and cabling the systems as defined on the approved shop drawings in preparation for the tests.

.3 Performing complete functional tests shall be in accordance with the Departmental Representative approved test procedure.

.4 The control system functional tests shall verify the bridge operating sequences for all modes of operation, prove the PLC logic in accordance with the specified sequence, and correct functionality of all control system interlocks and permissives.

.3 Field Testing.

The Contractor shall employ the services of an approved electrical testing company to test the bridge. The testing company shall be qualified for the defined and specified work and submit his qualifications and electrical testing experience for Departmental Representative approval. The proposed electrical testing company shall be experienced in the testing of electrical power, control and instrumentation systems. The testing company shall furnish all test equipment, materials, labor and technical supervision required to perform all of the tests to demonstrate that the equipment and installation comply with the requirements of the Contract Drawings and this specification. Testing procedures shall conform to applicable standards of the ANSI, IEEE, NEMA, CEC and NETA.

.1 Test equipment shall include, but not be limited to, the following:
   .1 500 and 1,000 volt megger test sets
   .2 Relay and metering primary injection test set
   .3 AC and DC digital and analog multi-meters
   .4 Ground ohmmeter
   .5 Multi-channel chart recorder with digital output
   .6 Power quality recorder

.2 Continuity Test: Perform continuity test to insure correct cable connection (i.e. correct phase conductor, grounded conductor, and Grounding conductor wiring) end-to end. The continuity of all conductors, including the circuit protective conductor of every ring final circuit, shall be verified for proper installation. The wire and cable shall be isolated completely all from all extraneous electrical connections at cable terminations and joints. Use substation and switchboard feeder breakers, disconnects in combination motor starters, circuit breakers in panel boards, and other disconnecting devices to isolate the circuits under test. Repair and re-verify any damages to existing or new electrical equipment resulting from improper wiring.

.3 Insulation Resistance: Perform insulation-resistance test on electrical switchgear, motors, and on each field-installed power and control conductor with respect to ground and adjacent conductors. For general facility branch circuit load conductors serving lights and receptacle outlets, insulation resistance testing is not required. The insulation resistance of the installation shall be tested in accordance with the Standard for Acceptance Testing Specification for Electrical Power Equipment and Systems. The resistance measured shall not be less than the recommended values set by the NETA testing standards pending on voltage class.

.4 Contact Resistance: Perform a contact-resistance test on each connection point of uninsulated busway, across each contactors, switchblade and fuse holder of motor controllers/starters, interrupters and isolation switches.

.5 Grounding System Resistance: The resistance of every ground electrode shall be measured to ensure that the ground resistance of the ground electrode will perform the intended design function and comply with the applicable code requirements.
   .1 Perform three-point fall-of-potential test per Institute of Electrical and Electronics Engineers (IEEE) Standard 81 on the main grounding

electrode or system. Resistance shall be no greater than 5 ohms.

.2 Perform the two-point method test per IEEE Standard 81 to determine the ground resistance between the main ground system and all major electrical equipment frames, system neutral, and/or derived neutral points. Resistance shall be no greater than 5 ohms.

.6 Polarity Test: Polarity test shall be performed to verify proper connection of voltage transformers, current transformers, meter, protective relay devices, electrical instruments, and proper connection to other electrical equipment.

.7 Phasing: Conduct phase-rotation tests on all three-phase circuits using a phase-rotation indicating instrument. Perform phase rotation of electrical connections to connected equipment clockwise, facing the source. Motor circuits shall be checked for proper rotation and motors "bumped" to verify correct machine rotation. Interconnection points between different source circuits shall be verified for proper phasing connections.

.8 Load Balancing: Perform load balancing of switchboards and panelboards. Measure phase current to panelboards in normal operating condition at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes. Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.9 All tests shall be conducted in the presence of and with the approval of the Departmental Representative. Any deviation from the prescribed requirements shall be corrected to the satisfaction of the Departmental Representative. The Contractor shall develop and submit comprehensive test procedures for all tests to be performed on the bridge power; control and instrumentation systems to assure all systems and sub systems are operating within their designed parameters and function as herein specified and in accordance with the manufacturer’s specifications. The test procedures shall be submitted to the Departmental Representative for approval and no tests shall be performed prior to Departmental Representative approval of the procedures. The Contractor shall give the Departmental Representative written notice of the tests at least two (2) weeks in advance of testing.

.10 The Contractor is responsible for all tests and test records. Testing shall be performed by and under the

immediate supervision of the Contractor. The Contractor for each piece of equipment shall keep test records. Copies shall be furnished to the Departmental Representative for his approval.

.11 The Contractor shall calibrate all test equipment. Tests shall be carried out in a safe and orderly manner. Care shall be taken to insure the safety of all personnel (authorized or unauthorized) who may be exposed to equipment or wires which are energized during tests.

.12 The Contractor shall be responsible for visual inspection of the equipment, which shall be made immediately prior to the testing, and/or energizing of that equipment.

.13 The Contractor shall prepare and submit to the Departmental Representative for approval an electrical testing schedule including a detailed description of the tests to be conducted prior to carrying out any electrical tests on the system.

.14 No adjustments or performance acceptance tests shall be conducted on the installation until all prescribed electrical tests have been carried out and approved by the Departmental Representative.

.4 Measurements and Adjustments.

Test instrumentation: During all adjustments described herein, where instrumentation is required the following data shall be recorded with recording meter.

.1 Phase voltages, phase currents, and power parameters (KVA, KW, KVAR, PF) at the main incoming service during bridge operation. Data for three complete operating cycles shall be provided.

.2 Harmonic data at common point of coupling at the main service during bridge operation. Data for three complete operating cycles shall be provided.

.3 Operating voltages, currents, and power parameters (KVA, KW, KVAR, PF) for bridge machinery equipment. For momentary loads, such as brakes and locks, only voltage and current are required to be measured during the operation.

.4 Adjust fully open and closed limit switches of all devices and the bridge to operate in accordance with the approved shop drawing schematic control diagram and prevailing field conditions.

.5 Performance Acceptance Testing.

.1 After erection is completed, and after all machinery, electrical equipment and structural work have been installed to the satisfaction of the Departmental Representative, the Contractor shall run tests on the respective mechanical and electrical systems and controls. These tests to demonstrate to the complete

satisfaction of the Departmental Representative all components and the complete assembly meet the intended requirements of the drawings and specifications and are capable of performing the work intended. These shall include but not be limited to all power, control (analog and digital) and instrumentation. Evidence of binding, vibration, uneven operation or faulty operation shall be cause for postponement of final acceptance. The Contractor shall make the necessary adjustments and/or replacements required to correct alignment, tolerances or any other defects which may cause improper operation of the machinery and do not satisfy the mechanical operating criteria and have not received the approval for service from the Departmental Representative. The Departmental Representative must witness all tests and it shall be the duty of the Contractor to submit a detailed testing schedule in advance and to coordinate with the Departmental Representative for the purpose of scheduling test dates.

.2 The Contractor shall provide all necessary personnel for carrying out the necessary tests, including complete direction of their duties and programming of the test process. This shall include his own personnel in addition to the systems vendor’s field personnel and the testing company personnel. As a minimum, for the electrical testing and verification of the satisfactory operation of the installed machinery, the Contractor shall provide an operator for the operator’s control console, and two field engineer or technical representatives of the manufacturer of the major electrical equipment.

.3 On the first day of performance acceptance testing, the Contractor shall have available 12 copies of the detailed test program, arranged with suitable spaces to record all results, instrument readings, designations to correlate with index markings to be noted on the charts during the tests, pertinent comments, etc. This program shall have been submitted to the Departmental Representative and approval received before finalization of test date. Although the Contractor shall direct the testing, the right is reserved by the Departmental Representative to call for certain notations to be made on the record copy of the test program as the tests proceed and to collaborate in the scope of interpretation of the program depending upon the results which develop.

.4 All test instruments or other test equipment required for all of the tests shall be provided by the Contractor.

.5 After completion of the performance acceptance tests, the Contractor shall submit records, adequately identified of all data recorded during the tests. The Departmental Representative shall also have the right to request different and/or additional tests when there is any disagreement relative to any test result as having established proof of acceptability and conformance to the specification.

.6 Charts and electronic files shall be made for each test and each one uniquely identified for each test, cycle of test and movement direction of the span. The chart identifications shall coordinate with those as noted on the detailed test program. The Departmental Representative may decide during testing that certain portions of the charts need not be included in the final sets to be processed and submitted by the Contractor. All other hard copy charts, to be submitted, shall be processed by the Contractor as follows:

.1 Cut and trim all of the charts and reproductions so that each identified portion is separate from other portions (for example: the span opening portion of the second cycle, from closed to fully open position, would be one identified portion).

.2 Fold flat wise to an overall length of 280mm with the identifying chart number exposed. The identifying numbers shall contain three parts: one pertaining to the chart speed and instrument used; one part pertaining to the index system correlated to the test program; and one part to the direction of span movement.

.3 Make reproduction copy sets as required to accompany the report of tests. These shall be high quality reproductions of legible prints. Copies with perceptible loss of detail will not be acceptable.

.4 Arrange each set of charts sequentially according to the identifying numbers, separated into groups with each group corresponding to the instruments used.

.7 Following completion and acceptance of the performance tests, the Contractor shall furnish copies of a test report to the Department. Each copy shall be suitably bound and include the following information:

.1 Title page, table of contents, introduction, electrical test conclusions, test program, summary of results, test identification numbers and charts.

.2 The introduction shall include complete description of instruments used, current

transformer ratios, and calculation of scale factors, available chart and recorder speeds used during the tests, dates tests were performed and any clarifying comments as appropriate to the full reporting of the tests.

.3 The test program will be a reproduction of the programs furnished by the Contractor when the tests were begun with notations as made during the tests including any recordings or chart portions not required to be included in the report.

.4 Summary of results shall describe the pertinent measured parameters and observable results for each test. Meaningful information shall be developed not requiring reference to the charts except for supplementary details. In other words, each test shall be described in narrative form giving recorded voltage, currents, power, speed changes and observable results pertaining to that test, including descriptions regarding acceleration, running and deceleration.

.5 The test identification numbers section of the report shall give the identifying number used, a list of the charts included in the report and a list of those charts which are not included.

.6 The charts portion of the report shall contain a pocket to enclose the reproduced charts, folded and identified as described herein.

.8 The original of the electronic data files and charts (complete, including those not reproduced in the report) shall be furnished to the Department.

The acceptance tests of the moving span shall be performed in conjunction with mechanical acceptance testing and shall include, but not be limited to:

.1 Normal load test: while recording the test data outlined herein open and close the span through two complete' cycles of operation for each of the duty modes of operation.

.6 Endurance Testing.

Prior to the bridge being placed into service and following performance acceptance testing, the Contractor shall perform a series of endurance tests on the complete bridge operating system. These tests shall be performed over an extended period and fully document the performance of each piece of machinery and electrical equipment including documenting failures and describing in a test report form all remedial actions taken to rectify failure conditions. Following any failure for any of the items indicated below, the Contractor shall repeat the endurance test on that item. The endurance

testing of the individual sub systems and bridge operating system shall consist of the following:

.1 Ten (10) consecutive full open and close operating cycles of the bridge span. Five-minute duration shall be allowed between bridge operations.

.2 Fifteen (15) consecutive operations of bridge machinery momentary loads such as brakes, locks, wedges, jacks or end lift as applicable to the project. Five-minute duration shall be allowed between individual operations.

.3 Twenty (15) consecutive full open and close operating cycles of each bridge traffic gate. Five-minute duration shall be allowed between operations.

.7 Training.

The Contractor shall provide training sessions, manuals, and training aids to the Department staff to provide the knowledge to operate and maintain the Bridge electrical systems.

.1 The Contractor shall submit complete training plans and manuals for all equipment provided under this contract. The training plans shall include a proposed schedule, resumes of personnel proposed to be instructors for each class, statement of purpose, and list of the required equipment, tools, and test equipment to be utilized as part of the training session. The training manuals shall illustrate information and procedures used, and shall also be prepared specifically for use as training aids.

.2 The Contractor shall schedule the training sessions through the Construction Manager at a time convenient to the Department. The Contractor shall notify the Construction Manager of the proposed training sessions at least 30 days before the dates the training will be held. The Contractor shall provide on-site, hands-on training sessions as required to demonstrate actual maintenance procedures on the equipment. Training sessions shall enable a qualified service technician to troubleshoot and sustain the equipment and systems.

.3 The Contractor shall provide all special tools, equipment, training aids, and other materials required for the training of Department personnel. The number of special tools and other training equipment shall be adequate for the number of participants attending the training sessions.

.4 As a condition to Substantial Completion, the Contractor shall train the bridge operating and maintenance (O&M) personnel in the operation, start-up and shut-down, adjustment, troubleshooting, servicing, and preventive maintenance of applicable equipment and systems installed under the Contract. The Contractor shall provide the services of manufacturers' representatives

for instruction and training when special equipment and systems require the knowledge and expertise of the various manufacturers for the proper operation and servicing of such equipment and systems.

.5 Training Manual and Student Training Material

.1 The Contractor shall furnish six bound copies of the Training Manual to the Department for approval 60 days prior to training. The Training Manual shall consist of material required for the instruction and training of designated Department personnel including but not limited to electricians, maintenance workers, mechanics, Departmental Representative

.2 The Contractor shall provide bridge operator trainers to supervise the operation of the bridge and to train the bridge operation and maintenance personnel for a period of 21 days prior to Final Acceptance Testing and approved by the Department.

.3 The Contractor shall provide recommended qualifications for Department personnel to be trained for bridge maintenance and operations.

.4 It shall also be the contractor team's responsibility to coordinate with the Department as to the location where training sessions will be held. Contractor shall give the Department a 30-day notice of scheduling the training sessions.

.5 Training and instruction shall be given on subjects such as troubleshooting, repair of motor controls, maintenance and adjustments of all limit switches and electrical equipment, maintenance and other items required for full bridge operation and maintenance.

.6 The Contractor shall furnish all the required number of Student Training Material. The material shall consist of visual aid equipment such as book, booklets, and other miscellaneous items required for training.

.8 Supervision of Operation.

The Contractor shall provide a person “on call” to supervise the operation of the bridge for six (6) complete operations of the span on 24 separate days. The schedule for span operation is to be determined by the Department after the span is completely operable. This person shall be able to operate the bridge, to supervise its operation and to make any adjustments or corrections that may be required in the electrical equipment of the bridge. He shall instruct and qualify during these operations, the employees of the Department in the operation of the bridge. Any adjustments

or corrections required during these visits shall be at no additional cost to the Department.
Following this initial operation, the Contractor shall have qualified personnel on call around the clock to correct or override defects in the new equipment for a period of three months.

.3 Carry out tests in presence of Departmental Representative.

.4 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.5 Manufacturer's Field Services:
- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in part 1 - QUALITY ASSURANCE.

.6 Verification requirements include:
- .1 Materials and resources.
- .2 Storage and collection of recyclables.
- .3 Construction waste management.
- .4 Resource reuse.
- .5 Recycled content.
- .6 Local / regional materials.
- .7 Certified wood.
- .8 Low-emitting materials.

3.9 SYSTEM STARTUP

.1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.

.2 Arrange and pay for services of manufacturer's factory service to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.

.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.10 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.11 MEASUREMENT AND PAYMENT PROCEDURES

.1 Lump Sum Amount. No measurement will be made for this item.

.2 Payment at the Contract price for this tender item shall be full compensation for all labor, equipment, supplies and material to do the work.

.3 Basis of payment shall be as follow:

Milestone	**Payment**	**Requirements**
Shop drawings approved	5%	Department Representative's approval of shop drawings
Substantial completion of electrical installation	65%	Department Representative's approval of Final Field Inspection Report
Completion of Electrical Tests	15%	Department Representative's approval of Field Electrical Report
Completion of Final Testing and Commissioning	15%	Department Representative's approval of the Final Testing and Commissioning Report
TOTAL	100%	

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENT

.1 This section includes general requirements for supply, service, delivery, storage, installation, testing and commissioning of wires and cables.

.2 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.2 REFERENCES

.1 CSA C22.2 No. 131 Type TECK 90 Cables.

.2 CSA C22.2 No. 38 Thermoset Insulated Wires and Cables.

.3 CSA C22.2 No. 174 Cables and Cable Glands for use in Hazardous Locations.

.4 CSA C68.3 Power Cables with Thermoset Insulation.

.5 CSA C21.1 600 V Control Cable.

.6 CSA C21.2 300 V Control Cable

.7 ANSI/NEMA WC70/ICEA S-95-658-2009 (14 AWG & larger) – Power Cables Rated 2,000 Volts or Less for the Distribution of Electrical Energy.

.8 ASTM B172-10 Standard Specification for Rope-Lay-Stranded Copper Conductors Having Bunch-Stranded Members, for Electrical Conductors.

.9 ASTM B174-10 Standard Specification for Bunch-Stranded Copper Conductors for Electrical Conductors.

.10 ICEA S-73-532/NEMA WC 57-2014 (22-16 AWG) - Standard for Control, Thermocouple Extension, and Instrumentation Cables.

.11 ICEA T-27-581/NEMA WC 53-2008 – Standard Test Methods for Extruded Dielectric Power, Control, Instrumentation, and Portable Cables for Test.

1.3 PRODUCT DATA

.1 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCTS

2.1 LOW VOLTAGE UNARMOURED WIRE AND CABLE (1000V AND BELOW)

.1 Construction: Stranded, annealed copper conductors, 1000 V, rating RWU90 cross-linked polyethylene (XLPE) insulation for all cables outside of buildings and RW90 cross-linked polyethylene (XLPE) insulation for cables within the building unless noted otherwise.

.2 Direct buried installations or installation in direct buried polyethylene pipe: Cross-linked polyethylene (XLPE), RWU90 insulation, 1000 V minimum rating.

.3 Standard: CSA C22.2 No. 38.

.4 Minimum conductor sizes: Unless otherwise indicated, #12 AWG for power and current transformer circuit.

.5 Multi-conductor cables: PVC flame retardant jacket overall, flame test rated.

2.2 LOW VOLTAGE UNARMOURED WIRE AND CABLE (600V AND BELOW)

.1 Construction: Stranded, annealed copper conductors, 600 V rating, UL1015-105°C PVC insulation for indoor applications.

.2 Standard: CSA.

.3 Minimum conductor sizes: Unless otherwise indicated, #12 AWG for power and current transformer circuit.

.4 Multi-conductor cables: PVC flame retardant jacket overall, flame test rated.

2.3 LOW VOLTAGE ARMOURED WIRE AND CABLE (1000V AND BELOW)

.1 Construction: Stranded, annealed copper conductors, 1000 V rating, RW90 cross-linked polyethylene (XLPE) insulation.

.2 Power cabling: TECK construction.

.3 Control cabling: TECK construction.

.4 Minimum conductor size: Unless otherwise indicated, #12 AWG for power and current transformer circuits and #14 AWG for control and fire alarm circuits.

.5 Grounding conductor: Stranded, soft, bare copper conductor in multiconductor cables, concentric copper wires over insulation in single conductor cable.

.6 Multi-conductor cables: With inner PVC jacket.

.7 Interlocking armour: Flexible, galvanized steel or aluminum for multi-conductor cables and aluminum for single conductors, spirally wound over inner jacket.

.8 Outer jacket: PVC, flame-retardant, FT4 flame test rated, low acid gas evolution, outer jacket extruded over the armour.

.9 Hazardous area installations: Where indicated, TECK cables and fittings accepted for the application. Stamp outer jacket, “HL”.

.10 Fastenings:

.1 One hole malleable iron straps to secure surface cables 50 mm and smaller. Two-hole steel straps for cables larger than 50 mm.
.2 Channel type supports for two or more cables at 500 mm centers.
.3 Threaded rods: 6 mm diameter to support suspended channels.

.11 Connectors: Watertight approved for TECK cable.

2.4 LOW VOLTAGE ARMOURED CABLE FOR VFD APPLICATION

.1 Designed to reduce high frequency noise interference with data and controls signals.

.2 Three bonding conductors - soft bare copper.

.3 Cross-linked Polyethelene RW90 insulation on main conductors.

.4 Continuously corrugated, corrosion resistant aluminum sheath with matching connectors.

.5 With overall PVC jacket rated FT4.

2.5 CONTROL CABLES

.1 Type: LVT: 2 soft annealed copper conductors, sized as indicated:
.1 Insulation: thermoplastic.
.2 Sheath: thermoplastic jacket, and armour of closely wound aluminum wire.

.2 Type: low energy 300 V control cable: stranded annealed copper conductors sized as indicated LVT: 2 soft annealed copper conductors, sized as indicated:
.1 Insulation: PVC TW 40 degrees C polyethylene.
.2 Shielding: tape coated with paramagnetic material tape coated with diamagnetic material wire over each conductor pair group over conductors.
.3 Overall covering: PVC jackets interlocked armour of flat galvanized steel.

2.6 INSTRUMENT CABLE

.1 For instruments: 4-20mA dc circuits shall be wired with #16 twisted shielded pair in separate conduit, maintain minimum 300mm clearance between instrumentation conduits (4-20mAdc

circuits) and conduits carrying control and power circuits (120V and up).

2.7 INSTRUMENT CABLE

.1 Voltage rating: 600-volt.

.2 General configuration consists of multiple conductor designed for flexing usage and meet all requirements for use on bascule, lift and swing-bridges. They are produced to meet specific combination of power, control and signal circuits (including fiber optic components).

.3 Central Strength Member: Flexible preformed Type 302 or 304 stainless steel aircraft cable.

.4 Conductor: Annealed uncoated copper in accordance with ASTM B-174 for 10 AWG and smaller or ASTM B-172 for 9 AWG or larger, class K stranding, and section 2 of ICEA S-95-658. Optical fibers are also available.

.5 Insulation: Ethylene propylene rubber (EPR) meeting the Type II requirements of ICEA S-73-532, NEMA WC 57 Table 3-2 (22 to 16 AWG), 600 Volt or ICEA S-95-658, NEMA WC70, Table 3-1 (14 AWG or larger, 600 to 2000 volt).

.6 Circuit Identification: Surface printed legend with number/color: (1-BLACK, 2-WHITE, 3-RED, etc.) per ICEA S-73-532, NEMA WC 57-1990, Method 3 and Table E-1.

.7 Assemble: Cable components are cabled together with non-hygroscopic fillers as required by the application.

.8 The cabled core is wrapped with a moisture-resistant binder tape. Maximum lay length shall be 12x O.D.

.9 Inner Jacket: Arctic, heavy duty and UV-resistant Neoprene® polychloroprene rubber per ICEA S-95-658, NEMA WC-70.

.10 Cable Jacket Reinforcement: Two layers of Kevlar® aramid fibers applied helically in reverse directions between the two jackets.

.11 Outer Jacket: Arctic, heavy duty and UV-resistant Neoprene® polychloroprene rubber per ICEA S-95-658, NEMA WC-70.

.12 Outer Identification: Outer jacket shall be marked with identifying information including construction, contract, manufacture date/location and sequential length.

.13 Droop cable manufacture shall provide proper selection, design, and construction of signal circuit cables, fiber optic cables and fiber optic cables that are incorporated within the droop cables, and the circuit cables will function properly as intended.

2.8 SUBMARINE CABLE

.1 Voltage rating: As applicable.

.2 General configuration consists of multiple conductor stranded copper conductors, cross-linked polyethylene (XLPE), cabled with fillers as necessary, binder tape, high density polyethylene (HDPE) inner jacket, galvanized steel armor wire (coated with HDPE), and a high-density polyethylene jacket overall. These cables shall be suitable for installations in wet or dry locations such as underwater, direct earth burial, or where additional protection is required. These cables shall also be sunlight (UV) and weather resistant.

.3 Conductor wires shall be annealed uncoated copper in accordance with ASTM B-3. Conductors shall be stranded in accordance with ASTM B-8, class "B" stranding and Section 2 of ANSI/NEMA WC 57 / ICEA S-73-532 or ANSI/NEMA WC 70 / ICEA S-95-658.

.4 The inner and outer jacket high density polyethylene (HDPE) material shall meet the following physical and thermal aging requirements:

UNAGED	
Tensile Strength – minimum, psi	2500
Elongation – minimum, %	300
AGED	
After air oven 48 hrs. @100C	75
Tensile Strength and Elongation at rupture – min. % of unaged:	
Heat Distortion @110C, max. %	25
Absorption coefficient, Milli (absorbance/meter), min.	320
(Certification by PE manufacture is acceptable)	No Cracks
Environmental Cracking:	

.5 The coated armor wires shall be applied at a lay angle of 17 to 25 degrees and provide a coverage of 92 to 98 percent. The armor wires shall be applied in a left lay helix. The armored layer shall then be covered with a 0.002” corrugated polyester tape, 25% minimum overlap followed by a 0.002” adhesive polyester tape, 25% minimum overlap. These tapes allow the outer high density polyethylene jacket to be easily removed during termination.

.6 All cables shall be designed and manufactured in accordance with:
- .1 ANSI/NEMA WC 57 / ICEA S-73-532 (20-16 AWG)
- .2 ANSI/NEMA WC 70 / ICEA S-95-658 (14 AWG & larger)
- .3 Standard Test Methods are in accordance with: ANSI/ICEA T-27-581 / NEMA WC 53

.7 Color Coding of the insulated conductors shall be accomplished by surface printed legends consisting of numbers and words. Color coding sequence shall be in accordance with ANSI/NEMA WC 57 / ICEA S-73-532, Annex E, Method No.4. Sequence shall begin from the inner conductor layer and progress to the outer conductor layer. For ease of identification during installation, numbering sequence may be reset to 1-ONE for each group of different size conductors.

.8 Contrasting color print shall be employed and be legible after normal handling during installation.

2.9 RTD CABLES

.1 Belden 8770

.2 Conductor: #18 AWG, 16-stranded copper.

.3 Construction: Twisted shielded pair, foil aluminum polyester shield with bare #20AWG copper drain wire.

2.10 CAT6 CABLES

.1 Conform with the requirements of the TIA/EIA 568-B specification for Category 6

.2 Unshielded Twisted Pair (UTP) cable:
- .1 Cable shall be tested up to 200MHz with a guaranteed performance that meets or exceeds the ANSI/TIA/EIA-568B/ISO/IEC 11801 horizontal cable requirements for PS-NEXT, attenuation, structural return loss and attenuation to crosstalk ratio (ACR).

.2 Constructed from 0.54mm (24AWG), bare copper wire insulated. Two (2) insulted conductors twisted together to form a pair and four (4) pairs laid up to form the basic unit.

.3 Cable shall be jacketed in flame retardant PVC. Cable run in conduit shall meet or exceed FT4 rating. Cable not run in conduit shall meet or exceed FT6 rating.

2.11 FIBER OPTIC CABLE

.1 Fibre terminations to be in wall mounted network access closets. Panduit FRME3 36/72 Fibre Optic Rack Mount Enclosure, Panduit FAP3WEIDSC SC Multimode Duplex Fibre Adapter Panel, Panduit FAP3WBUDSCZ Single-mode Duplex Fibre Adapter Panel.

.2 Fiber Performance: Multimode: 62.5/125um core/cladding, Single Mode: 8.3/125um core/cladding.

.3 Minimum LED Bandwidth: 200/500- MHz*km.

.4 Tensile Load (Installation): 3000N.

.5 Tensile Load (Operating): 1000N.

.6 Minimum Installation Bend Radius: 12.75cm.

.7 Minimum Operating Bend Radius: 8.5cm.

.8 Jacket: Flame Retardancy UL Listed Type OFNR (1666).

2.12 SERIAL CABLES

.1 EIA RS-232 applications; Belden #9945

.2 Conductor: #22AWG, 7-stranded copper.

.3 Shield: Overall Beldfoil aluminium polyester shield plus 65% minimum tinned copper braid shield

2.13 RS-485 CABLES

.1 EIA Industrial RS-485

.2 Conductors: Twisted pair, each conductor No. 22 AWG stranded copper

.3 Pairs: 2.

.4 Shield: Aluminum-polyester and 90% copper tinned braid.

.5 Jacket: Black UV resistant PVC.

.6 Electrical Characteristics at 20C.

.7 Capacitance: 36.1 pF/m

.8 Impedance: 120 ohms

.9 Propagation Velocity: 78%

2.14 WIRING ACCESSORIES

.1 Wire Markers: Identify all wiring with heat shrinkable slip-on markers c/w type written tag numbers, black letters on white background.

.2 Cable markers: For cables or conductors greater than 13 mm diameter, strap-on type,

.3 semi rigid PVC carrier strip.

.4 Terminal blocks: 600 V, 25 A minimum rating, modular, 35 mm DIN rail mounted, provision for circuit number labelling, individually removable, sized to accommodate conductor size and circuit current.

.5 Fused Terminal Blocks: 300 V, 25 A minimum rating, modular, 35 mm DIN rail mounted, provision for circuit number labelling, individually removable, sized to accommodate conductor size and circuit current., 5x20mm fuse, 100-250V AC/DC with Blown Fuse Indication.

.6 Field wiring terminations: Where screw-type terminal blocks are provided, supply insulated fork tongue terminals.

.7 Splice connectors for equipment pig-tail, lighting and receptacle circuits: For wire sizes #12 and #10 AWG inclusive, twist-on compression spring type.

.8 Moisture and waterproofing: In wet locations, with Liquid Tape.

.9 Equipment pig-tail power circuit connections: For wire sizes #8 AWG minimum, split-bolt type, sized to suit number and size of conductors.

.10 Low voltage (1000 V and lower) motor terminations: Heat shrinkable connection kit, including sleeves, caps and sealant.

.11 Cables ties: Nylon, one-piece, self-locking type.

.12 TECK cable connectors in wet or outdoor areas: Watertight type.

.13 Cable grips: To accommodate type and geometry of cable supported, single weave, variable mesh design.

.14 Cable pulling lubricant: Compatible with cable covering and not to cause damage or corrosion to conduits or ducts.

2.15 FACTORTY CUSTOM PANEL AND/OR CONTROL CABINET WIRING

.1 Relay panel and/or control cabinet wiring shall use flame retardant cross-linked polyethylene (XLP) or flame retardant ethylene-propylene rubber (EPR) insulation that meet or exceed requirements of UL 44 for Types SIS, and XHHW. Minimum size: No. 14 AWG (1.5 mm2).

.2 Instrumentation, thermocouple, and thermocouple extension wire shall use twisted shielded pairs/triads having flame retardant cross-linked polyethylene (XLPE) insulation, and Flame-retardant polyvinyl chloride (PVC) jacket. Minimum size: No. 16 AWG (1.0 mm2).

.3 Conductor terminal connectors shall be insulated, compression type connectors properly sized for conductor and terminal. Connectors shall be constructed of copper and shall be tin-plated.

.4 Current transformers shall terminate on shorting type terminal blocks. Ship with shorting jumpers installed.

.5 Prior to shipment of equipment, remove temporary wiring installed in factory for equipment testing

.6 Identification and labeling:

.1 Provide conductor identification sleeve on each end of each internal conductor. Mark each sleeve with opposite end destination identification with permanent black ink. Sleeves shall be UV-resistant self-adhesive type or PVC, not less than 1/2” long.

.2 Permanently label each terminal block, terminal, conductor, relay, breaker, fuse block, and other auxiliary devices to coincide with identification indicated on manufacturer’s drawings.

PART 3 - EXECUTION

3.1 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform tests using method appropriate to site conditions and to approval of Department's Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

.1 Cables shall be installed per manufacturer recommendations and instructions, and comply with the applicable codes and standards.

.2 Conductor length for parallel feeders to be identical.

.3 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

.4 Wiring in walls: typically drop or loop vertically from above to better facilitate future renovations. Generally wiring from below and horizontal wiring in walls to be avoided unless indicated.

.5 Branch circuit wiring for surge suppression receptacles and permanently wired computer and electronic equipment to be 2-wire circuits only, i.e. common neutrals not permitted.

.6 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

.7 Limit pulling tension and minimum bending radii to those recommended by manufacturer.

.8 Pull cable into ducts, conduits and cable trays in accordance with cable manufacturer's

.9 recommendations. Use patented cable grips suitable for cable type, or pulling eyes fastened directly onto cable conductors.

.10 Prevent damage to cable jackets by utilizing adequate lubricant when pulling cables through ducts and conduits.

.11 Support cables in manholes and utility tunnels on cable trays or cable racks.

.12 Connect cables to electrical boxes and equipment enclosures located in wet or sprinkled areas with watertight cable connectors.

.13 Provide cable grips for vertical, horizontal and catenary cable suspension installations to reduce cable tension at connectors and at cable bends.

.14 Install through wiring in junctions and pull boxes having no connection within the box. Leave 150 mm minimum of slack inside box.

.15 Facilitate making of joints and connections by leaving sufficient slack in each conductor at panelboards, outlet boxes and other devices.

.16 Install instrumentation signal and thermocouple extension wires in separate raceways from power and control wiring.

.17 Provide mechanical protection for cables within 1500 mm of the floor in buildings and within 2000 mm above grade outdoors.

.18 Identify each cable by attaching a cable marker at each end, in all intermediate manholes, junction boxes and pull boxes.

.19 Install cables to conserve headroom in exposed locations and to cause minimum interference in spaces through which they pass.

.20 Do not install horizontal runs in hollow masonry walls. Passage through any structural member or precast slab must be approved by the Department’s Representative.

.21 Where exposed, install raceways and cables parallel with building lines and group neatly.

.22 Maintain the integrity of all fire separations by sealing around all cables where they pass through any fire barriers. Generally, this includes all floors ceilings and concrete and masonry walls.

.23 As far as is practicable, all feeder wiring shall be continuous from origin to panel termination without running splices in intermediate pull boxes or splicing chambers. Sufficient slack shall be left at the termination point to make proper connections to the equipment.

.24 Conform with the following for Patch Cords:

.1 Provide CAT06 unshielded twisted pair (UTP) RJ45 patch cords complete with cable strain relief connector boots, factory assembled and tested by the manufacturer.

.2 Certify that the patch cords supplied under this Contract meet or exceed the requirements for CAT06 UTP patch cords. Provide written certification from the manufacturer at the time of shop drawing review.

.3 the Contractor is responsible for determining the length of patch cords.

.4 Use durable non-fading sleeve type wire markers to identify all network cables. Identify both ends.

.5 Provide 2 - 3 meter CAT06 UTP patch cords complete with connector boots spare and leave in the print pocket of the ICP.

.25 Circuit Cable Installation Around Structure Movable Joints

.1 Contractor shall utilize droop or flexible cables around structural movable joints. Install cables so tension, including that from the weight of the cables, won't be transmitted to the conductor terminals. Strain-relief fittings shall be utilized.

.2 Liquid-tight flexible metal conduit or liquid-tight flexible non-metallic conduit may be used, as long as the length is limited to 2m.

.3 Provide bushings or fittings to protect cords where they pass through holes in covers, outlet boxes, or similar enclosures.

.4 Transition from rigid conduit to liquid-tight conduit or flexible cable shall be made through a NEMA 4X termination junction boxes.

.5 The circuit cables shall securely be kept away from any pinch points.

3.3 WIRING IDENTIFICATION

.1 Identify wiring including fibre optic cabling, wire markers.

.2 Colour code power, feeder and branch conductors at both ends with coloured plastic tapes. Tapes are not required where conductors are identified by jacket colour. Maintain phase and colour sequence throughout.

.3 Identify each conductor, including spares, with a unique alphanumeric designation to facilitate troubleshooting and maintenance.

.4 Identify PLC wiring at terminal blocks and connection points with tagging as identified on the contract drawings.

.5 Cables shall also be numbered where they branch off from a main route and at both sides of a road crossing. For underground cabling, above ground route markers shall also be provided at every change of direction in the routing and at both sides of road or structure crossings.

3.4 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with electrical wires and cables shall be included in associated cost items for the Common Work Results for Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENT

.1 This section includes general requirements for supply, service, delivery, storage, installation, testing and commissioning of grounding system.

.2 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.2 REFERENCES

.1 CSA Group

.1 CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

.2 CAN/CSA-C22.2 No.41-13-Grounding and Bonding Equipment

.3 CAN/CSA-C22.2 No.04-04-Bonding Electrical Equipment (Protective Grounding)

.4 CAN/CSA-C22.2 No.41-07 Grounding and Bonding Equipment

.2 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)

.1 ANSI/IEEE 837-02, IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

.3 CSA International

.1 CSA Z32-09, Electrical Safety and Essential Electrical Systems in Health Care Facilities.

1.3 ACTION AND INFORMATIONALSUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

.2 Recycled Content:

.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

.3 Regional materials: submit evidence that project incorporates required percentage 50% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for grounding equipment for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect grounding equipment from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop a Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse of pallets, crates, padding, packaging materials as specified in the Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 GROUNDING AND BONDING CONDUCTORS

.1 Equipment grounding conductors shall be insulated stranded copper, except that sizes No. 10 AWG and smaller shall be solid copper. Insulation color shall be identified per CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

.2 Bonding conductors shall be bare stranded copper, except that sizes No. 10 AWG and smaller shall be bare solid copper. Bonding conductors shall be stranded for final connection to motors, transformers, and vibrating equipment.

.3 Grounding conductor sizes shall not be less than shown on the drawings, and not be less than grounding conductors sizing requirements in accordance with CAN/CSA-C22.2 No. 0., whichever is greater.

.4 Insulation: XLPE shall be used for isolated power systems.

2.2 GROUNDING ELECTRODE

.1 Steel or copper clad steel, 19 mm (0.75 mm) diameter by 3 m (10 feet) long.

.2 Quantity of rods shall be as shown on the drawings, and as required to obtain the specified ground resistance.

2.3 EQUIPMENT RACK AND CABINET GROUND BARS

.1 Provide solid copper ground bars designed for mounting on the framework of open or cabinet-enclosed equipment racks. Ground bars shall have minimum dimensions of 6.3 mm (0.25 mm) thick x 19 mm (0.75 mm) wide, with length as required or as shown on the drawings. Provide insulators and mounting brackets.

2.4 GROUND CONNECTIONS

.1 Below Grade and Inaccessible Locations: Exothermic-welded type connectors.

.2 Above Grade:

.1 Bonding Jumpers: Listed for use with aluminum and copper conductors.

.2 For wire size smaller than No. 8 AWG, use mechanical type lugs. For wire sizes No. 8 AWG and larger, use compression-type connectors. Connectors or lugs shall use zinc-plated or cadmium-plated, steel bolts, nuts, and washers as appropriate for the application.

.3 Connection to Building Steel: Exothermic-welded type connectors.

.4 Connection to Equipment Rack and Cabinet Ground Bars: Listed for use with aluminum and copper conductors. Use mechanical type lugs, with zinc-plated or cadmium-plated, steel bolts, nuts, and washers as appropriate for the application.

.5 Bolts shall be torqued to the values recommended by the manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION GENERAL

.1 Install complete permanent, continuous grounding and bonding system including, electrodes, conductors, connectors, accessories.

.2 Install connectors in accordance with manufacturer's instructions and in accordance with the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.

3.2 SYSTEM GROUNDING

.1 Electrical system grounding type (i.e. solidly grounded and/or resistively grounded) shall be as indicated on the design drawings.

.2 Secondary service neutrals: Ground at the supply side of the secondary disconnecting means and/or at the respective service transformer.

3.3 STRUCTURE GROUNDING ELECTRODE

.1 The bridge structure steel and attached electrical equipment shall be grounded by a direct connection to a suitable grounding electrode of one of the following types:

.1 Stainless steel plate of at least 1 m^2 of exposed area mounted as low as possible below water on the pier or substructure, such that the entire plate is completely below the lowest water elevation at all times;

.2 Steel pipe piles, steel H piles, or permanently placed steel sheet piling; or

.3 Copper ground rods driven at least 3 m into ground immediately adjacent to pier or substructure.

.2 Concrete or masonry substructures and piers shall not be considered adequately grounded. Reinforcing steel in concrete shall not be used in lieu of copper electrical cables for grounding.

.3 Copper cable, size 1/0 AWG or larger, shall be used to connect the bridge structure to the grounding electrode.

3.4 EQUIPMENT GROUNDING

.1 Metallic piping, building structural steel, electrical enclosures, raceways, junction boxes, outlet boxes, cabinets, machine frames, and other conductive items in close proximity with electrical circuits, shall be bonded and grounded.

.2 Grounding for all equipment, cabinets, and enclosures containing electric equipment shall be by dedicated grounding conductors run in each conduit and raceway from each piece of equipment, cabinet, and enclosure back to the system ground bus.

.3 Conduit and raceways shall not be utilized as the sole grounding means for electric equipment.

3.5 GROUND RESISTANCE

.1 Grounding system resistance to ground shall not exceed 5 ohms. Make any modifications or additions to the grounding electrode system necessary for compliance without additional cost to the Department. Final tests shall ensure that this requirement is met.

.2 Grounding system resistance shall comply with the electric utility company ground resistance requirements.

3.6 INACCESSIBLE GROUNDING CONNECTIONS

.1 Make grounding connections, which are normally buried or otherwise inaccessible, by exothermic weld.

3.7 MEDIUM-VOLTAGE EQUIPMENT AND CIRCUITS

.1 Switchgear: Provide a bare grounding electrode conductor from the switchgear ground bus to the grounding electrode system.

.2 Duct Banks and Manholes: Provide an insulated equipment grounding conductor in each duct containing medium-voltage conductors, sized per CSA C22.1, Canadian Electrical Code except that minimum size shall be No. 2 AWG. Bond the equipment grounding conductors to the switchgear ground bus, to all manhole grounding provisions and hardware, to the cable shield grounding provisions of medium-voltage cable splices and terminations, and to equipment enclosures.

.3 Pad-Mounted Transformers: Provide a driven ground rod and bond with a grounding electrode conductor to the transformer grounding pad. Ground the secondary neutral.

.4 Lightning Arresters: Connect lightning arresters to the equipment ground bus or ground rods taking most direct path as applicable.

3.8 LOW-VOLTAGE EQUIPMENT AND CIRCUITS

.1 Main Bonding Jumper: Bond the secondary service neutral to the ground bus in the service equipment.

.2 Metallic Piping, Building Structural Steel, and Supplemental Electrode(s):

.1 Provide a grounding electrode conductor sized per CSA C22.1, Canadian Electrical Code between the service equipment ground bus and all metallic water pipe systems, building structural steel, and supplemental or made electrodes. Provide jumpers across insulating joints in the metallic piping.

.2 Provide a supplemental ground electrode as shown on the drawings and bond to the grounding electrode system.

.3 Switchgear, Switchboards, Unit Substations, Panelboards, Motor Control Centers, Engine-Generators, Automatic Transfer Switches, and other electrical equipment:

.1 Connect the equipment grounding conductors to the ground bus.

.1 Connect metallic conduits by grounding bushings and equipment grounding conductor to the equipment ground bus.

.4 Transformers:

.1 Exterior transformers supplying interior service equipment shall have the neutral grounded at the transformer secondary. Provide a grounding electrode at the transformer.

.2 Separately derived systems (transformers downstream from service equipment): Ground the secondary neutral at the transformer. Provide a grounding electrode conductor from the transformer to the nearest component of the grounding electrode system or the ground bar at the service equipment.

3.9 CONTROL AND INSTRUMENT GROUNDING SYSTEM

.1 Provide signal reference grounding system named Instrument Grounding System (IE) system separated from the Protection Grounding System (PE). IE shall be isolated from PE and other exposed conductive parts.

.2 Two ground bars (for PE) shall be provided for each cabinet (one on each side). The ground bars shall be arranged at the bottom of the cabinet, and all the equipment instrument cases, metallic structures and cable armors shall be connected to it.

.3 All the intrinsically safety barriers and shield of cables shall be connected to IE.

.4 IE bars shall be arranged in a way to allow an easy connection of the wires (i.e., for long terminal strips, the earth bar shall be parallel to the strip). One IE bar shall be installed on the bottom side of the cabinet to be connected to the main IE ring.

.5 Both types of ground bar shall be suitable to connect #6 or #2 AWG copper wires to the main Grounding systems.

3.10 MAINTENANCE HOLES

.1 Install conveniently located grounding stud, electrode, size as indicated stranded copper conductor in each maintenance hole.

.2 Install ground rod in each maintenance hole so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements.

3.11 ELECTRODES INSTALLATION

.1 For outdoor installations, drive each rod vertically in the earth, until top of rod is 610 mm (24 mm) below final grade.

.2 For indoor installations, leave 100 mm (4 mm) of each rod exposed. Install rod, plate electrodes and make grounding connections as indicated for bridge electrical and storage

facility and bridge pivot pier electrical and structural systems.

.3 Bond separate, multiple electrodes together.

.4 Where buried or permanently concealed ground connections are required, make the connections by the exothermic process, to form solid metal joints. Make accessible ground connections with mechanical pressure type ground connectors.

.5 Where rock or impenetrable soil prevents the driving of vertical ground rods, install angled ground rods or grounding electrodes in horizontal trenches to achieve the specified ground resistance.

3.12 RACEWAY

.1 Conduit Systems:

.1 Ground all metallic conduit systems. All metallic conduit systems shall contain an equipment grounding conductor.

.2 Non-metallic conduit systems, except non-metallic feeder conduits that carry a grounded conductor from exterior transformers to interior or building-mounted service entrance equipment, shall contain an equipment grounding conductor.

.3 Metallic conduit that only contains a grounding conductor, and is provided for its mechanical protection, shall be bonded to that conductor at the entrance and exit from the conduit.

.4 Metallic conduits which terminate without mechanical connection to an electrical equipment housing by means of locknut and bushings or adapters, shall be provided with grounding bushings. Connect bushings with a equipment grounding conductor to the equipment ground bus.

.2 Feeders and Branch Circuits: Install equipment grounding conductors with all feeders, and power and lighting branch circuits.

.3 Boxes, Cabinets, Enclosures, and Panelboards:

.1 Bond the equipment grounding conductor to each pullbox, junction box, outlet box, device box, cabinets, and other enclosures through which the conductor passes (except for special grounding systems for intensive care units and other critical units shown).

.2 Provide lugs in each box and enclosure for equipment grounding conductor termination.

.4 Wireway Systems:

.1 Bond the metallic structures of wireway to provide electrical continuity throughout the wireway system, by connecting a No.

6 AWG bonding jumper at all intermediate metallic enclosures and across all section junctions.

.2 Install insulated No. 6 AWG bonding jumpers between the wireway system, bonded as required above, and the closest building ground at each end and approximately every 16 m (50 feet).

.3 Use insulated No. 6 AWG bonding jumpers to ground or bond metallic wireway at each end for all intermediate metallic enclosures and across all section junctions.

.4 Use insulated No. 6 AWG bonding jumpers to ground cable tray to column-mounted building ground plates (pads) at each end and approximately every 15 m (49 feet).

.5 Receptacles shall not be grounded through their mounting screws. Ground receptacles with a jumper from the receptacle green ground terminal to the device box ground screw and a jumper to the branch circuit equipment grounding conductor.

.6 Ground lighting fixtures to the equipment grounding conductor of the wiring system. Fixtures connected with flexible conduit shall have a green ground wire included with the power wires from the fixture through the flexible conduit to the first outlet box.

.7 Fixed electrical appliances and equipment shall be provided with a ground lug for termination of the equipment grounding conductor.

.8 Raised Floors: Provide bonding for all raised floor components as shown on the drawings.

3.13 OUTDOOR METALLIC FENCES AROUND ELECTRICAL EQUIPMENT

.1 Fences shall be grounded. Fences shall be grounded with a ground rod at each fixed gate post and at each corner post.

.2 Drive ground rods until the top is 300 mm (12 mm) below grade.

.3 Attach a No. 4 AWG copper conductor by exothermic weld to the ground rods, and extend underground to the immediate vicinity of fence post.

.4 Lace the conductor vertically into 300 mm (12 mm) of fence mesh and fasten by two approved bronze compression fittings, one to bond the wire to post and the other to bond the wire to fence. Each gate section shall be bonded to its gatepost by a 3 mm x 25 mm (0.375 mm x 1 mm) flexible, braided copper strap and ground post clamps. Clamps shall be of the anti-electrolysis type.

3.14 CORROSION INHIBITORS

.1 When making grounding and bonding connections, apply a corrosion inhibitor to all contact surfaces. Use corrosion inhibitor appropriate for protecting a connection between the metals used.

3.15 CONDUCTIVE PIPING

.1 Bond all conductive piping systems, interior and exterior, to the grounding electrode system. Bonding connections shall be made as close as practical to the equipment ground bus.

3.16 EXTERIOR LIGHT, TRAFFIC SIGNAL, AND OTHER UTILITY POLES

.1 Provide 6.1 m (20 feet) of No. 4 AWG bare copper coiled at bottom of pole base excavation prior to pour, plus additional unspliced length in and above foundation as required to reach pole ground stud.

3.17 LIGHTING PROTECTION SYSTEM

.1 Bond the lightning protection system to the electrical grounding electrode system.

3.18 ACCEPTANCE CHECKS AND TESTS

.1 Resistance of the grounding electrode system shall be measured using a four-terminal fall-of-potential method as defined in IEEE 81. Ground resistance measurements shall be made before the electrical distribution system is energized or connected to the electric utility company ground system, and shall be made in normally dry conditions not fewer than 48 hours after the last rainfall.

.2 Resistance measurements of separate grounding electrode systems shall be made before the systems are bonded together. The combined resistance of separate systems may be used to meet the required resistance, but the specified number of electrodes must still be provided.

.3 Below-grade connections shall be visually inspected by the DEPARTMENT on-site Department’s Representative prior to backfilling. The Contractor shall notify the Department’s Representative 3 days before the connections are ready for inspection.

3.19 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Department's Representative and local authority having jurisdiction over installation.

.3 Perform tests before energizing electrical system.

.4 Disconnect ground fault indicator during tests.

3.20 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.2 Leave Work area clean at end of each day.

.3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.4 Waste Management: separate waste materials for reuse in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.5 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.21 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Supply and installation of associated grounding and bonding will not be measured but considered incidental to the overall electrical work and payment shall be included in associated cost items for the Common Work Results for Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This section includes general requirements for supply, service, delivery, storage, installation of hangers and support for electrical systems.

.2 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.2 REFERENCES

.1 ASTM International:
- .1 ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
- .2 ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
- .3 ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- .4 ASTM E1966 - Standard Test Method for Fire-Resistive Joint Systems.

.2 Underwriters Laboratories Inc.:
- .1 UL 1479 - Fire Tests of Through-Penetration Firestops.
- .2 2. UL - Fire Resistance Directory

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for hangers and supports and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Firestopping: Submit data on product characteristics, performance and limitation criteria.
- .3 Firestopping Schedule: Submit schedule of opening locations and sizes, penetrating items, and required listed design numbers to seal openings to maintain fire resistance rating of adjacent assembly.
- .4 Design Data: Indicate load carrying capacity of trapeze hangers and hangers and supports.
- .5 Hangers and Supports: Submit special procedures and assembly of components.

.6 Firestopping: Submit preparation and installation instructions.

.7 Manufacturer's Certificate: Certify products meet or exceed specified requirements.

.3 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

.2 Recycled Content:

.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

.3 Regional Materials: submit evidence that project incorporates required percentage 50% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect disconnect switches - non-fused from nicks, scratches, and blemishes.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Requirements.

1.5 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.4 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 – PRODUCT

2.1 CONDUIT SUPPORTS

.1 Hanger Rods: Threaded high tensile strength galvanized carbon steel with free running threads.

.2 Beam Clamps: Malleable Iron, with tapered hole in base and back to accept either bolt or hanger rod. Set screw: hardened steel.

.3 Conduit clamps for trapeze hangers: Galvanized steel, notched to fit trapeze with single bolt to tighten.

.4 Conduit clamps - general purpose: One-hole malleable iron for surface mounted conduits.

.5 Cable Ties: High strength nylon temperature rated to 185 degrees F, self locking.

.6 Hanger rods, beam clamps, conduit clamps, support channel, and mounting hardware utilized within the machinery pit shall be stainless steel.

2.2 FORMED STEEL CHANNEL

.1 Product Description: 41.2 mm square Galvanized 12 gage thick steel. With holes 38.1 mm on center.

2.3 SLEEVES

.1 Sleeves for Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing

.2 Prefabricated fire rated sleeves including seals, UL listed.

.3 Fire-stopping Insulation: Glass fiber type, non-combustible.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for disconnect switch installation in accordance with manufacturer's written instructions.

.1 Inform Department’s Representative and/or Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department’s Representative.

3.2 INSTALLATION

.1 Anchors and Fasteners:

.1 Concrete Structural Elements: Provide expansion anchors.

.2 Steel Structural Elements: Provide beam clamps.

.3 Concrete Surfaces: Provide expansion anchors.

.4 Hollow Masonry, Plaster, and Gypsum Board Partitions: Provide structural backing plate.

.5 Solid Masonry Walls: Provide expansion anchors.

.6 Sheet Metal: Provide sheet metal screws.

.7 Wood Elements: Provide wood screws.

.2 Install conduit and raceway support and spacing in accordance with the National Electrical Code.

.3 Install all support devices according to manufacturer’s guidelines and recommendations.

.4 Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.

.5 Do not drill through structural framing members.

.6 Do not support equipment or fixtures from the roof deck. Provide necessary framing and joist hangers to span between structural members to locate hangers properly.

.7 Install multiple conduit runs on common hangers.

.8 Supports:

.1 Fabricate supports from structural steel or formed steel channel. Install hexagon head bolts to present neat appearance with adequate strength and rigidity. Install spring lock washers under nuts.

.2 Install surface mounted cabinets and panelboards with minimum of four anchors.

.3 In wet and damp locations install steel channel supports to stand cabinets and panelboards 25.4 mm off wall.

.4 Support vertical conduit at every floor level.

.9 For free standing floor mounted equipment: Provide housekeeping pads of concrete, minimum 152.4 mm thick and extending 304.8 mm beyond supported equipment. Using templates furnished with equipment, install anchor bolts, and accessories for mounting and anchoring equipment. Construct supports of formed steel channel. Brace and fasten with flanges bolted to structure.

.10 Penetrations:

.1 Provide through-penetration firestop systems that are installed to resist the spread of fire, passage of smoke and other hot gases according to requirements indicated, to restore the original fire-resistance rating of assembly penetrated.

.2 Install complete through penetration firestop systems that have been tested and are listed by recognized testing agencies per ASTM E 814 or UL 1479 fire tests in a configuration that is representative of site conditions.

.3 F-Rated Systems: Install through-penetration firestop systems with F-ratings indicated, as determined per ASTM E 814 or UL 1479, but not less than the fire resistance rating of the assembly being penetrated.

.4 T-Rated Systems: Install through-penetration firestop systems with T-ratings indicated, as well as F-ratings, as determined per ASTM E 814 or UL 1479, where required by the Building Code.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Requirements.

.4 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with hangers and support for electrical systems shall be included in associated cost item for the Common Work Results for Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL DESCRIPTION

.1 This section includes general requirements for supply, delivery, storage, installation, testing and commissioning of electrical panelboards required under the scope of the contract. Provide the following panelboards:
- .1 Service entrance rated main distribution panelboards.
- .2 Distribution panelboards.
- .3 Lighting and appliance branch circuit panelboards.
- .4 Load Centers

.2 The requirements of other related specification sections shall also apply for installation and coordination of work.

1.2 RELATED REQUIREMENTS

.1 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.3 REFERENCES

.1 Definitions:
- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Electrical systems shall be engineered, manufactured and installed in accordance with the National Electrical Codes. The design and engineering of the electrical installation shall satisfy all statutory requirements of the national and/or local authorities of the country in which the electrical installation will be located. The electrical installation shall be suitable for the site conditions as specified. Where necessary, special attention shall be paid to the selection and installation of electrical equipment suitable for seismic conditions. Where relevant, the specific publications are referenced herein.
- .3 The following reference standards documents form part of the specification to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the work.

.2 The design and engineering of the electrical installation shall satisfy all statutory requirements of the national and/or local authorities of the country in which the electrical installation

will be located. The electrical equipment and installation shall be suitable for the site conditions as specified. Where necessary, special attention shall be paid to the selection and installation of electrical equipment suitable for seismic conditions. Where relevant, the specific publications are referenced herein.

.3 The following documents form part of the Specifications to the extent stated. Where differences exist between codes and standards, the one affording the greatest protection shall apply. Unless otherwise noted, the referenced standard edition is the current one at the time of commencement of the work:

.4 Reference Standards:
- .1 CSA Group
  - .1 CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.
  - .2 CSA C22.2 No. 0 Through 10 as Applicable.

.5 National Fire Protection Association – NFPA
- .1 ANSI/NFPA 70 - National Electrical Code
- .2 ANSI/NFPA 70B - Recommended Practice for Electrical Equipment Maintenance
- .3 ANSI/NFPA 70E - Standard for Electrical Safety in the Workplace

.6 Institute of Electrical and Electronic Engineers – IEEE
- .1 ANSI/IEEE C2 - National Electrical Safety Code
- .2 ANSI/IEEE 43 - IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery
- .3 ANSI/IEEE 48 - IEEE Standard Test Procedures and Requirements for Alternating-Current Cable Terminations 2.5 kV through 765 kV
- .4 IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System Part I: Normal Measurements
- .5 IEEE 100 - The Authoritative Dictionary of IEEE Standards Terms
- .6 IEEE 400 - IEEE Guide for Field Testing and Evaluation of the Insulation of Shielded Power Cable Systems
- .7 IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations
- .8 IEEE 1584a - IEEE Guide for Performing Arc-Flash Hazard Calculations – Amendment 1

.7 International Electrical Testing Association – NETA
- .1 ANSI/NETA ETT - Standard for Certification of Electrical Testing Technicians
- .2 ANSI/NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems

.8 National Electrical Manufacturers Association – NEMA
- .1 ANSI/NEMA C84.1 - Electrical Power Systems and Equipment Voltage Ratings (60 Hz)
- .2 NEMA AB 1 Molded Case Circuit Breakers.
- .3 NEMA PB 1 Panelboards.
- .4 NEMA PB 1.1 Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- .5 NEMA PB 1.2 Application Guide for Ground-fault Protective Devices for Equipment.
- .6 NEMA AB4 - Guidelines for Inspection and Preventive Maintenance of Molded-Case Circuit Breakers Used in Commercial and Industrial Applications

.9 UL – Underwriters' Laboratories:
- .1 UL67 Panelboards
- .2 UL50 Enclosures for Electrical Equipment
- .3 UL489 Molded Case Circuit breakers and Circuit Breaker Enclosures

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Preconstruction Submittals:
- .1 Health and safety plan
- .2 Work plan
- .3 Quality Control(QC) plan
- .4 Schedule of submittal items with dates

.3 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for all items described in these specifications and include product characteristics, performance criteria, physical size, finish and limitations.

.4 Submit for review single line electrical diagrams under plexiglass and locate as indicated.
- .1 Electrical distribution system in the electrical equipment room.

.5 Shop drawings:
- .1 The Contractor shall submit copies of vendor, producer or manufacturer product data. These shall include design and installation shop drawings, catalog cuts, specifications, testing requirements, and installation instructions.

.2 Outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker arrangement, sizes and numbering system.

.6 Certificates:
.1 Provide CSA certified equipment and material.

.7 Startup and Commissioning Plan and Report
.1 Provide Startup and Commissioning Plan
.2 Startup and Commissioning Report

.8 Test Reports:
.1 Provide Factory Acceptance Test
.2 Provide Electrical Construction Field Testing and Commissioning Report

.9 Manufacturer's Field Reports: Submit to Department’s Representative manufacturer's written report, within 3 days of review, verifying compliance of Work and electrical system and electrical power and control testing, as described in PART 3 - FIELD

.10 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
.2 Recycled Content:
.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.
.3 Regional Materials: submit evidence that project incorporates required percentage 50% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for electrical equipment and installations for incorporation into manual.

.1 The Contractor shall provide Operation and Maintenance Manuals to be contained in one or more volumes for all electrical power and control systems and sub systems and interfaces with the communications network provided under this contract. The Department's Representative will review preliminary copies of the O&M Manuals and the Contractor will incorporate the changes made into the final manual. Provide for each system and principal item of equipment as specified in technical sections for use by operation and maintenance personnel.

.2 Operating instructions to include following:

.1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.

.2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.

.3 Safety precautions.

.4 Procedures to be followed in event of equipment failure.

.5 Warranty information.

.6 Other items of instruction as recommended by manufacturer of each system or item of equipment.

.3 Final "As-Built" Drawings shall be submitted for review and approval at the completion of the project. Any field modification during construction and/or deviations from the approved Shop Drawings shall be clearly indicated. Reproducible drawings shall be made on sheets using the Project standard title block. These drawings shall be stamped "As Built", immediately above the title block.

.4 Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures. Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

1.6 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Provide temporary electrical connections to equipment heaters, or provide temporary heaters, as required to prevent damage from moisture and as required in other Sections of these Specifications.

.2 Provide climate control environment for the storage for control equipment/ assemblies during construction. Thoroughly dry out and put through special dielectric test as directed by the Department’s Representative or replace if not tested to the satisfaction of the Department’s Representative, any apparatus that has been subjected to possible injury by water or dampness (including the interiors of motor control equipment or any other electrical devices). Store and protect equipment from damage from mishandling, dropping or impact. Do not install damaged equipment.

.3 Replace defective or damaged materials with new at no cost to the Department.

.4 Develop Construction Waste Management Plan related to the Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 BUS AND HARDWARE

.1 Panelboards shall be completely factory assembled and equipped with a main circuit breaker and the type, size and number of branch circuit breakers, arranged and numbered as indicated on the panel schedule(s).

.2 Bus bars shall be copper and plated per UL requirements. Bus bars shall be supported by glass-filled polyester-type insulators. Bus sequence shall be ABC top to bottom, left to right for both top and bottom fed panels. Neutral bus shall be copper, 200 percent rated and insulated from the cabinet and other parts.

.3 A copper equipment ground bus, of sufficient width and length, shall be solidly bolted and grounded to the enclosure at the bottom and shall leave clear space for the bottom cable entries.

.4 Bus bars shall be factory drilled and tapped with spacing arranged to permit breaker interchange, from the front, while the panel is energized.

.5 Current ratings, and minimum short circuit interrupting capability of the panel shall be as shown on the panel schedule. Panelboards shall be fully rated. Series rated panelboards are not acceptable.

.6 All multi-pole breakers shall be common trip. Branch circuits shall be arranged using double row construction.

.7 A minimum of 20 percent spare pole spaces, grouped in multiple of three, shall be provided in each panelboard, for future installation. Provide single pole filler plates in the spaces, as required. Provisions or space for future breakers shall be located at the bottom of the panel and be fully bussed, complete with the necessary mounting hardware.

.8 A nameplate shall be provided, and located near the top of the front trim on the exterior surface, listing panel type and ratings, as required by UL.

.9 Each circuit shall be permanently numbered to agree with the panel schedule, using plastic or metal buttons mounted adjacent to the breaker and secured by rivets or grommets with an engraved or depressed number. Adhesive numbering tape, painted numbers, or use of more than one number per breaker is not acceptable.

.10 Pre-installed locking devices shall be provided for locking the main circuit breaker and each branch circuit breaker in the OPEN

position, by means of a padlock. Locking devices shall not be removable from the front of the panel with the trim in place. Attachment of the locking device to the panel with adhesives is not acceptable.

2.2 CIRCUIT BREAKERS

.1 Molded Case Circuit Breakers: NEMA AB 1, FS W-C-375

.2 Provide bolt-on type circuit breakers with integral thermal and instantaneous magnetic trip in each pole (common trip type).

.3 Provide circuit breakers, UL listed as Type HACR, for air conditioning equipment branch circuits.

.4 Provide circuit breakers, UL listed as Type SWD, for lighting circuits.

.5 Provide UL Class A ground fault interrupter circuit breakers where specified on panelboard schedules and/or the Drawings.

.6 Breakers shall be bolt on type, rigidly mounted, separately removable and independent of trim plates for their support. Breakers shall be industrial grade with a minimum pole width of 1-mm (25.4 mm) and a minimum height of 5-1/2-mm (139.7 mm). Miniature circuit breakers are not acceptable.

.7 The minimum symmetrical interrupting rating for molded-case circuit breakers shall be as specified on the panelboard schedule and/or Drawings. Series rated breakers are not acceptable.

2.3 TRIP UNIT

.1 Provide adjustable instantaneous magnetic trips for breaker with frame size 100 amperes.

.2 Provide interchangeable trip units with adjustable trip pick up and delay settings for breaker with frame size 225 amperes.

.3 Provide solid state trip units with long-time, short-time, instantaneous, and ground fault (LSIG) tripping characteristics for breakers with frame size 400 amperes and higher

2.4 CABINET(BOXES)

.1 The panelboard enclosure shall be fabricated from corrosion resistance, code-gauge galvanized or galvanized-annealed steel without knockouts and with full front flange. All details of construction and methods of assembly shall meet the requirements

of the "Enclosures for Electrical Equipment" of the Underwriters' Laboratories. The panel front shall be either surface or flush mounted as indicated on the drawings.

.2 Surface mounted panel boxes shall be finished with corrosion resistance treatment. Color shall be ANSI-61 light grey.

.3 The panelboard enclosure ingress protection or NEMA rating shall be suitable for the install environment. Refer to Specification Section 26 05 00.00 Common Work Results for Electrical for the required electrical enclosure ingress protection rating requirements.

.4 The front trim shall have full-length hinged outer door designed to expose the wiring raceways and breakers, when open. Another, inner hinged door shall expose breakers only, when open, making this a door-in-door construction. Both doors shall open to the right.

.5 Panelboards shall bear the Underwriters' Laboratories label.

2.5 ELECTRONIC POWER METERING

.1 The panelboard shall be provided with the electronic power metering, where indicated on the Drawings and/or panelboard schedule.

.2 Provide an advanced digital electronic energy meter capable of measuring the real-time RMS values of the phase currents and voltages, KW, KW demand, KWHR, KVA, KVA, KVAR, power factor, frequency, and waveform capture for power quality monitoring and analysis.

.3 A communications module shall be provided using a 10Base-T Ethernet and industry standard RS-485 serial bus.

.4 Potential, control power and current transformers, shorting terminal block, fuse blocks and fuses shall be completely installed and wired to the energy meter in the panelboard.

PART 3 – EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for panelboards installation in accordance with manufacturer's written instructions.

.1 Inform Department’s Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department’s Representative.

3.2 INSTALLATION

.1 Install recessed mounted panelboards plumb and flush with wall finishes. Where surface mounted, provide suitable supports and rack branch circuit conduits. Where mounted on concrete wall, install with 1/2 mm (15 mm) steel spacers behind the panel. Mounting attachments and connections shall be designed in conformance with the minimum lateral seismic force of 0.5W per CBC.

3.3 NAMEPLATES AND LABELS

.1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

.2 Provide typed or printed circuit directory (panel schedule) for each panelboard to reflect the final as-built condition. Mount a directory card on the inside of hinged front door metal frame. The directory card shall be plastic 0.76mm thick minimum indicating circuit numbers, load controlled, and location. The directory card identifies each branch circuit breaker number with its respective connected load.

.3 Provide panel identification, warning and arc flash hazard labels per the requirements of relevant codes and standards.

3.4 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with power panel shall be included in associated cost items for the Common Work Results for Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This section includes general requirements for supply, service, delivery, storage, installation, testing and commissioning of field instrumentation devices.

.2 Provide supervision, labor, and assistance to manufacturer’s field representative and/or technical directors of installation for equipment installed as a part of this Contract. Follow specified procedures and instructions provided by these representatives. Representatives will not be present at all times. Department or Department’s Representative will determine when representatives are required.

.3 The requirements of other related specification sections shall also apply for installation and coordination of work.

1.2 REFERENCES

.1 CAN/CSA-Q9000-92 Quality Management Quality Assurance Standards for selection and use.

.2 MUTCDC - Manual of Uniform Traffic Control Devices for Canada.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 The Contractor shall submit copies of vendor, producer or manufacturer data for instrumentation devices and apparatus. These shall include design and installation shop drawings, catalog cuts, specifications, data sheets, physical dimensioned drawings, testing and calibration requirements, and installation instructions for the following items, but not excluding other items or materials not specifically mentioned herein.

.3 Product Data:
- .1 Limit Switches
- .2 Span Position Sensor and Display

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store limit switches off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect limit switches from damages.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCT

2.1 GENERAL DESCRIPTION

.1 The contractor shall furnish all limit switches defined herein.

.2 The limit switches shall consist of lever arm and plunger type limit switches as herein specified and described on the Contract Drawings.

.3 All limit switches shall be manufactured in accordance with the requirements of NEMA A600 and be U.L. Listed, CSA certified and CEC marked.

2.2 MECHANICAL LIMIT SWITCHES

.1 Function: Monitor position of machinery parts; protecting equipment and personnel from dangerous contacts and/or conditions.

.2 Construction:
- .1 Metallic, industrial heavy duty design
- .2 Suitable for application in harsh industrial or corrosive environments
- .3 Electrically isolated bodies for industrial/corrosive environments
- .4 Zinc casings sealed w/ epoxy resin
- .5 Shock and vibration resistant
- .6 Stainless steel operating rod or lever arm
- .7 Stainless steel cable gland
- .8 Limit switch operating heads are as indicated in the Limit Switch Application Table

.3 Operating Temperature: -40 °C to 85 °C

.4 Enclosure Rating / Degree of Protection: NEMA 4X / IP67.

.5 Minimum Actuation Speed:
- .1 Slow action contacts: 0.060 m/s
- .2 Snap action contacts: 0.001 m/s

.6 Ratings:
- .1 Rated operational voltage: 130 V
- .2 Rated Thermal Current: 10A min
- .3 Rated Insulation Voltage: 300V minimum

.7 Certifications / Approvals: UL & CSA

.8 Features and auxiliaries:
- .1 The switches shall be provided with 2 NO and 2 NC contacts

.2 The Contractor shall furnish formed galvanized steel supporting brackets and associated stainless steel hardware.
.3 Manufacturer pre-wired connection
.4 The joint of the mechanism between the spring buffer and the plunger rod shall be covered with a watertight, neoprene bellows-type boot.

.9 The Contractor shall submit outline drawings, dimensioned layout, switch contact configuration diagram and specification data sheet of the limit switches to the Department's Representative for approval prior to procurement.
.10 Provide four (4) spare mechanical limit switches.

2.3 MAGNETIC LIMIT SWITCHES

.1 Function: Monitor position of machinery parts; protecting equipment and personnel from dangerous contacts and/or conditions.

.2 Construction:
.1 Proximity triggering with ferrous metal and magnetic targets - no exposed moving parts
.2 Stainless steel, industrial heavy duty design
.3 Suitable for application in harsh industrial or corrosive environments
.4 Electrically isolated bodies for industrial/corrosive environments
.5 LED indications for switch function and contact operation.
.6 Shock and vibration resistant
.7 Stainless steel sensing face and housing
.8 Stainless steel cable gland
.9 3/8'' (10mm) sensing distance (ferrous metal)
.10 Provide target magnet to extended sensing as required (with resin cover or stainless cover)
.11 AC/DC, NO/NC Wiring Flexibility

.3 Operating Temperature -58°F to 221°F (-50°C to 105°C)

.4 Enclosure Rating / Degree of Protection: submersible to 50 m minimum.

.5 Contact Ratings: Dry Contact, Double Pole Double Throw (DPDT) contact arrangement; 5A/240VAC, 10A/120VAC, 3A/24VDC

.6 Certifications / Approvals: UL & CSA

.7 The Contractor shall submit outline drawings, dimensioned layout, switch contact configuration diagram and specification data sheet

of the limit switches to the Department's Representative for approval prior to procurement.

.8 Provide four (4) spare magnetic limit switches.

2.4 SPAN POSITION INDICATION (CABLE ACTUATED SENSOR & DIGITAL DISPLAY)

.1 Function: Monitor and provide span position indication.

.2 Cable Actuated Sensor Construction:
- .1 Absolute Linear Position Sensor
- .2 Industrial heavy duty design Suitable for application in harsh industrial or corrosive environments
- .3 Shock and vibration resistant
- .4 Stainless steel enclosure
- .5 Stainless steel cable, .047-mm diameter bare minimum, tension 36 oz., max. acceleration 5g, max. velocity 5 m/sec (200mm/sec)
- .6 Full Stroke Range: 0-1900 mm (0-75 mm)
- .7 Cable exit as required to accommodate field installation.
- .8 Output Signal 4-20 mA (2-wire)
- .9 Vibration: up to 10 g to 2000 Hz maximum
- .10 Accuracy: ±0.12% full stroke
- .11 Repeatability: ±0.05% full stroke
- .12 Operating Temperature: -40 °C to 90 °C
- .13 Enclosure Rating / Degree of Protection: NEMA 4X/6 (IP 67/68).
- .14 Provide with water proof instrument plug cable
- .15 Provide with Velocity Limiting System (VLS) option to prevent cable from reaching damaging velocity during an accidental free release.

.3 Digital Display Panel
- .1 Provide multipurpose digital display panel on the Bridge Operator Control Console.
- .2 The digital display panel shall be compatible with Absolute Linear Position Sensor.
- .3 The digital display panel shall be able to integrate traditional 4-20 mA or voltage inputs in the display scanning.
- .4 The display shall be set up/programmed to display horizontal angular position of the bridge span from fully closed to fully opened position in 1 degree increment.
- .5 The digital display shall be UL / C-UL listed and has CE marking.
- .6 The digital display shall be NEMA 4X front.
- .7 120 VAC supply.

.4 The Contractor shall submit outline drawings, dimensioned layout, and installation and mounting drawing on the machinery to the Department's Representative for approval prior to procurement.

.5 Provide one spare sensor and one spare digital display panel.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Install the limit switches and field sensor device in accordance with manufacturer's recommendations and the approved shop and working drawings.

.2 Each limit switch and field device shall be tested for correct operational functionality and repeatability.

3.2 FIELD QUALITY CONTROL

.1 Perform test in accordance with section 26 05 00.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

3.4 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with field instrument devices shall be included in associated cost item for the HPU Work-Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This section includes general requirements for supply, service, delivery, storage, installation, testing and commissioning of wiring devices.

.2 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.2 REFERENCES

.1 CSA International
- .1 CSA C22.2 No.42-10, General Use Receptacles, Attachment Plugs and Similar Devices.
- .2 CAN/CSA C22.2 No.42.1-00(R2009), Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
- .3 CSA C22.2 No.55-M1986 (R2008), Special Use Switches.
- .4 CSA C22.2 No.111-10, General-Use Snap Switches (Bi-national standard, with UL 20).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for wiring devices and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
  - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.

1.4 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Operation and Maintenance Data: submit operation and maintenance data for wiring devices for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect wiring devices from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Requirements.

1.6 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCTS

2.1 TOGGLE SWITCHES

.1 Provide heavy duty toggle switch for control lighting fixtures with rating suitable for the application voltage and current ratings.

.2 Manually-operated general purpose AC switches with following features:
- .1 Provide 20 A, 120 V, single pole, double pole and three-way switches per CSA C22.2 No.55 and CSA C22.2 No.111 as applicable.
- .2 Terminal holes approved for No. 10 AWG wire.
- .3 Silver alloy contacts.
- .4 Urea or melamine moulding for parts subject to carbon tracking.
- .5 Suitable for back and side wiring.
- .6 Ivory toggle.

.3 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.

.4 Weatherproof Switches:
- .1 Provide weatherproof switches for all outdoor locations or locations partially exposed to outdoor.
- .2 Provide switch in cast metal box with stainless steel cover and gasket.

2.2 RECEPTACLES

.1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, to: CSA C22.2 No.42 with following features:
- .1 Housing suitable for the install environment.
- .2 Suitable for No. 10 AWG for back and side wiring.
- .3 Break-off links for use as split receptacles.
- .4 Eight back wired entrances, four side wiring screws.
- .5 Triple wipe contacts and rivetted grounding contacts.

.2 Ground Fault Receptacles
- .1 Ground fault circuit interrupter duplex receptacles: 120 Volt, 60Hz, 20 ampere with built-in test, reset buttons. Interrupt circuit within 1/30 second on a five milliampere earth leakage current. Maximum circuit capacity 20 amperes. Straight blade, heavy duty, industrial specification grade. Provide receptacle outlets with ground fault protection as required by the CEC.
- .2 Weatherproof Metallic Covers for Duplex GFI Receptacles: WPO listed, covers with this listing shall meet applicable

section of CEC, and UL 514A receptacle requirements for wet location that is rated for wet location for either cover closed and/or cover open with device in use ("open").

.3 The degrees of ingress protection rating (IP Code) or NEMA enclosure rating shall be suitable for the installation environment.

.4 Provide weather Resistant and Tamper-Resistant Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498 Supplement sd, and FS W-C-596.

.5 Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

.3 The convenience receptacle outlets shall be standardized for each rating and type, shall comply with local standard. Plugs shall not be interchangeable with sockets of a different voltage or current rating. The receptacle outlets shall have a ground connection incorporated.

2.3 COVER PLATES

.1 Cover plates for wiring devices to: CSA C22.2 No.42.1.

.2 Stainless steel utility box cover for wiring devices installed in surface-mounted utility boxes, outlet box, and conduit boxes.

.3 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for duplex receptacles as indicated.

.4 Weatherproof spring-loaded cast aluminum cover plates complete with gaskets for single receptacles or switches.

.5 Screws: Vandal resistance stainless steel.

2.4 SOURCE QUALITY CONTROL

.1 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.2 Electrical equipment and materials shall be new and within one year of manufacture date.

.3 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for wiring devices installation in accordance with manufacturer's written instructions.
   .1 Inform Department’s Representative of unacceptable conditions immediately upon discovery.
   .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department’s Representative.

3.2 INTALLATION

.1 Switches:
   .1 Install single throw switches with handle in "UP" position when switch closed.
   .2 Install switches in gang type outlet box when more than one switch is required in one location.
   .3 Mount toggle switches at height as indicated in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Receptacles:
   .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
   .2 Mount receptacles at height as indicated in accordance with Section 26 05 00 - Common Work Results for Electrical.
   .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
   .4 Install GFI type receptacles as required by the electrical codes.

.3 Cover plates:
   .1 Install suitable common cover plates where wiring devices are grouped.
   .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
   .1 Leave Work area clean at end of each day.

.2 Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Requirements.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.

.3 Repair damage to adjacent materials caused by wiring device installation.

3.5 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with wiring devices shall be included in associated cost item for the Common Work Results for Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This section includes general requirements for supply, service, delivery, storage, installation, testing and commissioning of safety disconnect switches.

.2 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.2 REFERENCES

.1 Edit the following paragraphs for this specific project. CSA Group
- .1 CAN/CSA-C22.2 No.4-04 (R2009), Enclosed and Dead-Front Switches (Tri-National Standard, with ANCE NMX-J-162-2004 and UL 98).
- .2 CSA C22.2 No.39-13, Fuse holder Assemblies.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for disconnect switches - non-fused and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
  - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
- .2 Recycled Content:
  - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.
- .3 Regional Materials: submit evidence that project incorporates required percentage 50% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoors, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect disconnect switches - non-fused from nicks, scratches, and blemishes.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Requirements.

1.5 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCT

2.1 DISCONNECT SWITCHES

.1 Repeat the following paragraph for different types of disconnect switches.

.2 Non-fusible, Horsepower rated disconnect switch in CSA enclosure stainless steel, NEMA 4X, to CAN/CSA-C22.2 No.4 size as indicated on the Contract Drawings.

.3 Provision for padlocking in on-off switch position by 3 locks.

.4 Mechanically interlocked door to prevent opening when handle in ON position.

.5 Quick-make, quick-break action.

.6 ON-OFF switch position indication on switch enclosure cover.

2.2 DISCONNECT SWITCH WITH POWER RECEPTACLE

.1 The disconnect switch with the power receptacle shall be furnished and installed as a mobile generator hook-up as indicated on the Contract Drawings.

.2 The switch shall be NEMA type HD heavy-duty 3-pole, with visible blades; a quick make-and-break mechanism with reinforced, positive pressure type blade and jaw construction; pressure connectors are used for wire connectors. Additionally, where indicated on the contract drawings, auxiliary poles shall be provided.

.3 For maximum safety, the spring door receptacle at the bottom of the unit shall be mechanically interlocked with the switch operating mechanism. The switch shall be such that it cannot be closed until the plug is fully inserted and the plug cannot be withdrawn or inserted unless the switch is open; with the switch open, accidental plug withdrawal is prevented by the interlock mechanism; withdrawal can only be accomplished by activation of the interlock release lever located on the receptacle.

.4 Enclosures shall be compact and rectangular in shape with a gasketed, hinged door.

.5 Enclosure, handle and other exterior parts are corrosion-resistant.

.6 The switch enclosure covers shall be interlocked with the body and operating mechanism and shall be such that it cannot be opened when the plug is engaged and the switch is closed ("ON"). When the switch is open, the switch cannot be put in a closed ("ON") position with the door open.

2.3 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Indicate name of load controlled on size 4 nameplate.

PART 3 – EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for disconnect switch installation in accordance with manufacturer's written instructions.
   .1 Inform Department’s Representative and/or Consultant of unacceptable conditions immediately upon discovery.
   .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department’s Representative.

3.2 INSTALLATION

.1 Install disconnect switches complete with fuses if applicable.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
   .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and/or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal Requirements.
   .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with safety disconnect switches shall be included in associated cost item for the Common Work Results for Electrical.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

.1 Furnish and install navigation lighting systems, including all wiring, conduit, wiring devices, transformers, enclosures, grounding system, controls, protective devices, lights, etc., as shown in the Plans and in compliance with Canadian Coast Guard (CCG) Publication "Canadian Aid to Navigation System" and the Canadian Highway Bridge Design Code (CSA-S6-14). Navigation lights must operate from sunset to sunrise and during periods of low visibility.

1.2 RELATED REQUIREMENTS

.1 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.3 REFERENCES

.1 Edit the following paragraphs for this specific project.CSA Group
- .1 CSA C22.2 No.206-13, Lighting Poles.
- .2 CAN/CSA-Q9000-92 Quality Management Quality Assurance Standards for selection and use.
- .3 CAN/CSA-S6-14, Canadian Highway Bridge Design Code.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for navigation lights and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
- .2 Recycled Content:
  - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

1.5 DELIVERY,STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials in door, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect light fixtures from damage.
- .3 Replace defective or damaged materials with new.

.4 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.6 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCTS

2.1 GENERAL DESCRIPTION

.1 Navigation lights shall be furnished and installed as indicated on the Contract Drawings.

.2 The navigation lights shall conform to the requirements and be in accordance with the rule and regulations of the Canadian Coast Guard.

.3 The navigation lights shall be swing span type lights.

2.2 NAVIGATION BRIDGE SWING SPAN LIGHT

.1 Swing span type light shall consist of a green light mounted above a red light. Each of the swing span red and green lights shall have a 200mm diameter, alternate red (2) and green (2), each 60˚ and at 90˚ to each other.

.2 Fixed span and protection pier type light, located on the pivot pier shall be 180˚ red as indicated on the drawing.

.3 The housing shall be of cast silicon bronze. Casting alloy used shall be suitable for marine environment. Construction shall be rain-tight and fully gasketed. The light assembly shall be designed for heavy duty, long life service. Design shall provide ready access for lamp service.

.4 Lens shall be tempered fresnel glass. Lens colours shall meet Canadian Coast Guard standards. Inside lens diameter shall measure approximately 175mm. Outside lens diameter shall measure approximately 205mm.

.5 Lamps, dual lamps per section, shall be medium base, 120V, 100,000 hour LED lamps provided in a colour to match the lens. Medium base receptacles shall be rated for 250V, 660W and shall be porcelain with a nickel-plated brass shell to resist lamp freezing. The dual lamp arrangement shall be provided with an automatic transfer relay shall switch power to the backup lamp upon failure of the primary lamp. The relay shall provide a second independent contact for remote signaling of “primary lamp failure” status. Transfer relay components shall be contained in a cast box of the same material as the fixture head.

.6 Lamp fixture head and base shall be mounted on a 51mm schedule 40 pipe, 60mm O.D. Pipe material shall be stainless pipe used with bronze castings. Standard dimension from the light base to the focal plane of the lower lens shall be 356mm.

.7 Base shall be cast of the same material as the fixture head silicon bronze and be suitable for wall mount. Light assembly shall mount via four 13mm diameter bolts through the base, provided by the Contractor to suit installation.

.8 Power shall be switched between red (bridge closed to maritime traffic) and green (bridge open) sections remotely from the bridge control system.

.9 An indicator light to signal “primary lamp failure” status shall be included, when specified, for remote installation. The indicator light shall have a 360 degree blue Fresnel lens. A 27W lamp shall be included.

.10 Each light shall be securely bolted in place with bronze or stainless steel lag screws or bolts of not less than 9.5mm in diameter. The connections to the lights shall be made with No. 10 AWG conductors. The feeding conduits for the lights shall be securely clamped to the piers with two stainless steel anchor bolts.

.11 The contractor shall submit outline-dimensioned drawings, of his proposed bridge swing span navigation lighting unit, mounting details, and specification in the form of catalog cuts of proposed lights to be approved by the Department’s Representative.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for navigation lighting installation in accordance with manufacturer's written instructions.
   .1 Inform Department’s Representative of unacceptable conditions immediately upon discovery.
   .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval from the Department’s Representative to proceed.

3.2 INSTALLATION

.1 Navigation bridge swing span light layouts shall be approved by Canadian Coast Guard prior to the installation work.

.2 Install the bridge swing span light in accordance with manufacturer’s recommendations and the approved shop and working drawings.

.3 Each bridge swing span light shall be tested for correct operational functionality and repeatability. Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with section 26 05 00.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 MEASUREMENT AND PAYMENT

.1 Lump Sum Amount. No measurement will be made for this item.

.2 Payment at the contract price shall be full compensation for all labour, equipment, and material required to do the work, including the cost for the associated work applicable to this tender item per the requirements of the following specification sections:

26 05 00 - Common Work Results for Electrical
26 05 21 - Wires and Cables (0-1000 V)
26 05 26 - Grounding and Bonding for Electrical Systems

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This section includes general requirements for supply, delivery, storage, installation, testing and commissioning of vehicle traffic warning gates under the scope of the contract.

.2 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.2 REFERENCES

.1 CSA Group
- .1 CSA C22.1 Canadian Electrical Code Part 1, Safety Standard for Electrical Installations.
- .2 CAN/CSA-Q9000-91 Quality Management Quality Assurance Standards for selection and use.
- .3 TAC - Manual of Uniform Traffic Control Devices.
- .4 OTM – Ontario Traffic Manual.
- .5 CAN/CSA-S6-14, Canadian Highway Bridge Design Code.

.2 ANSI/NEMA MG 1-2011, Motor and Generators.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .1 Include requests for relevant data to be furnished by the Contractor, before, during or after construction.
- .2 Product Data:
- .3 Submit manufacturer's instructions, printed product literature and data sheets for traffic gates and include product characteristics, performance criteria, physical size, finish and limitations.
- .4 The Contractor shall submit outline drawings dimensioned layout, schematic and wiring diagrams of the warning gates to the Departmental Representative for approval prior to fabrication.

.2 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
  - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 50% of construction wastes were recycled or salvaged.
- .2 Recycled Content:

.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect warning gates from damage.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCT

2.1 GENERAL DESCRIPTION

.1 A total of two (2) electrically operated traffic gates shall be furnished.

.2 The gate shall be controlled from the operators control station.

2.2 WARNING GATES

.1 A total of two (2) motor-operated, single-arm, warning gates of the railway grade-crossing type shall be furnished and installed at the approach roadway to the bridge, as indicated on the Contract Drawings.

.2 The operating mechanism and main control components with the exception of the gate drive motor starter shall be contained in a weatherproof housing. The housing shall be constructed of .188” (4.8mm) carbon steel, hot dip galvanized after fabrication. Exterior surfaces shall be painted aluminum. All fasteners shall be corrosion resistant. Arm shaft openings shall incorporate O-ring seals.

.3 Each gate shall have an arm of length sufficient to straddle the width of the roadway Contractor to verify arm length requirements in the field).

.4 Each gate shall open through an angle of 90 degrees from the horizontal to the vertical.

.5 Each gate shall have a welded steel stand arranged to provide a weather tight housing for the motor, disconnect switch, gear train, limit switches and fuses for warning lights. The gate stands shall be hot-dip galvanized after fabrication. The transmission gearing for each gate shall be enclosed. weathertight, gasketed doors shall be provided for access to the operating equipment. A hand crank shall be provided for manual operation of each gate together with hand crank release limit switch.

.6 The gate arm shall be 4” (102mm) square, 6005-T5 aluminum extruded tubing. Stainless steel truss cables and a bumper rod with compression spring shall be provided near the end of each gate arm to stop the travel at the closed position without undue shock. Front and rear arm surfaces shall be covered with alternating red and white high intensity reflective sheeting. Stripes shall be 16” (406mm) wide, and vertical according to MUTCDC. Remaining exposed surfaces shall be painted white. Each assembled gate arm shall be designed for a 120 KPH wind load.

.7 The main arm shaft shall be of 2” (51mm) diameter AISI 4150 with a minimum tensile strength of 140,000 psi. The shaft shall be mounted in heavy duty re-lubricable ball bearings.

.8 All bolts, screws or other fastenings used in the gate arm assembly and for connection to the gate stand shall be corrosion-resisting metal or shall be hot-dip galvanized.

.9 The warning lights shall be furnished on the gate arms. The warning lights housing shall be of high impact molded plastic; moisture and corrosion proof with 2-way visibility, 7 inch (178mm) diameter red lenses. The lamp shall be 12 VDC, LED 100,000 hours design for the application.

.10 The flasher shall be heavy duty, solid state, fully factory wired, with two alternately flashing circuits and one steady burn circuit. The flasher shall include mounting hardware, solid state flashing circuitry, clearly labeled terminal block, heat sink, and transformer when required. The flashing rate shall be 0.5 seconds ON, 0.5 seconds OFF. Terminals shall be clearly labeled and shall be compression type screw terminals. Input voltage shall be 120 VAC. The flasher shall operate properly for input voltage within 10% of nominal.

.11 Each warning gate shall be provided with a warning gong. Each gong shall be a weatherproof, motor-operated, 12-inch gong mounted on the warning gate housing and provided with a suitable base for fastening to the gate housing. The gong shall be of cast bronze, fire alarm bell metal and shall be held with theft-proof nuts.

.12 An 8-circuit limit switch shall be provided in each gate, operated by the gate mechanism. Each limit switch shall be rotary-cam type and it shall be gear driven from the transmission. The contacts shall be quick-break with silver alloy buttons. The limit switch shaft shall be stainless steel, and cams shall be secured thereto with setscrews.

.13 The motor for each warning gate shall be furnished as part of the gate system. Motor shall be a totally enclosed, 3-phase, 575 volts, AC, provided with a fully rated disconnect switch and shall be capable of withstanding instant reversal when running at full speed. Each motor and gear train shall be capable of opening and closing the gate in about 11 seconds. A motor-mounted, spring set, magnetically-released, 575Volt, 60 Hz disc brake shall be provided for stopping and holding the mechanism. A watertight disconnect switch shall be provided to permit disconnecting the motor and brake from the incoming power. Each gate mechanism shall be furnished complete with space heaters, thermostats, work lights, light switches and duplex receptacles and be suitable for 120 volts, 60 Hz operation.

.14 Safety switches shall be installed and set at the factory to break the control circuit when either access door is opened. Door safety switches shall have a pull-to-override feature for test operation and shall automatically reset when doors are closed.

.15 All internal wiring for each gate shall be brought to numbered terminal blocks inside the housing for the connection of external circuits.

.16 The arms shall be counterbalanced and the limit switches adjusted so that the arms are stopped in a truly vertical or horizontal position. All warning gates shall be attached to the bridge deck with stainless steel or galvanized anchor bolts. Bolts and attachments to the deck shall be furnished in accordance with manufacturer's recommendations.

.17 No exposed electrical or control wiring shall be permitted. All wiring on the gate arm shall be in rigid metal conduit. Wiring between the gate arm and housing shall be of the armored flexible type.

.18 The Contractor shall submit outline drawings dimensioned layout, schematic and wiring diagrams of the warning gates to the Departmental Representative for approval prior to fabrication.

2.3 WARNING GATE CONCRETE BASES

.1 The warning gate concrete base shall be in accordance with Section 03 20 00 and 03 30 00 and manufacturer’s requirements.

.2 Anchor bolts: Shall be in accordance with gate manufacturer’s requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for warning gate installation in accordance with manufacturer's written instructions.
   .1 Inform Department’s Representative of unacceptable conditions immediately upon discovery.
   .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Department’s Representative.

3.2 INSTALLATION

.1 Install the warning gates in accordance with the manufacturer's printed instructions, current at the time of installation. Coordinate locations of operators with contract drawings, other trades and shop drawings.

.2 Each warning gates and barrier gates shall be tested for correct operational functionality and repeatability.

.3 Excavate for warning gate and barrier gate concrete bases in accordance with section 31 23 33.01.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Test gate operator through ten full cycles and adjust for operation without binding, scraping or uneven motion. Test limit switches for proper "at rest" gate position.

.3 All anchor bolts shall be fully concealed and fully tightened in the finished installation.

.4 Department, or Department’s Representative, shall complete “punch list” with installing contractor prior to final acceptance of the installation and submit completed warranty documentation to manufacturer.

.5 Ensure moving and working parts are lubricated where required.

3.4 CONTINUED SERVICE AND DOCUMENTATION

.1 Train Department’s personnel on how to safely shut off electrical power, release and manually operate barrier arm. Additionally,

demonstrate the general maintenance of the gate operator and accessories and provide one copy of "Installation and Reference" manual for the Department's use (a second manual is available upon request). Manuals will identify parts of the equipment for future procurement.

3.5 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
  .2 Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in any other location where they will pose health or environmental hazard.
  .3 Divert unused concrete materials from landfill to local facility approved by Department's Representative

3.6 MEASUREMENT AND PAYMENT

.1 Lump Sum Amount. No measurement will be made for this item.

.2 Payment at the Contract price shall be full compensation for all labor, Equipment, and Material required to do the work including the cost for the associated work applicable to this tender item per the requirements of the following specification sections:

26 05 00 - Common Work Results for Electrical
26 05 21 - Wires and Cables (0-1000 V)
26 05 26 - Grounding and Bonding for Electrical System

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

.1 Codes and Standards referenced shall be the latest versions at the time of project tender.

.2 Canadian Standards Association (CSA International):
- .1 CSA C22.1 Canadian Electrical Code Part 1, Safety Standard for Electrical Installations.
- .2 CAN/CSA Q9 000 Quality Management/Quality Assurance Standards for selection and use.

.3 Ontar Provincial Standard Specifications (OPSS):
- .1 OPSS 620, Traffic Signals.

.4 Ontario Traffic Manual (OTM)
- .1 Book 6, Warning Signs.
- .2 Book 12, Traffic Signals.

1.2 SUMMARY

.1 This specs covers the requirements for the installation of traffic signals.

.2 Equipment, including traffic signal heads, mast arms, brackets, signal hangers, optically directed lens assemblies, LED modules and a Flashing LED Warning Beacon with Sign Panel.

1.3 SHOP DRAWINGS AND PRODUCT DATA

.1 Submit shop drawings and product data in accordance with Section 01 33 00.

1.4 WASTE, MANAGEMENT AND DISPOSAL

.1 Separate recycle and waste materials.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

.3 Collect and separate for disposal paper, plastic, polystyrene, corrugated cardboard, packaging material in appropriate on-site bins for recycling in accordance with Waste Management Plan.

.4 Divert unused metal materials from landfill to metal recycling facility as approved by the Departmental Representative.

.5 Fold up metal banding, flatten and place in designated area for recycling.

PART 2 - PRODUCT

2.1 GENERAL DESCRIPTION

.1 Traffic Signal: A total of two (2) sets of electrically-operated, post mounted traffic signals shall be furnished and installed as per details shown on the drawings and as indicated in the specification. The traffic signals shall be controlled from the operator's control station.

.2 Flashing LED Warning Beacon: A post mounted flashing warning LED beacon with traffic sign panels shall be furnished and installed as shown on the drawing and as indicated in the specification. The flashing LED warning beacon shall be controlled from the operator's control station.

2.2 TRAFFIC SIGNALS

.1 Traffic Signal Heads; Each traffic signal head shall be provided with LED modules unless otherwise specified in the contract documents. Traffic signal heads shall be in accordance with OPSS 2461, OTM Book 12 and the Ontario Highway Traffic Act.

.2 Traffic Signal Posts, Cantilever Arms, Brackets and Signal Hangers; Traffic signal posts, cantilever arms, brackets and signal hangers shall be according to OPSS 2460 and details shown on the contract documents. Traffic signal post shall be of aluminum and according to OPSD 2432.010. The details of mounting heights of signal lights, cantilever arm length shall be according to OPSD 2500.010. Concrete footing of the signal posts shall be according to OPSD 2200.04

.3 Traffic Signal Cables; Traffic signal cables shall be according to OPSS 2409. Electrical insulating tape shall be according to CSA C22.2 No.197 and rated for 600V and -10 to 90 degree C working temperature.

.4 LED Modules; LED modules shall be according to OPSS 2461.

.5 Strapping and Buckles; All strappings and buckles shall be of stainless steel type 316 and shall have a minimum ultimate strength of 4.5 Kn.

.6 Fittings and Mounting Equipment; Fittings, accessories and mounting hardware shall be stainless steel 316 and as indicated in the contract documents. Grommets shall be rubber or neoprene sized to suit the aperture, metal thickness and cable diameter.

.7 Grounding Materials; Grounding materials shall be according to OPSS 609 and CSA/C22.2 No.41

2.3 FLASHING LED AMBER BEACON

.1 Flashing Beacon Signal Head: Continuously flashing amber beacon signal head shall be with LED modules in accordance with OPSS 2461 and OTM Book 12 with heavy duty polycarbonate housing. Beacon must be flashing at a rate of not more than 60 or less than 50 ON and OFF flashes per minute with the length of each ON period approximately equal to the length of each OFF period.

PART 3 – EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for warning gate installation in accordance with manufacturer's written instructions.

.2 Inform Department’s Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Department’s Representative.

3.2 INSTALLATION

.1 Install the traffic signals in accordance with manufacturers recommendations and the approved shop and working drawings.

.2 Each traffic signal shall be tested for correct operational functionality and repeatability.

.3 Excavate for traffic signal post concrete bases and cable trenches in accordance with Section 31 23 33.

3.3 CONSTRUCTION METHODS

.1 The electrical installation work shall be performed as indicated on the Contract Drawings and in accordance with approved shop drawings and manufacturer's recommendations.

.2 All associated construction and installation work of traffic signal and flashing beacon shall be performed using good installation judgment and in accordance with all prevailing national and local codes and ordinances.

3.4 FIELD QUALITY CONTROL

.1 Perform tests in accordance with section 26 05 00.
.2 Ensure moving and working parts are lubricated where required.

3.5 MEASUREMENT AND PAYMENT

.1 Lump Sum Amount. No measurement will be made for this item.

.2 Payment at the Contract price shall be full compensation for all labor, Equipment, and Material required to do the work including the cost for the associated work applicable to this tender item per the requirements of the following specification sections:

26 05 00 - Common Work Results for Electrical
26 05 21 - Wires and Cables (0-1000 V)
26 05 26 - Grounding and Bonding for Electrical System

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENT

.1 This section includes general requirements for supply, delivery, storage, installation, testing and commissioning of low voltage, 3-phase, fractional and integral horsepower squirrel cage induction electric motors 1/2 to 400 hp.

.2 Provide motors either separately or as an integral part of mechanical system. Motor horsepower and torque characteristics shall be coordinated with driven piece of equipment by manufacturer. Provide Low-Voltage Motors of a sufficient size and characteristic for the application and duty of the driven equipment with appropriate design margin meeting the specific application requirements.

.3 The requirements of other related specification sections shall also apply for installation and coordination of work.

1.2 RELATED SECTIONS

.1 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.3 REFERENCES

.1 CSA Group
- .1 CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.
- .2 CAN/CSA-Z462-12, Workplace Electrical Safety.
- .3 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards - Guidelines for Selection and Use.

.2 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.3 National Electrical Manufacturers Association (NEMA)
- .1 NEMA MG 1 (2014) Motors and Generators

.4 Institute of Electrical and Electronics Engineers(IEEE)
- .1 IEEE 112 (2004) Standard Test Procedure for Polyphase Induction Motors and Generators
- .2 IEEE 841 (2009) IEEE Standard for Petroleum and Chemical Industry--Premium-Efficiency, Severe-Duty, Totally Enclosed Fan-Cooled (TEFC) Squirrel Cage Induction Motors--Up to and Including 370 kW (500 hp)

.5 International Electrical Testing Association (NETA)

.1 NETA ATS Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 The Contractor shall submit copies of vendor, producer or manufacturer product data. These shall include design and installation shop drawings, catalog cuts, specifications, testing requirements, and installation instructions.

.3 Product Data:
- .1 Submit manufacturer's instructions, printed product literature and data sheets for motor control centres and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Data sheets and publications on all major components including, but not limited to the following:
  - .1 Product description, motor physical dimension and terminal connection drawings
  - .2 Motor performance curves

.4 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures and maintenance information.

.5 Test Report

.6 Factory Test Procedures

.7 Certificates

.8 Closeout Submittals Warranty

.9 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
- .2 Recycled Content:
  - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit.

.3 Provide instructions on how to adjustment, trouble-shooting, configuration, modify program settings, and modify the control program.

.4 Include copies of as-built submittals.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoor, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect motor control centres from damages.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.7 QUALITY ASSURANCE

.1 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.2 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.3 Electrical equipment and materials shall be new and within one year of manufacture date.

.4 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.5 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCTS

2.1 DESCRIPTION

.1 Motors shall be in accordance with applicable requirements of, NEMA MG-1, NFPA 70, IEEE 112, and UL 1004.

.2 The motor’s torque characteristics in relation to the speed and starting current, shall conform to the motor design classification.

.3 General duty motors installed in an environmentally controlled indoor, non-corrosive environment shall conform to NEMA MG-1.

.4 Special purpose motor(s) shall conform to the specific technical and manufacturer’s requirements for the application and shall have precedence over the technical requirements for the general duty motors.

.5 Outdoor motors and motors on bridge structures shall be totally enclosed and rated for application in high humidity, wet, and salty environments.

2.2 GENERAL PERFORMANCE AND REQUIREMENTS

.1 The motors shall be designed to adequately braced for direct-on-line starting, with full rated voltage applied at their terminals. The starting performance of the motors shall comply with NEMA MG-1 requirements.

.2 Maximum voltage dip at motor terminal during initial starting condition, for motor started directly across line shall not exceed 20% of the system nominal voltage

.3 Motor locked rotor current shall be limited to 650% when started at full voltage.

.4 The motors shall withstand the dynamic torque stressing due to the switching phenomena (direct-on-line starting, short-circuit followed by transfer to another source and re-acceleration).

.5 Torque and Acceleration: The torque characteristics of all induction motors shall be as required to accelerate the inertia loads of the motor and driven equipment to full speed without damage to the motor or the equipment at any voltage from 90% to 110% of motor nameplate voltage.

.6 When electrically driven equipment differs from that indicated, make adjustments to the motor size, wiring and conduit systems, disconnect devices, and circuit protection to accommodate the equipment actually installed, at no additional cost to the Government.

2.3 MOTOR RATING

.1 Motor ratings as indicated on the design drawing and as specified.

.2 Provide general purpose totally enclosed ac motors with a service factor of 1.15.

2.4 VARIABLE SPEED MACHINES

.1 Motors driven by adjustable speed drive shall have duty ratings be suitable for operation on an adjustable speed drive over the operational speed range duty cycle without exceeding the maximum temperature rise.

.2 Provided motors with external cooling fans to force cool the machine if it is not possible to maintain motor’s temperature rise below its rating limit with an integral fan performance.

2.5 ENCLOSURE SYSTEM

.1 Non-Hazardous Area Applications

.2 Totally Enclosed Fan Cooled (TEFC): General industrial applications relatively clean, dry locations (pumps, fan, compressors). Prevents the free exchange of air between the inside and outside of the frame, but does not make the frame completely air tight. A fan is attached to the shaft and pushes air over the frame during its operation to help in the cooling process.

.3 Totally Enclosed Non-Ventilated (TENV): Exposed to dirt or dampness, but not very moist. The motor is similar to a TEFC, but has no cooling fan and relies on convention for cooling. No vent

openings, tightly enclosed to prevent the free exchange of air, but not airtight. The motor is designed with a low enough temperature rise so that an external fan is not required for cooling, or duty is limited so the motor does not overheat.

.4 Totally Enclosed Air Over (TEAO): Dust-tight fan and blower duty motors designed for shaft mounted fans or belt driven fans. The motor must be mounted within the airflow of the fan.

.5 Totally Enclosed Wash down (TEWD): Application in moist corrosive environments. Designed to withstand high pressure wash-downs or other high humidity or wet environments. Available on TEAO, TEFC and TENV enclosures totally enclosed, hostile and severe environment motors.

.6 Hazardous Area Applications

.1 Hazardous Location (HAZ): Hazardous location motor applications are classified by the type of hazardous environment present, the characteristics of the specific material creating the hazard, the probability of exposure to the environment, and the maximum temperature level that is considered safe for the substance creating the hazard

.2 Explosion-proof enclosures (EXPL): The explosion proof motor is a totally enclosed machine and is designed to withstand an explosion of specified gas or vapor inside the motor casing and prevent the ignition outside the motor by sparks, flashing or explosion - Explosion-proof enclosures (EXPL)

.7 Provision for Vibration Monitoring

.1 Provide a smooth surface on motor housing in the vertical, horizontal, and axial directions at each bearing housing for attaching a magnet mounted accelerometer in order to monitor the motor vibration. Ensure the smooth surface is on the bearing housing, with the axial surface as close to the motor centerline as possible.

.2 Provide a motor housing with a surface finish of 1.6002 micrometer minimum, corrosion resistant, with a minimum diameter finished surface of 50 millimeters. As an option sound disks with a minimum thickness of 9 millimeters can be used to meet the smooth surface requirement. Ensure surface is level within 1 degree or 0.0254 millimeters. Identify the smooth surface using a printed label or embossed plate stating "Vibration data collection point - Do Not Paint".

2.6 MOTOR FRAME

.1 Motor’s frame construction shall be heavy-duty, using cast iron or welded steel construction. Motor frame, fan covers, end brackets, drip shields, and bearing housing shall be cast iron with

corrosion-resistant treatment. Motor supporting feet shall be an integral part of frame for very rigid mounting and to minimize vibration.

.2 Provide motors with stainless steel replaceable automatic drainage fittings. Locate drain holes at low point of motor in final mounted position.

.3 Drill and tap for ground lug connection. Locate bolt holes on motor frame, external to, and on same side as terminal box.

2.7 STATOR AND STATOR ASSEMBLY

.1 The motors of 250hp and larger shall have form wound coils and a sealed Vacuum Pressure Impregnation (VPI) insulation system with epoxy resins.

.2 The motors smaller than 250hp may have form wound or random wound coil. The motors with form wound coil shall have a sealed VPI insulation system with epoxy resins that withstand an immersion type test as required by applicable reference standards. The motors with random wound coil shall have a moisture resistant VPI insulating system or another type of insulation designed to prevent growth of fungus and ingress of moisture.

.3 Windings shall be copper.

.4 Windings shall be random-wound coils; winding insulation shall be of Class F at least, but the temperature rise shall correspond to Class B conditions.

.5 The six (6) terminals of the three (3) phases of the stator windings shall be brought out in the main motor terminal box for testing purposes.

2.8 ROTOR AND SHAFT ASSEMBLIES

.1 Motor shaft shall be machined, carbon steel capable of transmitting torque produced by motor.

.2 The rotor squirrel-cage shall be made copper, copper-alloy bars or shall be fabricated aluminum, or integrally die-cast aluminum.

.3 Rotor shall be epoxy-coated.

.4 Dynamically balance motors by one of following means:

.5 Drilling out parent metal in such a manner that structural strength of rotor is not weakened.

.6 Use balance washers securely pinned in place.

.7 Chiseling, sawing, or use of solder or similar deposit materials to achieve balance is not acceptable.

2.9 BEARING

.1 Construct and provide bearing and bearing housing seals to prevent dirt or moisture from entering motor. The bearings shall be protected by a dust-proof and water-proof enclosure according to IP55 degree of protection or higher.

.2 The bearings with oil lubrication shall be fitted with a sight gauge marked with the proper oil level and shall have fill and drain openings. When oil rings are used, means shall be provided for observing oil ring rotation while the motor is operating. The bearings with grease lubrication shall have grease valves for lubrication while the motor is running.

.3 Where insulated bearings are required as a protection against the occurrence of shaft currents, one or both bearings shall be insulated, in consideration of the motor driven equipment assembly. At motors with one shaft extension, at least the bearing opposed to the driven equipment has to be insulated. At motors with two shaft extensions, both bearings have to be insulated, as well as one of the shaft couplings. Generally, piping and conduit to insulated bearings shall also be insulated.

.4 Anti-friction type bearings shall be grease lubricated and have minimum rated life L10 with a median life no less than 50% of L10 life, as defined by AFBMA. Reliability of each bearing shall be greater than 90%.

.5 Provide interior bearing caps or other suitable means to prevent lubricant from entering motor.

.6 Design bearings so damage does not occur by axial rotor movement during motor startup and shutdown.

.7 Motors provided with roller bearings or angular contact ball bearings shall be fitted with a transport lock to prevent damage to the bearings, due to vibration, during transport.

.8 Shaft and bearings for belt-connected motor shall withstand normal belt pull of equipment furnished and momentary and continuous overloads due to acceleration caused by incorrect belt tension.

.9 Bearings for motors shall be designed to carry 200% of maximum thrust develops during starting and stopping, and while operating at any capacity on rated performance curve.

.10 Motors shall have metallic bearing isolators on each bearing.

.11 Furnish vertical motors coupled to vertical pumps with non-reversing ratchets and bolted couplings with case drip shields.

2.10 LUBRICATION SYSTEM

.1 System shall be capable of operating at least 8,000 hours without requiring addition of grease or complete change of grease.

.2 Provide system with readily accessible grease inlet and outlet plugs in bearing housings to enable regreasing while motor is in service.

2.11 ANTI-CONDENSATION SPACE HEATERS

.1 Provide low surface-temperature, anti-condensation space heaters for motors installed indoors and outdoors for motor size indicated. The heater shall be mounted on inside of otor frame or winding end turns. Anti-condensation space heaters shall be provided in all the motors of the following types:

.2 Indoor motors rated 200kW or 250HP and larger.

.3 Outdoor motors rated 30kW or 40HP and larger

.4 The space heaters shall have sufficient capacity to keep the motor windings and internal parts dry when the motor is not running.

.5 Space heaters shall be rated and designed to operate at the supply source voltage indicated on the design drawings and/or Data Sheet. Space heaters shall be suitable for installation environment.

.6 The space heaters and their connections shall be protected against accidental contact with the personnel, but shall be accessible for service and replaceable in the field.

.7 Flame retardant insulated wires shall be used for the space heater connections.

.8 Sheath temperature at 110% of rated voltage, when operating at ambient temperature, shall not exceed 200°C or cause motor insulation temperature to exceed 130 °C, whichever is more restrictive.

2.12 MOTOR TERMINAL BOXES

.1 Equip each motor with corrosion resistance, cast iron terminal boxes, unless indicated otherwise.

.2 Provide motor with oversized terminal box to accommodate oversize motor power supply cables and to allow ample room for bending radius and stiffness of motor supply cables, and for terminating grounding conductor. For the motors larger than 100 kW, two (2) cable entrances shall be provided.

.3 Motor leads shall have brass or stainless steel ferrules embossed with appropriate lead number, or leads imprint with lead number.

.4 Fit motor terminal box with neoprene gaskets.

.5 Main terminal boxes shall be capable of rotation in 90° increments to permit connection on any one of four sides. The direction of the cable entrance in the terminal boxes, especially for the main terminal box, shall be adjustable in the field and changeable at a later date.

.6 Provide motor lead seal and separator gasket between motor frame and terminal box.

.7 Provide main terminal boxes with threaded conduit entrances or hubs for cable glands. Coordinate size with Department's Representative.

.8 Terminate main lead electrical connections with tinned lugs suitable for cooper and aluminum conductor cables.

.9 The terminal leads of the motor windings, of the heaters and of the monitoring devices shall be connected to terminals in separate terminal boxes (one for each of the lead groups indicated above).

.10 Each terminal box shall have a corresponding mark or an indication of the purpose.

.11 The holes in the terminal boxes for cable entrance shall be hermetically sealed for shipment.

.12 Motor main or accessory leads that pass outside the motor enclosure shall be protected against mechanical damage.

2.13 MONITORING PROVISIONS

.1 Provide the following monitoring provisions for motor rated 200kW or 250HP and larger:

.2 The Stator winding.
- .1 Minimum six (two for each phase) Resistance Temperature Detectors (RTD), uniformly distributed. The RTD's shall be embedded in the stator slots as follows:
- .2 If there are two or more coil-slides per slot, the RTD's shall be located between the insulated coil-sides within the slot.
- .3 If there is one coil-slide per slot, the RTD's shall be located between the wedge and the outside of the winding insulation.
- .4 Minimum three (one for each phase) thermistors.

.3 Bearings.
- .1 One RTD for each bearing. Instead of RTD's, thermocouples may be provided.
- .2 The temperature monitoring devices of the bearings shall be installed as close as possible to the heat generating surfaces and shall be located preferably in the bottom half of the bearing housing.
- .3 The three-lead RTD's shall be of platinum Pt 100 (100 Ohm at 0°C).
- .4 The thermocouples (if used) shall be chromel-constantan (E) type.
- .5 The preferable solution is to provide adequate two-wire transducers (for RTD's, thermocouples, etc.) with output 4-20 mA.
- .6 The transducers shall be mounted into appropriate motor terminal boxes. Electrical connections of the transducers shall be made on terminal blocks conveniently located for external wiring.
- .7 For motors with great vibration, the transducers may be installed in a box mounted outside of the motor.

.4 Provisions shall be made for installation of vibration detector/s (e.g. proximity probe/s) in agreement with the drive equipment manufacturer.

2.14 IDENTIFICATION AND TAGGING

.1 Securely attach embossed or stamped, stainless steel nameplates with stainless steel screws or pins.

.2 Nameplate shall contain standard information in accordance with applicable reference standards.

.3 If identification number cannot be included on motor nameplate, provide separate stainless steel equipment identification nameplate in accordance with equipment identification as indicated.

.4 Motor power and space heater circuits may be derived from different sources. Covers of motor terminal boxes containing space heater leads shall be provided with nameplate reading: "ISOLATE MOTOR AND HEATER CIRCUITS BEFORE REMOVING COVER".

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that existing conditions are acceptable for new electrical equipment installation in accordance with manufacturer's written instructions.

.1 Inform Department's Representative and Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department's Representative.

3.2 INSTALLATION

.1 Install, align, and connect motors in accordance with the equipment manufacturer's instructions.

.2 Mount motors with bolts. Ensure motor feet are coplanar within 0.0254 millimeters, and base mounting points are accessible and adjustable to enable machine alignment. Install alignment jack bolts for motors over 15 hp to enable alignment.

.3 Alignment

.1 Before attempting alignment, demonstrate that the load does not have any load/force imposed by the piping system. Minimum alignment values (below) are for motor and load at normal running temperatures. Ensure values are compensated for thermal growth. Correct limited movement of the motor or load (commonly known as bolt-bound) to ensure alignment capability. Do not undercut hold down bolts in order to perform adjustment.

.2 Provide commercially die-cut shims, without seams or folds, made of corrosion resistant stainless steel.Use no more than four shims at any single point.

.3 Align motor and load to the following minimum specifications:

Speed(RPM)	Close-Coupled Offset	Close-Coupled Angle(mils/in.)	Spool Piece Angle (mils/in. @
600	6.0	2.0	3.0
900	5.0	1.5	2.0
1200	4.0	1.0	1.5
1800	3.0	0.5	1.0
3600	1.5	0.4	0.5

7200	1.0	0.3	0.4

.4 Perform motor and load alignment under the direction of the manufacturer's representative.

.5 Recheck alignment of motors and adjust as required after the motor has been in operation for not less than 48 hours.

.6 Provide written final alignment settings as part of the final test data.

3.3 FIELD QUALITY CONTROL

.1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Ensure moving and working parts are lubricated where required.

.3 Perform inspections and test procedures on all motors in accordance with NETA ATS and NETA MTS 7.15.1 for rotating machinery, AC motors.

.4 Utilize Vibration Analyzer to measure vibration levels.

.5 Use an accelerometer, either stud-mounted or mounted using a rare earth, low mass magnet and sound disk (or finished surface) with the FFT analyzer to collect data. Ensure the mass of the accelerometer and its mounting have minimal influence on the frequency response of the system over the selected measurement range.

.6 Vibration Data

.1 Collect vibration data in the axial, vertical, and horizontal direction for each motor bearing.

.2 Obtain two narrowband spectra for each data collection point in the following manner:

.3 For all machines regardless of operating speed, obtain a 5 to 500 Hz spectrum with a minimum of 400 lines of resolution.

.4 Acquire an additional spectrum of 5 to 2500 or 5 to 5000 Hz for machines operating at or below 1800 RPM or greater than 1800 RPM, respectively.

.7 Ensure vibration limits conform to the following:

Frequency Range(CPM)	Vibration limit(mm/sec)
0.3 x RPM to 0.8 x RPM	1.016
0.8 x RPM to 1.2 x RPM	19.05

1.2 x RPM to 3.5 x RPM	1.016
3.5 x RPM to 120,000cpm	0.762

.8 Provide final test reports to the Department and/or Department's Representative.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.

.1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with motors shall be included in associated cost items for the installation of motorized equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This performance specification provides the minimum requirements to furnish and install a complete master-to-master IP-based digital duplex loud speaking public address system as described and shown on the plans. System shall include, but not be limited to, fully electronic digital Central Exchange with power supply, IP station hubs, terminal blocks, master stations, and remote public address speakers as necessary to provide a complete operating system. Complete programming of system stations and features shall be provided.

.2 The contractor shall furnish and install all equipment, accessories and materials necessary for a complete operating system in accordance with the specifications and applicable drawings.

1.2 RELATED SECTIONS

.1 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.3 REFERENCES

.1 The Public Address System that will be provided for the movable bridge shall comply with the latest revised applicable codes, specifications and standards here below listed:

.2 CSA Group
- .1 CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.
- .2 CAN/CSA-Z462-12, Workplace Electrical Safety.
- .3 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards – Guidelines for Selection and Use.

.3 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.4 Electronic Industry Association (EIA) 232-D: Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

.5 International Society of Automation (ISA):
- .1 ANSI/ISA-50.00.01: Compatibility of Analog Signals for Electronic Industrial Process Instruments

.6 International Electrotechnical Commission (IEC)

.1 IEC 61508 Functional Safety of Electrical/Electronic /Programmable Electronic Safety-related Systems
.2 IEC 61000 series Electro Magnetic Compatibility (EMC)

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 The Contractor shall submit copies of vendor, producer or manufacturer product data. These shall include design and installation shop drawings, catalog cuts, specifications, testing requirements, and installation instructions.

.3 Product and System Data:
- .1 Submit manufacturer's instructions, printed product literature and product data shall include as minimum product characteristics, performance criteria, physical size, weights, arrangements of components, type of material used, type and characteristics of used electrical devices and the minimum space for the erection and maintenance.
- .2 Schematic wiring diagrams
- .3 Package control system architecture
- .4 Bill of material
- .5 Functional description all the equipment included in the package
- .6 Specifications of all control equipment included in the package

.4 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures and maintenance information.

.5 Project Software and application programs (i.e. all the program source files) fully commented provided that the software developed for the application shall be property of the Department who has to receive a copy of all software files prior of the package provisional acceptance

.6 Closeout Submittals Warranty

.7 Sustainable Design Submittals:
- .1 Construction Waste Management:
  - .1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
- .2 Recycled Content:
  - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and

percentages of post-industrial content, and total cost of materials for project.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include data for each type and style of starter, relay and control device.

.3 Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit.

.4 Provide instructions on how to adjustment, trouble-shooting, configuration, modify program settings, and modify the control program.

.5 Include copies of as-built submittals.

1.6 EXTRA STOCK MATERIALS

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include: the following parts:
- .1 One (1) Field Call Station.
- .2 One (1) Loud Speaker.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
- .1 Store materials off ground, indoor, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
- .2 Store and protect motor control centres from damages.
- .3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 QUALITY ASSURANCE

.1 The equipment furnished under this specification shall be a standard product of a single manufacturer. Manufacturer shall have engaged in the design, manufacture and support of public address system for a minimum of ten (10) years. Each major component shall bear the manufacturers name and catalog number.

.2 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.3 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.4 Electrical equipment and materials shall be new and within one year of manufacture date.

.5 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.6 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 – PRODUCTS

2.1 FUNCTIONS

.1 The system is mainly used in industrial plants & facilities for the following inter-plant communication functions:

.1 For communication between Bridge Operator Kiosk & the field personnel and public.

.2 For communication between different field personnel and public working in on and near the bridge.

.3 For PA-GA (public address & general alarm) function. This provides Automatic broadcasting of "stored safety voice messages / alarm tones" over public address system to instruct public to clear the bridge during operation and/or during emergency situations like fire, hazard, gas leak, accidents and other mishaps.

.4 For communication between Public Address system and EPABX / Telephone system

.5 For communication between Mobile telephone users with Public Address System

2.2 EQUIPMENT

.1 The system comprises of MASTER CONTROL STATION (located in the Bridge Operator House), LOUDSPEAKERS installed at various locations at each end of the bridge structure.

.2 The system shall be suitable for use in harsh & hostile environment characterized by: indoor & outdoor usage, presence of dust & water ingress, corrosive atmosphere, varying temperature, loud ambient noise, vibration, people's safety etc.

.3 The communication channels of the system comprise of multiple PAGE CHANNELS (6 channels minimum), with 5 output zones

.4 The loudspeakers shall be provided as indicated on drawings. The loudspeaker shall have the required output power capacity, sound pressure levels for the ambient conditions. The system shall be designed to provide excellent reproduction of sound, clear audible announcements and high intelligibility of speech, even in high noisy areas.

.5 Passive paging microphone for use with mixer-amplifier

2.3 FEATURES AND PERFORMANCE

The public address system shall have the following features and performance:

.1 Amplifier Power: 120 watts minimum
.2 Master and individual channel volume control.
.3 Seven bands graphic equalizer.
.4 Tuner/CD(MP3) module

.5 Paging + Alarm Broadcasting
.6 No requirement of AC Mains supply in the field
.7 Direct & Instant connectivity between the control room operator and the field stations
.8 Zoning capability for public announcements
.9 Facility for broadcasting emergency siren alarm tone over system loudspeakers

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that the existing conditions are acceptable for public address system installation in accordance with manufacturer's written instructions.
  .1 Inform Department’s Representative and Consultant of unacceptable conditions immediately upon discovery.
  .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department’s Representative.

3.2 INSTALLATION

.1 The electrical installation work shall be installed as indicated on the Contract Drawings and in accordance with approved shop drawings and manufacturer’s recommendations.

.2 All associated construction and installation work shall be installed using good installation judgement and in accordance with all prevailing national and local codes and ordinances.

3.3 WARRANTY

.1 Warranty period: refer to Commercial documentation.

.2 Manufacturer shall warrant that equipment is free from defects in labor and materials and shall provide a minimum of two (2) years warranty of its equipment.

.3 The contractor shall guarantee availability of local service by factory-trained personnel from an authorized dealer of the equipment manufacturer. The dealer shall have available a stock of the manufacturer's standard parts. On-the-premise maintenance shall be provided, at no charge to the purchaser, for a period of twelve (12) months from date of completion of installation, unless damage or failure is caused by misuse, abuse or accident.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
  .1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
  .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 MEASUREMENT AND PAYMENT

.1 Lump Sum Amount. No measurement will be made for this item.

.2 Payment at the Contract price for this tender item shall be full compensation for all labor, equipment, supplies and material to do the work, including the cost for the associated work applicable to this tender item per the requirements of the following specification sections:

26 05 00 - Common Work Results for Electrical
26 05 21 - Wires and Cables (0-1000 V)
26 05 26 - Grounding and Bonding for Electrical Systems

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 This performance specification provides the minimum requirements to furnish and install a video surveillance system as described and shown on the plans. System shall include, but not be limited to, ethernet switch with power supply, IP video cameras, master stations, and monitor as necessary to provide a complete operating system. Complete programming of system stations and features shall be provided.

.2 The contractor shall furnish and install all equipment, accessories and materials necessary for a complete operating system in accordance with the specifications and applicable drawings.

1.2 RELATED SECTIONS

.1 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.3 REFERENCES

.1 The Video Surveillance System that will be provided for the movable bridge shall comply with the latest revised applicable codes, specifications and standards here below listed:

.2 CSA Group
.1 CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.
.2 CAN/CSA-Z462-12, Workplace Electrical Safety.
.3 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards – Guidelines for Selection and Use.

.3 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.4 Electronic Industry Association (EIA) 232-D: Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

.5 International Society of Automation (ISA):
.1 ANSI/ISA-50.00.01: Compatibility of Analog Signals for Electronic Industrial Process Instruments

.6 International Electrotechnical Commission (IEC)
.1 IEC 61508 Functional Safety of Electrical / Electronic / Programmable Electronic Safety-related Systems
.2 IEC 61000 series Electro Magnetic Compatibility (EMC)

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 The Contractor shall submit copies of vendor, producer or manufacturer product data. These shall include design and installation shop drawings, catalog cuts, specifications, testing requirements, and installation instructions.

.3 Product and System Data:
.1 Submit manufacturer's instructions, printed product literature and product data shall include as minimum product characteristics, performance criteria, physical size, weights, arrangements of components, type of material used, type and characteristics of used electrical devices and the minimum space for the erection and maintenance.
.2 Schematic wiring diagrams
.3 Package control system architecture
.4 Bill of material
.5 General arrangement drawings showing
.6 Functional description all the equipment included in the package
.7 Specifications of all control equipment included in the package
.8 Control logic diagrams (open and closed control loops, automatic sequences, functional groups, interlocks) covering all the equipment included in the package
.9 Control graphic displays for the HMI

.4 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures and maintenance information.

.5 Project Software and application programs (i.e. all the program source files) fully commented provided that the software developed for the application shall be property of the Department who has to receive a copy of all software files prior of the package provisional acceptance

.6 Closeout Submittals Warranty

.7 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
.2 Recycled Content:
.1 Submit listing of recycled content products used, including details of required percentages or recycled content

materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include data for each type and style of starter, relay and control device.

.3 Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit.

.4 Provide instructions on how to adjustment, trouble-shooting, configuration, modify program settings, and modify the control program.

.5 Include copies of as-built submittals.

1.6 EXTRA STOCK MATERIALS

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground, indoor, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect motor control centres from damages.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.5 QUALITY ASSURANCE

.1 The equipment furnished under this specification shall be a standard product of a single manufacturer. Manufacturer shall have engaged in the design, manufacture and support of public address system for a minimum of ten (10) years. Each major component shall bear the manufacturers name and catalog number.

.2 Regulatory requirements: Perform electrical construction in accordance with industry acceptable practice and complies with applicable country, region and local codes.

.3 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.4 Electrical equipment and materials shall be new and within one year of manufacture date.

.5 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.6 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 - PRODUCTS

2.1 FUNCTIONS

The system is mainly used in facilities for the following video surveillance functions:

.1 For surveillance of on-coming and off-going vehicle and pedestrian traffic as well as coming and going marine traffic to ensure safe operation of the bridge when inside the operator house.

.2 For surveillance of vandalism to the bridge and/or operator house.

2.2 EQUIPMENT

.1 Provide a CCTV system as indicated in the Contract Drawings and as herein specified. The system shall consist of CCTV cameras, a joy stick controller, and a CCTV monitor provided and installed under this contract as indicated on the Contract Drawings.

.2 The system shall be suitable for use in harsh & hostile environment characterized by: indoor & outdoor usage, presence of dust & water ingress, corrosive atmosphere, varying temperature, loud ambient noise, vibration, people's safety etc.

.3 The PTZ dome network camera shall be a full high definition camera of the super dynamic weather resistant type. The camera shall be 1,920 X 1,080 H.264 camera featuring optical 30X zoom. The camera shall provide 1080p images at a rate of up to 30 fps. The camera shall provide super resolution of full high definition/1,920 X 1,080 created by 2.4 megapixel high sensitivity MOS sensor. The high sensitivity shall be provided with both day and night functionality with 0.5 Lx for color and 0.06 Lx for B&W at F1.6. The camera shall be power over Ethernet plus (PoE+).

.4 A Category (CAT)-V cable will be the primary source for carrying signals up to 100 m (300 ft.) from a switch hub or network server. If any camera is installed greater than 100 m (300 ft.) from the controlling device then the following will be required:

.1 A local or remote 12 VDC or 24 VAC power source will be required from a Class 2, UL compliant power supply.

.2 A signal converter will be required to convert from a CAT-V cable over to a fiber optic or standard signal cable. The signal will need to be converted back to a CAT-V cable at the controlling device using a signal converter card.

.5 A CCTV monitor shall be installed in the bridge tender house as indicated on the Contract Drawings. The CCTV monitor shall be an LED monitor, 1920 X 1080. The LED display shall deliver robust color production and with finite detail. The monitor shall be capable of 178 Degree wide angle viewing from either the horizontal or vertical positions. The monitor shall be of the desktop free standing type with high contrast ratio of 800:1 with 2 X BNC inputs/outputs, S-video and RGB for PC input and two built-in speakers.

.6 Network Video Recorder (NVR):

.1 Minimum 12 channel IP camera input

.2 H.265/H.264/MJPEG dual codec decoding

.3 Max 200Mbps incoming bandwidth

.4 Up to 8ch@1080P(4ch@H.265+4ch@H.264) real-time live-view

.5 Up to 12Mp resolution live-view&playback

.6 2HDMI/1 VGA simultaneous video output

.7 8/16 channel synchronous real-time playback, GRID interface

.8 Support Multi-brand network cameras: Dahua, Arecont Vision, AXIS, Bosch, Brickcom, Canon, CP Plus, Honeywell, Panasonic, Pelco, Samsung, Sanyo, Sony, Videotec, Vivotek and etc.

.9 ONVIF Version 2.4 conformance

.10 3D intelligent positioning with Dahua PTZ camera

.11 Support 4 SATA HDDs up to 24TB, 3 USB(2 USB3.0), 1 eSATA port up to 16TB

.12 Support IPC UPnP, 16PoE ports (for -16P model)

.13 Support P2P, QR code scan & add

.14 Multiple network monitoring: Web viewer, CMS(DSS/Smart PSS) & Smart Phone(DMSS)

.7 The Contractor shall submit outline-dimensioned drawings of his proposed CCTV system, mounting details, CCTV camera pole details, block, schematic and wiring diagrams of the CCTV system, monitor and PC interface and specification in the form of catalog cuts and data sheets of proposed system to the Engineer for approval prior to procurement.

PART 3 – EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that the existing conditions are acceptable for video surveillance system installation in accordance with manufacturer's written instructions.

.1 Inform Department’s Representative and Consultant of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department’s Representative.

3.2 INSTALLATION

.1 The electrical installation work shall be installed as indicated on the Contract Drawings and in accordance with approved shop drawings and manufacturer’s recommendations.

.2 All associated construction and installation work shall be installed using good installation judgement and in accordance with all prevailing national and local codes and ordinances.

3.3 WARRANTY

.1 Warranty period: refer to Commercial documentation.

.2 Manufacturer shall warrant that equipment is free from defects in labor and materials and shall provide a minimum of two (2) years warranty of its equipment.

.3 The contractor shall guarantee availability of local service by factory-trained personnel from an authorized dealer of the equipment manufacturer. The dealer shall have available a stock of the manufacturer's standard parts. On-the-premise maintenance shall be provided, at no charge to the purchaser, for a period of twelve (12) months from date of completion of installation, unless damage or failure is caused by misuse, abuse or accident.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.5 MEASUREMENT AND PAYMENT PROCEDURES

.1 Lump Sum Amount. No measurement will be made for this item.

.2 Payment at the Contract price for this tender item shall be full compensation for all labor, equipment, supplies and material to do the work, including the cost for the associated work applicable to this tender item per the requirements of the following specification sections:

26 05 00 - Common Work Results for Electrical
26 05 21 - Wires and Cables (0-1000 V)
26 05 26 - Grounding and Bonding for Electrical Systems

END OF SECTION

PART 1 - GENERAL

1.1 STANDARDS

.1 All new machinery items must meet the requirements of CSA S6-14 Canadian Highway Bridge Design Code, hereinafter referred to as the CHBDC.

.2 Standards referred to in the Contract Documents are published by the following organizations and are directly applicable to the material and workmanship required by this item.
- .1 ASTM - American Society for Testing and Materials.
- .2 ANSI - American National Standards Institute.
- .3 CSA - Canadian Standards Association.
- .4 AWS - American Welding Society.
- .5 SSPC - The Society for Protective Coatings.
- .6 ASME – American Society of Mechanical Engineers.

1.2 ADMINISTRATIVE

.1 Submit to the Departmental Representative submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.

.2 Do not proceed with Work affected by submittal until review is complete.

.3 Present shop drawings, product data, samples.

.4 Where items or information is not produced in SI Metric Units, converted values are acceptable.

.5 Review submittals prior to submission to the Departmental Representative. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.

.6 Notify Departmental Representative, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.

.7 Verify field measurements and affected adjacent Work is coordinated. Contractor's responsibility for errors and omissions in submission is not relieved by the Departmental Representative's review of submittals.

.8 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by the Departmental Representative's review of submittals.

.9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by the Departmental Representative's review.

.10 Keep one reviewed copy of each submission on site.

.11 Items specified by manufacturer name or part number on the Contract Drawings may be replaced by an equivalent item by another manufacturer, subject to approval by the Departmental Representative, with the understanding that all changes required by the substitution are made at no additional cost. Item equivalency shall be determined at the sole discretion of the Departmental Representative and may be based on one or more of the following: quality, function, ease of maintenance, physical size, reliability, value, load capacity (static and dynamic), durability, availability and other criteria as deemed appropriate by the Departmental Representative.

1.3 DIMENSIONS/CERTIFIED DRAWINGS

.1 Dimensions indicated on the Contract Drawings are nominal and intended for information. Many of the dimensions indicated on the Contract Drawings have been obtained from existing drawings or from information provided by various machinery manufacturers. The dimensions have not been field verified or obtained from certified drawings from the various manufacturers. All dimensions indicated on the Contract Drawings must be verified in the field or from certified drawings from the various machinery manufacturers by the Contractor. Notify the Departmental Representative of any dimensional deviations found during the verification. Make all required field measurements and obtain certified dimensions for all manufactured products necessary before proceeding with shop drawings, fabrication, and installation. The Contractor is solely responsible for converting dimensions from Metric to Imperial Units, or vice versa, as required.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Shop drawings, erection drawings, machinery installation procedures, final record drawings, and other required submittals specified herein, shall be submitted in accordance with the requirements of the Contract. Submit complete drawing packages for all mechanical machinery system submittals as follows. Any submittals that do not contain all documents required for the manufacture, assembly and erection of the machinery system will be returned without review.

.1 Center Pivot Bearing Assembly.
.2 Live Load Roller Assemblies.
.3 Span Drive System.
.4 End Lift System.
.5 Balance Wheel and Track Assemblies.
.6 End Castor Assemblies.
.7 Locking Pin Assembly.
.8 End Stop Assemblies.
.9 Hydraulic Control System.
.10 Hydraulic Power Unit.
.11 Hydraulic Cylinder Assemblies.
.12 Hydraulic Schematic.

1.5 SHOP DRAWINGS AND PRODUCT DATA

.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.

.2 Shop drawings for work of this section do not require an engineer seal, but full dimensions and details for all components must be provided. Dimensions shall be based on field measurements where required.

.3 Draw all shop drawings to scale and provide the scale on the drawings. Ensure that details of a given part are clearly visible at the scale selected for that part with the exception that enlarged views of small details within a part may be used to improve clarity and prevent excessively large drawings.

.4 Indicate materials, methods of construction and attachment or anchorage, connections, schedules for fabrication, shop assembly procedures, diagrams showing sequence and details for erection, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.

.5 Identify conflicts between manufacturers' instructions and Contract Documents and submit resolution for review and approval.

.6 Identify variations between Contract Documents and product or system limitations that may be detrimental to the successful performance of the completed work.

.7 Submit copies of producer or manufacturer data. This includes specifications, tests and installation instructions for the following items, but not excluding other items or materials not specifically mentioned.
- .1 Mill reports and physical tests of all metals.
- .2 Bolts, nuts, screws, washers, cotter pins and other fasteners.
- .3 Paint and other coatings.
- .4 Lubricants.
- .5 Standard manufactured items.

.8 Allow thirty (30) days for the Departmental Representative's review of each submission.

.9 Adjustments made on shop drawings by Departmental Representative are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to the Departmental Representative prior to proceeding with Work.

.10 Make changes in shop drawings as Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify Departmental Representative in writing of revisions other than those requested.

.11 Accompany submissions with transmittal letter containing:
- .1 Date.

.2 Project title and number.
.3 Contractor's name and address.
.4 Identification and quantity of each shop drawing, product data and sample.
.5 A sequential number (Number resubmittals with the original submittal number and an alphabetic suffix).
.6 Other pertinent data.

.12 Submissions shall include:
.1 Date and revision dates.
.2 Project title and number.
.3 Name and address of:
.1 Subcontractor
.2 Supplier
.3 Manufacturer

.13 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.

.14 A complete shop bill of materials for all machinery parts.

.15 Details of appropriate portions of Work as applicable:
.1 Fabrication.
.2 Assembly views, section views and individual part views.
.3 Layout, showing dimensions, including identified field dimensions and clearances
.4 Setting or erection details.
.5 Capacities.
.6 Performance characteristics.
.7 Standards.
.8 Operating weight.
.9 Wiring diagrams.
.10 Single line and schematic diagrams.
.11 Relationship to adjacent work.
.12 Instructions for painting the machinery.
.13 All appropriate weld symbols along with stress relieving process for weldments.
.14 The surface finish of machined surfaces and tolerances for each dimension for which a specific fit is required. Fit and finish per CHBDC Section 13.8.20.2.
.15 Dimension and provide tolerances for all parts to ensure that components of a common purpose that are fabricated from the same detail are interchangeable.
.16 Tolerances for all drawing dimensions, either directly or via a standard title block, as necessary to obtain proper fit and function of assembled components.
.17 The required tension, method of tightening and all other pertinent information for all machinery connection bolts.
.18 Proprietary parts shown in outline on the drawings with sufficient dimensions and data to determine the clearances required for installation and operation.
.19 Certified dimension prints from equipment manufacturers stating

pertinent ratings of the equipment, and indicating, when applicable, provisions for adding, draining, and checking the lubricant, method of lubrication, amount and type of lubricant required. The type of fittings, the location of inspection openings and the location and type of venting devices.

.20 Complete assembly and erection drawings shall be furnished. These drawings shall be given identifying marks and essential dimensions for locating each part or assembled unit with respect to the bridge or equipment foundation. Every part shall be cross referenced to the sheet on which it is detailed. Contract Drawings shall not be submitted as a substitute for assembly or erection drawings.

.16 Indicate on the shop drawings, for review by the Departmental Representative, the type of tightening, type of wrench and the value of torque or other pertinent information of all connection bolts for all items and machinery.

.17 After the Departmental Representative's review, distribute copies.

.18 Submit electronic copies of product data sheets or brochures for requirements requested in the specifications where shop drawings will not be prepared due to standardized manufacture of product.

.19 Submit electronic copies of test reports for requirements requested in the specifications and as requested by the Departmental Representative.

.20 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.

.1 Testing must have been within three (3) years of date of contract award for project.

.21 Submit electronic copies of certificates for requirements requested in the specifications and as requested by the Departmental Representative.

.1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.

.2 Certificates must be dated after award of project contract complete with project name.

.22 Submit electronic copies of manufacturer's instructions for requirements requested in specification Sections and as requested by the Departmental Representative.

.1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.

.23 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by the Departmental Representative.

.1 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's

standards or instructions.

.24 Submit electronic copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by the Departmental Representative.
.1 Delete information not applicable to project.
.2 Supplement standard information to provide details applicable to project.

.25 If upon review by the Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, approved electronic documents will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.6 MACHINERY INSTALLATION PROCEDURE

.1 Prepare a detailed written installation procedure for the installation of all mechanical machinery. Include sequence of installation, alignment methods, bolt tightening methods and required tension values for all bolts. Include resumes for all supervising engineers and millwrights associated with machinery installation and alignment with the written installation procedure.

.2 Demonstrate to the Departmental Representative that the Contractor has full knowledge of machinery connections and alignment procedures and that the work will be performed by qualified millwrights.

.3 Begin installation of the machinery after the procedures and resumes have been submitted by the Contractor and they are satisfactory in the sole opinion of the Departmental Representative. Correct and resubmit the procedure and/or submit resumes for alternate personnel as necessary to the satisfaction of the Departmental Representative. This resubmission procedure, if required, is not cause for delay.

.4 Ship machinery items to the job site after the Contractor has submitted a satisfactory installation procedure.

1.7 FINAL RECORD (AS-BUILT) DRAWINGS

.1 Submit reproducible hard copies of drawings of all materials as fabricated following fabrication. Clearly indicate any deviations from the approved shop drawings. Make reproducible drawings using the Department's standard title block. Stamp these drawings "As Built", immediately above the title block. Also provide an electronic copy in portable document format (PDF).

1.8 MAINTENANCE AND LUBRICATION

.1 Contents of Manual:
.1 Table of contents, in the following order.
.2 Manufacturer's literature describing each piece of equipment and

giving manufacturer's model number and drawing number.

.3 Schematics that show all components of the machinery that require lubrication. Include also on the charts, the type and frequency of lubrication.

.4 Copies of all warranties on equipment supplied to the project. For each item of work defined in this specification, provided with a warranty.

.5 Copies of all approved machinery installation procedures.

.6 Copies of all assembly, erection and shop drawings. These drawings to include "as built" information in the final version of the manual.

.7 Steps for cursory inspection that should be carried out annually.

.8 Steps for semi-in-depth inspection that should be carried out every (three) 3 years.

.9 Steps for in-depth inspection that should be carried out every six (6) years.

.10 List of nearest local suppliers of all equipment parts.

.11 List of parts and supplies that are to be furnished as part of the Contract.

.12 Name, address, and telephone number of the local manufacturer's representative and of the service company for each piece of equipment so that pieces or spare parts can easily be obtained.

.2 Submit six (6) preliminary copies of the manual prior to shipment of machinery to the site. Complete the preliminary manual in all respects with regard to material content, organization and legibility for review by the Departmental Representative. Preliminary copies need not comply with presentation requirements including size, paper weight, paper reinforcement and protection including oil, moisture and wear resistant covers, and copy method.

.3 Preliminary copies will be reviewed, and the changes made will be incorporated into the final manual. Submit six (6) final copies of the manual after the machinery is in operation. Incorporate into the final manual the Departmental Representative's comments on the preliminary manual and all field changes made during construction and installation. Ensure permanence of the manuals by complying with all presentation requirements.

.4 Provide an electronic copy of the final manual in portable document format (PDF).

.5 Furnish manufacturer's operating and maintenance manuals giving complete instructions relative to assembly, installation, operation, adjustment, lubrication, maintenance, and carrying complete parts lists for every item of equipment furnished by Contractor.

.6 Manuals may be manufacturer's standard publications provided that they comply with specified requirements relative to quantity and quality of information and data.

.7 Neatly imprint the covers and title page with a descriptive title and that contain the name of the bridge, owner, and location. Include on the title page the names of the Departmental Representative, the Contractor, and the date of issue. Separate the various sections which comprise the manual with divider pages. All parts information must be correct for the equipment

provided under this Contract. Modify standard parts drawings to be suitable and block out irrelevant material. Modify all general information used as necessary to show pertinence to the equipment furnished under this Contract and remove irrelevant material. Submit the arrangement of the manual, method of binding, including material and text to the Department Representative for approval.

.8 Illustrations must be clear. Printed matter, including dimensions and lettering on drawings, must be easily legible. If reduced drawings are incorporated into the manuals, darken the original lines and letters if necessary to retain their legibility after reduction. Larger drawings may fold into manuals to page size. Reproduce diagrams and prints used in the manual to a size less than 280 mm by 432 mm. Include diagrams on white paper and vacuum seal in transparent plastic material impervious to moisture and oil, and resistant to abrasion. Other formats which are equal in clarity, sharpness, durability and permanence will be considered.

.9 Prepare the manuals from the following materials:
- .1 Tear, water, and grease resistant paper.
- .2 Page size, 216 mm by 279 mm.
- .3 Fold out diagrams and illustrations.
- .4 Reproducible by dry copy xerography method.
- .5 Oil, moisture and wear resistant hard or flexible plastic covers.

.10 Provide the Departmental Representative with a lubrication plan for approval. Develop with the plan from recommendations made by the machinery manufacturers and in accordance with the requirements of section 2.4, Lubrication.

.11 Furnish a minimum of one (1) lubrication chart which shows all points requiring lubrication with type of lubricant to be used at each point and the frequency and the method of lubrication. Produce the lubrication chart on a 559 mm by 864 mm sheet. Submit the chart to the Departmental Representative for approval and mount the approved chart in a watertight frame. Mount the lubrication chart in the Parks Building near the hydraulic power unit or as directed by the Department Representative.

1.9 DELIVERY STORAGE AND HANDLING

.1 Immediately upon signing Contract, review product delivery requirements and anticipate foreseeable supply delays for items. If delays in supply of products are foreseeable, notify the Departmental Representative of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

.2 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.

.3 Coat finished metal surfaces and unpainted metal surfaces that would be damaged by corrosion, as soon as practical after finishing with a corrosion inhibitor. Remove this coating from all surfaces prior to lubrication for operation and from all surfaces prior to painting after erection.

4 Mount assembled units on skids or otherwise crate for protection from weather, dirt and all other injurious conditions during shipment and storage as approved by the machinery manufacturer. Submit in advance information as to methods and materials which will be used for protection for approval by the Departmental Representative.

.5 Store machinery items as to permit easy access for inspection and identification. No outdoor storage of machinery components is permitted regardless of the methods of protection provided.

.6 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.

.7 Store products subject to damage from weather in weatherproof enclosures.

.8 Store cementitious products clear of earth or concrete floors, and away from walls.

.9 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.

.10 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.

.11 Correct damage that occurs to the machinery components as a result of improper protection during shipment or storage by the Contractor to the satisfaction of the Departmental Representative at no additional cost.

.12 Touch-up damaged factory finished surfaces to the Departmental Representative's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

PART 2 - PRODUCTS

2.1 GENERAL MATERIALS AND WORKMANSHIP

.1 All materials shall be new and conform to ASTM standards and other standards listed in these Specifications and on the Contract Drawings, unless noted otherwise.

.2 Supply materials from manufacturers who have manufactured similar materials for similar applications for a period of not less than ten (10) years.

.3 Brinell or Rockwell hardness tests shall be made, and results included on inspection reports for all materials for which hardness values are required on the Contract Drawings, in the material specifications, or specified herein.

.4 Do not fabricate, machine, weld, cast or forge items without sufficient

advance notification to the Departmental Representative to permit scheduling of required inspection. Furnish all facilities and provide for free access at the plant or shop for the inspection of materials and workmanship, and to witness shop tests. The inspector has the authority to recommend to the Departmental Representative rejection of material or workmanship that does not meet the requirements of the Contract Documents. The Departmental Representative shall make the final decision for rejection.

.5 Furnish the Departmental Representative with the number of unpriced copies of purchase orders as may be required for scheduling tests as outlined in these Specifications.

.6 Unless otherwise provided, furnish without charge, test specimens required herein, and all labor, testing machines, tools and equipment necessary to prepare the specimens and to make the physical tests and chemical analyses. Submit copies of test reports and various tests to the Departmental Representative.

2.2 FASTENERS

.1 Bolts smaller than 1 1/2 in. (38 mm): Finished high-strength bolts shall meet the requirements od ASTM A449 unless otherwise specified on the Contract Drawings. High-strength bolts shall have finished bodies and regular hexagonal heads. Holes for high strength bolts shall be not more than 0.25 mm (0.01 in) larger than the actual diameter of the individual bolts, and shall be drilled to match the tolerances for each bolt. The clearance shall be checked with 0.28 mm (0.011 in) wire. The hole shall be considered too large if the wire can be inserted into the hole together with the bolt.

.2 Anchor bolts: in accordance with Section 05 50 00.

.3 Bolts greater than 1 1/2 in. (38 mm): high strength finished body bolts made from material equal to ASTM A449-07b.

.4 All bolts: conform to the United Thread Standards, coarse thread series, for threads on bolts, nuts, and cap screws with a Class 2A tolerance for bolts and Class 2B tolerance for nuts, in accordance with ANSI/ASME N1.1-2003, unless otherwise specified. Bolt head and nut bearing surface must be flat and square with the axis of the bolts hole. Spot face as necessary to produce no less than 80% contact between mating surfaces.

.5 Turned bolts are called out by nominal thread diameter on the Contract Drawings. The bodies of turned bolts shall be 63 micro-inch (1.6 micro-meter) finish or finer, and as defined by CHBDC 13.8.17.8, unless noted otherwise on the Contract Drawings. Turned bolt body diameters shall be 1/16 inch (1.6 mm) larger than thread diameter. Turned bolt heads shall be standard hex for bolts of the next nominal size larger than the thread diameter or heavy hex for nominal thread diameter, unless noted otherwise on the Contract Drawings. Unless otherwise noted, bolt holes in machinery parts required for connecting to supporting steel may be sub-drilled (in the shop) smaller than the turned bolt diameter and shall be reamed together with supporting structural steel either during assembly or at erection to provide an LC6 fit, after the parts are correctly assembled and aligned.

.6 Hex socket head cap screws: ASTM A574-08.

.7 Hex socket flat countersunk head cap screws: ASTM F835-04.

.8 Stainless steel hex cap screws ASTM F593-02 (2008)

.9 Hex cap screws ASTM A449-07b

.10 Lock Washers: ASME B18.21.1-2009

.11 Brass hex socket flat countersunk head cap screws: ASTM F468-06

.12 Furnish positive type lock nuts and hardened washers for all bolts and for all flat countersunk head cap screws used as bolts. Double heavy hex nuts conforming to ASTM A563-07a are required unless indicated otherwise on the Contract Drawings. Submit alternate locking methods to the Departmental Representative for approval. All hardened steel washers: in accordance with ASTM F436-09.

.13 Tighten fasteners to provide a tension of 70% of the bolt's ultimate tensile strength unless otherwise specified on the drawings. Provide the method of tightening and of verifying the tension in all bolts on the Shop Drawings for approval by the Departmental Representative.

2.3 FORGINGS

.1 Forgings: reduced to size from a single bloom or ingot until perfect homogeneity is obtained. Blooms and ingots: have a cross sectional area equal to at least three times the required size. Forging: done at no less than red heat. Rounds for shafts and bars: true, straight and free from all injurious flaws such as piping, laps, seams or cracks. Forgings shall be subjected to ultrasonic examination in accordance with ASTM A388. Any indications using the straight beam method that cannot be readily explained by the geometry of the piece shall be cause for rejection. Any forgings that are rejected shall be replaced at no cost to the Department.

2.4 LUBRICATION

.1 The size of grease lubricating fittings shall be standardized and shall be of the giant button head type, unless indicated otherwise on the Contract Drawings or unless the location of the fitting requires the use of a fitting that is smaller than the giant button head fitting. Under no circumstance shall the use of more than 2 different types of grease fittings be permitted. The minimum rated pressure of the fittings is 68.9 MPa (10,000 psi).

.2 Provide fittings with a steel check valve that will receive grease and close against backpressure.

.3 Locate fittings in a protected and conveniently accessible position for use. Connect the fittings to the points requiring lubrication by pipe extensions where necessary. All fittings and pipe material: stainless steel meeting ASTM A312/A312M-09 Type 316. Indicate piping necessary to provide access for lubrication on the shop drawings and list pipe components in

the bill of materials.

.4 Furnish the Departmental Representative with copies of letters from the machinery manufacturers endorsing the lubricants that have been selected. Select lubricants for year-round exposure at the bridge. All lubricants selected shall be compatible with lubricants currently in use by the Department. Submit written documentation indicating compatibility for any lubricant which is not in current use by the Department.

.5 Furnish grease for installation and testing of the machinery. Furnish an additional supply for future maintenance use to include a one (1) year supply of lubricant. For the center bearing lubricant, provide two (2) times the volume used to fill the bearing. Provide the lubricant in the original manufacturer's sealed container to prevent contamination.

.6 Protect all lubricants used during construction from contamination.

2.5 PAINT

.1 All machinery components shall be painted in the shop.
Paint and touch-up of field damaged paint for all non-machined surfaces shall be in accordance with Section 09 97 19.

.2 Use an epoxy mastic high build, aluminum filled primer for all machined surfaces that require paint but cannot be blast cleaned. Provide surface preparation in accordance with paint manufacturer's requirements. Provide intermediate and top coat of paint in accordance with paint requirements noted in Section 09 97 19.

.3 Exercise caution to prevent cleaning and painting materials from entering machinery components and coming into contact with sliding surfaces which would be damaged by such intrusion. Exercise extreme care to protect all lubricated and faying surfaces. Do not paint lubricated, sliding and faying surfaces.

.4 The colour for the final coat of all parts to match existing blue as described in Section 09 97 19.

.5 Include all painting instructions on the Shop Drawings.

2.6 GALVANIZING

.1 Galvanized required components per ASTM A123/A123M, Coating Grade 65.

.2 Protect areas where the galvanized coating is removed during the machining process with a galvanized coating per ASTM A780/780M-09.

.3 Prepare and paint all galvanized surfaces which are to be painted in accordance with ASTM D6386-99 (2005).

2.7 SHAFTING AND PINS

.1 Provide rolled shafts and pins that meet the requirements of ASTM

A675M-03(009) Grade 75 unless indicated otherwise on the Contract Drawings.

.2 Finish shafts and pins accurately, round, smooth and straight. Straightness: 0.15 mm per meter for shafts up to and including 38 mm in diameter and 0.25 mm per meter for shafts over 38 mm in diameter.

.3 Forged shafts and pins: meet the requirements of Forgings. Provide a 60-degree lathe center with clearance hole at the exact center of the shaft for finished ends of forged shafts.

.4 Prepare the ends of forged shafts with bored holes for a device equivalent to the lathe center.

.5 For stepped shafts, finish fillets smoothly to adjacent surfaces without tool marks or scratches. The maximum surface finish roughness for fillets is 0.8 micro-meter in accordance with ANSI B46.1-2002 unless indicated otherwise on the Contract Drawings.

2.8 JOURNAL BEARINGS AND BUSHINGS

.1 Produce bronze bushings of the materials indicated on the Contract Drawings.

.2 Provide bronze bushings in journal bearings with grease grooves as indicated on the Contract Drawings. Blend the edges of the grease grooves smoothly into the bearing surface. The entry hole from the grease fitting must intersect and lie completely within the grooves. Machine cut the grease grooves. Hand cutting of grease grooves is not acceptable.

2.9 SHIMS

.1 Produce shims required for levelling and alignment of machinery and equipment from stainless steel ASTM A240/A240M Type 304. Nominal shim pack shall be 12mm thick unless otherwise noted on Contract Drawings.

.2 Neatly trim the shims to the dimensions of the assembled part base and drill for all bolts that pass through the shims.

.3 Furnish sufficient shims to provide for a total thickness of not less than two (2) times the dimensions given as "nominal shims", with one (1) shim equal to the nominal thickness.

.4 Provide shims to allow adjustments of 0.075 mm for machinery parts unless otherwise noted on the Contract Drawings.

.5 Make every effort to use full-size shims and achieve full contact between the shims and mating components to achieve the specified alignment requirements. In some cases, the use of partial or custom-machined tapered shims may be required to achieve the alignment requirements. Partial shims shall only be used when the gaps produced between mating parts by the use of partial shims is less than 0.4 mm.

.6 At least 1 bolt must pass through any partial shim that is used. Shims shall be shown and fully dimensioned as details on the shop drawings. Shims with

open side or U-shaped holes for bolts will not be permitted. Bolt holes shall not be punched at machine shop to prevent distortion of the shims.

.7 In cases where partials shims would produce a gap greater than or equal to 0.4 mm, use a custom-machined tapered shim. The cost of any partial or custom shims (including materials, manufacturing, engineering, shipping, field measurements, etc.) is considered incidental to the work and no additional compensation will be made for providing partial or custom shims.

.8 Assemble shims not installed after final alignment and tag with the part number from the approved shop drawings, then deliver to a location determined by the Departmental Representative for future use.

2.10 NON-SHRINK EPOXY GROUT

.1 Provide non-shrink epoxy grout for use under machinery supports.

.2 Minimum compressive strength: 103.4 MPa (15,000 psi) per ASTM C579-01(2006)

.3 Linear shrinkage: less than 0.0001 mm./mm.

.4 Store and use grout in strict accordance with the manufacturer's recommendations.

2.11 WELDING

.1 Perform welding required for the work and weld inspection in accordance with the requirements of the Structural Welding Code as stated in ANSI/AWS D1.1M/D1.1-2008.

.2 Treat all machinery and weldments that support machinery as main members, all welds as joining primary components, unless otherwise specified in the Contract Documents.

.3 Do not perform field welding on these components unless specified in the Contract Documents.

.4 Open ended welds are not acceptable under any circumstances.

.5 Stress relieve welded machinery parts or supports by heat prior to final machining.

.6 Include welding and stress relieving procedures with the shop drawings for parts that require welding.

2.12 PIVOT BEARING

.1 A new pivot base weldment or casting shall be provided as indicated on the Contract Drawings.

.2 A new split pivot ring shall be provided to complement the new pivot base weldment or casting and new pivot bearing components as indicated on the Contract Drawings.

.3 A new bottom disc shall be provided. The bottom disc shall be made from stainless steel according to ASTM A564/A564M, Type 630, Condition A, with nominal hardness of 311 BHN. The bottom disc shall be provided with keys to center the disc relative to the pivot base casting and prevent movement at this interface.

.4 A new top disc, self-lubricating bearing, with supplemental radial grease grooves fed from a central lubrication hole. The top disc shall be made from alpha nickel aluminum bronze according to ASTM B148 C95800, with a nominal hardness of 159 BHN. The top disc shall be provided with keys to center the disc relative to the pivot top and prevent movement at this interface.

.5 A new pivot top shall be provided as indicated on the Contract Drawings. Provide tapped holes and custom machined stainless steel threaded rod with different thread diameters at each end to connect the string potentiometer to the pivot top.

.6 A new split debris shield shall be provided with stainless steel hardware for connection to the pivot top. The debris shield shall be made from stainless steel according to ASTM A240/A240M, Type 304 and detailed to prevent debris and runoff from entering the new pivot bearing cavity.

.7 The pivot bearing shall be assembled, checked for fits and painted in the shop. Protect the machined surfaces during cleaning and painting operations.

2.13 LIVE LOAD AND END CASTOR BEARING ASSEMBLIES

.1 The live load bearing assemblies (2) and end castor bearing assemblies (2) shall be replaced with new assemblies according to the Contract Drawings.

.2 Each bearing bushing shall be cast bronze, ASTM B22/B22M C91100.

.3 Each bearing shall utilize a forged alloy steel pin with a lubrication passage drilled through the center. Grease lubrication shall be utilized for corrosion protection and the purging of bearing contaminants.

.4 Each bearing shall be assembled, checked for fits and painted in the shop. Protect the machined surfaces during cleaning and painting operations.

2.14 SPAN DRIVE HYDRAULIC SYSTEM

.1 The span drive hydraulic system shall be replaced with a new assembly according to the Contract Drawings.

.2 Mill duty hydraulic cylinders (2) shall be provided with dimensions as shown on the Contract Drawings Each cylinder shall be cardanic ring mounted to a base as shown in the Contract Drawings. The bushings in the cardanic ring and rod end shall be self-lubricating using the materials specified on the contract drawings.

2.15 END LIFT SYSTEM

.1 The end lift systems (2) shall be replaced with new assemblies according to the Contract Drawings.

.2 Each end lift system shall be provided with two sets of bronze bushings. The bushings shall be made from Cast Bronze according to ASTM B22/B22M C91100 with a nominal hardness of 135 BHN.

.3 Each end lift shall utilize a forged alloy steel shaft ASTM A668/A668M Class K with lubrication passages (3) drilled axially and radially as shown in the Contract Drawings to provide grease between the half bushings. Grease lubrication shall be utilized for corrosion protection and the purging of bearing contaminants.

.4 The end lift systems shall be assembled, checked for fits and painted in the shop. Protect the machined surfaces during cleaning and painting operations. Shaft ends shall be painted except for the areas in contact with sliding bushings and parts in fixed contact.

.5 Mill duty hydraulic cylinders (2) shall be provided with dimensions as shown in the Contract Drawings. Each cylinder shall be clevis bracket mounted to a base as shown in the Contract Drawings. Each cylinder shall be provided with a Type 316 stainless steel cover(s). 1.5 mm thick. The cover shall cover and protect the clevis at the blind end and the rod end with the cylinder retracted from vertically falling and/or splashing or ricocheting precipitation and debris. A debris deflector shall be provided over the abutment side of the roller to prevent debris from collecting on the roller where it meets the rest. This cover shall not interfere with the movement of the wheel and shall not be any higher that the retracted wheel.

2.16 BALANCE WHEEL ASSEMBLIES

.1 Each of the existing balance wheel assemblies (8) shall be replaced according to the Contract Drawings.

.2 Each assembly shall be provided with cylindrical bronze bushings. The bushings shall be made from Cast Bronze according to. ASTM B22/B22M C91100. The shaft shall be ASTM A276/A276M TYPE 431 CONDITION A.

.3 Each assembly shall utilize a forged alloy steel pin with a lubrication passage drilled axially and radially as shown in the Contract Drawings. Grease lubrication shall be utilized for corrosion protection and the purging of bearing contaminants. Grease fitting shall be located at the outboard side of the pin during installation.

.4 Each assembly shall be assembled, checked for fits and painted in the shop. Protect the machined surfaces during cleaning and painting operations.

.5 The new balance wheel track assembly shall be constructed of three (3) standard 80 lb. ASCE rail sections, adequately supported by non-shrink grout and anchored steel plates secured by means of rail clips as shown on the Contract Drawings.

.6 The track assembly shall be positioned with a concentricity and elevation tolerance as defined on the Contract Drawings.

.7 The new track anchors shall be positioned to avoid interference with existing anchor locations. The Contractor shall coordinate the pivot pier rehabilitation work such that installation of the new anchor bolts are imbedded into solid concrete, and to the depth required for the minimum tension value.

2.17 LOCKING PIN SYSTEM

.1 The locking pin system shall be replaced with a new assembly according to the Contract Drawings. The locking pin system shall be provided with cast bronze guide bushings, fabricated from ASTM B22/B22M C91100.

.2 The locking pin system shall utilize a forged alloy steel bar. Grease lubrication shall be applied by grease fittings in the bushings and by brush to the portions of the steel bar that are retracted from the guides when in the withdrawn position.

.3 The locking pin system shall be assembled, checked for fits and painted in the shop. Protect the machined surfaces during cleaning and painting operations.

.4 A tie rod type hydraulic cylinder shall be provided with an 63 mm bore, rod diameter of 45 mm, and total stroke of 75 mm to retract and extend the locking pin.

2.18 BUMPER ASSEMBLY

.1 Elastomeric bumpers shall be made from an elastomer that is UV stabilized, oil resistant and suitable for outdoor installation in a marine environment.

.2 The bumpers shall have a rated energy capacity of 3200 N-m (2360 lbf-ft) with a peak dynamic force of 110 kN (24,730 lbf).

2.19 HYDRAULIC CONTROL SYSTEM

.1 A hydraulic control system shall be provided according to the Contract Drawings.

.2 Hydraulic circuitry shall provide power for the span drive cylinders, locking pin cylinders, and end lift cylinders.

.3 The hydraulic power unit (HPU) shall be powered by two 30 HP motors at 1800 RPM.

2.20 SPARE PARTS

.1 (3) Bumper assemblies for the end stops.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of conditions: Prior to fabricating new machinery components, the Contractor is responsible for shop drawing coordination between the new superstructure, the refurbished pier work and the new machinery components. The Contractor is responsible to ensure the shop drawing accuracy is sufficient to eliminate errors in fit.

3.2 CONSTRUCTION DETAILS

.1 Supply all apparatus, tools, devices, materials and labour to manufacturer, ship, install, erect, align, adjust, lubricate, test, and paint, to complete machinery as provided in the Contract Documents. Furnish any apparatus, tools, devices, materials and labour incidental to the work, but not specifically stated or included at no additional cost.

3.3 COMPONENTS TO BE REMOVED

.1 Remove these components in accordance with Section 02 42 92 of these specifications.

.2 The existing components to be removed and turned over to Parks Canada or the Departmental Representative are listed in Section 02 42 92.
- .1 Existing Balance Wheels
- .2 Existing End Castors
- .3 Existing Split Pivot Ring
- .4 Existing Drive Cylinders
- .5 Existing HPU

3.4 QUALITY

.1 Products, materials, equipment and articles incorporated in Work shall be new (unless specified otherwise in the Contract Documents), not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.

.2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at Contractor’s expense and be responsible for delays and expenses caused by rejection.

.3 Should disputes arise as to quality or fitness of products, decision rests strictly with the Departmental Representative based upon requirements of Contract Documents.

.4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout.

3.5 INSPECTION

.1 The Departmental Representative reserves the right to inspect all machinery at the factory prior to shipping. Provide the Department Representative with full access to the manufacturer's fabrication facility for such inspections.

.2 Inspections are based on the requirements of the Specifications and Contract Drawings, referenced codes or standards, and the Contractor's approved submittal documents. The Departmental Representative has the authority to stop fabrication or shipment of any material, component, or assembly that does not comply with specified requirements. Replace or repair to the satisfaction of the Departmental Representative any such rejected item. All such replacements or repairs are made at the Contractor's expense.

.3 The Department Representatives will make inspections of equipment and machinery throughout the construction period. Correct defects, deficiencies, or deviations from the Contract Drawings or Specifications discovered during such inspections at no additional cost. Shop approval of machinery does not relieve the Contractor from making such repairs as directed by the Departmental Representative.

3.6 REJECTED WORK

.1 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by the Departmental Representative as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.

3.7 MANUFACTURERS INSTRUCTIONS

.1 Unless otherwise indicated in specifications install or erect products in accordance with manufacturer's instructions.

.2 Notify the Departmental Representative in writing, of conflicts between specifications and manufacturer's instructions, so that the Departmental Representative will establish course of action.

.3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes the Departmental Representative to require removal and reinstallation at no increase in Contract Price or Contract Time.

3.8 MACHINERY INSTALLATION

.1 Commence demolition of existing components after the navigation closure begins, and after all required components have been manufactured and approved for installation, preparations by others where required have been satisfactorily completed and machinery installation procedure has been approved.

.2 The installation and adjustment of all machinery (all of the products listed in this Section of the specification) shall be lead by the same Professional

Engineer identified to complete the work of Section 24 05 00, paragraph 1.3.2.

3.9 SEQUENCE OF WORK

.1 As part of the installation procedure, provide a complete sequence of installation for review by the Departmental Representative.

.2 Prior to setting the final end lift elevations to produce the required dead load reaction and roadway transition it is necessary to complete the balancing work and set the elevations of the end castors. Achieving the required dead load reactions and roadway transitions may require adjustment of the swing span elevation at the pivot bearing assembly. This will require jacking the swing span to add or remove shims between the new pivot top and pivot girder.

.3 Prior to final adjustment of the balance wheel clearances, set the final end lift elevations.

3.10 ALIGNMENT

.1 General

.1 All standard manufactured components shall be aligned to the tolerances specified by the manufacturer of that component unless otherwise noted on the Contact Drawings or the Specifications. Submit the manufacturers recommended alignment tolerances for a new installation as part of the installation procedure.

.2 Pivot Bearing

.1 The center point of the pivot bearing shall be measured and located by the contractor prior to removal. The Contractor shall provide accurate and redundant reference monuments in the pier top to re-establish the pivot location after the center pier rehabilitation is complete.

.2 The elevation of the pivot bearing base shall be adjusted using shims or levelling nuts prior to installation of the grout material beneath the base. The Contractor shall submit elevation values based on the swing span camber, deflection, the approach elevations that are to be achieved. This is the basis for establishing the elevation of all remaining machinery components.

.3 Live Load Bearings

.1 The alignment of the live load bearing rollers and load plates will be considered acceptable when the rollers have a clearance of 0.5 mm or interference of 0.5 mm with the load plate. Adjustments shall be made using the levelling nuts and shims to achieve the clearance between the components with the swing span supported at the proper elevation for roadway traffic.

.4 Main Cylinders

.1 The alignment of the main cylinders will be considered acceptable when the cylinder is level within 3 mm over the length of the cylinder.

.5 End Lifts

.1 The alignment of the end lift will be considered acceptable when the

dead load reaction at each end lift is measured to be 226 kN ± 10%, with the top and bottom chords at equal temperature, the elevation of the roadway on the swing span is within 3 mm of the abutment over the width of the roadway and the eccentric wheels are centered in the load plate within ± 3 mm.

.6 Balance Wheels and Track

.1 The alignment of the balance wheel rail will be considered acceptable when the top of the rail is flat and level within ± 0.5 mm over the entire rail and the rail is concentric to the center bearing within ± 1.5 mm.

.2 The alignment of the balance wheels will be considered acceptable when the gap between each balance wheel and the track is 2.5 mm ± 0.5 mm with the span in the closed position and the end lifts fully engaged and supporting the specified load.

.7 End Castors

.1 The alignment of the end castors will be considered acceptable when the castors are in full contact (gap of less than 0.05 mm at either edge) with the rest plate, the pin axis is in line with the pivot point of the swing span (tolerance is ± 2 mm from centerline of pivot) and the elevation of the roadway on the swing span is within 3 mm of the abutment over the width of the roadway.

.8 End Stop Assembly

.1 The alignment of the end stop assemblies will be considered acceptable when the bumper assembly is in contact with the strike plate with the span fully closed, locking pin is driven, and the end lift is centered relative to the load plate ± 1 mm.

.2 The bumper assemblies shall be sufficiently centered so the bumper fully bears on the strike plate with the span in all possible positions of tilt, at mean ambient temperature for navigational operation.

.9 Locking Pin Assembly

.1 As the swing span is aligned to the roadway approaches in the closed position, the locking pin shall be pushed into the guides using the receiving socket ramp the span closed locking pin assemblies shall be located at the Southwest corner abutment. The locking pin receiving sockets are located and mounted to the bottom chords of the swing span superstructure. The locking pin assembly mounting frame should be located with respect to the centerline of the receiving socket, and attached to the abutment using adhesive anchor bolts. Final adjustment can be achieved utilizing the provided shims, for the clearances specified on the Contract Drawings.

3.11 SPAN BALANCE

.1 The swing span is symmetrical about the longitudinal roadway centerline, and about the transverse pivot girder. The swing span has end castors fastened to the East end and only load plates fastened to the West end. This would result in an unbalanced condition causing the East end to be heavier. Weight shall be added to the West end of the swing span to cause the West end to be heavier than the East end by 40kN +/- 15kN measured or calculated to be at the balance wheel radius. The following procedure is suggested for fine tuning the bridge balance using the counterweight adjustment plates to an acceptable condition. The transverse balance

tolerance shall be less than 10kN measured or calculated to be at the balance wheel radius.

.2 The Contractor shall test the balance of the swing span longitudinally and transversely about the pivot bearing at least two (2) times. The initial span balance shall be performed after the span is set on the pivot bearing. The final span balance work shall be performed at the completion of the Contract work including installation of permanent balance material. A detailed balance procedure sealed by a Professional Engineer licensed in Ontario, Canada, shall be submitted to the Departmental Representative for review at least six (6) weeks prior to balancing the swing span. The following procedure is offered for the Contractor's consideration. The Contractor is advised that the procedure offered below demonstrates a method of balancing the bridge but is not complete in all respects. The Contractor's procedure shall include a complete description of all equipment and methods to be employed. The Contractor may submit an alternate procedure for review. Alternate procedures will be reviewed and accepted or rejected at the sole discretion of the Departmental Representative.

.3 Longitudinal Balance

.1 Allow the pivot bearing to be the sole supporter of the swing span.

.2 Determine the distance between the balance wheels and the balance wheel track for each of the balance wheels (four total) at the longitudinal centerline of the bridge.

.3 Jack the bridge using two hydraulic jacks, equally spaced from the longitudinal centerline of the bridge, placed on the side of the center bearing which has the least clearance at the balance wheels. The jacks should be the same distance from the center bearing. Connect the two jacks so that the pressure to each jack is the same. Jacks shall be equipped with load cell indicators.

.4 Jack the bridge until one of the balance wheels on the opposite side of the pivot bearing from the jacks just contacts the balance wheel track.

.5 Release the pressure in the jacks and determine if the bridge remains in the jacked position or returns to the position prior to jacking.

.6 If the bridge returns to the position prior to jacking then the span is out of balance in the longitudinal direction. If the span does not return to its original position proceed to step 10.

.7 Drive the end lifts, or install blocking to secure bridge for the purpose of adding weight to the bridge.

.8 Add temporary weight at the end of the bridge opposite from the jacks. Weights may be placed on deck along the end floor beam.

.9 Repeat steps 1 through 8 until the span does not return to its original position after jacking. For every successive cycle, increase the weight versus the weight used in previous cycle.

.10 Jack the bridge from the low side (side with balance wheel in contact) with a dial indicator positioned to indicate movement of the pivot top casting on the opposite side of the center bearing from the jacks. Dial indicator to be on longitudinal centerline of the bridge. Determine the force required to initiate movement. Record this value as F north or F south accordingly.

.11 Jack the bridge until the balance wheels opposite the jacks just contact the balance wheel track.

.12 Jack the bridge from the opposite side with a dial indicator positioned

to indicate movement of the pivot top casting of the opposite side of the center bearing from the jacks. Dial indicator to be on longitudinal centerline of the bridge. Determine the force required to initiate movement of the pivot top casting. Record this value as F north or F south accordingly.

.13 Determine the imbalance force at the north side using the following equation: F ie = F West - (F East + F West)/2

14. Determine the required weight change at the north side of the bridge using the following equation: W West = (F ie * d)/D

Where,

F ie = Imbalance force East (from step 13).

d = Distance to jacks along longitudinal axis of bridge

D = Distance to added weight along longitudinal of bridge

W East = Weight change at East side of bridge. If W East is negative, remove weight from East end of bridge or add weight to West end of bridge. If W East is positive, add weight to East side of bridge or remove weight from West end of bridge.

Note: All weight changes shall be made so as to keep the total weight used to a minimum.

.4 Transverse Balance

.1 Allow the pivot bearing to be sole supporter of the swing span.

.2 Determine the distance between the balance wheels and the balance wheel track for each of the balance wheels (two total) closest to the transverse centerline of the bridge.

.3 Jack the bridge using two hydraulic jacks, equally spaced from the transverse centerline of the bridge, placed on the side of the center bearing which has the least clearance at the balance wheels. The jacks should be the same distance from the bearing. Connect the two jacks so that the pressure to each jack is the same. Jacks shall be equipped with load cell indicators.

.4 Jack the bridge until one of the balance wheels on the opposite side of the center bearing from the jacks just contacts the balance wheel track.

.5 Release the pressure in the jacks and determine if the bridge remains in the jacked position or returns to the position prior to jacking.

.6 If the bridge returns to the position prior to jacking then the span is out of balance in the transverse direction. If the span does not return to its original position proceed to step 10.

.7 Drive the end lifts, or install blocking to secure bridge for the purpose of adding weight to the bridge.

.8 Add temporary weight at the side of the bridge opposite from the jacks. Weights may be placed on the deck-in-line with the pivot girder.

.9 Repeat steps 1 through 8 until the span does not return to its original position after jacking. For every successive cycle, additional weight versus the weight used in previous cycle. Total weight shall be added permanently along that side of the bridge as directed by the Departmental Representative.

.10 Jack the bridge from the low side (side with balance wheel in contact) with a dial indicator positioned to indicate movement of the pivot top casting on the opposite side of the bearing from the jacks. Dial indicator to be on transverse centerline of the bridge. Determine the force required to initiate movement. Record this value as F South or F North accordingly.

.11 Jack the bridge until the balance wheels opposite the jacks just contact the balance wheel track.

.12 Jack the bridge from the opposite side with a dial indicator positioned to indicate movement of the pivot top casting of the opposite side of the

bearing from the jacks. Dial indicator to be on transverse centerline of the bridge. Determine the force required to initiate movement of the pivot top casting. Record this value as F South or F North accordingly.

.13 Determine the imbalance force at the North side using the following equation:

F is = F South - (F North + F South)/2

.14 Determine the required weight change at the North side of bridge using the following equation: W North = (F is * d)/D

Where,

F is = Imbalance force North (from step 13).

d = Distance to jacks along transverse axis of bridge.

D = Distance to added weight along transverse or bridge.

W North = Weight change at North side of bridge. If W North is negative, remove weight from North side or bridge or add weight to South side of bridge. If W North is positive, add weight to North side or bridge or remove weight from South side or bridge.

The balance shall be considered acceptable when the span is balanced in the longitudinal and transverse directions within 6180 N-m.

Note: All weight changes shall be made so as to keep the total weight used to a minimum.

.5 Report the required weight of balance material to the Departmental Representative for review. Furnish and install permanent weights in locations as directed by the Departmental Representative.

.6 For bidding purposes, Contractor shall refer to the structural drawings to calculate the Tonnes of steel plate in total (unit C for longitudinal imbalance adjustment) for "Furnishing Counterweight Material", total for span balancing of counterweight material and materials required to install counterweight material.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 23 10 - Earth Excavation

.2 Section 32 11 18 - Granular 'A'.

.3 Section 32 11 19 - Granular 'B', Type II.

1.2 References

.1 OPSS.PROV 206 November 2014, Grading

.2 OPSS.PROV 314 November 2015, Untreated Granular Subbase, Base, Surface, Shoulder, and Stockpiling

.3 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.3 Samples

.1 Submit test results for granular gradation in accordance with Section 01 33 00.

1.4 Measurement for Payment

.1 No measurement for payment will be made for Granular material or Rock Fill under this section.

PART 2 - PRODUCTS

2.1 Materials

.1 Aggregate quality: sound, hard, durable material free from soft, thin, elongated or laminated particles, organic material, clay lumps or minerals, or other substances that would act in deleterious manner for use intended.

.2 Use of recycled materials (RAP or RCM) on this project is not permitted.

.3 Rock fill shall be in accordance with OPSS.PROV 206.

2.2 Source Approval

.1 Inform Departmental Representative of proposed source of aggregates and provide test results for sampling at least 4 weeks prior to commencing production.

.2 If, in opinion of Departmental Representative, materials from proposed source do not meet, or cannot reasonably be processed to meet,

specified requirements, locate an alternative source or demonstrate that material from source in question can be processed to meet specified requirements.

.3 Should a change of material source be proposed during work, advise Departmental Representative 2 weeks in advance of proposed change and provide documentation for testing.

.4 Acceptance of material at source does not preclude future rejection if it fails to conform to requirements specified, lacks uniformity, or if its field performance is found to be unsatisfactory.

PART 3 - EXECUTION

3.1 Processing

.1 Process aggregate uniformly using methods that prevent contamination, segregation and degradation.

.2 Blend aggregates, if required, to obtain gradation requirements, percentage of crushed particles, or particle shapes, as specified.

.3 Wash aggregates, if required to meet specifications. Use only equipment approved by Departmental Representative.

3.2 Handling

.1 Handle and transport aggregates to avoid segregation, contamination and degradation.

3.3 Stockpiling

.1 If stockpiling is required by Contractor:

.1 Stockpile aggregates on site in locations as indicated unless directed otherwise by Departmental Representative. Do not stockpile on completed pavement surfaces.

.2 Stockpile aggregates in sufficient quantities to meet project schedules.

.3 Stockpiling sites to be level, well drained, and of adequate bearing capacity and stability to support stockpiled materials and handling equipment.

.4 Separate different aggregates by strong, full depth bulkheads, or stockpile far enough apart to prevent intermixing.

.5 Do not use intermixed or contaminated materials. Remove and dispose of rejected materials as directed by Departmental Representative within 48h of rejection.

.6 Stockpile materials in uniform layers of thickness as follows:

1. Max 1.5m for coarse aggregate and base course materials.
2. Max 1.5m for fine aggregate and sub-base materials.
3. Max 1.5m for other materials.

.7 Uniformly spot-dump aggregates delivered to stockpile in trucks and build up stockpile as specified.

.8 Do not cone piles or spill material over edges of piles.

.9 Do not use conveying stackers.

.10 During winter operations, prevent ice and snow from becoming mixed into stockpile or in material being removed from stockpile.

.11 Provide silt fence barrier around perimeter of stockpile (considered incidental to work).

3.4 Aggregate Stockpile Cleanup

.1 Leave aggregate stockpile site in tidy, well drained condition, free of standing surface water. Remove sand base and restore stockpile site at completion of the work.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

.1 Ministry of Transportation (MTO)
.1 Designated Sources of Materials (DSM):
http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.2 MEASUREMENT PROCEDURES

.1 Any clearing and grubbing will be included in the unit price for the debris removal.

1.3 RELATED REQUIREMENTS

.1 Section 31 00 99: Earthwork for Minor Works
.2 Section 31 25 05: Erosion and Sediment Control

1.4 DEFINITIONS

.1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of previously fallen trees, previously uprooted trees and stumps, and surface organic debris.

.2 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.

.3 Grubbing consists of excavation and disposal of stumps and roots, boulders and rock fragments of specified size, as directed by Departmental Representative.

1.5 MEASURMENT PROCEDURES

.1 Clearing and grubbing to be completed to facilitate debris removal is included in the unit rate for debris removal.

1.6 QUALITY ASSURANCE

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.7 PROTECTION

.1 Protect trees at the Site as directed by the Departmental Representative. Any removal of trees or shrubs shall be completed according to typical guidelines and mitigation measures.

.2 Debris piles may be located off-Site on land designated as a Provincial Park. Access to this area should be coordinated through the appropriate authorities and any required access or tree removal permits should be obtained by the Contractor at their cost.

.3 Restrict trees and shrub removal to the immediate areas of the concentrated debris piles, only as required, and as directed by the Departmental Representative.

.4 Do not proceed with trees removal before coordinating with authority having jurisdiction and obtain any permit, if required, for the tree removal.
.1 Contractor to pay any fees associated with the permit application.

.5 Where possible, limit excavation around the drip zone of trees which are not being removed.

.6 Damage to trees designated to remain, will require replacement at the discretion of the Departmental Representative.

1.8 WASTE MANAGEMENT AND DISPOSAL
.1 Separate waste materials for recycling in accordance with Section 01 74 20.
.2 Trim limbs and tops, and saw into saleable/usable lengths (approximately 2 m) for saw logs or firewood, as directed by Departmental Representative.

PART 2 PRODUCTS

2.1 NOT USED
.1 Not used.

PART 3 EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and in accordance to Section 31 25 00.
.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

3.2 PREPARATION

.1 Inspect the debris dumpsites and debris piles within the Site and verify with Departmental Representative, items designated to remain.

.2 Notify Departmental Representative if any utility lines were observed within the debris dumpsites or piles before starting clearing.

3.3 CLEARING

.1 Clearing includes felling, trimming, and cutting of trees into sections and satisfactory disposal of trees and other vegetation approved for removal, including previously downed timber, snags, brush, and vegetative rubbish occurring within cleared areas.

.2 Clear as directed by Departmental Representative, by cutting at height of not more than 150mm above ground.

.3 In approved tree removal areas, cut standing trees smaller than 250 mm in trunk diameter. Only cut trees marked by Departmental Representative.

.4 Cut off branches overhanging area cleared as directed by Departmental Representative.

.5 Cut off unsound branches on trees designated to remain as directed by Departmental Representative.

3.4 UNDERBRUSH CLEARING

.1 Clear underbrush from areas as indicated at ground level to within 100 mm of ground surface.

3.5 GRUBBING

.1 Tree grubbing is not permitted; isolated trees stumps are to remain in place.

.2 Grub out visible rock fragments and boulders, greater than 0.3 meters in greatest dimension from the debris pile areas.

3.6 REMOVAL AND DISPOSAL

.1 Grind, chip and spread cleared above ground vegetative material on Site as directed by Departmental Representative.

.2 Remove grubbed materials and stockpile at designated locations on Site as directed by Departmental Representative.

.3 Burning of materials is not permitted.

3.7 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 On completion and verification of performance of work, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 14 13 – Soil Stripping and Stockpiling

.2 Section 32 01 90.33 - Tree and Shrub Preservation.

1.2 REFERENCES

.1 American Society for Testing and Materials (ASTM)

.1 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction of Soil Standard Effort (600 kN-m/m³).

.2 Ministry of Transportation (MTO)

.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.3 EXISTING CONDITIONS

.1 Examine subsurface investigation report which is available for inspection from the Department Representative.

.2 Known underground and surface utility lines and buried objects are as indicated on site plan.

.3 Refer to dewatering in Section 31 23 33.01.

1.4 MEASUREMENT AND PAYMENT

.1 Measurement and payment shall be provided for under the price item associated with Section 31 23 33.01.

1.5 PROTECTION

.1 Protect and/or transplant existing fencing, trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as directed by Department Representative. If damaged, restore to original or better condition unless directed otherwise.

.2 Maintain access roads to prevent accumulation of construction related debris on roads.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Fill material: Type 1 or Type 3 in accordance with of Section 31 23 33.01.

.2 Type 3 fill material from the site may be suitable to use as fill for grading work, if approved by Departmental Representative.

PART 3 EXECUTION

3.1 GRADING

.1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.

.2 Grade ditches to depths as indicated.

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

.4 Compact filled and disturbed areas to corrected maximum dry density to ASTM D698, to be confirmed with the soils report, as follows:

.1 85% under landscaped areas.

.2 95 % under paved and walk areas.

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

3.2 TESTING

.1 Inspection and testing of soil compaction will be carried out by testing laboratory designated by ULC. Costs of tests will be paid by Departmental Representative. Refer to Sections 01 29 83 and 01 45 00.

3.3 SURPLUS MATERIAL

.1 Remove surplus material and material unsuitable for fill, grading or landscaping off site in accordance with Section 31 11 00.

END OF SECTION

PART 1 - GENERAL

1.1 Related Sections

.1 Section 31 05 16 - Aggregate Materials.

1.2 Description

.1 The work of this section covers the requirements for all earth excavation required on this project.

.2 Earth Excavation includes the excavation of all materials of whatever nature, including asphalt, topsoil, granular, dense tills, and frozen materials that can be ripped and excavated with heavy construction equipment.

.3 Earth excavation shall also include sawcutting the asphalt full depth at the limits of the new approach slab. To ensure that there is a "clean" edge to which the approach slab can be cast, the initial removal shall be limited to within 150 mm of the end of the approach slab and the last 150 mm of removal (with sawcutting) shall only be done immediately before casting of the slab.

.4 Earth excavation shall include any required shoring, bracing, and dewatering of excavation.

1.3 Measurement and Payment

.1 No measurement for payment will be made. Include all costs for labour, materials and equipment necessary for the excavation of asphalt, granulars etc., to the limits as shown on the drawings and as directed by the Departmental Representative.

.2 Payment will be under the Contract Combined Price Amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.4 References

.1 ASTM C117-17, Standard Test Method for Materials Finer Than 0.075 mm (No.200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C136/C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM D422-63(2007)-e2, Standard Test Method for Particle-Size Analysis of Soils.

.4 ASTM D1557-12e1, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbs/ftü) (2,700 kN-m/m^3)

.5 ASTM D4318-17e1, Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

.6 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.7 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction.

.8 OPSS.PROV 401 November 2015, Trenching, Backfilling and Compacting.

.9 OPSS.PROV 1003 November 2017, Aggregates Hot Mixed, Hot Laid, Asphaltic Concrete.

.10 OPSS.PROV 1010 April 2013, Aggregates Granular A, B, M and select subgrading materials.

.11 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.5 Definitions

.1 Unclassified excavation: excavation of deposits of whatever character encountered in work.

.2 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.3 Waste material: excavated material unsuitable for use in work or surplus to requirements.

.4 Borrow material: material obtained from locations outside area to be graded, and required for construction of fill areas or for other portions of work.

.5 Unsuitable materials:

1. Weak and compressible materials under excavated areas.
2. Frost susceptible materials under excavated areas.
3. Frost susceptible materials:

.1 Fine grained soils with plasticity index less than 10 when tested to ASTM D4318, and gradation within limits specified when tested to ASTM D422, and ASTM C136/C136M-14: Sieve sizes to CAN/CGSB-8.1.

Sieve Designation	% Passing
2.000 mm	100
0.100 mm	45 - 100
0.020 mm	10 - 80
0.005 mm	0 - 45

.2 Coarse grained soils containing more than 20% by mass passing 0.075 mm sieve.

1.6 Protection of Existing Features

.1 Existing buried utilities and structures:

.2 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

.1 Prior to commencing excavation work, arrange with the designated utility locator to stake existing Municipal, Parks Canada and private utility locations.

.2 Existing utilities to be exposed in advance by hand excavation.

.3 Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered.

.4 Where utility lines or structures exist in area of excavation, obtain direction of Departmental Representative before removing or re-routing.

.5 Record location of maintained, re-routed and abandoned underground lines.

.3 Existing features:

.1 Protect existing features from damage while work is in progress. In event of damage, immediately make repair to approval of Departmental Representative.

PART 2 - PRODUCTS

2.1 Not Used

.1 Not Used.

PART 3 - EXECUTION

3.1 Site Preparation

.1 Remove obstructions, ice and snow, from surfaces to be excavated within limits indicated.

.2 Sawcut pavement neatly along limits of proposed excavation in order that surface may break evenly and cleanly. Do not complete final cut of asphalt on approaches until immediately before casting of the new approach slabs.

3.2 Stripping of Topsoil

.1 Strip topsoil and disposal of surplus off-site. Do not mix topsoil with subsoil.

3.3 Stockpiling

.1 Topsoil shall be disposed of off-site in locations arranged by the Contractor.

.2 Protect fill materials from contamination.

3.4 Excavation

.1 Excavate to lines, grades, elevations and dimensions as indicated.

.2 Dispose of waste material (i.e.,asphalt, excess or unsuitable excavated material) off site.

.3 Do not obstruct flow of surface drainage or natural watercourses.

.4 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter.

.5 Notify Departmental Representative when bottom of excavation is reached.

.6 Obtain Departmental Representative approval of completed excavation.

.7 Remove unsuitable material to extent and depth as directed by Departmental Representative.

.8 Correct unauthorized over-excavation as follows:
.1 Fill with Granulars to depths indicated on Contract Drawings, compacted to not less than 95% of Standard Proctor Maximum Dry Density.

.9 Trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

3.5 Backfilling

.1 Do not proceed with backfilling operations until Departmental Representative has inspected and approved installations.

.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

.3 Do not use backfill material which is frozen or contains ice, snow or debris.

.4 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.

3.6 Compaction of Roadway

.1 Compaction in accordance with OPSS MUNI 501.

.2 Contractor shall proof roll excavated area prior to the placement of any granular material.

END OF SECTION

PART 1 - GENERAL

1.1 MEASUREMENT PROCEDURES

.1 Stripping: measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
.1 Departmental Representative will take initial cross sections after clearing and grubbing completed.
.2 Stripping unit price to include cost of placing material on slopes upon completion of excavation and embankment.

.2 Common Excavation: measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
.1 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.

.3 Borrow: measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
.1 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.

.4 Rock Excavation:
.1 Calculate volume excavated from solid rock masses in cubic metres from cross sections of original rock surface and design grade line for excavation.

.2 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.
.3 Measure rock excavated beyond design grade as Common Excavation when placed in embankment within established lines and grades.
.4 Measure excavated boulders and rock fragments measured individually. Determine volume of excavated boulders and rock fragments by measuring three maximum mutually perpendicular dimensions.

.5 Unclassified excavation:
.1 Measure in cubic metres calculated from cross sections taken by Departmental Representative in areas of excavation.
.2 Departmental Representative will take initial cross sections after clearing, grubbing and stripping completed and immediately prior to excavation of material to be incorporated into work.

.6 Measure overhaul in cubic metre-kilometres and computed by "Mass Diagram Method". Overhaul as designated by Departmental Representative.

.7 No separate payment for:
.1 Excavating unnecessarily beyond lines established by Departmental Representative, with exception of unavoidable slide material. Do not measure slide material, when such slides are attributable to negligence.
.2 Ripping and/or drilling and blasting of material.
.3 Scarifying or benching existing slopes or existing road surfaces.
.4 Removing and disposing of roots, stumps and other materials

excavated during waste operation.
.5 Burying existing culverts from old road.
.6 Removing unsuitable material from embankment attributable to negligence.
.7 Shattering rock to 300 mm below subgrade elevation.
.8 Scaling and removing loose rock from rock face.
.9 Watering, drying and compacting.
.10 Finishing.

1.2 REFERENCES

.1 Definitions:

.1 Rock Excavation: excavation of:
.1 Material from solid masses of igneous, sedimentary or metamorphic rock which, prior to removal, was integral with parent mass. Material that cannot be ripped with reasonable effort with a Caterpillar D9 crawler bulldozer or equivalent to be considered integral with parent mass.
.2 Boulder or rock fragments measuring in volume 1 cubic metre or more.
.2 Common Excavation: excavation of materials that are not Rock Excavation or Stripping.
.3 Free Haul: distance that excavated material is hauled without compensation. Free haul distance to be 0.5 km or less.
.4 Stripping: excavation of organic material covering original ground.
.5 Over Haul: authorized hauling in excess of free haul distance that excavated material is moved.
.6 Embankment: material derived from usable excavation and placed above original ground or stripped surface up to top of subgrade.
.7 Waste Material: material unsuitable for embankment, embankment foundation or material surplus to requirements.
.8 Borrow Material: material obtained from areas outside right-of-way and required for construction of embankments or for other portions of work.
.9 Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

.2 Reference Standards:
.1 ASTM International (ASTM)
.1 ASTM D698-12e2, Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,000 ft-lbf/ft^3) (600 kN-m/m^3).
.2 American Association of State Highway and Transportation Officials (AASHTO)
.1 AASHTO T99-15, Standard Method of test for Moisture-Density Relations of Soils Using a 2.5 kg (5.5lb) Rammer and 305 mm (12 in) Drop.
.3 Ministry of Transportation (MTO)
.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.
.2 Submit for approval and review blasting program including preshear details, powder factors fly-rock control, and vibration monitoring

methods.

1.4 QUALITY ASSURANCE

.1 Regulatory Requirements:
.1 Adhere to regulations of authority having jurisdiction when blasting is required.
.2 Adhere to Provincial and National Environmental requirements when potentially toxic materials are involved.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Embankment materials require approval by Departmental Representative.

.2 Material used for embankment not to contain more than 3% organic matter by mass, frozen lumps, weeds, sod, roots, logs, stumps or other unsuitable material.

.3 Borrow material:

.1 Obtain from sources such as quarry, or borrow pit as indicated by Departmental Representative.
.1 Earth Embankment materials to consist of acceptable earth material and processed rock material free from objectionable quantities of organic matter, frozen soil, stumps, trees, moss, and other unsuitable materials.

PART 3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that condition of substrate is acceptable for roadway embankment Work:
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 COMPACTION EQUIPMENT

.1 Compaction equipment: vibratory rollers or vibrating plate compactors capable of obtaining required density in materials on project.
.1 Demonstrate compaction equipment effectiveness on specified material and lift thickness by documented performance of test-strip before start of Work.
.2 Replace or supplement equipment that does not achieve specified densities.

.2 Operate compaction equipment continuously in each embankment when placing material.

3.3 WATER DISTRIBUTORS

.1 Apply water with equipment capable of uniform distribution.

3.4 STRIPPING OF TOPSOIL

.1 Place top soil and finish grading in accordance with Section 32 91 19.13.

.2 Commence topsoil stripping of areas as directed by Departmental Representative after unwanted vegetation have been removed from these areas.

.3 Strip topsoil to depths as directed by Departmental Representative. Do not mix topsoil with subsoil.

.4 Stockpile in locations as directed by Departmental Representative.
.1 Stockpile height: not to exceed 2 m.

.5 Dispose of unused topsoil as directed by Departmental Representative.

.6 Remove clearing and grubbing debris from stripping.

.7 Spread organic stripping, on completion of excavation and embankment construction, on slopes and trim or remove from site if quantity exceeds ability to grade on site.

3.5 EXCAVATING

.1 General:
.1 Notify Departmental Representative when waste materials are encountered and remove to depth and extent directed.
.2 Do excavating in accordance with Section 31 23 33.

.2 Drainage:
.1 Maintain profiles, crowns and cross slopes to provide good surface drainage.
.2 Provide ditches as work progresses to provide drainage.
.3 Construct interceptor ditches as indicated or as directed before excavating or placing embankment in adjacent area.

.3 Rock excavation:

.1 Notify Departmental Representative, when material appearing to conform to classification for rock is encountered, to enable measurements to be made to determine volume of rock.
.2 Submit blasting program to Departmental Representative, for approval 48 hours minimum before start of Work.
.1 Do not proceed without written approval of blasting program from Departmental Representative.
.3 Shatter rock to 300 mm below subgrade elevation as indicated.
.4 Reduce overbreak and increase stability of rock faces by using smooth blasting techniques.
.5 Use smooth blast and excavate short sections in rock cuts to determine optimum spacing of holes when requested by Departmental Representative.
.6 Stem holes as necessary to contain blast.
.7 Do not use prilled type ammonium nitrate and fuel oil (ANFO) explosives within 4 m of final cut line.
.8 Form back wall by pre-splitting at least 10 m in advance of

production blasting.

.1 Smooth wall blast just prior to or just after production blast as determined by approved blast program.

.9 Scale rock backslopes to achieve smooth, stable face, free of loose rock and overhangs to design backslope.

.10 Control blasting to minimize flying particles.

.4 Borrow Excavation:

.1 Completely use in embankments, suitable materials removed from right-of-way excavations before taking material from borrow areas.

.2 Obtain embankment materials, in excess of what is available from cut areas, from designated borrow areas.

.1 Departmental Representative to designate extent of borrow areas and allowable depth of excavation.

.2 Remove waste and stripping material from borrow pits to designated locations.

.3 Slope edges of borrow areas to minimum 2:1 and provide drainage as directed.

.4 Trim and leave borrow pits in condition to permit accurate measurement of material removed.

3.6 EMBANKMENTS

.1 Scarify or bench existing slopes in side hill or sloping sections to ensure proper bond between new materials and existing surfaces.

.1 Method used to be to be pre-approved in writing by Departmental Representative.

.2 Break up or scarify existing road surface prior to placing embankment material.

.3 Do not place material which is frozen nor place material on frozen surfaces except in areas authorized by Departmental Representative.

.4 Maintain crowned surface during construction to ensure ready run-off of surface water.

.5 Drain low areas before placing materials.

.1 Place and compact to full width in layers not exceeding 200 mm loose thickness. Departmental Representative may authorize thicker lifts if specified compaction can be achieved and if material contains more than 25% by volume stone and rock fragments larger than 100 mm.

.6 Where material consists of rock:

.1 Place to full width in layers of sufficient depth to contain maximum sized rocks, but in no case is layer thickness to exceed 1 m.

.2 Distribute rock material to fill voids with smaller fragments to form compact mass.

.3 Fill surface voids at subgrade level with rock spalls or selected material to form earth-tight surface.

.4 Do not place boulders and rock fragments with dimensions exceeding 150 mm within 300 mm of subgrade elevation.

.7 Deductions from excavation will be made for overbuild of embankments.

3.7 COMPACTION

.1 Break material down to sizes suitable for compaction and mix for uniform moisture to full depth of layer.

.2 Deposit, spread, and level, embankment material in layers 200 mm maximum thickness before compaction.

.1 Compact each layer of embankment until compaction equipment achieves no further significant consolidation.

.2 Ensure required compaction for each layer before placing any material for next layer.

.3 Use specialized compaction equipment supplemented by routing, hauling, and leveling equipment over each layer of fill.

.4 Obtain written approval from Departmental Representative before using specialized compaction equipment such as tamping rollers, vibratory rollers, or other alternate compaction equipment that produces the required results.

.1 For tamping rollers, use equipment that exerts 1000 kPa minimum of pressure on tamping surface of each tamping foot in transverse row.

.5 Compact each layer to minimum 95% maximum dry density: ASTM D698 except top 150 mm of subgrade.

.1 Compact top 150 mm to 100% maximum dry density.

.6 Add water or dry as required to bring moisture content of materials to level required to achieve specified compaction.

3.8 FINISHING

.1 Shape entire roadbed to within 25 mm of design elevations.

.2 Finish slopes, ditch bottoms and borrow pits true to lines, grades and drawings where applicable. Scale slope by removing loose fragments, for cut slopes in bedrock steeper than 1:1.

.3 Remove rocks over 150 mm in dimension from slopes and ditch bottoms.

.4 Hand finish slopes that cannot be finished satisfactorily by machine.

.5 Round top of backslope 1.5 m both sides of top of slope.

.6 Run tractor tracks over slopes exceeding 3 m in height to leave tracks parallel to centreline of highway.

.7 Trim between constructed slopes and edge of clearing to provide drainage and free of humps, sags and ruts.

3.9 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 20.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.10 PROTECTION

.1 Maintain finished surfaces in condition conforming to this section until acceptance by Departmental Representative.

.2 Provide silt fences and erosion protection as required to mitigate and prevent impacts to adjacent properties.

END OF SECTION

Part 1 GENERAL

1.1 SECTION INCLUDES

.1 Permanent erosion and sediment control devices.

1.2 RELATED SECTIONS

.1 Section 31 37 10 - Riprap.

.2 Section 32 92 23 - Sodding: Sodding for soil stabilization.

1.3 REFERENCES

.1 OPSS.PROV 206 November 2014, Grading

.2 OPSS.PROV 518 November 2016, Control of Water from Dewatering Operations

.3 OPSS.PROV 804 November 2014, Seed and Cover

.4 OPSS 805 November 2015, Temporary Erosion and Sediment Control Measures

.5 OPSS.PROV 1004 November 2012, Aggregates - Miscellaneous

.6 OPSS.PROV 1801 April 2018, Corrugated Steel Pipe Products

.7 OPSS 1840 November 2015, Non-Pressure Polyethylene Plastic Pipe Products

.8 OPSS.PROV 1860 April 2018, Geotextiles

.9 ASTM D1777-96(2015) - Standard Test Method for Thickness of Textile Materials.

.10 ASTM D3776/D3776M-09a(2017) - Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.

.11 ASTM D4355/D4355M-14 - Standard Test Method for Deterioration of Geotextiles by Exposure to Light, Moisture and Heat in a Xenon Arc Type Apparatus.

.12 ASTM D4632/D4632M-15a - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

.13 ASTM D4751-16 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.14 EPA 832/R-92-005 - Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices, September 1992.

.15 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

.16 Local erosion and sediment control guidelines.

1.4 DEFINITIONS

.1 Erosion: Deterioration, displacement, or transportation of land surface by wind or water, intensified by land-clearing practices related to construction activates.

.2 Rain or Rain Storm: An event defined causing the pooling of water on road or other impervious surfaces.

.3 Sediment: Particulate matter transported and deposited as a layer of solid particles within a body of water.

.4 Snow Melt: An event in snow conditions when the temperature is above 0 degrees C or when environmental conditions causing snow on the ground to melt.

1.5 PERFORMANCE REQUIREMENTS

.1 Design erosion and sediment control system to eliminate erosion of soil and prevent sedimentation of storm sewers and receiving streams.

1.6 ADMINISTRATIVE REQUIREMENTS

.1 Coordination:

.1 Coordinate with other work having a direct bearing on work of this section.

.2 Coordinate with maintenance, monitoring, and reporting procedures.

1.7 SUBMITTALS FOR REVIEW

.1 Section 01 33 00: Submission procedures.

.2 Provide within thirty (30) days of date established for commencement of the Work.

.3 Application for Payment: Provide Inspection Log information with each application, including:

.1 Weekly inspection record.

.2 Report of damages, deficiencies and maintenance of erosion and sediment control measures.

.3 Identify standing rainwater or snowmelt conditions.

.4 Erosion and Sediment Control Plan (ESCP):

.1 Provide erosion control plan with erosion and sediment control highlighted.

1.8 SUBMITTALS FOR INFORMATION

.1 Section 01 33 00: Submission procedures.

.2 Test Reports: Submit substantiating engineering data, test results of previous tests which purport to meet performance criteria, and other supportive data.

.3 Installation Data: Manufacturer's special installation requirements.

1.9 QUALITY ASSURANCE

.1 Products of This Section: Manufactured to ISO 9000 certification requirements.

.2 Design Erosion and Sediment Control Plan conforming to applicable erosion and sedimentation control codes and standards under direct supervision of a Professional Engineer experienced in design of this Work and licensed at the place where the Project is located.

Part 2 PRODUCTS

2.1 SILT FENCING

.1 Use in accordance to OPSS 805.

EXECUTION

2.2 PREPARATION

.1 Prepare Erosion and Sediment Control Plan (ESCP) conforming to local erosion and sediment control codes and standards designed to meet the following:

.1 Prevent loss of soil by wind erosion and storm water runoff.

.2 Prevent sedimentation in storm sewer and receiving streams.

.3 Prevent air pollution by dust and particulate matter.

2.3 SILT FENCES

.1 Install in accordance with OPSS 805.

2.4 MISCELLANEOUS MEASURES

.1 Diversion Structures: Construct swales and berms as indicated to divert surface run-off from disturbed areas to sediment trap or basin.

.2 Rip Rap: Install rip rap as shown. Fill open joints with rock spalls or cobbles.

2.5 MONITORING AND MAINTENANCE

.1 Comply with maintenance requirements specified and with standards.

2.6 CLEAN-UP AND REMOVAL

.1 Clean in accordance with Section 01 74 11.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.2 MEASUREMENT AND PAYMENT

.1 Payment will be under the Contract Combined Price Amount and such payment shall compensate necessary geotextiles required on this project.

1.3 REFERENCES

.1 ASTM International

.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM D4491/D4491M-17, Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.3 ASTM D4595-17, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.

.4 ASTM D4716/D4716M-14, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

.5 ASTM D4751-16, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.2 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-4.2 No. 27.5-2008, Textile Test Methods Flame Resistance - 45° Angle Test — One-Second Flame Impingement.

.2 CAN/CGSB-148.1-2015, Methods of Testing Geotextiles and Complete Geomembranes.

.1 No.2-M85, Methods of Testing Geosynthetics - Mass per Unit Area.

.2 No.3-M85, Methods of Testing Geosynthetics - Thickness of Geotextiles.

.3 No.6.1-93, Methods of Testing Geotextiles and Geomembranes - Bursting Strength of Geotextiles Under No Compressive Load.

.4 No.7.3-92, Methods of Testing Geotextiles and Geomembranes - Grab Tensile Test for Geotextiles.

.5 No. 10-94, Methods of Testing Geosynthetics - Geotextiles - Filtration Opening Size.

.3 CSA International.

.1 CSA G40.20/G40.21-13(R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.4 OPSS 805 November 2015, Temporary Erosion and Sediment Control Measures

.5 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for geotextiles and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit following samples 4 weeks prior to beginning Work.

.1 Minimum length of 2 m of roll width of geotextile.

.2 Methods of joining.

.4 Test and Evaluation Reports:

.1 Submit copies of mill test data and certificate at least 4 weeks prior to start of Work.

.5 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect geotextiles from direct sunlight and UV rays.

.3 Replace defective or damaged materials with new.

.3 Packaging Waste Management: remove in accordance with Section 01 74 20.

PART 2 PRODUCTS

.1 MATERIAL

.2 Geotextile: non-woven synthetic fibre fabric, supplied in rolls.

.1 Width: 3.81 m minimum.

.3 Physical properties:

.1 Thickness: to CAN/CGSB-148.1, No.3, minimum 1.905 mm.

.2 Mass per unit area: to CAN/CGSB-148.1, No.2, minimum 204 g/m^2.

.3 Grab tensile strength and elongation: to CAN/CGSB-148.1, No.7.3.

.1 Breaking force: minimum 734 N, wet condition.

.2 Elongation at future: 50%.

.4 Bursting strength: to CAN/CGSB-148.1, No.6.1 minimum 2137 kPa, wet condition.

.4 Hydraulic properties:

.1 Permitivity: to ASTM D4491, 1.5 per sec.

.5 Securing pins and washers: to CSA G40.20/G40.21-13(R2018), Grade 300W, hot-dipped galvanized with minimum zinc coating of 600 g/m^{2}to ASTM A123/A123M.

.6 Factory seams: sewn in accordance with manufacturer's recommendations.

.7 Thread for sewn seams: equal or better resistance to chemical and biological degradation than geotextile.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for geotextile material installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Department Representative.

.2 Inform Department Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department Representative.

3.2 INSTALLATION

.1 Place geotextile material by unrolling onto graded surface in orientation, manner and locations indicated and retain in position with securing pins and washers.

.2 Place geotextile material smooth and free of tension stress, folds, wrinkles and creases.

.3 Place geotextile material on sloping surfaces in one continuous length from toe of slope to upper extent of geotextile.

.4 Overlap each successive strip of geotextile 600 mm over previously laid strip.

.5 Pin successive strips of geotextile with securing pins at 400 mm interval at mid-point of lap.

.6 Protect installed geotextile material from displacement, damage or deterioration before, during and after placement of material layers.

.7 After installation, cover with overlying layer within 4 hours of placement.

.8 Replace damaged or deteriorated geotextile to approval of Department Representative.

.9 Place and compact soil layers in accordance with Section 31 24 13 and 33 46 16.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials in accordance with Section 01 74 20.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.4 PROTECTION

.1 Vehicular traffic not permitted directly on geotextile.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 MEASUREMENT PROCEDURES

.1 Payment for work associated with Rip Rap is included in the Combined Price.

1.3 REFERENCES

.1 ASTM D6473-15, Standard Test Method for Specific Gravity and Absorption of Rock for Erosion Control.

.2 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Collect and separate plastic, paper packaging and corrugated cardboard in accordance with Waste Management Plan.

.3 Place materials defined as hazardous or toxic in designated containers.

.4 Fold up metal banding, flatten and place in designated area for recycling.

.5 Divert left over aggregate materials from landfill to local facility for reuse as approved by Departmental Representative.

.6 Divert left over geotextiles to local plastic recycling facility as approved by Departmental Representative.

PART 2 PRODUCTS

2.1 STONE

.1 Produced from crushed or fractured bedrock fragments with 100% fractured faces or crushed from cobbles or boulders greater than 300 mm diameter and to not deteriorate when exposed to air and water and be resistant to deterioration by cycles of wetting, drying, freezing, and thawing.

.2 Physical property requirements for rip-rap:

.1 Minimum specific gravity: 2.50 to ASTM D6473.

.2 Maximum absorption: 2.0% to ASTM D6473.

.3 Rip-rap to meet following size distribution:

Sieve Size (mm)	Percent Passing
305	100
265	70-90
210	40-55
180	-
155	-
125	-
105	-
100	0-15
60	-

2.2 GEOTEXTILE FILTER

.1 Geotextile: in accordance with Section 31 32 19.01.

PART 3 EXECUTION

3.1 PLACING

.1 Where rip-rap is to be placed on slopes, excavate trench at toe of slope to dimensions as indicated.

.2 Fine grade area to be rip-rapped to uniform, even surface. Fill depressions with suitable material and compact to provide firm bed.

.3 Place geotextile on prepared surface in accordance with Section 31 32 19.01 and as indicated. Avoid puncturing geotextile. Vehicular traffic over geotextile not permitted.

.4 Place rip-rap to thickness and details as indicated.

.5 Place stones in manner approved by Departmental Representative to secure surface and create a stable mass. Place larger stones at bottom of slopes.

.6 Hand placing:

.1 Use larger stones for lower courses and as headers for subsequent courses.

.2 Stagger vertical joints and fill voids with rock spalls or cobbles.

.3 Finish surface evenly, free of large openings and neat in appearance.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 31 62 16.13 – Steel Sheet Piles.

1.2 MEASUREMENT PROCEDURES

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.3 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and manufacturer's instructions.

.1 Protect piles from damage due to excessive bending stresses, impact, abrasion or other causes during delivery, storage and handling.

.2 Replace damaged piles as directed by Departmental Representative.

1.4 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 21.

.2 Collect and separate plastic, paper packaging, corrugated cardboard in accordance with Waste Management Plan.

.3 Divert unused, or cut off concrete materials from landfill to local facility as approved by Departmental Representative.

1.5 EXISTING CONDITIONS

.1 Sub-surface investigation report is available for inspection as noted in Section 01 71 00.

.2 Notify Departmental Representative in writing if subsurface conditions at site differ from those indicated and await further instructions from Departmental Representative.

1.6 SCHEDULING

.1 Submit schedule of planned sequence of driving to Departmental Representative for review, not less than two (2) weeks prior to commencement of pile driving.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Material requirements for piles are specified in Section 31 62 16.13.

.2 Supply or fabricate full length piles as indicated and provide equipment to handle full length piles without cutting and splicing.

.3 Do not splice piles without written approval of Departmental Representative. When permitted, provide details for Departmental Representative review. Design details of splice to bear dated signature stamp of professional engineer registered or licensed in Province Ontario, Canada.

PART 3 - EXECUTION

3.1 EQUIPMENT

.1 Prior to pile installation, submit to Departmental Representative for review, details of equipment for installation of piles.
.1 Impact hammers: provide manufacturer's name, type, rated energy per blow at normal working rate, mass of striking parts of hammer, mass of driving cap and type and elastic properties of hammer and pile cushions.

.2 Hammer:
.1 Hammers to be selected on basis of driveability analysis using wave equation theory, performed to show that piles can be driven to levels indicated.
.2 Driveability analysis to include, but not be limited to, following: hammer, cushion, and cap block details; static soil parameters; quake and damping factors, total soil resistance, blow count, pile stresses and energy throughput at representative penetrations.
.3 Submit driveability analysis to Departmental Representative for approval of hammers.
.4 When required criteria cannot be achieved with the proposed hammer, use larger hammer and take other measures as required.

.3 Leads:
.1 Construct pile driver leads to provide free movement of hammer. Hold leads in position at top and bottom, with guys, stiff braces, or other means approved reviewed by Departmental Representative, to ensure support to pile while being driven. Inclined leads to be used for battered piles.
.2 Length: except for piles driven through water, provide sufficient length of leads to ensure that use of follower is unnecessary.
.3 Swing leads:
.1 Obtain approval from Departmental Representative.

.4 Followers:
.1 Obtain approval form Departmental Representative prior to using followers. Provide followers of such size, shape, length and mass to permit driving pile in desired location to required depth and resistance. Provide followers with socket or hood carefully fitted to top of pile to minimize loss of energy and prevent damage to pile.
.2 Drive applicable load test piles using similar follower.

3.2 PREPARATION

.1 Protection:
.1 Protect adjacent structures, services and work of other sections from hazards due to pile driving operations.
.2 Arrange sequencing of pile driving operations and methods to avoid damages to adjacent existing structures.
.3 When damages occur, remedy damaged items to restore to original or better condition at own expense.

.2 Ensure that ground conditions at pile locations are adequate to support pile driving operation and load testing operation. Make provision for access and support of piling equipment during performance of Work.

3.3 INSTALLATION

.1 Installation of each pile will be subject to review of Departmental Representative.
.1 Departmental Representative will be sole judge of acceptability of each pile with respect to final driving resistance, depth of penetration.
.2 Departmental Representative to review final driving of all piles prior to removal of pile driving rig from site.
.2 Drive each pile to surface of bedrock.
.1 Do not overdrive to cause damage to piles.

3.4 DRIVING

.1 Use driving caps and cushions to protect piles. Reinforce pile heads as required by Departmental Representative. Piles with damaged heads as determined by Departmental Representative will be rejected.

.2 Hold piles securely and accurately in position while driving.

.3 Deliver hammer blows along axis of pile.

.4 Ensure no contact between pile and structure takes place when driving piles adjacent to existing structures.

.5 Restrike already driven piles lifted during driving of adjacent piles to confirm set.

.6 Cut off piles neatly and squarely at elevations as indicated. Provide sufficient length above cut-off elevation so that part damaged during driving is cut off. Do not cut tendons or other reinforcement which will be used to tie sheet piles to each other and to rest piers.

.7 Remove cut-off lengths from site on completion of work.

3.5 DRIVING TOLERANCES

.1 Deviation from vertical not more than 1H:50V out of vertical alignment.

.2 Deviation from the specified inclination for battered piles shall not exceed 1H:25V.

.3 Cut-off elevation +/- 25 mm.

3.6 OBSTRUCTIONS

.1 Where obstruction s encountered that causes sudden unexpected change in penetration resistance or deviation from specified tolerances, remove obstruction.

3.7 REPAIR/RESTORATION

.1 Pull out rejected piles and replace with new piles.

.2 Remove rejected pile and replace with a new, and if necessary, a longer pile.

.3 No extra compensation will be made for removing and replacing or other work made necessary through rejection of defective piles.

3.8 PROTECTION

.1 Protect adjacent structures, services and work of other sections from hazards due to pile driving operations.

.2 Arrange sequencing of pile driving operations and methods to avoid damages to adjacent existing structures. When damages occur, remedy damaged items to restore to original or better condition at own expense.

3.9 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 05 12 33 – Structural Steel for Bridges.

.2 Section 31 61 13 - Pile Foundations, General Requirements.

1.2 MEASUREMENT PROCEDURES

.1 There shall be no measurement for this work.

.2 Supply and installation of associated hardware, welds, anchors and protection of ends will not be measured but considered incidental to the work.

.3 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.3 REFERENCES

.1 ASTM International

.1 ASTM A6/A6M-16A, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling.

.2 ASTM A307-14, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile.

.3 ASTM A615/A615M-16, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.

.4 ASTM A1011/A1011M-15, Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High- Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability, and Ultra High Strength.

.5 ASTM A328/A328M-13A, Standard Specification for Steel Sheet Piling.

.6 ASTM A857/A857M-07(2013), Standard Specification for Steel Sheet Piling, Cold Formed, Light Gage.

.2 CSA International

.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.

.2 CSA G30.18-09(R2014), Carbon and Steel Bars for Concrete Reinforcement.

.3 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.4 CSA S16-14, Design of Steel Structures.

.5 CSA S6-14 Package, Canadian Highway Bridge Design Code.

.6 CSA W59-13, Welded Steel Construction (Metal Arc Welding).

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:
.1 Submit manufacturer's instructions, printed product literature and data sheets for steel sheet piles and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:
.1 Submit steel sheet piles drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.4 Field Quality Control Submittals:
.1 Maintain field driving records for each shell, including elevation of bedrock, driven depth of pile and rock socket depth, cut-off elevation of shell and protruding core.
.2 Provide Departmental Representative with three (3) copies of field records.
.3 Submit detailed method statement and procedures for controlling and monitoring verticality and alignment of piles before starting pile installation.
.4 Submit mill report and results of concrete tests.

.5 Certificates:
.1 Submit two (2) weeks prior to fabrication, two (2) copies of steel producer certificates in accordance with ASTM A1011/A1011M, and mill test reports in accordance with ASTM A328M Grade 50.
.2 Submit copy of certification for fusion welding in accordance with CSA W47.1 Division 1 or Division 2.1.

1.5 QUALITY ASSURANCE

.1 Inspection and testing of steel sheet piling material will be carried out by testing laboratory designated by Departmental Representative at any time during course of Work.

.2 Materials inspected or tested by Departmental Representative which fail to meet contract requirements will be rejected.

.3 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, Contractor to pay costs for additional tests or inspections. Departmental Representative to approve corrected work.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:
.1 Store materials off ground in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect piles from nicks, scratches, and blemishes.
.3 Replace defective or damaged materials with new.

.4 Use slings for lifting piling make sure mass is evenly distributed and piling is not subjected to excessive bending stresses.

.5 Store sheet piling on level ground or provide supports so that sheet piling is level when stored.

.1 Provide blocking at spacing not exceeding 5 m so that there is no excessive sagging in piling.

.2 Overhang at ends not to exceed 0.5 m.

.3 Block between lifts directly above blocking in lower lift.

.6 If material is stock-piled on structure, ensure structure is not overloaded.

.7 Develop Construction Waste Management Plan related to Work of this Section.

.8 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding and packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Steel sheet piles: to ASTM A328M or CSA G40.21, including chemical and mechanical requirements, Grade 50W or Grade 350W, and following:

.2 Continuous interlocking AZ 13-700 section:

.1 As shown on Contract Drawings.

.3 Structural steel for walers, bearing plates, waler splices, capping channels, support angles and miscellaneous steel: to CSA G40.21, Grade 300W.

.4 Bent plates: to the requirements of Section 05 12 33.

2.2 SOURCE QUALITY CONTROL: HOT ROLLED SHEET STEEL PILING

.1 Provide results of tests of sheet piling material to be used on project as follows:

.1 One (1) tension test and one (1) bend test from each heat for quantities of finished material less than 50 tonnes.

.2 Two (2) tension tests and two (2) bend tests from each heat for quantities of finished material exceeding 50 tonnes.

.2 Tension tests in accordance with CSA G40.20/G40.21.

.1 Bend tests: to ASTM A6/A6M.

2.3 SOURCE QUALITY CONTROL: COLD FORMED SHEET STEEL PILING

.1 Provide results of tension tests of sheet piling material to be used on project as follows:

.1 One (1) tension test from each heat for quantities of finished material less than 50 tonnes.

.2 Two (2) tension tests from each heat for quantities of finished material exceeding 50 tonnes.

.2 Tension tests: to CSA G40.20/G40.21.

.3 Provide results of bend tests of sheet piling material to be used on project as follows:
.1 Bend tests: to ASTM A6/A6M, with amendments as follows:
.1 Perform S14.1 bend tests with material in condition as used in cold forming operation. Three (3) tests to be made from each heat and each thickness of material produced. Take bend test specimens from edge of each coil. Longitudinal axis of specimen to be transverse to coil rolling direction.
.2 S14.1.1 - Except as provided below, bend test specimens to have minimum width to thickness ratio of 8, with both edges parallel throughout section in which bending occurs, and is maintained.
.3 S14.2 - Minor surface separations less than 0.8 mm in depth related to superficial steel surface or subsurface discontinuities to not cause rejection. Surface separations in excess of 0.8 mm depth or cracks normal to metal surface are cause for rejection.

PART3 - EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for pile installation in accordance with manufacturer's written instructions.
.1 Visually inspect substrate in presence of Departmental Representative.
.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.
.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 INSTALLATION

.1 Do pile installation Work in accordance with Section 31 61 13 except where otherwise specified.

.2 Do welding in accordance with CSA W59.

.3 Do not begin pile installation until required quality control tests have been completed and test results approved by Departmental Representative.

.4 Submit full details of method and sequence of installation of piling to Departmental Representative for approval prior to start of pile installation work. Details must include templates, bracing, setting and driving sequence and number of piles in panels for driving.

.5 When installing sheet piles in abutment and guide pier wall, use procedure as follows:
.1 Provide temporary templates or bracing to hold piles in alignment during setting and driving.
.2 Drive piles two at a time. Drive first double pile to full depth,

then place panel of five to eight double sheet piles in templates and secure last (end) double pile in location to prevent spreading of piles in panel.

.3 Drive end double pile in panel sufficiently deep into ground to ensure that it will remain plumb, then, drive remaining double piles in panel to full depth beginning with double pile next to end double pile and finishing with double pile next to double pile first driven.

.4 After one panel has been driven, place and drive succeeding panels in similar manner. Complete driving of end double pile of first panel after double piles of second panel have been driven.

.6 When installation is complete, face of wall at top of sheet piles to be within 150 mm of location as indicated and deviation from vertical not to exceed 1 in 100.

3.3 OBSTRUCTIONS

.1 If obstruction encountered during driving, leave obstructed pile and proceed to drive remaining piles. Return and attempt to complete driving of obstructed pile later.

.2 Advise Departmental Representative immediately if impossible to drive pile to full penetration, and obtain direction from Departmental Representative on further steps required to complete Work.

3.4 HOLES

.1 Patch holes in sheet pile wall, except where permanent holes are indicated.

.1 Use plate of material equal to that of piling to patch holes and overlap not less than hole diameter.

.2 Weld to develop full strength of plate.

.3 No patched holes are permitted in piles in surfaces

.2 Drill any required holes in piling. Do not use flame cutting without permission of Departmental Representative.

3.5 CUTTING

.1 When flame cutting tops of piles, and flame cutting holes in piles approved by Departmental Representative, use following procedure:

.1 When air temperature is above 0 degrees C, no pre-heat is necessary.

.2 When air temperature is below 0 degrees C, pre-heat until steel 25 mm on each side of line of cut has reached a temperature very warm to hand (approximately 35 degrees C). Temperature indicating crayon marks may be used to measure temperature.

.3 Use torch guiding device to ensure smooth round holes or straight edges.

.4 Make cut smooth and free from notches throughout thickness. If grinding is employed to remove notch or crack, finished radius to be minimum 5 mm.

3.6 SPLICING

.1 Use full length piles unless splicing is approved on site by Departmental Representative.

3.7 BACKFILL

.1 Do not place backfill or tremie concrete behind sheet piles until they have been completely driven, adjusted and secured in final position.

3.8 PERMANENT ANCHORS OF SHEETS TO TREMIE

.1 Install permanent anchors to secure the sheet piles to the tremie prior to driving sheets.

.2 Permanent anchors to be in accordance with Ontario Provincial Standard Drawing (OPSD) 3000.200.

3.9 MICROPILES

.1 The Contractor is to install micropiles between the sheet pile and the bent plate welded to the lower portion of the sheet piles, as shown on the Contract Drawings.

.2 Sheet piles to be fully installed and secured prior to installing micropiles.

3.10 TREMIE CONCRETE

.1 Prior to placing the tremie concrete, the Contractor shall seal all edges of the sheet piles, to resist the lateral pressure of the tremie and to prevent leakage of material into the canal.

.2 This work is part of the work to install the sheet piles.

.3 Sandbags are shown in the Contract Documents, as a method to seal the sheets from leakage of the tremie at the canal bottom. This is conceptual only and is to be designed by the Contractor.

3.11 BACKFILLING

.1 Backfill as indicated.

.2 Protect piling temporary and permanent anchorage systems from damage or displacement during backfilling operations.

3.12 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.
  .1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 01 35 43 – Environmental Procedures.

.2 Section 01 74 21 - Construction Demolition Waste Management and Disposal

.3 Section 03 20 00 – Concrete Reinforcing.

.4 Section 03 30 00 – Cast-In-Place Concrete.

.5 Section 05 50 00 - Metal Fabrication.

.6 Section 31 23 34 – Excavation for Structure and Backfill to Structure.

.7 Geotechnical Report Repair/Upgrade-Replacement of Hamlet Swing and Fixed Bridges – Report Number: 1659973, January 19, 2018, Golder Associate.

1.2 DESCRIPTION

.1 The work in this section includes, but is not limited to, the following:
.1 Prepare and submit shop drawings for the micropiles.
.2 Supply all components of the micropiles including but not limited to high strength steel reinforcement assemblies, grout, steel casing, bearing plates and nut.
.3 Undertake all testings as specified herein and on the contract drawings.
.4 The working load for the production anchors shall be as indicated on the drawings or on reviewed shop drawings.
.5 Micropiles shall be installed using pressure grouting with provisions for post-grouting. The Contractor is responsible for carrying out the grouting procedures to obtain the required anchor load.
.6 All access, control of effluent during drilling/grouting and all cleanup at the conclusion of the work.

1.3 MEASUREMENT PROCEDURES

.1 There shall be no measurement for this work.

.2 Payment will be under the Contract Lump Sum Amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

1.4 REFERENCES

.1 ASTM International (ASTM)
.1 ASTM A722/A722M-12 Uncoated High-Strength Bar for Prestressing Concrete.
.2 A153 Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
.3 A252-10 Standard Specification for Welded and Seamless Steel Pipe

Piles.
.4 C144-11 Standard Specification for Aggregate for Masonry Mortar.
.5 D1143-07 Standard Test for Deep Foundations Under Static Axial Compressive Load.
.6 D1784-11 Standard Specification for Rigid PVC Compounds and CPVC Compounds.
.7 D3689-07 Standard Test Method for Individual Piles Under Static Axial Tensile Load.
.8 D 4380-84 Standard Test Method for Density of Bentonite Slurries.

.2 CSA International
.1 CSA A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
.2 CSA G30.18-09(R2014), Carbon and Steel Bars for Concrete Reinforcement.
.3 CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
.4 CSA S16-14, Design of Steel Structures.
.5 CSA S6-14 Package, Canadian Highway Bridge Design Code.
.6 CSA W59-13, Welded Steel Construction (Metal Arc Welding).
.7 CSA A283-06 Qualification Code for Concrete Testing Laboratories.

.3 American Welding Society, AWS:
.1 D 1.2 Structural Welding Code – Reinforcing Steel.
.2 D 1.5 Structural Welding Code – Steel.

.4 American Society of Civil Engineers, ASCE:
.1 ASCE 20-96 Standard Guidelines for the Design and Installation of Pile Foundations.

.5 International Organization for Standardization/International Electrotechnical Committee, ISO/IEC:
.1 DIS 17025:1999General Requirements for the Competence of the Testing and Calibration Laboratories.

.6 Others:
.1 Post Tensioning Institute Publications - Recommendations for Prestressed Rock and Soil Anchors – 1996.
.2 Canadian Foundation Engineering Manual (CFEM), 4th Edition.
.3 Federal Highway Administration Publication No. FHWA NHI-05- 039: Micropile Design and Construction.

1.4 DEFINITION

.1 For the purposes of this Special Provision, the following definitions apply:
.1 Admixture means a substance added to the grout to either control bleed and/or shrinkage, improve flowability, reduce water content, retard setting time, or resist washout.
.2 Alignment Load (AL) means a nominal load applied to a micropile during testing to keep the testing equipment correctly positioned.
.3 Apparent Free Micropile Length means the length of micropile that is not bonded to the surrounding ground, as calculated from the elastic movement data during testing.

.4 Bond Length means the length of the micropile that is bonded to the ground and capable of transferring the applied axial loads to the surrounding soil or rock.
.5 Bond-Breaker means a sleeve placed over the reinforcement steel to prevent load transfer.
.5 Casing means a steel pipe introduced during the drilling process to temporarily stabilize the drill hole and/or permanently reinforce the pile.
.6 Centralizer means a device used to centrally locate the reinforcing element(s) within the casing and/or borehole to ensure that minimum grout cover is provided.
.7 Central Bar or Central Steel means steel reinforcing bars or pipes used to strengthen or stiffen the pile, excluding any left-in drill rod or casing.
.8 Coupler means a device used to transmit load from one partial length of reinforcement to another.
.9 Creep Movement means the movement that occurs during the creep test of a micropile under a constant load.
.10 Design Engineer means the Engineer retained by the Contractor who produces the original design and/or Working Drawings.
.11 Design Checking Engineer means the Engineer retained by the Contractor who checks the original design and/or Working Drawings.
.12 Design Load (DL) means the anticipated final maximum service load in the micropile. The design load includes appropriate factors to ensure that the overall structure has adequate capacity for its intended use.
.13 Duplex Drilling means a drilling system involving the simultaneous rotation and advancement of (inner) drill rod and (outer) drill casing in which the cuttings from the inner drill rod exit the borehole via the annulus between the rod and the casing.
.14 Elastic Movement means the recoverable movement measured during a micropile test.
.15 Encapsulation means a corrugated or deformed tube protecting the reinforcing steel against corrosion.
.16 Engineer means a professional engineer, licensed by the Professional Engineers of Ontario to practice in the Province of Ontario.
.17 Free (Unbonded) Length means the designed length of the micropile that is not bonded to the surrounding ground or grout during testing.
.18 Micropile means a bored, cast-in-place pile containing steel reinforcement, designed to accept load (axial, bending or lateral) directly, and transfer it to an appropriate bearing stratum.
.19 Maximum Test Load (TL) means the maximum load to which the micropile is subjected during testing.
.20 Overburden means a non-lithified material, natural or placed, which normally requires cased drilling methods to provide an open borehole to underlying strata.
.21 Post-Grouting means the injection of additional grout into the load transfer length of a micropile after the Primary grout has set.
.22 Pre-Production Micropile means a sacrificial micropile that is not part of the final foundation system and is subjected to load testing to verify the design and installation procedures.
.23 Primary Grout means Portland cement based grout that is injected into the micropile hole prior to or after the installation of the reinforcement to provide the load transfer to the surrounding ground along the micropile and affords a degree of corrosion protection when the micropile is in

compression.

.24 Production Micropile means a micropile that forms part of the final foundation support system to a structure.

.25 Proof Load Test means the incremental loading of a production micropile, recording the total movement at each increment.

.26 Quality Engineer (QE) means an engineer who has a minimum of five (5) years' experience in the field of design and/or installation of micropiling or alternatively has demonstrated expertise by providing satisfactory quality verification services for the work at a minimum of two (2) projects of similar scope to the Contract. The Quality Engineer shall be retained by the Contractor to certify that the work is in general conformance with the Contract Documents and to issue Certificate(s) of Conformance.

.27 Reinforcement Steel means the steel component(s) of the micropile which accepts and/or resists applied loadings. This includes the central steel bar and/or the permanent steel casing.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 One (1) week prior to commencing any work associated with the micropile operation, the Contractor shall submit to the Departmental Representative, a condition survey of property and structures that may be affected by the work. The survey shall include, but not be limited to, the locations and conditions of adjacent properties, buildings, underground structures, utility services and structures such as houses and buildings adjacent to the site.

.3 At least three (3) weeks prior to the commencement of the micropile operations, the Contractor shall submit three (3) copies of the Working Drawings to the Departmental Representative for information purposes only. Information to be shown on the Working Drawings shall describe and illustrate the complete details of the micropile installations, as well as the micropile testing equipment, test set-up, and reaction system(s) for the pre-production and production test micropile(s). This information shall include the following:

.1 Plans, Elevations and Sections (at each foundation element):

.1 Micropile spacing.

.2 Orientation.

.3 Minimum total micropile length.

.4 Casing plunge length.

.5 Uncased bond length.

.6 Design load.

.7 A unique identification number for each micropile.

.8 Micropile components and details.

.2 Materials:

.1 Physical properties of reinforcement steel (central bar and casing), including mill test reports.

.2 Physical properties of pile top attachment.

.3 Bond length grout materials and mix proportions.

.4 Corrosion protection material physical/mechanical properties (if any).

.3 Micropile Installation:
.1 Construction methods.
.2 Work restrictions.
.3 Schedule of major equipment resources.
.4 Sequence of pile installation and coordination of work.
.5 Procedures for monitoring micropile installation.
.6 Type, number and location of pre-production and production load tests.
.7 Method of evaluation of load test results.

.4 Micropile Construction Details:
.1 Detailed description of the proposed construction procedures.
.2 Method of drilling the micropile holes and maintaining the stability of the holes during the micropile installation.
.3 Detailed description of the drilling equipment and materials including drill bit/auger diameter and lengths, casing diameter and lengths, flush type, slurry materials or other materials to facilitate the construction of the micropile hole.
.4 Method of verifying the lengths of micropile holes.
.5 Method of placing and centering the central bar reinforcement steel including the method used to maintain it in the centre of the hole over the design bond length.
.6 Detailed description of the grout mixing procedure and the method of grout installation and placement. The description shall include the grout pressures and details of the procedure(s) for assuring that the annulus between the outside of the micropile casing and bedrock is completely filled with grout during the installation.

.5 All design assumptions, loads, parameters and bond stresses used for production and test micropiles.

.6 Testing records and evaluation when testing has been completed to assess bond stress and micropile movement.

.7 All of the above stamped by the Contractor’s Engineer who is licensed in the Province of Ontario.

.4 The Contractor shall submit to the Departmental Representative at the time of delivery to the job site, one copy of the certified mill test reports, indicating that the steel meets the requirements for the appropriate standards for casing and central bar reinforcement, plates and shapes. The ultimate strength, yield strength, elongation, and material properties composition shall be included. For steel pipe used as permanent casing, or core steel, the Contractor shall submit a minimum of two representative coupon tests or mill certifications on each lot of material delivered to the project.

Where mill test certificates originate from a mill outside Canada or the United States of America the Contractor shall have the information on the mill certificate verified by testing by a Canadian laboratory. The laboratory shall be accredited by a Canadian National Accreditation Body to comply with the requirements of ISO/IEC DIS 17025 for the specific tests or type of tests required by the material standard specified on the mill test certificate. The mill test certificates shall be stamped with the name of the Canadian testing laboratory and appropriate wording stating that the material conforms to the specified material requirements. The

stamp shall include the appropriate material specification number, the date and the signature of an authorized officer of the Canadian testing laboratory.

One copy of the stress-strain curves representative of the lots to be used shall be submitted to the Departmental Representative together with the mill certificates detailed in OPSS 1440.

.5 The Contractor shall submit to the Departmental Representative a suitable, site specific grout mix design, including details of all materials to be incorporated, and the procedure for mixing and placing the grout. This submittal shall include certified test results verifying the acceptability of the proposed mix designs. The acceptability of the mixes will be further verified on site prior to production by casting a series of grout cubes. These cubes are to be tested by the Contractor and the results submitted to the Departmental Representative.

.6 The Contractor shall submit micropile installation records, signed by the Quality Engineer, to the Departmental Representative, within 3 business days after each pile installation (including all test piles and production piles) is completed. The installation records shall include the following information:

.1 Pile identification number and location.

.2 Pile drilling duration, including date of installation and start and finish time.

.3 Pile drilling observations, including nature of and variation in cuttings return, penetration rates for each 0.5 m of penetration, presence of boulders or obstructions, connections between holes, top of bedrock.

.4 Information on depth of drilling and soil and rock types encountered, including description of strata, depth to water, etc.

.5 Sequence of installation.

.6 Inclination and direction.

.7 Final tip elevation.

.8 Casing tip elevation.

.9 Cut-off elevation.

.10 Length and diameters of all components.

.11 Bar length, spacers/coupler details.

.12 Description of unusual installation behaviour, conditions.

.13 Any deviations from the intended parameters, exceptions and “unusual” events.

.14 Grout pressures attained, where applicable.

.15 Grout mix proportions (grout test results provided at 7, 14 and 28 days).

.16 Grout quantities pumped.

.17 Pile materials and dimensions.

.18 Micropile test records, analysis and details.

.19 As-built drawings showing the location of the piles, their depth and inclination, and details of their composition shall be submitted within thirty (30) calendar days of each abutment completion. Locations shall be surveyed by the Contractor providing northing, easting and elevation.

.7 The Contractor shall submit to the Departmental Representative details of the micropile load testing, three (3) weeks prior to construction. The

details shall include the following:

.1 Detailed description of the proposed load testing procedures.

.2 Shop drawings and structural calculations for the design of the pile load testing, including reaction systems. The structural calculations shall confirm that the materials will meet the specified load and movement criteria.

.3 Detailed plans for the set-up method proposed for testing the pre-production and production micropiles including all necessary drawings and details to clearly describe the test method and equipment proposed. Special attention shall be paid to providing adequate structural stability of the reaction piles/ground anchors and loading frame connections. Special attention shall be paid to the method of freeing the upper portion of the test pile from the overburden soils for the pre-production load tests.

.4 Calibration reports for each test jack, pressure gauge, and master pressure gauge to be used. The calibration tests shall have been performed by an independent testing laboratory and tests shall have been performed within one year of the date submitted. Testing shall not commence until the Departmental Representative has reviewed the jack, pressure gauge and master pressure gauge calculations.

.5 All of the above submittals for procedures, calculations and certifications shall have the seal and signature of an Engineer licensed in the Province of Ontario.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Water for mixing grout shall be according to Section 03 30 00.

2.2 ADMIXTURES

.1 Admixtures shall be according to Section 03 30 00. Admixtures which control bleed, allows placement in standing water without washout, improve flowability, reduce water content, and retard set may be used in the grout only if the admixture manufacturer certifies that their use will not affect the required properties of the grout. Expansive admixtures shall only be added to the grout used for filling sealed encapsulations (if used). Accelerators and admixtures with chlorides shall not be permitted. Admixtures shall be compatible with the grout and mixed in accordance with the manufacturer’s recommendations.

2.3 CEMENT

.1 All cement shall be Type GU General Use hydraulic cement conforming to Section 03 30 00 requirements.

2.4 FILLER

.1 Inert fillers such as sand may be used in the grout in special situations (e.g., presence of large voids in the ground, when grout take and travel are to be limited) and only if the Quality Engineer certifies that their use will not affect the required properties of the grout.

2.5 GROUT

.1 The grout mix materials and procedures for placement and testing shall conform to OPSS 1301, OPSS 1302, OPSS 1303, OPSS 1350 and CSA A23.2-1B.

.2 The Contractor shall provide a stable, homogenous neat cement grout or a sand cement grout. The grout shall be free of any lumps and not contain any evidence of poor or incomplete mixing. The grout shall be mixed to the supplier's specification. The water/cement ratio of the grout (by weight) shall not exceed 0.45. The grout shall have the following physical properties:

.1 A minimum compressive strength of 25 MPa at 7 Days.

.2 A minimum compressive strength of 35 MPa at 28 Days.

.3 No segregation and a bleed of less than 2 percent when allowed to stand for 1 hour.

.4 Mix design shall be by the Contractor, to suit his production and testing requirements.

.5 The Contractor shall produce a trial batch and test the grout by casting cubes, curing the cubes and having them broken in a certified laboratory.

2.6 REINFORCING

.1 Steel reinforcing bar shall be high strength Threadbar according to OPSS 1440 Grade 517 MPa. Bar shall meet ASTM A722 (Grade 150).

.2 Couplers for steel reinforcing bar shall be as specified by the supplier of the steel reinforcing bar and shall develop at least 100% of the guaranteed minimum ultimate strength of the reinforcing bar.

.3 The permanent steel casing shall meet the requirements of API N80 (80 ksi).

.1 New "Structural Grade" (a.k.a. "Mill Secondary") steel pipe meeting the above but without Mill Certification is acceptable for use as permanent casing provided it is free from defects (dents, cracks, tears) and is accompanied by two coupon tests per truckload confirming it meets the above requirements.

.2 All casing joints shall be threaded. The casing joints shall develop at least the required compressive, tensile and/or bending strength used in the design of the micropile.

.4 Structural steel plates and shapes for pile top attachments shall be according to CSA G40.21/.20 Grade 350W.

.5 Centralizers shall be fabricated from schedule 40 PVC pipe or tube, steel, or material that is non-detrimental to the reinforcement steel. Wood shall not be used.

2.7 SOURCE QUALITY CONTROL

.1 Materials, fabrication and installation will be subjected to Quality Assurance Inspection by the Departmental Representative or by the organization appointed by the Departmental Representative to ensure that

the Contractor follows specifications, shop drawings and good engineering practice.

PART3 - EXECUTION

3.1 EQUIPMENT

.1 The limited working spacing at the abutments and piers, and the soft/loose subsurface conditions at the abutments may limit the ability to utilize large/heavy pile driving equipment; therefore, suitable equipment shall be used at the site.

.2 All equipment for the installation, testing and monitoring of the pre-production (verification) and production micropiles shall be suitable for the intended purposes and capable of working on the site under the prevailing access and clearance conditions.

.3 The equipment used shall be capable of installing and grouting the micropiles to the prescribed depths or elevations without damage to the pile materials or to the adjacent structures.

.4 All grout mixers, pumps and hoses shall be of an adequate capacity and shall be sized to enable the grout to be pumped in one continuous operation, while keeping the grout in constant agitation prior to pumping, and to allow continuous grouting of an individual micropile within one hour.
.1 A high speed, high shear, colloidal grout mixer with a gauge to measure the quantity of water discharged into the mixer shall be used. A paddle mixer is not acceptable table.
.2 The grout pump(s) shall be equipped with a pressure gauge to monitor grout pressures of at least 1 MPa or twice the actual grouting pressures used, whichever is greater.

.5 Micropile testing equipment shall be capable of loading the test piles to the maximum specified test load (TL) within the rated capacity.
.1 The equipment shall be capable of loading the pile in increments so that the load on the pile can be increased or decreased in accordance with the test procedures outlined in the Contract Documents.
.2 Dial gauges shall have at least a 75 mm travel and longer gauge stems or sufficient gauge blocks shall be provided to allow for greater travel where required. Gauges shall have precision of at least 0.02 mm.
.3 Dial gauges shall allow the measurement of total micropile movement at every load increment to be read to the nearest 0.02 mm increment. The gauge shall have sufficient travel to record the total pile movement at Test Load without the need to reset at an interim point.
.4 Loading equipment shall be calibrated within an accuracy of +/-2% immediately prior to use.
.5 Current calibration curves, bearing the seal and signature of an Engineer shall be provided for all gauges and jacks.

3.2 CONSTRUCTION

.1 The Contractor shall be responsible for the material, fabrication, installation, testing and monitoring of the test micropiles and the

production micropiles. In addition, for non-Owner designed reaction piles/ground anchors, the Contractor shall be responsible for design parameters and the design of the reaction piles/ground anchors.

.2 The drilling and installation method shall allow for all drilled holes to be inspected for cleanliness, depth and diameter prior to placement of any grout and pile reinforcement steel (i.e. permanent casing and reinforcing bar).

.3 The Contractor shall not proceed with the installation of production micropiles until the completion of the pre-production load tests and until approval has been given by the Departmental Representative.

3.3 SUBSURFACE CONDITIONS

.1 A foundation Investigation Report that describes the subsurface conditions for the project is available, as specified elsewhere in the Contract. The Departmental Representative warrants that the information provided in the Foundation Investigation Report can be relied upon with the following limitations and exceptions:

.1 Any interpretation of data or opinions expressed in the reports is not warranted.

.2 Although the raw measured data presented is warranted, the Contractor must satisfy itself as to the sufficiency of the information presented for the intended construction purpose and obtain any updating or additional information as required to facilitate the deep foundation works.

3.4 TRANSPORTATION, HANDLING, STORAGE

.1 Casings and reinforcing bar shall be transported, stored and handled in such a manner that damage and distortion is prevented and that the strength and integrity are maintained.

.2 All materials, including cement, additives for grout and pile reinforcement steel (reinforcing bar and casing) shall be stored off-ground, under cover and protected against moisture and directly from the elements.

.3 Lifting of any casings and bar reinforcement shall not cause excessive bending.

3.5 TESTING REQUIREMENTS

.1 The Contractor shall be responsible for the design of the pile load testing set-up including the reaction systems, the reaction piles/ground anchors and all loading frames and connections.

.1 An ultimate geotechnical resistance factor = 0.5 for the axial geotechnical capacity of the micropiles should be used based on the recommendation in CHBDC (2014) and in Section 5.9.2 (FHWA/NHI 2005), considering the micropile bond zone will be formed in the competent strong to very strong bedrock, and assuming at least one (1) verification test should be conducted prior to commencing production micropile installation.

.2 In consideration of the potential for aggressive ground conditions

at the site, it is recommended to have a minimum 1.6 mm section loss (all around) be included in the design of the outer casing of the micropiles.

.3 The reaction piles/ground anchors and the reaction systems shall be designed to safely withstand the applied loads specified in the Contract Documents.

.4 The design assumptions shall accurately represent the subsurface conditions prevalent at the site.

.5 Except as specified herein, the reaction piles/ground anchors shall be designed in accordance with the design recommendations of the Post Tensioning Institute Recommendations for Prestressed Rock and Soil Anchors and the FHWA Publication NHI-05-039 (most current version).

.6 The reaction piles or ground anchors shall be located no closer than 2 m to the test micropiles.

.7 The maximum load in the reaction piles/ground anchors shall not exceed 80% of the guaranteed minimum ultimate tensile strength of the central bar reinforcement or tendon.

.8 The Contractor shall make provisions, as appropriate and necessary, to ensure safety and structural stability of the reaction piles or ground anchors and their connection to the load frame.

.2 Pre-production tests shall be carried out on sacrificial test micropile(s). Verification tests and proof tests shall be carried out on production micropile(s). The micropile load testing shall be carried out according to the Working Drawings and as specified herein.

.3 The Contractor shall provide to the Departmental Representative a minimum of three (3) Working Days' notice of when the load tests will be carried out. The load tests shall be conducted at a time mutually acceptable to the Contractor and Departmental Representative.

.4 The testing shall not be performed until after the grout in the micropiles (or reaction piles/ground anchors) has reached a minimum 7 Days unconfined compressive strength of 25 MPa.

.5 The load tests shall be closely monitored for the duration of the test by the Contractors Quality Engineer and the test results recorded and submitted to the Departmental Representative.

.6 The layout of the reference systems and testing equipment required for testing shall be as detailed on the Working Drawings prepared by the Contractor and as specified herein.

.1 The Contractor shall supply a suitable means for providing independent reference beams for measuring micropile head movement, jack, electronic load cell, dial gauges or electronic displacement transducers, anchor extension, and any other hardware necessary to carry out the load tests. A minimum of 3 dial gauges or electronic displacement transducers and piano wire, is required. Dial gauges or displacement transducers shall have an accuracy of ±0.0254 mm (0.001 in). Load cells shall have an accuracy of ±2% of the maximum test load. The calibration curve between the jack pressure and the load shall be submitted to the Departmental Representative for information purposes.

.2 All reference beams shall be independently supported with the support firmly embedded in the ground at a distance of not less than 2.5 m from

the reaction system. Reference beams shall be sufficiently rigid to support instrumentation such that variations in readings do not occur.

.3 All gauges, scales and reference points attached to the micropile (or reaction piles/ground anchors) shall be mounted so as to prevent movement relative to the micropile (or reaction piles/ground anchors) during the test.

.4 The jacks shall be secured with chains to provide adequate protection to personnel in the event of breakage of the micropile, ground anchor or loading system.

.7 The Contractor shall perform the micropile load tests according to ASTM D-1143 and ASTM D-3689, superseded where applicable by the procedures specified in this Special Provision, and submit to the Departmental Representative the following information three (3) days prior to the test:

.1 Type and accuracy of apparatus for measuring load.

.2 Type and accuracy of apparatus for applying load.

.3 Type and accuracy of apparatus for measuring the micropile displacement.

.4 Type and capacity of reaction load system, including sealed shop drawings.

.5 Hydraulic jack calibration report.

.8 The Contractor shall perform a pre-production load test on sacrificial micropiles to verify the design assumptions, and the appropriateness of the proposed construction procedures prior to installation of production micropiles.

.1 In the pre-production micropile test, the micropile shall be loaded to failure 2.5 DL in compression.

.2 One (1) sacrificial, vertical micropile to be tested in static compression in the vicinity of the pier.

.3 One (1) sacrificial, battered micropile to be tested in the vicinity of either abutment.

.4 One (1) sacrificial, vertical micropile to be tested in static compression in the vicinity of the opposite abutment to .3 above.

.5 The Contractor shall employ the drilling and grouting methods, casing and other reinforcement details, and depth of embedment for the test micropile identical to those to install the production micropiles, except where specified otherwise by the Departmental Representative. In this regard, the upper portion of the pre-production test micropile, down to the same excavation elevation as the production micropiles is to be free from the overburden soils. The details of the test pile set-up and excavation and/or over-drilling shall be submitted to the Departmental Representative for information purposes only.

.6 The Quality Engineer shall be responsible for logging the holes for the pre-production micropiles to be tested and for the associated reaction piles (ground anchors). The subsurface conditions in terms of stratigraphy at the test locations are required for proper interpretations of the load test results. The Contractor shall also make provisions, as appropriate, to facilitate the Departmental Representative in carrying out their own logging of the holes for the pre-production sacrificial micropile and the association reaction piles.

.7 Upon completion of the sacrificial, pre-production micropile load tests, and prior to demobilization from the site, the test section area

is to be restored to near original conditions as per the direction of the Departmental Representative.

.8 Once the pre-production tests are complete and all test data provided to the Departmental Representative by the Contractor's Quality Engineer, the Departmental Representative shall have two (2) days to review the data before the Contractor commences installing production microplies.

.9 The Contractor shall perform a pre-production micropile axial compression load test on each of the reaction piles (ground anchors).

.10 The loading test increments for the reaction piles shall be as shown in Table 1, Verification Test Load Schedule except on the fourth cycle the loading shall be reviewed after 1.75DL to:

Table 1 - Verification Test Load Schedule

Load	Minimum Hold Time (Minutes)
1.9DL	2.5
2.0DL	2.5
2.1DL	2.5
2.2DL	2.5
2.3DL	2.5
2.4DL	2.5
2.5DL	10*
2.0DL	5
1.5DL	5
1.0DL	5
0.5DL	5

* Hold until acceptance criterion for creep movement is satisfied as specified in this specification.

.9 The Contractor shall perform verification tests on selected production micropiles as follows:

.1 The Contractor shall submit to the Departmental Representative a proposal recommending the production micropile(s) to be selected for testing, however, the final selection will be up to the Departmental Representative.

.2 In the verification micropile test, the production micropile shall be tested to 200% of its Design Load (DL).

.3 The selected micropiles for proof testing will be tested no sooner than 7 Days after installation to allow the grout to reach sufficient strength. It is noted that the use of adjacent vertical micropiles as reaction anchors is acceptable, provided that the minimum spacing requirements between the reaction piles and the test pile (as defined in Section 7.06.02) can be satisfied. The reaction system, including any reaction anchors, if necessary, is to be entirely designed by the Contractor and submitted to the Departmental Representative for information purposes.

.4 The Contractor shall set-up the reaction frame and load test set-up, complete with jacks, load cells and gauges in a manner similar to the pre-production load tests. The Contractor shall repair any previously installed production micropiles that may have been damaged during the course of proof load testing to the approval of the Departmental Representative and at no cost to the Owner.

.10 The Contractor shall perform proof tests on selected micropiles after the verification tests are completed and the results interpreted.

.1 The Contractor shall submit to the Departmental Representative a proposal recommending the production micropile(s) to be selected for testing, however, the final selection will be up to the Departmental Representative.

.2 In the proof micropiles test, the production micropile shall be tested to 160% of its Design Load.

.3 Two (2) battered production micropile from each of the west and east abutments (total four (4)) to be tested in static compression.

.4 The selected micropiles for proof testing will be tested no sooner than 7 Days after installation to allow the grout to reach sufficient strength and allow a minimum of 3 days to interpret the verification test data. It is noted that the use of adjacent vertical micropiles as reaction anchors is acceptable, provided that the minimum spacing requirements between the reaction piles and the test pile (as defined in Section 7.06.02) can be satisfied. The reaction system, including any reaction anchors, if necessary, is to be entirely designed by the Contractor and submitted to the Departmental Representative for information purposes.

.5 The Contractor shall set-up the reaction frame and load test set-up, complete with jacks, load cells and gauges in a manner similar to the pre-production load tests. The Contractor shall repair any previously installed production micropiles that may have been damaged during the course of proof load testing to the approval of the Departmental Representative and at no cost to the Owner.

.11 Verification Test Procedures and Measurement:

.1 The Contractor shall load the tested micropile(s) to a minimum of 200 % of the design load (DL) (i.e., 2.0 DL). The jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test will not be required. The Contractor shall apply an Alignment Load (AL) to the pile prior to setting the movement recording devices. This Alignment Load shall be no more than 10 % of the Design Load (i.e., 0.1 DL). Dial gauges shall be zeroed at the first setting of the AL.

.2 The Contractor shall carry out the axial load test by loading the micropile and recording the micropile head movement according to the load increments presented in Table 3. The Contractor shall maintain each load increment for the minimum duration indicated in Table 3 or until the settlement rate is less than 1 mm/log cycle of time.

Table 3 - Verification Test Load Schedule

Load	Minimum Hold Time (Minutes)
AL	2.5
0.15 DL	2.5
0.30 DL	2.5
0.50 DL	2.5
AL	1
0.15 DL	1
0.45 DL	1

0.60 DL	2.5
0.75 DL	2.5
0.90 DL	2.5
1.00 DL	2.5
AL	1
0.15 DL	1
1.00 DL	1
1.15 DL	2.5
1.30 DL	10*
1.45 DL	2.5
AL	1
0.15 DL	1
1.45 DL	1
1.60 DL	1
1.75 DL	2.5
1.90 DL	2.5
2.00 DL	10*
1.50 DL	5
1.00 DL	5
0.50 DL	5
AL	5

AL = Alignment Load DL = Design Load
* Hold until acceptance criterion for creep movement is satisfied as specified in 3.5.11.2.

.3 The movement of the test pile (or reaction pile/ground anchor) shall be measured at each load increment. The load hold period shall be started as soon as the test load is applied. The pile movement shall be measured and recorded, with respect to a fixed reference, at 1, 2, 3, 4, 5 and 10 minutes, and at 10 minute increments thereafter (if applicable). For durations longer than 60 minutes, take readings at 30 minute intervals (if applicable).

.12 Verification Test Acceptance Criteria:

.1 Sustaining the axial load with no more than 15 mm total vertical movement (at 0.78 DL) and with no more than an additional 3 mm of total vertical movement (from 0.78 DL to 1.00 DL) at the top of the pile, as measured relative to the top of the pile prior to the start of testing. If an Alignment Load is used, then the allowable movement will be reduced by multiplying by a factor of (DL-AL)/DL.

.2 Creep rate at the end of the 2.0 DL increment on Axial Test micropiles not greater than 1 mm/log cycle time from 1 to 10 minutes or 2 mm/log cycle time from 5 to 60 minutes and having a linear or decreasing creep rate.

.3 Failure does not occur at the 2.00 DL axial load. Failure is defined as the slope of the applied load versus deflection (at end of load increment) curve exceeding 0.15 mm/kN.

.4 The above is under the assumption that the test pile has been installed in accordance with the specifications and drawings to a proper standard of care.

.13 Proof Test Procedures and Measurement:

.1 The Contractor shall carry out proof load testing in axial compression and loading in increments to 1.6 DL as shown in Table 4.

Table 4 – Proof Test Load Schedule

Load	Minimum Hold Time (Minutes)
AL	2.5
0.15 DL	2.5
0.30 DL	2.5
0.45 DL	2.5
0.60 DL	2.5
0.75 DL	2.5
0.90 DL	2.5
1.00 DL	2.5
1.15 DL	2.5
1.30 DL	10*
1.45 DL	2.5
1.60 DL	2.5
1.30 DL	4
1.00 DL	4
0.75 DL	4
0.50 DL	4
0.25 DL	4
AL	4

AL = Alignment Load DL = Design Load

* Hold until acceptance criterion for creep movement is satisfied as specified in this specification.

.14 Proof Test Target Criteria:

.1 Total vertical movement at the top of the micropile shall not be greater than 15 mm total vertical movement (at 0.78 DL) and with no more than an additional 3 mm total vertical movement (from 0.78 DL to 1.00 DL), as measured relative to the top of the micropile prior to the start of testing.

.2 Creep rate at the end of the 1.00 DL and 1.60 DL load increments shall not be greater than 1 mm/log cycle of time.

.3 Failure does not occur. Failure is defined as the slope of the applied load versus deflection (at the end of load increments 1.00 DL and 1.60 DL) curve exceeding 0.15 mm/kN.

.15 Installation:

.1 The Contractor shall install the micropiles in accordance with the diameter, orientation and length specified in the Contract Documents and as detailed on the Working Drawings.

.2 The micropile installation technique shall be such that it is consistent with the geotechnical, logistical, environmental, and load carrying conditions of the project.

.3 The micropiles will be installed in close proximity to each other. The Contractor shall carry out the drilling and grouting works in such a manner as to prevent any damage to previously installed micropiles, to prevent any loss of ground, and to prevent ground movement at the adjacent structure.

.4 The available working space is limited. The Contractor shall inspect the work area to ensure that adequate access and headroom are available for the proposed equipment and procedures for the micropile installation work.

.5 The Contractor shall employ drilling equipment and methods suitable for drilling through the anticipated subsurface conditions to be encountered, and cause no damage to these conditions or any overlying or adjacent structure or service. The drill hole must be open to the defined nominal diameter, full length, prior to installing reinforcement steel and prior to placing grout. The Contractor shall use steel casing during drilling to the rock level and installation as required. Bentonite slurries to stabilize the holes are not permitted.

.6 The Contractor shall determine and schedule all installation techniques such that there will be no interconnection or damage to previously installed micropiles.

.7 The Contractor shall be responsible for determining the number of centering devices required. As a minimum, centralizers shall be provided at 3 m centre maximum spacing on reinforcing bar. The uppermost centralizer shall be located a maximum of 1.5 m from the top of the micropile. Centralizers shall permit the free flow of grout without misalignment of the reinforcement.

.8 The central bar reinforcement steel with centralizers shall be lowered into the stabilized, open and unobstructed drill holes to the desired depth.

.9 All pile top elevations shall be surveyed by the Contractor and adjusted to ensure all installed micropiles are installed to the planned elevations.

.10 The pile reinforcement steel connections (splices) shall be constructed using mechanical connectors only, to develop the required design strength of the pile section. The proposed pile splice/connections shall be submitted to the Contract Administrator, for information purposes only, prior to use.

.11 Reinforcement steel bar connections shall not be in the same plane as casing connections/splices. Secure lengths of casing and reinforcement steel central bar to be joined in proper alignments and in such a manner that causes no eccentricity between the axes of the two joined lengths or the angle between them.

.16 Grouting:

.1 The contractor should provide to the Departmental Representative a grout quality control plan, at a minimum including cube or cylinder compression testing and grout density (water/cement ratio) testing for review prior to the construction.

.2 The grout shall be installed as specified in the Contract Documents and as detailed on the stamped Working Drawings provided by the Contractor.

.3 The Contractor shall provide systems and equipment to measure the grout quality and pumping pressure during the grouting operations.

.4 After drilling, the Contractor shall flush the hole to remove drill cuttings and/or other loose debris.

.5 As soon as practical after completion of drilling and installation of reinforcement steel, the Contractor shall inject the grout from the lowest point of the drill hole (by tremie methods) until clean, pure grout flows from the top of the micropile (to be verified by specific gravity testing with a Baroid mud balance). The tremie grout may be pumped through grout tubes or drill rods.

.6 During grouting, the exit of the tremie pipe is to be kept at least 3 m below the level of the grout in the hole.

.7 Subsequent to tremie grouting, all installation operations associated with completion of the micropile must ensure complete continuity of the grout column. The use of compressed air to directly pressurize the fluid grout is not permissible. The grout pressures and grout take volumes shall be controlled for each stage of each pile to prevent excessive heave or fracturing in the foundation soils, rock formations or adjacent structure. The entire micropile shall be grouted to the design cut-off level through the tremie grout tube(s). Grout volumes per micropile shall be calculated and compared with the theoretical volume to confirm minimal grout loss into the rock.

.8 The grout within the micropiles shall attain the minimum design strength prior to being loaded.

.9 Any micropiles not installed according to the specifications shall be replaced, or otherwise remediated appropriately. The cost of replacement and any required foundation modifications are to be carried out at no additional cost to the Owner.

.10 If necessary, the Contractor shall undertake cold weather protection requirements, preparation and protection in accordance with CSA CAN3-A23.1. The temperature of the grout during mixing and pumping shall be maintained between 10°C and 30°C.

.11 Any grout mixture showing evidence of dampness, lumps, harden pieces, or contamination shall not be incorporated in the work.

.17 Grout Testing:

.1 The Contractor shall be responsible for testing of bleeding, preparation, initial storage and testing of grout cubes for determination of compressive strength.

.2 The Contractor shall employ staff from a testing company certified according to CSA A283 - Certification for Additional Tests 1B, by an organization accredited by the Standards Council of Canada, to carry out testing for bleeding, making and curing of grout cubes and early strength determination.

.3 Making of grout cubes for compressive strength test and testing of bleeding, shall be done on a level, vibration free surface.

.4 The Contractor shall perform specific gravity testing using a Baroid mud balance following ASTM D4380-84 on the grout utilized for each and every micropile.

.5 The testing for bleed of the grout shall be according to CSA A23.2-1B.

.6 Prior to the grouting operation, in the presence of the Quality Engineer and the Departmental Representative, a trial batch shall be mixed and the grout tested for bleed, to ensure that the grout meets the requirements specified in the Contract Documents. The trial batch of grout shall not be used in the actual grouting operation unless it meets the requirements for bleed as specified herein.

.7 During the grouting operation, bleeding measurements shall be performed on the grout sampled at the mixer. The measurements shall be performed at least once a day and as requested by the Contract Administrator.

.8 The bleed test results shall be submitted to the Departmental Representative in writing at the end of each calendar day. The test results that indicate the grout is not meeting the requirements of the Contract Documents shall be reported immediately to the Departmental Representative and the grouting operation halted until the cause of the problem is identified and corrected.

.9 Grout cubes shall be prepared as follows on site from the grout pumped into the micropile:

.1 Three sets of grout cubes, consisting of three cubes each, shall be made each day the grouting operations are carried out.

.2 The grout cubes shall be prepared and stored according to CSA A23.2-1B, and shall not be moved prior to demoulding.

.3 The grout cubes shall be demoulded and transported to the laboratory within 24 hours ± 4 hours.

.4 The grout cubes shall be transported in a sealed white opaque plastic bag containing at least 250 mL of water and maintained at a temperature between 15°C and 25°C.

.5 Compressive strength testing shall be carried out on the grout cubes according to CSA A23.2-1B at 3, 7 and 28 Days and the test results provided to the Departmental Representative.

.18 Tolerances:

.1 The allowable tolerances are as follows:

.1 Centreline of the installed micropiles, for micropiles that are not combined with sheet piles, shall not be more than 75 mm from that shown on the Contract Drawings.

.2 Centreline of the installed micropiles that are combined with the abutment sheet piles shall be installed such that they match the sheet pile layout and micropile sleeves that are installed on the inside face of the sheet piles.

.3 Micropile-hole alignment shall be within 2 % of the total-length plan alignment.

.4 Top elevation of micropile shall be within +25 mm or -50 mm maximum of the vertical design elevation.

.5 Centreline of central bar reinforcement shall not be more than 19 mm from centerline of micropile.

.19 Quality Control:

.1 In addition to the information identified above, the Contractor’s Quality Engineer for micropile installation shall:

.1 Provide all test results (including graphs of force /displacement) and the pile pre-production, verification and proof testing. The Certificate of Conformance for each test shall indicate the results meet the general conformance of the specifications.

.2 At the conclusion of installation of the micropiles, provide all identical deliverables in this section and a Certificate of Conformance that the micropile installation has been completed in general conformance with the Contract requirements.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

.1 Department of Justice Canada (Jus).

.1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
.2 Fertilizers Act (R.S. 1985, c. F-10).
.3 Fertilizers Regulations (C.R.C., c. 666).
.4 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.2 Health Canada - Pest Management Regulatory Agency (PMRA).
.1 National Standard for Pesticide Education, Training and Certification in Canada (2004).

.3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
.1 Material Safety Data Sheets (MSDS).

.4 ASTM A1064/A1064M-17, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.

.5 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.2 QUALITY ASSURANCE

.1 Health and Safety:
.1 Do construction occupational health and safety in accordance with Section 01 35 29.

1.3 SCHEDULING

.1 Obtain approval from Departmental Representative of schedule indicating beginning of Work.

1.4 MAINTENANCE DURING WARRANTY PERIOD

.1 From time of acceptance by Departmental Representative to end of warranty period, perform following maintenance operations.

.1 Water to maintain soil moisture conditions for optimum growth and health of plant material without causing erosion.

.2 Apply pesticides in accordance with National Standard for Pesticide Education, Training and Certification in Canada, Federal, Provincial and Municipal regulations as and when required to control insects, fungus and disease. Obtain product approval from Departmental Representative prior to application.

.3 Apply fertilizer in early spring at manufacturer's suggested rate.

.4 Remove dead, broken or hazardous branches from plant material.

PART 2 - PRODUCTS

2.1 MATERIALS

.1 Anti-desiccant: commercial, wax-like emulsion.

.2 Filter Cloth: Biodegradable burlap.

.3 Wood posts: 38 x 89 x 2400 mm length, untreated wood.

.4 Welded wire fabric (WWF): 100 x 100 mm to ASTM A1064/A1064M-17.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND PROTECTION

.1 Do construction occupational health and safety in accordance with Section 01 35 29.

.2 Identify plants and limits of root systems to be preserved as approved by Departmental Representative.

.3 Protect plant and root systems from damage, compaction and contamination resulting from construction as approved by Departmental Representative.

.4 Ensure no pruning is done inside drip line. If pruning inside drip line is required consult an aborist or Canadian Certified Horticultural Technician (CCHT) as approved by Departmental Representative.

3.2 ROOT CURTAIN SYSTEM

.1 Identify limits for required construction excavation as approved by Departmental Representative.

.2 Prior to construction excavation, hand dig trench minimum 500 mm wide x 1500 mm deep, along perimeter of excavation limits.

.3 Prune exposed roots cleanly at side of trench nearest plants to be preserved. Pruned ends to point obliquely downwards.

.4 Install wooden posts and welded wire fabric against construction edge of trench.

.5 Securely attach Type 2 filter fabric on plant side of wire mesh.

.6 Prepare homogeneous mixture of fertilizer, parent material and organic matter.

.1 Add organic matter to mixture to achieve 7-9% organic matter content by weight.

.2 Incorporate with mixture grade 2:12:8 ratio fertilizer (dry) at rate of 1.5 kg/m^3.

.7 Backfill with homogeneous mixture between curtain wall and plants to be preserved in layers not exceeding 150 mm in depth. Compact each layer to 85% Standard Proctor Maximum Dry Density.

.8 Protect root curtain from damage during construction operations.

.9 Water plants and root curtain sufficiently during construction to maintain optimum soil moisture condition until backfill operations are complete.

.10 Protect root curtain before backfill operations. Ensure root curtain is cut down to 300 mm below finished grade and remove cut material.

3.3 ANTI-DESICCANT

.1 Apply anti-desiccant to foliage where applicable and as directed by Departmental Representative.

END OF SECTION

PART 1 - GENERAL

1.1 Measurement Procedures

.1 Payment for the work of supplying and placing Granular 'A' shall be made under the unit price item, "Granular A" (by the tonne) and shall include the costs for all labour, equipment and material necessary to complete the work of installing Granular 'A' in accordance with these Specifications and the Contract Drawings.

1.2 Related Sections

.1 Section 31 23 10 - Earth Excavation.

.2 Section 31 05 17 - Aggregate Materials.

1.3 References

.1 OPSS.PROV 501 November 2014, Compacting

.2 OPSS.PROV 1010 April 2013, Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

.3 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.4 Delivery, Storage and Handling

.1 Deliver and stockpile aggregates in accordance with Section 31 05 17.

PART 2 - PRODUCTS

2.1 Materials

.1 Granular 'A' shall be in accordance with the provisions of OPSS.PROV 1010 April 2013, Aggregates – Base, Subbase, Select Subgrade, and Backfill Material. Maximum aggregate size of 19 mm.

PART 3 - EXECUTION

3.1 General

.1 All granular material shall be placed in small lifts, not to exceed 150 mm, that can be fully compacted to 100% standard proctor density in accordance with the technical provisions of OPSS.PROV 501, Compacting.

END OF SECTION

PART 1 - GENERAL

1.1 Measurement Procedures

.1 Payment for the work of supplying and placing "Granular 'B'" Type II shall be made under the unit price item, "Granular B type II" (by the tonne) and shall include all costs for labour, equipment and material necessary to complete the work of installing Granular 'B' Type II in accordance with these Specifications and the Contract Drawings.

1.2 Related Sections

.1 Section 31 23 10 - Earth Excavation

.2 Section 31 05 17 - Aggregate Materials

.3 Section 32 11 18 - Granular 'A'

1.3 References

.1 OPSS.PROV 501 November 2014, Compacting

.2 OPSS.PROV 1010 April 2013, Aggregates – Base, Subbase, Select Subgrade, and Backfill Material

.3 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

PART 2 - PRODUCTS

2.1 Materials

.1 Granular B to conform to the requirements of OPSS.PROV 1010. Type II, maximum size 26.5mm.

PART 3 - EXECUTION

3.1 General

.1 All granular material shall be placed in small lifts (not to exceed 150 mm) that can be fully compacted to 100% Standard Proctor density in accordance with the technical provisions of OPSS.PROV 501.

END OF SECTION

PART 1 GENERAL

1.1 SECTION INCLUDES

.1 Granular 'A'

1.2 MEASUREMENT AND PAYMENT

.1 Payment for work in accordance with Section 31 05 16 and Section 32 11 18.

1.3 REFERENCES

.1 ASTM International

.1 ASTM C117-17, Standard Test Methods for Material Finer Than 0.075 mm (No. 200) Sieve in Mineral Aggregates by Washing.

.2 ASTM C131/C131M-14, Standard Test Method for Resistance to Degradation of Small- Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.3 ASTM C136/C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.4 ASTM D698-12e2, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400ft-lbf/ft^3) (600kN-m/m^3).

.5 ASTM D1557-12e1, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000ft-lbf/ft^3) (2,700kN-m/m^3).

.6 ASTM D1883-16, Standard Test Method for CBR (California Bearing Ratio) of Laboratory Compacted Soils.

.7 ASTM D4318-17e1, Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 Ontario Provincial Standard Specifications (OPSS)

.1 OPSS.PROV 1004 November 2012, Aggregates – Miscellaneous

.2 OPSS.PROV 1010 April 2013, Aggregates - Base, Subbase, Select Subgrade, and Backfill Material.

.4 Ministry of Transportation (MTO)

.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.4 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 31 05 16.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Granular base: material in accordance with Section 31 05 16 and

OPSS.PROV 1010.
.1 Crushed stone or gravel to OPSS Granular 'A' specifications.
.2 Gradations to be within OPSS limits.

PART 3 EXECUTION

3.1 PREPARATION

.1 Temporary Erosion and Sedimentation Control:
.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings.
.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PLACEMENT AND INSTALLATION

.1 Placing:
.1 Place granular base after subgrade or sub-base surface is inspected and approved in writing by Departmental Representative.
.2 Ensure no frozen material is placed.
.3 Place material only on clean unfrozen surface, free from snow and ice.
.4 For spreading and shaping material, use spreader boxes having adjustable templates or screeds which will place material in uniform layers of required thickness.
.5 Place material to full width in uniform layers not exceeding 150 mm compacted thickness. Departmental Representative may authorize thicker lifts (layers) if specified compaction can be achieved.
.6 Shape each layer to smooth contour and compact to specify density before succeeding layer is placed.
.7 Remove and replace that portion of layer in which material becomes segregated during spreading.

.2 Compaction Equipment:
.1 Ensure compaction equipment is capable of obtaining required material densities.

.3 Compacting:
.1 Compact to density not less than 100% maximum dry density in accordance with ASTM D698/D1557.
.2 Shape and roll alternately to obtain smooth, even and uniformly compacted base.
.3 Apply water as necessary during compacting to obtain specified density.
.4 In areas not accessible to rolling equipment, compact to specified density with mechanical tampers approved in writing by Departmental Representative.
.5 Correct surface irregularities by loosening and adding or removing material until surface is within specified tolerance.

.4 Proof rolling:
.1 For proof rolling use standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to

620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.

.2 Obtain written approval from Departmental Representative to use non-standard proof rolling equipment.

.3 Proof roll at level in granular base as indicated.

.1 If use of non-standard proof rolling equipment is approved, Departmental Representative to determine level of proof rolling.

.4 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.

.5 Where proof rolling reveals areas of defective subgrade:

.1 Remove base, sub-base and subgrade material to a depth as directed by Departmental Representative.

.2 Backfill excavated subgrade and sub-base materials with base material and compact in accordance with Section 32 11 23.

.3 Replace base material and compact in accordance with this Section.

3.3 SITE TOLERANCES

.1 Finished base surface to be within plus or minus 10 mm of established grade and cross section but not uniformly high or low.

3.4 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.2 Divert unused granular material from landfill to local facility approved by Departmental Representative.

3.5 PROTECTION

.1 Maintain finished base in condition conforming to this Section until succeeding material is applied or until acceptance by Departmental Representative.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 32 12 16 - Asphalt Paving.

.2 Section 32 11 23 - Aggregate Base Courses.

1.2 MEASUREMENT PROCEDURES

.1 Asphalt tack coat will be measured in square metres at 15 degrees C of undiluted emulsified asphalt actually applied.

.1 Volume to be corrected to the volume at 15 degrees C to ASTM D1250 for cutback asphalt, and ASTM D633 for tar, and Table IV-3 of the Asphalt Institute's Manual MS-6 for emulsified asphalt.

.2 Water added to emulsified asphalt will not be measured for payment.

1.3 REFERENCES

.1 American Association of State Highway and Transportation Officials (AASHTO).

.1 AASHTO M081-92-UL-04, Standard Specification for Cutback Asphalt (Rapid-Curing Type).

.2 ASTM International.

.1 ASTM D140/D140M-16, Standard Practice for Sampling Bituminous Materials.

.2 ASTM D633-11(2016), Standard Volume Correction Table for Road Tar.

.3 ASTM D1250-08(2013)e1, Standard Guide for Use of the Petroleum Measurement Tables.

.3 Canadian General Standards Board (CGSB).

.1 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.

.4 Ministry of Transportation (MTO)

.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for asphalt tack coat and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Samples:

.1 Submit two - 4 L samples of asphalt tack coat material proposed for use in new, clean, airtight, sealed, wide mouth plastic lined cans to Department Representative, at least 2 weeks prior to beginning Work.

.2 Sample asphalt tack coat material to: D140/D140M-16.

.3 Provide access on tank truck for Department Representative to sample asphalt material to be incorporated into Work to [ASTM D140].

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements in accordance with 01 74 21.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

.3 Recycled Content:

.1 Submit listing of recycled content products used, including details of required percentages of recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

.4 Regional Materials: submit evidence that project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 QUALITY ASSURANCE

.1 Upon request from Department Representative, submit manufacturer's test data and certification that asphalt prime material meets requirements of this Section.

1.6 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Replace defective or damaged materials with new.

.4 Deliver, store and handle materials in accordance with D140/D140M-16.

.5 Provide, maintain and restore asphalt storage area.

.6 Develop Construction Waste Management Plan related to Work of this Section and in accordance with Section 01 74 20.

.7 Packaging Waste Management: remove for reuse and return by manufacturer of asphalt tack coat as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

1.7 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials in accordance with Section 01 74 20.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Anionic emulsified asphalt: to CAN/CGSB-16.2, grade: SS-1.

.2 Cut-back asphalt; to AASHTO M081-92-UL, grade RC-70 or RC-250.

.3 Water: clean, potable, free from foreign matter.

2.2 EQUIPMENT

.1 Equipment required for Work of this Section to be in satisfactory working condition and maintained for duration of Work.

.2 Pressure distributor:

.1 Designed, equipped, maintained and operated so that asphalt material can be:

.1 Maintained at even temperature;

.2 Applied uniformly on variable widths of surface up to 5 m;

.3 Applied at readily determined and controlled rates from 0.2 to 5.4 L/m^2 with uniform pressure and with allowable variation from any specified rate, not exceeding 0.1 L/m^2.

.4 Distribute in uniform spray without atomization at temperature required.

.2 Equipped with meter, registering travel in metres per minute, visibly located to enable truck driver to maintain constant speed required for application at specified rate.

.3 Equipped with pump having flow meter graduated in units of 5 L or less per minute passing through nozzles and readily visible to operator. Pump power unit to be independent of truck power unit.

.4 Equipped with easily read, accurate and sensitive device which registers temperature of liquid in reservoir.

.1 Measure temperature to closest whole number.

.5 Equipped with accurate volume measuring device or calibrated tank.

.6 Equipped with nozzles of same make and dimensions, adjustable for fan width and orientation.

.7 Equipped with nozzle spray bar, with operational height adjustment in increments of 0.6 metres and capable of being raised or lowered.

.8 Cleaned if previously used with incompatible asphalt material.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for asphalt tack coat installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of Departmental Representative.

.2 Inform Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 APPLICATION

.1 Apply asphalt tack coat only on clean and dry surface.

.2 Dilute asphalt emulsion with water at 1:1 ratio for application.

.1 Mix thoroughly by pumping or other method approved by Departmental Representative.

.3 Apply asphalt tack coat evenly to pavement surface at rate between 0.2 to 5.4 L/m^2.

.4 Paint contact surfaces of curbs, gutters, headers, manholes and like structures with thin, uniform coat of asphalt tack coat material.

.5 Ensure that tack coat is not applied to surfaces where asphalt will NOT be applied.

.6 Apply asphalt tack coat only when air temperature is greater than 10 degrees C and when rain is not forecast within 2 hours minimum of application.

.7 Apply asphalt tack coat only on unfrozen surface.

.8 Evenly distribute localized excessive deposits of tack coat by brooming as directed by Departmental Representative.

.9 Where traffic is to be maintained, treat no more than one half of width of surface in one application.

.1 Control traffic in accordance with Section 01 35 00.06.

.10 Keep traffic off tacked areas until asphalt tack coat has set.

.11 Re-tack contaminated or disturbed areas as directed by Departmental Representative.

.12 Permit asphalt tack coat to set before placing asphalt pavement.

.13 Submit summary report within 7 days minimum of date of application and include information as follows:

.1 Total area tack coated.

.2 Quantity of tack coat used.

.3 Mean application rate.

.4 Actual product quantity used when using equipment on pressure distributors.

.5 Dipstick measurements or electronic printouts are acceptable.

.14 Carry out measurements in presence of Departmental Representative upon request.

.15 Inspect tack coat application to ensure uniformity.

.1 Re-spray areas of insufficient or non-uniform tack coat coverage as directed by Departmental Representative.

.2 Ensure tack coating performed using hand held devices is consistent in appearance with adjacent areas of machine applied material.

3.3 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section - 01 74 11.

.3 Waste Management: separate waste materials in accordance with Section 01 74 20.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 31 05 17 – Aggregate Materials

1.2 DESCRIPTION

.2 The work includes the supply, placement and compaction of HL3 and HL8 hot mix asphalt, sawcutting in asphalt pavements, pavement cleaning, tack coat, cold planing to create stepped joints and elsewhere as required and asphalt patch repair.

.3 This work is intended to cover the placement of asphalt within the limits as called for on the drawings and, any remediation work necessary should the existing roadway be damaged during construction activities.

1.3 MEASUREMENT AND PAYMENT

.1 Payment for the items "Hot Mix Asphalt HDBC" and, "Hot Mix Asphalt HL1" shall be by the tonne. All costs associated with the work of supply and placement of asphalt shall be included in the contract unit prices for these items.

.2 All labour, equipment and material necessary to complete the work in accordance with these specifications and Contract Drawings shall be included. The following shall be included in the above items, no additional payment shall be made for:

1. Sawcutting
2. Pavement cleaning
3. Tack coat
4. Cold Planing to fully tie in and place the asphalt
5. The supply and installation of hot poured rubberized asphalt joint sealant at sawcut joints

1.4 REFERENCES

.1 CAN/CGSB-8.2-M88, Sieves Testing, Woven Wire, Metric.

.2 CAN/CGSB-16.2-M89, Emulsified Asphalts, Anionic Type, for Road Purposes.

.3 CAN/CGSB-16.3-M90, Asphalt Cements for Road Purposes.

.4 ASTM C88-13, Test Method for Soundness of Aggregates by Use of Sodium Sulphate or Magnesium Sulphate.

.5 ASTM C117-17, Test Method for Material Finer Than 0.075mm (No.200) Sieve in Mineral Aggregates by Washing.

.6 ASTM C123/C123M-14, Test Method for Lightweight Pieces in Aggregate.

.7 ASTM C127-15, Test Method for Density, Relative Density (Specific Gravity) and Absorption of Coarse Aggregate.

.8 ASTM C128-15, Test Method for Specific Gravity and Absorption of Fine Aggregate.

.9 ASTM C131/C131M-14, Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine.

.10 ASTM C136/C138M-14, Method for Sieve Analysis of Fine and Coarse Aggregates.

.11 ASTM D140/D140M-16, Practice for Sampling Asphalt Materials.

.12 ASTM D995-95b(2002), Specification for Requirements for Mixing Plants for Hot-Mixed, Hot-Laid Bituminous Paving Mixtures.

.13 ASTM D2419-14, Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

.14 ASTM D3203/D3202M-17, Test Method for Percent Air Voids in Compacted Dense and Open Bituminous Paving Mixtures.

.15 ASTM D4791-10, Test Method for Flat and Elongated Particles in Coarse Aggregate.

.16 Asphalt Institute MS-2-2015 Sixth Edition, Mix Design Methods for Asphalt Concrete and Other Hot-Mix Types.

.17 OPSS.MUNI 310 November 2017, Construction Specification for Hot Mixed, Hot Laid Asphaltic Concrete Paving and Hot Mix Patching

.18 OPSS.PROV 914 November 2014, Waterproofing Bridge Deck with Hot Applied Asphalt Membrane

.19 OPSS 1001 November 2013, Aggregates - General

.20 OPSS.PROV 1003 November 2017, Aggregates - Hot Mix Asphalt

.21 OPSS.PROV 1101 November 2014, Asphalt Cement

.22 OPSS.PROV 1103 November 2016, Emulsified Asphalt

.23 OPSS 1150 November 2010, Hot Mix Asphalt

.24 OPSS.PROV 1151 November 2016, Superpave and Stone Mastic Asphalt Mixtures

.25 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.5 PRODUCT DATA

.1 Upon request submit manufacturer's test data and certification that asphalt cement meets requirements of this section.

1.6 SAMPLES

.1 Submit samples in accordance with Section 01 33 00.

.2 Provide design mix 2 weeks prior to commencing work.

.3 Inform Departmental Representative of proposed source of aggregates and provide access for sampling at least 2 weeks prior to commencing work.

.4 Submit samples of following materials proposed for use at least 2 weeks prior to commencing work:

1. One L container of asphalt cement if specifically requested by Departmental Representative. Provide name of supplier to Departmental Representative such that the necessity of supplying samples can be assessed.

PART 2 - PRODUCTS

2.1 MATERIALS AND MIX DESIGN

.1 Asphalt cement shall meet the requirements of OPSS.PROV 1101, shall be in accordance with the MTO Guide for the use of Performance Grade Asphalt Cement (PGAC), a PGAC grading of 64-28 will be used for this roadway.

.2 HL3 and Medium Duty Binder Course shall meet the requirements of OPSS.MUNI 310 and OPSS 1150.

.3 Mix designs will be the responsibility of the Contractor.

.4 The requirements of OPSS 1150 Table 3 for AADT >5000 shall apply. Marshall stability shall be a minimum of 8900 for HL3

.5 No recycled material will be permitted for this project.

PART 3 - EXECUTION

3.1 GENERAL

.1 The quantity of asphalt required to repair the roadway at the bridge is relatively small but involves multiple lifts of asphalt. The asphalt of each layer must be allowed to thoroughly cool in a natural manner. Methods such as using cooling water that cools the surface of a layer are not sufficient to allow multiple lifts to be delivered in one truck even with the use of box heaters. It is expected and required that a mobilization will be used for each lift.

.2 Asphalt shall be placed using good practices and appropriate cooling times. The roadway shall be constructed in the same manner as an arterial roadway.

3.2 EQUIPMENT

.1 Equipment to be in accordance with OPSS 310.

3.3 PLANT

.1 Plant to be in accordance with OPSS 1150.

.2 Plant to be MTO approved.

3.4 PREPARATION

.1 Prior to applying tack coat, clean surfaces of loose and foreign material.

.2 Apply tack coat evenly to clean dry pavement surface, not exceeding 0.5 L/m2 prior to paving on existing asphalt surface or prior to surface course paving.

.3 Mill existing asphalt and concrete surface, as indicated or directed, and clean milled surfaces from dust.

3.5 TRANSPORTATION OF MIX

.1 Transport mix to job site in vehicles cleaned of foreign material.

.2 Paint or spray truck beds with limewater, soap or detergent solution, or non petroleum based commercial product, at least daily or as required. Elevate truck bed and thoroughly drain. No excess solution to remain in truck bed.

.3 Deposit mix from surge or storage silo to trucks in multiple drops to reduce segregation. Do not dribble mix into trucks.

.4 Deliver material to paver at uniform rate and in an amount within capacity of paving and compacting equipment.

.5 Deliver loads continuously in covered vehicles and immediately spread and compact. Deliver and place mixes at temperature within range as directed by the Departmental Representative, but not less than 135°C.

3.6 PLACING AND COMPACTING

.1 Place asphalt concrete to thicknesses, grades and lines as indicated on the contract drawings.

.2 Placing of asphalt will be in accordance with OPSS 310

3.7 ASPHALT THICKNESS

.1 The asphalt thickness of the lifts off the structure shall match those shown on the drawing or in cases where paving is occurring over existing asphalt shall have a minimum lift thickness of 40 mm.

3.8 FINISH TOLERANCES

.1 Finished asphalt surface to be within 6 mm of design elevation but not uniformly high or low.

.2 Finished asphalt surface not to have irregularities exceeding 6 mm when checked with 4.5 m straight edge placed in any direction.

.3 At the abutment, asphalt shall be finished within 3 mm and have no rutting.

3.9 DEFECTIVE WORK

.1 Correct irregularities which develop before completion of rolling by loosening surface mix and removing or adding material as required. If irregularities or defects remain after final compaction, remove surface course promptly and lay new material to form true and even surface and compact immediately to specified density.

.2 Repair areas showing checking, rippling, or segregation.

.3 Adjust roller operation and screed settings on paver to prevent further defects such as rippling and checking of pavement.

3.10 ASPHALT PATCHING

.1 Asphalt patching on the approaches to the bridge shall include sawcutting and cold planning of the area as shown on the drawing and as directed by the Departmental Representative, for the placement of asphalt.

.2 Asphalt shall include one base course of Medium Duty Binder Course asphalt paving and one lift of HL3 top course.

END OF SECTION

PART 1 GENERAL

1.1 RELATED SECTIONS

.1 Section 31 22 13 – Rough Grading

.2 Section 31 23 33.01 – Excavating, Trenching and Backfilling.

1.2 REFERENCES

.1 Ministry of Transportation (MTO)
.1 Designated Sources of Materials (DSM):
http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.3 MEASUREMENT PROCEDURES

.1 Measurement and Payment:

.1 Payment for work associated with Roadway Dust Control is included in the Contract Combined Price.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Water: to Department Representative's approval.

PART 3 EXECUTION

3.1 APPLICATION

.1 Apply water with equipment approved by Departmental Representative and when directed by Departmental Representative.

.2 Apply water with distributors equipped with means of shut-off and with spray system to ensure uniform application.

END OF SECTION

PART 1 – GENERAL

1.1 DESCRIPTION

.1 This item is for the white dashed and solid lane lines, including stop bar markings, white dashed and solid bike lane lines, white edge lines and yellow directional dividing lines as shown on the Contract Drawings and/or directed by the Departmental Representative.

1.2 MEASUREMENT AND PAYMENT

.1 Measurement for payment shall be by the horizontal length in metres of 10 cm wide lines, excluding gaps. Wider lines shall be measured in 10 cm equivalents.

.2 Payment shall be made at the unit price and shall be full compensation for all labour, materials and equipment required to complete this work as specified in the Contract Documents.

1.3 REFERENCES

.1 OPSS 710 November 2010, Pavement Markings

.2 OPSS 1713 February 1991, Thermoplastic Pavement Marking Materials

.3 OPSS 1714 February 1991, Field Reacted Polymeric Pavement Marking Materials

.4 OPSS 1750 December 1983, Traffic Paint Reflectorized Glass Beads

.5 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

PART 2 – PRODUCTS

2.1 MATERIALS

.1 All non-coning permanent durable markings and reflectorizing glass beads supplied for the Work under this Contract shall be from sources indicated in the Ministry of Transportation's Designated Sources Manual (DSM).

.2 Non-coning permanent durable markings shall meet the requirements of OPSS 1713 or OPSS 1714, and reflectorizing glass beads shall meet the requirements of OPSS 1750.

.3 The Contractor shall provide proof that the material is from an approved source under the Ministry of Transportation's DSM and meets the requirements of the applicable OPSS, referenced above.

PART 3 – EXECUTION

3.1 EXECUTION

.1 Scope of Work

.1 The Contractor shall supply and apply reflectorized, non-coning, permanent durable pavement markings.

.2 The Contractor shall provide premarking to establish the position of all pavement markings in accordance with OPSS 710.

.3 The Contractor shall ensure that all freshly painted lines are protected from being tracked or smeared by the travelling public, by the use of appropriate traffic control measures.

.4 A self-propelled pavement marking unit, capable of producing top quality markings, with true edges, free from waviness or variations, shall be used. The unit shall have positive skip line mechanisms capable of varying both line and skip distances from a 3 metre line and a 3 metre skip to a 3 metre line and a 6 metre skip to a 3 metre line and a 9 metre skip. The unit shall be capable of spraying paint and glass beads at the rate required. The lane line unit shall be equipped with two tanks with a minimum combined capacity to hold 1900 litres of paint, three paint guns (two left and one right), two outboard booms (one left and right), paint heaters, paint pumps and a pressurized glass bead system with dispensers. The unit shall have a large sign with a checkerboard border mounted on the rear of the vehicle to advise motorists that line painting operations are in progress and shall be equipped with a full complement of lights for safety.

.2 Equipment Requirements

.1 Minimum two (2) safety warning trucks equipped with a full complement of lights for safety.

.2 Rotating amber lights mounted on each vehicle and clearly visible from the front and the rear of each vehicle.

.3 Four (4) way flashers on each vehicle.

.4 Rear mounted bi-directional arrow board sign (TC 12), in accordance with the Ontario Traffic Manual, Book 7, for each vehicle.

.5 All vehicles shall be equipped with a mobile radio for direct truck to truck communication.

.6 The equipment shall be subject to inspection and approval by the Departmental Representative.

.3 Operations

.1 The Contractor shall ensure that all pavement marking work is carried out in accordance with OPSS 710 and as amended herein:

.2 Traffic control shall be maintained in accordance with the requirements of the Ontario Traffic Manual, Book 7. The Contractor shall ensure that freshly painted lines are not tracked or smeared by motorists.

.3 All work shall be carried out in compliance with the Occupational Health and Safety Act, Highway Traffic Act and Environmental Protection Act and all applicable regulations of these statutes.

.4 Actual painting operations shall be restricted to the hours between 9:00 a.m. and 4:00 p.m. These hours of work may be extended only with the prior written approval of the Departmental Representative.

.5 Pavement marking work shall be conducted by qualified operators who have all of the necessary licensing requirements to carry out the work.

.6 Paint application shall have a wet film thickness of 0.40 mm and a dry film thickness of 0.30 mm, plus or minus 10%. No paint thinners shall be used. The rate of paint application shall be a minimum of 20 metres per litre and a maximum of 18 metres per litre.

.7 Glass beads shall be applied at the rate of 0.7 kg/litre of raw paint applied.

.8 The minimum width of line applied shall not be less than 100 mm. Where double line is applied, the space between the two lines shall not be less than 100 mm. The maximum width of the above described line or space shall not exceed 115 mm.

.9 Centre line markings shall be yellow 10 cm wide line(s).

.10 Pavement markings shall be applied when the temperature is above 10 degrees Celsius and the pavement is completely dry, as determined by the Departmental Representative.

.11 Any workmanship that does not conform to the requirements of OPSS 710, as amended herein, shall be corrected at the Contractor's expense.

.12 The Contractor shall correct any severe tracking situation which was created by the Contractor, or as a result of poor traffic control operations or other errors/omissions on the part of the Contractor.

END OF SECTION

PART 1 - GENERAL

1.1 MEASUREMENT PROCEDURES AND PAYMENT

.1 Preparation of sub-grade for placing of topsoil will not be measured for payment and shall be included in the supply of topsoil.

.2 Topsoil stripping will not be measured.

.3 Measurement for payment of topsoil for the restoration of the areas disturbed by construction shall per each square metre of topsoil satisfactorily placed to the specified depth of topsoil.

.4 Specified depth of topsoil: as shown on drawings and approved by Departmental Representative after settlement and consolidation.

.5 Payment shall be made at the unit price and shall be full compensation for all labour, equipment and materials required to complete this work as specified.

1.2 REFERENCES

.1 Agriculture and Agri-Food Canada
.1 The Canadian System of Soil Classification, Third Edition, 1998.

.2 Canadian Council of Ministers of the Environment
.1 PN1340-2005, Guidelines for Compost Quality.

.3 U.S. Environmental Protection Agency (EPA)/Office of Water
.1 EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.4 Ministry of Transportation (MTO)
.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.3 DEFINITIONS

.1 Compost:
.1 Mixture of soil and decomposing organic matter used as fertilizer, mulch, or soil conditioner.
.2 Compost is processed organic matter containing 40% or more organic matter as determined by Walkley-Black or Loss On Ignition (LOI) test.
.3 Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth C:N ratio below 25, and contain no toxic or growth inhibiting contaminates.
.4 Composed bio-solids to: CCME Guidelines for Compost Quality, Category (A) (B).

1.4 SUBMITTALS

.1 Provide submittals in accordance with Section 01 33 00.

.2 Quality control submittals:
.1 Soil testing: submit certified test reports showing compliance with specified performance characteristics and physical properties as described in PART 2 - SOURCE QUALITY CONTROL.
.2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 QUALITY ASSURANCE

.1 Pre-installation meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Divert unused soil amendments from landfill to official hazardous material collections site approved by Departmental Representative.

.3 Do not dispose of unused soil amendments into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 GENERAL

.1 Topsoil: mixture of particulates, micro organisms and organic matter which provides suitable medium for supporting intended plant growth.
.1 Soil texture based on The Canadian System of Soil Classification, to consist of 20 to 70% sand, minimum 7% clay, and contain 2 to 10% organic matter by weight.
.2 Contain no toxic elements or growth inhibiting materials.
.3 Finished surface free from:
1. Debris and stones over 25 mm diameter.
2. Course vegetative material, 10 mm diameter and 100 mm length, occupying more than 1% of soil volume.
.4 Consistence: friable when moist.

2.2 SOIL AMENDMENTS

.1 Fertilizer:
.1 Fertility: major soil nutrients present in following amounts:
.2 Nitrogen (N): 20 to 40 micrograms of available N per gram of topsoil.
.3 Phosphorus (P): 40 to 50 micrograms of phosphate per gram of topsoil.
.4 Potassium (K): 75 to 110 micrograms of potassium per gram of topsoil.
.5 Calcium, magnesium, sulfur and micro-nutrients present in balanced ratios to support germination and/or establishment of intended vegetation.

.6 Ph value: 6.5 to 8.0.

.2 Peat moss:
.1 Derived from partially decomposed species of Sphagnum Mosses.
.2 Elastic and homogeneous, brown in colour.
.3 Free of wood and deleterious material which could prohibit growth.
.4 Shredded particle minimum size: 5 mm.

.3 Sand: washed coarse silica sand, medium to course textured.

.4 Organic matter: compost Category A in accordance with CCME PN1340, unprocessed organic matter, such as rotted manure, hay, straw, bark residue or sawdust, meeting the organic matter, stability and contaminant requirements.

.5 Use composts meeting Category B requirements for land fill reclamation and large scale industrial applications.

.6 Limestone:
.1 Ground agricultural limestone.
.2 Gradation requirements: percentage passing by weight, 90% passing 1.0 mm sieve, 50% passing 0.125 mm sieve.

.7 Fertilizer: industry accepted standard medium containing nitrogen, phosphorous, potassium and other micro-nutrients suitable to specific plant species or application or defined by soil test.

2.3 SOURCE QUALITY CONTROL

.1 Advise Departmental Representative of sources of topsoil and manufactured topsoil to be utilized with sufficient lead time for testing.

.2 Contractor is responsible for amendments to supply topsoil as specified.

.3 Soil testing by recognized testing facility for PH, P and K, and organic matter.

.4 Testing of topsoil will be carried out by testing laboratory designated by Departmental Representative.
1. Soil sampling, testing and analysis to be in accordance with Provincial standards.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.
.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 PREPARATION OF EXISTING GRADE

.1 Grade soil, eliminating uneven areas and low spots, ensuring positive drainage.

.2 Remove debris, roots, branches, stones in excess of 25 mm diameter and other deleterious materials.
.1 Remove soil contaminated with calcium chloride, toxic materials and petroleum products.
.2 Remove debris which protrudes above surface.
.3 Dispose of removed material off site.

.3 Cultivate entire area which is to receive topsoil to minimum depth of 100 mm.
.1 Cross cultivate those areas where equipment used for hauling and spreading has compacted soil.

3.3 PLACING AND SPREADING OF TOPSOIL/PLANTING SOIL

.1 Place topsoil after Departmental Representative has accepted subgrade.

.2 Spread topsoil in uniform layers not exceeding 150 mm.

.3 For sodded areas keep topsoil 15 mm below finished grade.

.4 Spread topsoil to following minimum depths after settlement.
1. 135 mm for sodded areas.

.5 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

3.4 FINISH GRADING

.1 Grade to eliminate rough spots and low areas and ensure positive drainage.
.1 Prepare loose friable bed by means of cultivation and subsequent raking.

.2 Consolidate topsoil to required bulk density using equipment approved by Departmental Representative.
.1 Leave surfaces smooth, uniform and firm against deep footprinting.

3.5 ACCEPTANCE

.1 Departmental Representative will inspect and test topsoil in place and determine acceptance of material, depth of topsoil and finish grading.

3.6 CLEANING

.1 Proceed in accordance with Section 01 74 11.

.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 GENERAL

1.1 REFERENCES

.1 Ministry of Transportation (MTO)

.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.2 MEASUREMENT PROCEDURES

.1 Payment for sodding will be made at unit price bid of actual area surface measurements taken and computed by Departmental Representative for:

.1 Turf Grass Nursery Sod per square metre.

1.3 SUBMITTALS

.1 Samples.

.1 Submit samples in accordance with Section 01 33 00.

.2 Obtain approval of samples by Department Representative.

1.4 QUALITY ASSURANCE

.1 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.

.2 Certificates: product certificates signed by sod nursery certifying materials comply with specified performance characteristics and criteria and physical requirements.

.3 Pre-Installation Meetings: conduct pre-installation meeting to verify project requirements, installation instructions and warranty requirements.

1.5 SCHEDULING

.1 Schedule sod laying to coincide with preparation of soil surface.

.2 Schedule sod installation when frost is not present in ground.

1.6 WASTE MANAGEMENT AND DISPOSAL

.1 Separate and recycle waste materials in accordance with Section 01 74 20.

.2 Divert unused fertilizer from landfill to official hazardous material collections site approved by the authority having jurisdiction and the Departmental Representative.

.3 Do not dispose of unused fertilizer into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop.

.1 Turf Grass Nursery Sod types:

.1 Number One Named Cultivars: Nursery Sod grown from certified seed.

.2 Turf Grass Nursery Sod quality:

.1 Not more than 2 broadleaf weeds or 10 other weeds per 40 square metres.

.2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.

.3 Mowing height limit: 35 to 65 mm.

.4 Soil portion of sod: 6 to 15 mm in thickness.

.2 Water:

.1 Supplied and paid for by Contractor from a designated source.

.3 Fertilizer:

.1 Supply fertilizer to Canada Fertilizers Act.

.2 Supply in bags bearing the manufacturer’s label indicating weight and guaranteed analysis.

.3 Fertilizer shall be in granular form, dry, free-flowing without lumps.

.4 Minimum analysis shall be: 16% nitrogen, 3% phosphorus and 15% potash. The guaranteed ratio shall be 3-1-2.

.5 The total nitrogen component of the fertilizer shall be a minimum of 30% water soluble nitrogen (controlled, slow release nitrogen) by weight.

2.2 SOURCE QUALITY CONTROL

.1 Obtain approval from Departmental Representative of sod at source.

.2 When proposed source of sod is approved, use no other source without written authorization from Departmental Representative.

PART 3 EXECUTION

3.1 PREPARATION

.1 Verify that grades are correct and prepared in accordance with Section 32 91 19.13. If discrepancies occur, notify Department Representative and do not commence work until instructed by Department Representative.

.2 In general, sod is to be placed in the boulevard space between the curb and the sidewalk and behind the sidewalk where the sidewalk abuts private property and landscaped areas.

.3 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.

.4 Fine grade surface free of humps and hollows to smooth, even grade, and elevations indicated, to tolerance of plus or minus 8b mm, for Turf Grass Nursery Sod.

.5 Remove and dispose of weeds; debris; stones of 50 mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; off site.

3.2 SOD PLACEMENT

.1 Lay sod within 24 hours of being lifted if air temperature exceeds 20 degrees C.

.2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Cut out irregular or thin sections with sharp implements.

.3 Roll sod as directed by Department Representative. Provide close contact between sod and soil by light rolling. Use of heavy roller to correct irregularities in grade is not permitted.

.4 Areas to be sodded include, but not limited to, the following:

.1 Boulevard area between sidewalk and curb;

.2 Area immediately behind sidewalk against private property;

.3 Area around the Bridge Control Building.

3.3 SOD PLACEMENT ON SLOPES AND PEGGING

.1 Install and secure geotextile fabric in areas indicated, in accordance with manufacturer's instructions.

.2 Start laying sod at bottom of slopes.

.3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1m of catch basins and drainage channels and ditches to following pattern:

.1 100 mm below top edge at 200 mm on centre for first sod sections along contours of slopes.

.2 Not less than 3-6 pegs per square metre.

.3 Not less than 6-9 pegs per square metre in drainage structures. Adjust pattern as directed by Departmental Representative.

.4 Drive pegs to 20 mm above soil surface of sod sections.

3.4 FERTILIZING PROGRAM

.1 Fertilizer shall be applied uniformly to the surface area designated for sodding a maximum of 48 hours prior to the laying of sod and at the rate specified on the bag supplied by the manufacturer.

.2 Supply a second application of fertilizer at the start of the growing season in the year following initial placement of sod.

3.5 MAINTENANCE DURING ESTABLISHMENT PERIOD

.1 Perform following operations from time of installation until acceptance.

.2 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100 mm.

.3 Cut grass to 50 mm when or prior to it reaching height of 75 mm. Remove clippings which will smother grassed areas.

.4 Maintain sodded areas weed free 95%.

.5 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.

3.6 ACCEPTANCE

.1 Turf Grass Nursery Sod areas will be accepted by Departmental Representative provided that:

.1 Sodded areas are properly established.

.2 Sod is free of bare and dead spots.

.3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.

.4 Sodded areas have been cut minimum 2 times prior to acceptance.

.2 Areas sodded in the Fall of the year will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.7 MAINTENANCE DURING WARRANTY PERIOD

.1 Perform following operations from time of acceptance until end of warranty period:

.1 Water sodded Turf Grass Nursery Sod areas at weekly intervals to obtain optimum soil moisture conditions to depth of 100 mm.

.2 Repair and re-sod dead or bare spots to satisfaction of Departmental Representative.

.3 Cut grass and remove clippings as directed by Departmental Representative to height as follows:

.1 Turf Grass Nursery Sod:

.1 50 mm during normal growing conditions.

.2 Cut grass at 2 week intervals but, as a minimum, at intervals so that approximately one third of growth is removed in single cut.

.3 Fertilize areas in accordance with fertilizing program. Spread half of required amount of fertilizer in one direction and remainder at right angles.

.4 Eliminate weeds by mechanical means to extent acceptable to Departmental Representative.

3.8 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 31 23 10 – Earth Excavation

.2 Section 32 11 18 – Granular 'A'

.3 Section 32 11 19 – Granular 'B'

1.2 DESCRIPTION

.1 The work of this section covers the installation of all catch basins, maintenance holes and ditch inlet structures as shown in the Contract Documents.

1.3 MEASUREMENT AND PAYMENT

.1 Measurement for payment of maintenance holes and catch basin structures shall be "each" unless otherwise indicated in the Contract Plans and/or by the Departmental Representative.

.2 Payment at the applicable unit price for these items shall be full compensation for all labour, equipment and materials required to complete this work, including the installation of all frames with grates or covers as specified in the Contract Drawings.

.3 A 150 mm diameter perforated pipe shall be installed into main line maintenance holes as shown on OPSD 809.010. Payment for this work will be made at the unit price for pipe sub drains.

.4 Connections of sewer pipes and subdrain shall be cored into the structure unless pre-cut holes at the proper locations are available. The Contractor shall place grout on the walls of the connection holes before inserting the pipes and shall parge the inside and outside of the structure.

1.4 REFERENCES

.1 OPSS.PROV 180 November 2016, Management Of Excess Materials

.2 OPSS.PROV 206 November 2014, Grading

.3 OPSS.PROV 209 November 2014, Swamp Excavation

.4 OPSS.MUNI 353 November 2016, Concrete Curb and Gutter Systems

.5 OPSS.PROV 402 April 2017, Excavating, Backfilling, And Compacting For Maintenance Holes, Catch Basins, Ditch Inlets, And Valve Chambers

.6 OPSS.PROV 403 April 2017, Rock Excavation for Pipelines, Utilities, and Associated Structures in Open Cut

.7 OPSS.PROV 404 November 2017, Support Systems

.8 OPSS 407 November 2015, Maintenance Hole, Catch Basin, Ditch Inlet, And Valve Chamber Installation

.9 OPSS 408 November 2015, Adjusting or Rebuilding Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

.10 OPSS 490 April 2016, Site Preparation for Pipelines, Utilities, and Associated Structures

.11 OPSS.PROV 491 November 2017, Preservation, Protection, and Reconstruction of Existing Facilities

.12 OPSS 492 November 2015, Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures

.13 OPSS.PROV 501 November 2014, Compacting

.14 OPSS.PROV 510 November 2014, Removal

.15 OPSS.PROV 517 November 2016, Dewatering of Pipeline, Utility, and Associated Structure Excavation

.16 OPSS.PROV 904 November 2014, Concrete Structures

.17 OPSS.PROV 920 November 2016, Deck Joint Assemblies, Preformed Seals, Joint Fillers, Joint Seals, Joint Sealing Compounds, and Waterstops – Structures

.18 OPSS 1001 November 2013, Aggregates – General

.19 OPSS.PROV 1004 November 2012, Aggregates - Miscellaneous

.20 OPSS.PROV 1010 April 2013, Aggregates-Base Material, Subbase, Select Subgrade, And Backfill Material

.21 OPSS 1301 November 2007, Cementing Materials

.22 OPSS 1302 September 1996, Water

.23 OPSS 1350 November 2016, Concrete - Materials and Production

.24 OPSS 1351 November 2014, Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers

.25 OPSS.PROV 1359 November 2016, Unshrinkable Backfill

.26 OPSS.PROV 1440 November 2014, Steel Reinforcement for Concrete

.27 OPSS.PROV 1850 April 2018, Frames, Grates, Covers, and Gratings

.28 OPSS 1853 November 2007, Rubber Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers

.29 OPSS.PROV 1854 April 2018, High Density Polyethylene (HDPE) and Expanded Polystyrene (EPS) Adjustment Units for Maintenance Holes, Catch Basins, and Valve Chambers

.30 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

PART 2 – PRODUCTS

2.1 Not Used

.1 Not Used

PART 3 – EXECUTION

3.1 EXECUTION

.1 All work shall be accordance with OPSS.PROV 402 and OPSS 407 unless otherwise noted on the Contract Drawings and/or directed by the Departmental Representative.

.2 Backfill material shall be Granular 'B', Type I material conforming to the requirements of OPSS.PROV 1010.

.3 The disposal of all surplus and/or unsuitable material shall be the responsibility of the Contractor in accordance with OPSS 180. No separate payment will be considered for the disposal of the surplus or unsuitable material, regardless of the amount.

.4 Structures of the type specified in the Contract Documents shall be installed on 150 mm of Granular 'A' in the locations, and to the elevations, specified in the Contract Documents and shall be constructed plumb and true to alignment.

.5 Precast concrete maintenance holes, catch basin maintenance holes, valve chambers and catch basins shall be placed on a 150 mm thick, Granular 'A' mat.

.6 All maintenance holes must be benched, except those in gutter lines.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

.1 Section 31 23 10 – Earth Excavation

.2 Section 32 11 18 – Granular 'A'

.3 Section 32 11 19 – Granular 'B'

1.2 DESCRIPTION

.1 The work of this section covers the installation of all storm sewers and culverts as shown in the Contract Documents.

1.3 MEASUREMENT AND PAYMENT

.1 Measurement for payment of Storm Sewers will be per linear metre (m) along the length of the pipe unless otherwise indicated in the Contract Plans and/or by the Departmental Representative.

.2 Payment shall include all costs for labour, materials and equipment necessary for the excavation of asphalt, granulars, etc. to the limits shown in the Contract Drawings and/or as directed by the Departmental Representative.

.3 If, due to unsuitable material, the Departmental Representative orders additional excavation beyond 150mm below the design grade, measurement will be made in cubic meters of the excavation. Payment for additional excavation and backfill will be made using the Unit Price for Excavation.

1.4 REFERENCES

.1 OPSS.PROV 180 November 2016, Management and Disposal of Excess Material

.2 OPSS.PROV 206 November 2014, Grading

.3 OPSS.PROV 209 November 2014, Embankments Over Swamps

.4 OPSS.PROV 212 November 2013, Borrow

.5 OPSS.PROV 401 November 2015, Trenching, Backfilling, and Compacting

.6 OPSS.PROV 404 November 2017, Support Systems

.7 OPSS 407 November 2015, Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation

.8 OPSS.PROV 409 November 2017, Closed-Circuit Television (CCTV) Inspection of Pipelines OPSS 490 Site Preparation for Pipelines, Utilities, and Associated Structures

.9 OPSS.PROV 491 November 2017, Preservation, Protection, and Reconstruction of Existing Facilities

.10 OPSS 492 November 2015, Site Restoration Following Installation of Pipelines, Utilities, and Associated Structures OPSS 501 Compacting

.11 OPSS.PROV 510 November 2014, Construction Specification for Removal

.12 OPSS.PROV 517 November 2016, Dewatering of Pipeline, Utility, and Associated Structure Excavation

.13 OPSS.PROV 539 November 2014, Temporary Protection Systems

.14 OPSS 802 November 2010, Topsoil

.15 OPSS.PROV 804 November 2014, Seed and Cover

.16 OPSS 904 November 2014, Concrete Structures

.17 OPSS 905 November 2014, Steel Reinforcement for Concrete

.18 OPSS.PROV 1004 November 2012, Aggregates - Miscellaneous

.19 OPSS.PROV 1010 April 2013, Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

.20 OPSS.PROV 1205 April 2015, Clay Seal

.21 OPSS 1301 November 2007, Cementing Materials

.22 OPSS 1302 September 1996, Water

.23 OPSS.PROV 1350 November 2016, Concrete - Materials and Production OPSS 1440 Steel Reinforcement for Concrete

.24 OPSS.PROV 1801 April 2018, Corrugated Steel Pipe Products

.25 OPSS.PROV 1820 November 2014, Circular Concrete Pipe OPSS 1840 Non-Pressure Polyethylene Plastic Pipe Products

.26 OPSS 1841 November 2015, Non-Pressure Polyvinyl Chloride (PVC) Pipe Products

.27 OPSS.PROV 1843 April 2018, Non-Pressure Polypropylene (PP) Plastic Pipe Products

.28 OPSS.PROV 1860 April 2018, Geotextiles

.29 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.5 DEFINITIONS

.1 Backfilling: means the operation of filling the trench with bedding, cover, and backfill material or embedment and backfill material.

.2 Concrete Appurtenances: means concrete head walls, cut-off walls, stiffeners, aprons, collars, and any other concrete fixtures associated with the pipe sewer, excluding concrete bedding or concrete structures specified in the Contract Documents.

.3 Dimension Ratio: means the average specified outside diameter of a pipe divided by the minimum specified wall thickness.

.4 Drainage Structure: means a maintenance hole, catch basin, or ditch inlet.

.5 Excavation, Earth and Rock: means the excavation classified as earth and rock according to OPSS 206.

.6 Flexible Pipe: means pipe that can deflect 2% or more without cracking, such as polyvinyl chloride or polyethylene or steel pipe.

.7 Pipe Class: means a pipe’s physical material specification, such as load and pressure ratings, wall thickness, protective coatings, corrugation profiles, ring stiffness constants, and reinforcement.

.8 Pipe Run: means a section of a pipe sewer between two drainage structures or between a drainage structure and an outlet.

.9 Pipe Sewer: means an installation designed for the conveyance of sanitary sewage or storm water using preformed or precast pipe sections, circular or non-circular in cross-section, laid end to end using suitable jointing material and connected by maintenance holes for sanitary pipe sewers and by maintenance holes, catch basins, ditch inlets, or concrete appurtenances for storm pipe sewers.

.10 Pipe Type: means a pipe’s inner wall design, which can be smooth or corrugated.

.11 Service Connection: means the pipe used to convey sanitary sewage or storm water from the property line to the main sanitary or storm pipe sewer respectively.

PART 2 – PRODUCTS

2.1 Not Used

.1 Not Used

PART 3 – EXECUTION

3.1 EXECUTION

.1 The minimum class of pipe shall be as specified in the Contract Documents.

.2 The disposal of all surplus and/or unsuitable material shall be the responsibility of the Contractor in accordance with the requirements of OPSS 180. No separate payment will be considered for the disposal of the surplus and unsuitable material, regardless of the amount.

.3 All pipes shall be cleaned and flushed just prior to inspection and acceptance. Prior to commencing any flushing, the Contractor shall submit a Methodology Summary to the Departmental Representative for review and approval. The Methodology Summary shall detail the entire operation including the source of water, and the method to be employed to capture and deal with the silt, debris and deleterious materials resulting from the flushing operation. Sewer pipes will not be accepted until the CCTV result is satisfactory to the Departmental Representative.

.4 Asphalt pavement and concrete removal, including saw cutting, shall be considered to be part of the work of these items.

.5 Connections of sewer pipe into maintenance holes or catch basins shall be made by coring. The connections shall be grouted between the pipe and the wall of the structure to the satisfaction of the Departmental Representative. No separate payment will be made for connecting sewers to the structures.

.6 CCTV video inspection, as specified in OPSS 409, shall be completed prior to acceptance of the pipes. A clear image of the pipe interior shall be submitted to the Departmental Representative on a portable USB hard drive or approved equal within 5 Working Days of completion of the CCTV video inspection.

.7 Bedding material shall be Granular ‘A’ for rigid (concrete) pipe. Embedment material for flexible pipe shall be Granular ‘B’, Type I.

.8 Bedding for rigid (concrete) pipe storm sewers shall conform to Class ‘B’.

.9 Cover material shall be Granular ‘B’, Type I for all pipes.

.10 Trench backfill material shall be Granular 'B', Type I. Trenches off the roadway, two meters or more from the edge of pavement, shall be backfilled with selected native Site material.

.11 At maintenance hole and catch basin connections, if concrete pipe is used, the Contractor shall use a concrete cradle in accordance with OPSD 708.020.

.12 Cover and backfill materials shall meet the requirements of OPSS MUNI.501.

.13 Deflection testing in accordance with OPSS 410.07.16.05 Deflection Testing of Pipe Sewers shall be performed and the costs of the testing shall be included in the unit prices for all plastic pipes.

.14 All storm sewers shall be installed according to OPSD 802.010, 802.014, 802.030, 803.030 and 803.031.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

.1 Section 33 05 16 – Aggregate Materials.

.2 Section 33 41 00 – Storm Utility.

1.2 MEASUREMENT AND PAYMENT

.1 Excavation and backfill will be measured under Section 31 23 33.01.

.2 Supply and installation of sub-drainage including, trenching, backfill, bedding, granular filter material and geotextile will be measured horizontally from structure face to catch basin face in metres of each pipe size and depth class installed.

1.3 REFERENCES

.1 ASTM International

.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.2 ASTM C136/C136M-14, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

.3 ASTM C444-17, Standard Specification for Perforated Concrete Pipe [Metric].

.4 ASTM C654-15, Standard Specification for Porous Concrete Pipe [Metric].

.5 ASTM D698-16, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3(600 kN-m/m^3)).

.6 ASTM D3034-16, Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.

.7 ASTM F679-16, Poly (Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.

.8 ASTM F794-03(2014), Poly (Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.

.9 ASTM F949-15, Poly (Vinyl Chloride) (PVC) Corrugated Sewer Pipe with a Smooth Interior and Fittings.

.10 ASTM F1760-16, Coextruded Poly (Vinyl Chloride) (PVC) Non-Pressure Plastic Pipe Having Reprocessed-Recycled Content.

.11 ASTM F1803-15, Poly (Vinyl Chloride) (PVC) Closed Profile Gravity Pipe and Fittings Based on Controlled Inside Diameter.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-8.1-88, Sieves, Testing, Woven Wire, Inch Series.

.2 CAN/CGSB-8.2-M88, Sieves, Testing, Woven Wire, Metric.

.3 CSA International

.1 CAN/CSA-B1800-18, Thermoplastic Non-Pressure Pipe Compendium.

.2 B182.1-06, Plastic Drain and Sewer Pipe and Pipe Fittings [Part of B1800-18, Plastic Non-pressure Pipe Compendium]

.3 B182.2-06, PSM Type Polyvinylchloride (PVC) Sewer Pipe and Fittings [Part of B1800-18, Plastic Non-pressure Pipe Compendium]

.4 B182.4-06, Profile Polyvinylchloride (PVC) Sewer Pipe and Fittings [Part of B1800-18, Plastic Non-pressure Pipe Compendium]

.5 B182.7-06. PSM Type Multilayer Polyvinylchloride (PVC) Sewer Pipe Having Reprocessed-Recycled Content [Part of B1800-18, Plastic Non-pressure Pipe Compendium]

.6 CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.

.4 Uni-Bell PVC Pipe Association

.1 UNI-B-9-90, Polyvinyl Chloride (PVC) Profile Wall Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter (Nominal Pipe Sizes 4 - 48-inch).

.5 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.6 Ministry of Transportation (MTO)

.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for pipes, pipe fittings, tiles, and aggregate and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Certificates:

.1 Submit manufacturer's certification that drain pipe materials meet requirements of this Section.

.2 Certification to be marked on pipe.

.4 Test and Evaluation Reports:

.1 Submit manufacturer's test data that drain pipe materials meet requirements of this Section.

.5 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

.2 Recycled Content:

.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations.

.2 Store and protect pipes and tiles from damage.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Perforated plastic pipe and fittings: to CAN/CSA-B1800. Nominal pipe size 150 mm.

.2 Bedding gravel or crushed stone; hard, durable particles, graded evenly in size from 16 to 8 mm.

.3 Granular filter material in accordance with Section 31 05 16.

.4 Geotextile filter: In accordance with Section 31 32 19.01.

.5 Pipe subdrains behind abutments:

.1 Subdrain to be a perforated polyvinyl chloride pipe.

.2 Polyvinyl chloride pipe products:

.1 The extruded, moulded, and fabricated material to be polyvinyl chloride plastic according to CSA B182.1, CSA B182.2, CSA B182.4, CSA B182.7, ASTM D3034-16, ASTM F679-16, ASTM F794-03(2014), ASTM F949-15, ASTM F1760-16, ASTM F1803-15, or UNI-B-9, as applicable, for the appropriate type of polyvinyl chloride plastic pipe products.

.3 Outlets to be constructed of polyvinyl chloride pipe, SDR35 having a minimum stiffness of 300 kPa.

.4 Fittings:

.1 To be suitable for and compatible with the class and type of pipe with which they will be used.

.2 Caps to be polyethylene.

.3 Galvanizing of rodent gates to be according to ASTM A123/A123M-17.

.5 Clear stone: To NSTIR Standard Specification Division 3, Section 4 - Clear Stone.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for sub-drainage piping installation in accordance with manufacturer's written instructions.

.1 Visually inspect substrate in presence of the Departmental Representative.

.2 Inform the Departmental Representative of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from the Departmental Representative.

3.2 PREPARATION

3.3 TRENCHING

.1 Do excavating and backfilling in accordance with Section 31 23 33.01.

.2 Place bedding material after approval of excavation by the Departmental Representative.

3.4 INSTALLATION OF PIPE SUB-DRAINS

.1 Lay pipe drains on prepared bed, true to line and grade with inverts smooth and free of sags or high points.

.1 Ensure barrel of each pipe is in contact with bed throughout full length.

.2 Begin laying at outlet and proceed in upstream direction.

.3 Lay perforated pipes with perforations at 4 o'clock and 8 o'clock positions.

.4 Wrap or sleeve the perforated pipe with geotextile filter as indicated.

.5 Perforated pipe with supplied geotextile sock is permitted for use.

.6 Lay bell and spigot pipe with bell ends facing upstream.

.1 Do not mortar joints.

.7 Make joints tight in accordance with manufacturer's instructions.

.8 Make watertight connections to existing drains, new or existing manholes and catch basins where indicated or as directed by the Departmental Representative.

.9 Plug open upstream ends of pipes with watertight concrete, steel or wood bulkheads.

.10 Surround pipe with bedding gravel and compact as directed by the Departmental Representative.

.11 Subdrain to be connected to maintenance holes, catch basins, and ditch inlets by a 1 m section of non-perforated pipe.

.12 Subdrain and outlet pipe connections to concrete maintenance holes, catch basins, and ditch inlets to be cored and grouted as specified in the Contract Documents.

.13 Surround and cover drain with granular filter material in uniform 150 mm layers to an elevation of at least the bottom of the base granular roadbed and compact to at least 95% of corrected maximum dry density.

.14 Do not place bedding surround and backfill materials in frozen condition.

.15 Protect sub-drains against flotation during installation.

3.5 PIPE SUBDRAINS BEHIND ABUTMENTS

.1 The stability of the subdrain and outlet pipe trenches to be maintained at all times during excavation and backfilling.

.2 Geotextile:

.1 Wrap subdrain with a knitted sock geotextile.

.2 When a geotextile wrapped trench is specified in the Contract Documents, wrapping of the subdrain with a knitted sock geotextile is not required, and the geotextile is to be installed as specified in the Contract Documents.

.3 When clear stone embedment is specified in the Contract Documents, the subdrain trench and outlet pipe trench are to be wrapped with geotextile.

.4 When granular embedment and backfill material are specified for an outlet pipe connection to a catch basin, the outlet pipe trench does not require geotextile wrap.

.3 Bedding to be placed in the trench to the depth specified in the Contract Documents prior to laying the subdrain or outlet pipe. The pipe bedding grade is to be inspected with grade checks and certified by the Contractor prior to laying the subdrain or outlet pipe.

.4 Pipe installation:

.1 The pipe is to be placed firmly on the bedding and secured in place to prevent any movement or disturbance during backfilling. Lay perforated pipes with perforations at 4 o'clock

and 8 o'clock positions. Pipe is not to be laid in water or on saturated bedding. Pipe is not be used as a drain for the Contractor's operation.

.2 Connections between the subdrain and outlet pipe to be made with prefabricated 45° elbows or pre-manufactured pipe curves as required.

.3 Outlet pipe is to be installed at all low lying areas, at the end of subdrain, and at a uniform spacing of 100 m along the length of the subdrain.

.4 Subdrain and outlet pipe installation to be inspected and approved by the Departmental Representative prior to backfilling.

.5 Outlets:

.1 The outlet is to have an internal diameter that is slightly larger than the outlet pipe diameter so that the outlet pipe can be inserted into the outlet a minimum distance of 300 mm.

.2 Outlets to extend beyond the front of the ditch or fill slope for a distance of 300 mm.

.3 The ends of all outlets to be fitted with galvanized rodent gates.

.4 The joint between the outlet pipe and the outlet to be wrapped with a 0.5 m width of geotextile.

.6 Embedment material to be as specified in the Contract Documents.

.7 Ensure that the subdrain and outlet pipe are not damaged or dislodged during the placement and compaction of embedment and backfill material. Damaged or dislodged subdrain and outlet pipe to be removed and replaced.

3.6 CONNECTIONS TO MUNICIPAL FACILITIES

.1 Connect pipe sub-drains to municipal catch basins where indicated.

3.7 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11.

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11.

.3 Waste Management: separate waste materials in accordance with Section 01 74 20.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 GENERAL

1.1 MEASUREMENT AND PAYMENT

.1 Measure the supply and erection of roadside steel W-beam guide rail including posts and necessary hardware in metres of guide rail installed and measured from outer tips of steel W-beam guide rail, including guide rail used in anchorages and terminal sections.

1.2 REFERENCES

.1 American Association of State Highway and Transportation Officials (AASHTO)

.1 AASHTO M180-2012, Standard Specification for Corrugated Sheet Steel Beams for Highway Guardrails.

.2 ASTM International

.1 ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

.2 ASTM A307-14e1, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.

.3 CSA International

.1 CAN/CSA O80 Series-15, Wood Preservation.

.1 CAN/CSA-G164-18, Hot Dip Galvanizing of Irregularly Shaped Articles.

.4 Forest Stewardship Council (FSC)

.1 FSC-STD-01-001-2004, FSC Principle and Criteria for Forest Stewardship.

.2 FSC-STD-20-002-2004, Structure and Content of Forest Stewardship Standards V2-1.

.3 FSC Accredited Certified Bodies.

.5 Master Painters Institute (MPI)

.1 Architectural Painting Specification Manual – September 2012.

.6 U.S. Environmental Protection Agency (EPA) / Office of Water

.1 EPA 832/R-92-005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

.7 OPSS.PROV 732 April 2016, Guide Rail End Treatment – Steel Beam Energy Attenuating Terminal Systems

.8 OPSS.PROV 1504 April 2017, Steel Beam Guide Rail

.9 Ministry of Transportation (MTO)

.1 Designated Sources of Materials (DSM): http://www.roadauthority.com/mpl/mpl.asp?MPIShortName=MTO+DSM

1.3 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00.

.2 Product Data:

.1 Submit manufacturer's instructions, printed product literature and data sheets for guide rail, wood, and coatings and include product characteristics, performance criteria, physical size, finish and limitations.

.3 Shop Drawings:

.1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.

.4 Sustainable Design Submittals:

.1 Construction Waste Management:

.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.

.2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 75% of construction wastes were recycled or salvaged.

.2 Wood Certification: submit manufacturer's Chain-of-Custody Certificate number for FSC certified wood.

1.4 QUALITY ASSURANCE

.1 Sustainable Standards Certification:

.1 Certified Wood: submit listing of wood products and materials used in accordance with FSC-STD-01-001.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

.2 Store and protect guide rails from damage.

.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan.

.5 Packaging Waste Management: remove for reuse and/or return of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 20.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Steel W-beam guide rail as indicated and as follows:

.1 Steel rail and terminal sections: to Table 2 of AASHTO M180, Class A Type 2 with a nominal base metal thickness of 2.82 mm and 2.50mm minimum, in accordance with NSTIR Standard Specification Division 5, Section 6.

.2 Bolts, nuts and washers: to ASTM A307, hot dip galvanized to ASTM A123/A123M.

.2 Energy Absorbing Guide Rail Terminal (EAGRT) as follows

.1 The EAGRT systems shall meet the requirements of National Cooperative Highway Research Program (NCHRP) Report 350, Test Level 3.

.2 Only proprietary EAGRT systems approved by the MTO will be acceptable. The approved systems may include:

.1 Road system Inc., Big Spring, Texas.

.2 Trinity Industries Inc., Dallas, Texas.

.3 Barrier Systems Inc., Rio Vista, California

.4 Mixing and Matching of parts are not acceptable.

.3 All other specifications of the EAGRT system shall be in accordance with NSTIR Division 5 Section 6.

.3 Sawn timber posts and offset blocks:

.1 Guide Rail posts shall be eastern hemlock, Red pine or mixed hardwood (birch, maple, oak or ash).

.2 Guide rail posts shall be in accordance with NSTIR Standard Specifications, Division 5, section 6 – Steel Guard Rail Systems and Wooden Guide Posts.

.4 Energy Attenuator, End Treatment Steel Beam Energy Attenuating Terminal Extruder Terminal System with Steel Posts: in accordance with OPSD 922.532.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for guide rail installation in accordance with manufacturer's written instructions.

.1 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Departmental Representative.

3.2 PREPARATION

.1 Temporary Erosion and Sedimentation Control:

.1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of these specifications.

.2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.

.3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 ERECTION

.1 Set posts by instrument for alignment, and locations as indicated and as directed by Departmental Representative.

.2 Excavate post holes to depths as indicated and to diameter of 360 mm plus or minus 20 mm.

.1 Compact bottom to provide firm foundation.

.2 Set post plumb and square in hole.

.3 Backfill around posts using excavated material and compact in uniform layers not exceeding 150 mm compacted thickness.

.4 Cut off tops of posts as indicated, with tops parallel to grade of pavement edge.

.5 Worker protection: ensure workers wear personal protective clothing when handling, drilling, sawing, cutting or sanding preservative treated wood and applying preservative materials.

.6 Any exposed cuts shall be treated with two coats of 2% copper napthenate wood preservative. Field applied wood preservative which comes in contact with any galvanized components shall be removed immediately.

.7 Construct anchorages to details as indicated.

.1 Place and compact backfill for anchors as directed by Departmental Representative

.8 Erect steel W-beam components to details as indicated. Lap joints in direction of traffic and tighten nuts to 100 Nm torque.

.9 Two 50 mm x 75 mm delineators are required for each post. A white delineator shall be placed on the side of the post facing traffic; a yellow delineator shall be placed on the opposite side. The delineators shall be located at the edge of the post nearest the road, vertical, with the top 75 mm below the lowest point of the guard rail panel. The delineators shall be attached with galvanized nails.

3.4 TOUCH UP

.1 Galvanized steel-touch up:

.1 Clean damaged surfaces with wire brush removing loose and cracked coatings.

.1 Apply 2 coats of organic zinc-rich paint to damaged areas.

.2 Pre-treat damaged surfaces in accordance with manufacturer's written recommendations for zinc-rich paint.

3.5 CLEANING

.1 Progress Cleaning:

.1 Leave Work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

.3 Waste Management: separate waste materials for reuse recycling in accordance with Section 01 74 20.

3.6 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by guide rail installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTION

.1 Section 01 14 00 – Work Restrictions.

.2 Section 01 15 01 – Dewatering.

.2 Section 01 22 01 – Measurement and Payment.

.3 Section 01 33 00 – Submittal Procedures.

.4 Section 01 35 43 – Environmental Procedures.

.5 Section 01 41 00 – Regulatory Requirements.

.6 Environmental regulations per Parks Canada Agency Environmental Management Plan (EMP)

1.2 DESCRIPTION OF WORK

.1 Supply, Installation, maintenance, and replacement (as needed) of a turbidity curtain (silt curtain) on Severn River during the construction as part of the preservation of the water course.

1.3 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this section.

.2 Payment will be under the Contract Lump Sum amount and such payment shall be full compensation of all labour, equipment and materials necessary to complete the work.

.3 Contractor is wholly responsible for the work including but is not limited to the supply, installation, maintenance, and replacement of a Turbidity Curtain (Silt Curtain) within the Severn River during the construction.

1.4 REFERENCES

.1 American Society for Testing and Materials (ASTM):
.1 ASTM D4491-99a (2014), Standard Test Methods for Water Permeability of Geotextiles by Permittivity.
.2 ASTM D4595-17, Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method.
.3 ASTM D4716 / D4716M - 14, Standard Test Method for Determining the (In-Plane) Flow Rate Per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.
.4 ASTM D4751-16, Standard Test Method for Determining Apparent Opening Size of a Geotextile.

.2 Canadian General Standards Board(CGSB):
.1 CAN/CGSB-4.2, Textile Test Methods.

.2 CAN/CGSB-148.1, Methods of Testing Geosynthetics Geotextile.
.1 No. 2-M85, Mass per Unit Area.
.2 No. 3-M85, Thickness of Geotextiles.
.3 No. 6.1-93, Bursting Strength of Geotextiles Under No Compressive Load.
.4 No. 7.3-92, Grab Tensile Test for Geotextiles.

.3 Canadian Standards Association (CSA):
.1 CAN/CSA-G40.20/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel.
.2 CAN/CSA-G164-M92 (R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.

.4 Ontario Provincial Standard Drawings(OPSD):
.1 OPSD 219.260 November 2015, Turbidity Curtain.
.2 OPSD 219.261 November 2015, Turbidity Curtain, Seam Detail.

.5 Ontario Provincial Standard Specification (OPSS):
.1 OPSS 805 November 2015, Construction Specification for Temporary Erosion and Sediment Control Measures.

.6 Greater Horseshoes Area Authorities:
.1 Erosion and Sediment Control Guidelines for Urban Construction, December 2006, Toronto and Region Conservation Authority (available on-line).
.2 Toronto and Region Conservation, 2008 Erosion and Sediment Control Inspection Guide.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit details of the proposed turbidity curtain system to the Departmental Representative three (3) weeks prior to the start of the work.

.2 Submit to Departmental Representative details of geotextile material and seam at least two (2) weeks prior to commencing work.

.3 Complete the submission of a Sediment Control Plan to the Departmental Representative, to meet the requirements of all review agencies. Ensure compliance of the sediment control plan throughout the project.

1.6 DELIVERY AND STORAGE

.1 During delivery and storage, protect geotextiles from direct sunlight, ultraviolet rays, excessive heat, mud, dirt, dust, debris and rodents.

PART 2 - PRODUCTS

2.1 MATERIAL

.1 Geotextile: Woven synthetic fibre fabric, supplied in rolls:
.1 Width: Approved by the Departmental Representative.
.2 Length: As specified on contract drawings.
.3 Composed of: Minimum 85% by mass of polypropylene polyester with inhibitors added to base plastic to resist deterioration by ultra-violet

and heat exposure for 60 days.

.2 Physical properties:
.1 Thickness: To CAN/CGSB-148.1, No. 3, minimum 0.8 mm.
.2 Mass per unit area: To CAN/CGSB-148.1, No. 2, minimum 220 g/m2.
.3 Tensile strength and elongation (in any principal direction): To ASTM D4596:
.1 Tensile strength: Minimum 1350N, wet condition.
.2 Elongation at break: Minimum maximum 25%.
.3 Seam strength: Minimum 1350N equal to or greater than tensile strength of fabric.
.4 Mullen burst strength: To CAN/CGSB-4.2, method 11.2, minimum 4000N, equal to or greater than tensile strength of fabric.

.3 Hydraulic properties:
.1 Apparent opening size (AOS): To ASTM D4751.

.4 Seams: Sewn in accordance with manufacturer's recommendations.

.5 Thread for sewn seams: Equal or better resistance to chemical and biological degradation than geotextile.

PART 3 - EXECUTION

3.1 GENERAL

.1 Complete the submission of a Sediment Control Plan as described in the Ministry of Natural Resources Technical Note, TN-20, Sediment Control Plans: Reducing Sediment Concerns at Water Crossings, dated 1992, to the Departmental Representative. Where directed by the Departmental Representative, submit to the review agencies, as part of any permitting requirements. Modify the Sediment and Erosion Control Plan to address the review agency comments. Ensure compliance of the Sediment Control Plan throughout the project.

.2 Supply, install, maintain and remove silt curtains when instructed by the Departmental Representative.

.3 Monitoring of water turbidity outside the silt curtain will be carried out by the Contractor as set out in Section 01 41 00. Maximum allowable increase of turbidity above background levels is 5 NTUs (Nephelometric Turbidity Units).

3.2 INSTALLATION

.1 Turbidity curtains shall consist of turbidity curtain geosynthetic, load line, flotation, ballast, anchors, mooring buoys, mooring lines, adjustment lines and tie-downs.

.2 Design to conform to Ontario Provincial Standard Specification, OPSS 805 and Ontario Provincial Standard Drawings OPSD 219.260 and OPSD 219.261, as a minimum.

.3 Turbidity curtains shall be constructed as follows:

.1 The floatation shall provide support along the length of the turbidity curtain.

.2 A sleeve shall be formed and heat-sealed or sewn along the entire bottom edge of the turbidity curtain geosynthetic, to contain the ballast in the sleeve. Breaks may be made in the sleeve to facilitate pulling, provided they are a minimum 100 mm in size and spaced at minimum 3 m intervals.

.3 Where turbidity curtain geosynthetic is joined to provide a continuous run, the sections shall be connected to provide a continuous seal and prevent the escape of turbid water between the sections.

.4 The turbidity curtain, as prepared for installation, shall be of sufficient width to account for water depth and wave action.

.5 Adjustment lines shall be placed at maximum intervals of 10 m and are to encircle the turbidity curtain from top to bottom.

.6 The turbidity curtain shall be prepared for installation by furling and tying with hurling ties every 1.5 m for the entire length of the curtain.

.7 Anchor locations shall be established as is necessary to maintain the turbidity curtain in place and functioning.

.8 Provide buoys or other navigation markers to identify the location of the turbidity curtain to boaters.

.9 Place turbidity curtain to maintain a clear navigation channel as set out in the contract drawings and approved by the Departmental Representative.

3.3 OPERATION AND MAINTENANCE

.1 Turbidity curtains shall be installed to prevent sediment passage from the area enclosed by the curtain to the remaining water body. Turbidity curtains shall be installed and maintained in a manner that avoids entry of equipment, other than hand-held equipment or boats, to the remaining water body.

.2 Equipment is permitted in the work area enclosed by the turbidity curtain.

.3 Turbidity curtains shall be operated and maintained in the specified location, with the entire top edge above the water surface.

.4 The curtain shall be free of tears and gaps and the bottom edge of the curtain is to be continuously in contact with the water course bed, so that sediment passage from the area enclosed is prevented.

.5 Any folds in the turbidity curtain, which form next to the floatation collar, shall be regularly monitored and freed of collected sediment.

.6 Monitor and maintain the turbidity curtain booms both during and outside normal working shifts as required. Provide all personnel, materials and equipment necessary to maintain, repair, or relocate the silt curtain system.

.7 Carry out construction operations to minimize impact on fish habitat from both disturbed sediments and fill materials.

.8 Replace damaged or deteriorated geotextile to approval of Departmental Representative.

.9 Remove debris trapped by the turbidity curtain regularly and dispose at an approved location.

.10 Remove turbidity curtain when authorized by the Departmental Representative after completion of the work.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL REQUIREMENT

.1 The bridge control system shall perform the function as indicated on the design drawings and as specified herein.

1.2 SEQUENCE OF OPERATION

.1 OPENING SEQUENCE

BRIDGE STATUS PRIOR TO OPENING: Bridge Span closed, bridge open to vehicle and pedestrian traffic, but closed to marine traffic.

.1 Operator initiates "CONTROL POWER ON" via an "ON/OFF" selector switch.

.2 Operator initiates "TRAFFIC LIGHTS RED" sequence via a maintained selector switch.

.1 Vehicle traffic signals automatically sequence from GREEN to AMBER to RED.

.2 Bridge Control automatically sends command to HPU Control to "ENABLE HPU."

.3 Bridge Control automatically initiates vehicle traffic gate's "WARNING BELL SOUND" and "GATE ARM LIGHTS ON."

.3 The Bridge Control enables "TRAFFIC SIGNAL RED PERMISSIVE."

.4 The Bridge Control enables "HPU ENABLED PERMISSIVE." (HPU system ready permissive signal from HPU Control to Bridge Control).

.5 Operator initiates "NORTH/SOUTH GATEARMS LOWER" via separate spring return selector switches.

.6 The Bridge Control enables "ALL GATES LOWERED PERMISSIVE" (limit switch, circuit interlock and indication).

.7 Operator initiates warning horn.

.8 The Bridge Operator initiates "OPEN SPAN" sequence by turning spring return selector switch.

.9 The Bridge Control automatically sends command to HPU control system to "RETRACT END LIFT."

.10 The Bridge Control received "END LIFT RETRACTED PERMISSIVE" from HPU control system and enables "END LIFT RETRACTED PERMISSIVE" (limit switches, circuit interlocks and indications).

.11 The Bridge Control automatically sends command to HPU control system to "RETRACT LATCH PIN."

.12 The Bridge Control automatically initiates traffic gate's "WARNING BELL SILENCE."

.13 The Bridge Control receives "LATCH PIN RETRACTED PERMISSIVE" from the HPU control system and enables "LATCH PIN RETRACTED PERMISSIVE" (limit switches, circuit interlocks and indications).

.14 The Bridge Control automatically sends command to HPU control system to "OPEN SPAN."

.15 When the span reaches a "Nearly Open" position, the HPU control system to disable the normal speed control function, and enables creep speed control function.

.16 When the span reaches a "Fully Open Position", the HPU control system disables the creep speed control function, and enables "Stop" function. The span will automatically stop at its final fully open position.
.17 The Bridge Control enables "BRIDGE SPAN FULLY OPEN PERMISSIVE" (limit switches, circuit interlocks and indications).
.18 When the span reaches a "Fully Open Position", the Bridge Control automatically initiates "NAVIGATION GREEN LIGHT."

Note: The HPU system will remain enabled and maintain system operating pressure between the bridge span open and close cycle.

BRIDGE STATUS: Bridge Span Opened, bridge opened to marine traffic, but closed to vehicle and pedestrian traffic.

.2 CLOSING SEQUENCE
BRIDGE STATUS PRIOR TO CLOSING: Bridge Span Opened, bridge opened to marine traffic, but closed to vehicle and pedestrian traffic.
.1 Operator verifies "CONTROL POWER ON"
.2 Operator initiates warning horn.
.3 Operator initiates "BRIDGE CLOSE" sequence via a spring return selector switch.
.4 Bridge Control automatically sends command to HPU Control to "ENABLE HPU."
.5 The Bridge Control receives "HPU ENABLED PERMISSIVE." (HPU system ready permissive signal from HPU Control to Bridge Control).
.6 Bridge Control automatically initiates "LATCH PIN DRIVE"
.7 The Bridge Control receives "LATCH PIN EXTENDED PERMISSIVE" from the HPU control system and enables "LATCH PIN EXTENDED PERMISSIVE" (limit switches, circuit interlocks and indications)
.8 The Bridge Control System sends close bridge span signal to HPU control system.
.9 When the span reaches a "Near Close" position, the Bridge Control automatically initiates a command to HPU Control to disable the normal speed control function, and enables creep speed control function.
.10 When the span reaches a "Fully Closed Position", the Bridge Control automatically initiates a command to HPU Control to disable the creep speed control function, and initiates command "STOP." The span will automatically stop at it final fully closed position.
.11 The Bridge Control enables span "FULLY CLOSED PERMISSIVE" (limit switch, safety interlock and indication).
.12 The Bridge Control automatically sends command to HPU control system to "DRIVE END LIFTS."
.13 The Bridge Control receives "END LIFT DRIVEN PERMISSIVE" from the HPU Control System, and enables "END LIFT DRIVEN PERMISSIVE" (limit switches, circuit interlocks and indications).
.14 Bridge Control automatically sends command to HPU Control to "REMOVE ENABLE HPU" after a set time delay.

.15 The Bridge Operator initiates "NORTH/SOUTH GATEARMS RAISE."

.16 The Bridge Control automatically confirms when all gates are raised (limit switch, safety interlock and indication) and enables "ALL GATES RAISED PERMISSIVE."

.17 Bridge Control automatically initiates traffic gate's "WARNING BELL SILENCE" and "GATE ARM LIGHT OFF."

.18 The Bridge Operator initiates vehicle traffic signal to sequence from "RED" to "GREEN" by turning selector switch.

.19 Operator initiates "CONTROL POWER OFF" via an "ON/OFF" selector switch.

BRIDGE STATUS: Bridge Span closed, bridge open to vehicle and pedestrian traffic, but closed to marine traffic.

.3 "EMERGENCY STOP" and "BYPASS CONTROLS":

"EMERGENCY STOP" - The "Emergency Stop" push button located on the Operator Control Console and on the HPU Control Panel, when pressed will disable the HPU system and all bridge control functions.

"EMERGENCY OFF/CLOSE" - The "Emergency Off/Close" selector switch located on the Operator Control Console and on the HPU Control Panel, in "Close" position, will allow the operator to bypass the bridge control relay interlocks and PLC control to close the bridge. The emergency close contact shall send signal directly to the selected HPU pump motor and open the bridge emergency close control valve to close the bridge at reduced speed.

"INTERLOCK BYPASS" - The "INTERLOCK BYPASS" keyed switches located on the Bridge Control Cabinet Maintenance Bypass Panel, when switched to "BYPASS" position will bypass respective interlock circuitry to allow the continuation of operation sequence. The Operator shall assess conditions and determine safe conditions before continue the bridge operation.

"HPU STOP" - The "HPU Stop" push button located on the Bridge Control Cabinet Maintenance Bypass Panel, when pressed will initiate command to HPU Control to stop the running HPU pump motor(s) only. The control system remains in active control. Use for maintenance purpose only.

1.3 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with this tender item shall be included with payment item for the Hydraulic Power Unit (HPU) Work Electrical.

END OF SECTION

PART 1 – GENERAL

1.1 GENERAL REQUIREMENT

.1 This section includes general requirements for supply, delivery, storage, installation, testing and commissioning of Programmable Logic Controller (PLC) required under the scope of the contract.

.2 Provide a complete PLC system, fully programmed (in terms of automation, control logic, operator interface, alarm and events logging) and ready for proper operation of the movable bridge. The supply shall be complete and shall include all equipment necessary to guarantee the proper control of the package from operator control panel and/or HMI.

.3 The requirements of other related specification sections shall also apply for installation and coordination of work.

1.2 RELATED SECTION

.1 The requirements contained in other sections of project specification shall also apply for installation and coordination of work.

1.3 REFERENCES

.1 The Automation Systems that will be provided for the movable bridge control system shall comply with the latest revised applicable codes, specifications and standards here below listed:

.2 CSA Group
.1 CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations.
.2 CAN/CSA-Z462-12, Workplace Electrical Safety.
.3 CSA C22.2 NO. 254-05 Motor Control Centres.
.4 CAN/CSA-Q9000-92, Quality Management and Quality Assurance Standards – Guidelines for Selection and Use.

.3 Electrical Equipment Manufacturers Association of Canada (EEMAC)

.4 Electronic Industry Association (EIA) 232-D: Interface between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

.5 National Electrical Manufacturer’s Association (NEMA):
.1 AB-1: Molded Case Circuit Breakers
.2 ICS-1: General Standards for Industrial Control and Systems
.3 ICS-2: Standards for Industrial Control Devices, Controllers and Assemblies

.4 ICS-4: Terminal Blocks for Industrial Use
.5 ICS-6: Enclosures for Industrial Controls and Systems

.6 International Society of Automation (ISA):
.1 ANSI/ISA-50.00.01: Compatibility of Analog Signals for Electronic Industrial Process Instruments
.2 ANSI/ISA-51.1: Process Instrumentation Terminology
.3 ANSI/ISA -18.2 – Management of Alarm Systems for the process Industries (Article 11 – HMI Design for Alarm Systems)

.7 International Electrotechnical Commission (IEC)
.1 IEC 61131 Program languages for PLC based systems
.2 IEC 61508 Functional Safety of Electrical/Electronic/Programmable Electronic Safety-related Systems
.3 IEC 61000 series Electro Magnetic Compatibility (EMC)

.8 ANSI/IEEE Standards
.1 ANSI/IEEE C37.90.1: Standard Surge Withstand Capability (SWC) Tests for Protection Relay Systems.
.2 ANSI/IEEE C37.90.2: Trial Use Standard Withstand Capability of Relay Systems to Radiated Electromagnetic Interference from Trans-receivers.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 The Contractor shall submit copies of vendor, producer or manufacturer product data. These shall include design and installation shop drawings, catalog cuts, specifications, testing requirements, and installation instructions.

.3 Product and System Data:
.1 Submit manufacturer's instructions, printed product literature and product data shall include as minimum product characteristics, performance criteria, physical size, weights, arrangements of components, type of material used, type and characteristics of used electrical devices and the minimum space for the erection and maintenance.
.2 Schematic wiring diagrams
.3 Package control system architecture
.4 Bill of material
.5 General arrangement drawings showing
.6 Wiring Diagram: cross wiring diagrams from field terminal strip to intrinsically safe barrier (if applicable), terminals etc. (drawings and database format - Excel)
.7 System cable schedule(s) including cable number, number of wire, wire size, etc.

.8 Input/Output (I/O) list (with indication of range, unit, alarm and safety thresholds)
.9 Functional description all the equipment included in the package
.10 Specifications of all control equipment included in the package
.11 Control logic diagrams (open and closed control loops, automatic sequences, functional groups, interlocks) covering all the equipment included in the package
.12 Control graphic displays for the HMI

.4 Manufacturer's Instructions: provide to indicate special handling criteria, installation sequence, cleaning procedures and maintenance information.

.5 Factory Acceptance Test (FAT) Procedures

.6 Site Acceptance Test (SAT) procedures

.7 Test Report

.8 Certificates

.9 Application programs (i.e. all the program source files) fully commented provided that the software developed for the application shall be property of the Department who has to receive a copy of all software files prior of the package provisional acceptance

.10 Project Software with backup copy

.11 Closeout Submittals Warranty

.12 Sustainable Design Submittals:
.1 Construction Waste Management:
.1 Submit project Waste Management Plan highlighting recycling and salvage requirements.
.2 Recycled Content:
.1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.

1.5 CLOSEOUT SUBMITTALS

.1 Submit in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include data for each type and style of starter, relay and control device.

.3 Provide service and maintenance information including preventive maintenance, assembly, and disassembly procedures. Include electrical drawings from electrical general sections. Submit additional information necessary to provide complete operation, repair, and maintenance information, detailed to the smallest replaceable unit.

.4 Provide instructions on how to adjustment, trouble-shooting, configuration, modify program settings, and modify the control program.

.5 Include copies of as-built submittals.

1.6 EXTRA STOCK MATERIALS

.1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.

.2 Include: the following parts:
.1 One (1) indicating light unit for each type and color used.
.2 Two (2) indicating light colored caps for each type and color used.
.3 Twelve (6) indicating light unit lamps for each type used.
.4 One (1) circuit breaker for each size and type used. One (1) complete overload relay for each size and type used.
.5 Two (2) pushbutton contact blocks for each size and type used.
.6 Two (2)-selector switch contact blocks for each size and type used.
.7 Two (2)-control relays of each size and type used.
.8 Two (2) PLC CPU modules of each type used.
.9 One (1) PLC processor module.
.10 One (1) PLC I/O module of each type used.
.11 One (1) PLC Power supply modules.
.12 One (1) PLC interface module of each type used.

1.7 DELIVERY, STORAGE AND HANDLING

.1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.

.2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.

.3 Storage and Handling Requirements:

.1 Store materials off ground, indoor, in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
.2 Store and protect motor control centres from damages.
.3 Replace defective or damaged materials with new.

.4 Develop Construction Waste Management Plan related to Work of this Section.

.5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, crates, padding, packaging materials as specified in Construction Waste Management Plan in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

1.8 QUALITY ASSURANCE

.1 The programmable controller system manufacturer shall be a Company specializing in manufacturing these products with minimum 5 years documented experience. Contractor shall use manufacturers whose equipment will continue to be manufactured for a period of at least 5 years or who will maintain a stock of compatible spare parts for a period of 15 years after start-up of the control system.

.2 The company specializing in programming systems specified shall have minimum 5 years of documented experience. Contractor shall demonstrate minimum of 5 years of experience for projects of similar size and complexity involving control systems with continuous process operation, PID loop control, data communications, graphic screens and reports in similar applications.

.3 Products shall be tested, approved and labeled/listed by Underwriters Laboratories, Inc., or by a nationally recognized testing laboratory (NRTL).

.4 Equipment and materials shall be new and within one year of manufacture date.

.5 Electrical work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23nd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.

.6 Material and workmanship shall conform to the requirements of the specifications. Contractor shall ensure material and workmanship quality and provide Certificates of Conformance per the requirement of Specification Section 01 45 00 Quality Control.

PART 2 – PRODUCTS

2.1 MATERIALS AND CONSTRUCTION

.1 The PLC system shall be designed to operate properly in a harsh environment condition with vehicle traffic vibration, high moisture and salinity ratio. The operating environment includes possible electromagnetic and radio frequency fields. All signal and power wiring shall be designed to avoid interference from electromagnetic equipment.

.2 The PLC shall comply with electromagnetic compatibility standard. Proper documentation issued by authorized certification bodies shall be attached.

.3 As a general rule, the PLC system shall be designed to be power supplied by two independent feeders from UPS (single phase 120Vac, 60Hz).

.4 The system shall be immune to and not emit RFI and EMI. A dedicated circuit breaker, installed inside the PLC cabinet, shall be foreseen for each incoming line.

.5 Protections shall be instead performed downstream (distribution level) by single dedicated automatic breaker or fuse. Fuses, current limiting devices or circuit breakers to protect the system from short circuits shall be applied to all I/O card and power circuits.

.6 Each PLC cabinet shall have at least one socket for utilities or maintenance and an internal cabinet light.

.7 The cabinets, according to the related location, shall satisfy the following minimum protection requirements:
.1 NEMA 12 - Control panels installed inside electrical equipment room;
.2 NEMA 4X - Equipment installed outdoor or under outdoor climate conditions.

.8 PLC System Components Environmental Ratings (independent of control panel enclosure ratings)
.1 Operating temperature: -40 °C up to +70 °C
.2 Operating in wet environment: resistance to 95% humidity
.3 Immunity to hazardous gases and salt mist: Salt mist EN 60068-2-52 / EN 60068-2-11
.4 Immunity to vibration:
.1 4 g root mean square random vibration up to 500 Hz

.2 2 g sinusoidal vibration up to 500 Hz

.5 EMC requirements:

.1 EN 61000-4-5 surge immunity test

.2 EN 61000-4-4 transient / burst immunity test

.6 The characteristic of free-standing and floor-mount panels shall be as follows:

.1 Control panel shall be self-supporting with angle iron or plate framework as necessary to obtain proper stiffness and support

.2 Fabricate control panel of 12-gage carbon steel plate with all-welded construction throughout

.3 Welds shall be ground smooth, corners shall be rounded, and weld spatter cleaned. Corner construction shall be a minimum of 3 inside radius

.4 Surface of control panel shall be free from mars and defects. Finished panel surfaces shall be flat within 1.6mm in 2m and be smooth with rounded edges. Instrument cutouts and drilling shall be straight and true

.5 12-gage full height access doors. Access doors shall have triple-point latch, stainless steel handle and lock, full length stainless steel "piano" type hinge, and sponge rubber gaskets. Door shall be supplied with devices to hold door in 105° position when fully opened.

.6 Full-width, full height, real rectangular subpanel for surface mounting of programmable controller, other surface-mounted instruments, wiring troughs, and terminals strips

.7 Full-length, side-mounted subpanels for installation of terminal strips

.8 4 identical master keys which will operate all locks of each control panel

.7 The characteristic of surface-mounted panels shall be as follows:

.1 Panel with seam-sealed construction with no holes or knockouts and with stainless steel collar studs for mounting subpanels

.2 Panel with Type 316 stainless steel hasp for padlocking

.3 Provide full size subpanel

2.2 PROCESSOR UNIT

.1 Multiple processors shall function as a network interfaced through data communication system with network programming capability.

.2 Processors shall support simultaneous on-line/remote programming and continuous data acquisition and control. Programming/configuration software shall be ladder logic and/or Function Block Diagram (FBD) IEC 61131-3 compliant, employ fill-in-the blanks or interactive techniques.

.3 The PLC system shall be fully programmable on line, maintenance and program editing shall be done without interruption of the bridge operation. Programming shall be possible from a laptop. Contractor shall supply the laptop computer equipped with configuration and communication software.

2.3 PLC I/O

.1 Each I/O module shall have multiple internal power supply paths to ensure that output power is not lost due to a single fault.

.2 Each input shall be normally powered by PLC system and suitable to detect any status change with loop impedances (including contact resistance) of at least 600 Ohm.

.3 Each pulse input card shall accept pulse rates up to 10Hz simultaneously on all pulse inputs.

.4 PLC shall be able to interface the following signal typologies:

.1 Analogue Input (AI) from field device transmitter (4-20mA)

.2 Analogue Output (AO) to field devices (4-20mA)

.3 Digital Input (DI) from field (dry contact)

.4 DI from MCC are dry contact wired to interposing relay panel terminal.

.5 DI from proximity switches

.6 DI from other devices (relay contacts)

.7 Digital output (DO) to Field/MCC/Interposing relay Panel (with the insertion of interposing relay if required by the application).

.8 The I/O subsystem shall be composed of modular plug-in cards for each kind of signal. Each card shall be installed or removed from the system without turning off the power, without affecting the normal functions of the other parts of the system, including adjacent cards.

.9 Digital cards shall be equipped with LED’s indicating the logical status of the signal in order to allow a quick check for commissioning and maintenance.

.10 Power supplies shall be fully redundant and shall be replaced without affecting the functions of the system.

.11 I/O analog cards shall perform a typical diagnosis of signals quality (4-20mA broken wire, over and under range, short circuit, etc).

.12 The distribution of power sources for input and output channels shall be functionally performed, complying with the following rules:

.1 The power sources shall be different for redundant sensors;

.2 The power sources shall be identical for related actuators;

.3 The power supply for solenoid valves (if foreseen) shall be independent from the ones feeding I/O cards.

.13 Card loading criteria shall be applied to prevent the single point of failure affecting the package availability. For redundant instrumentation/equipment card assignment the following criterion shall be applied:

.1 Signals from redundant field initiators shall be wired to different input cards

.2 Signals to redundant field equipment shall be wired to different output cards

.14 The general criterion for spare signals is the following:

.1 The PLC hardware shall be sized including 20% of the I/O total number as equipped spare points evenly distributed. All equipped spare points shall be wired to the terminal strips towards the field.

.2 The PLC cabinets shall be sized including 25% unequipped spare racks for additional cards, in order to allow I/O modules ready to be used for Department future use.

.15 For each type of interface module the Contractor shall provide the relevant technical data-sheet.

.5 Analog Input

.1 The controlled Analog input signals shall be provided with at least field to channel isolation. Each input shall be protected from short circuits causing other inputs to fail.

.2 Common mode rejection ratio shall be less than 70dB, channel to channel cross talk rejection shall not be less than 30dB.

.3 The Contractor shall declare the insulation level between the system and field, and between each channel.

.4 Analog input cards shall have the following characteristics:

.1 Capacity: 16-point single ended

.2 Voltage/current: 24Vdc/4-20mA, supplied by the card or externally supplied

.3 Resolution: 16-bit

.4 Galvanic insulation between the system (PLC) and the field

.5 Over current and voltage peaks protection

.5 In the case of failure of the card, all the signals from the relevant transmitters shall be ignored. The measure recorded in the database shall be identified as “invalid” and an alarm shall inform the operator.

.6 Analog Output

.1 Analog outputs shall be 4-20mA current sources.

.2 Each output shall have individual current limiting such that the effect of a short-circuit to earth in an output does not affect the operation of any other, and that the fault current is limited to less than 30mA.

.3 The controlled analog output signals shall be provided with at least field to channel isolation.
.4 Each output shall be protected from short circuits causing other output to fail.
.5 Analog Output cards shall have the following characteristics:
.1 Capacity: 8-point
.2 Voltage/current: 24Vdc 4-20mA, supplied by the card
.3 Loading: 0-750Ohm
.4 Resolution: 15-bit
.5 Open field wiring detection
.6 In the case of failure of the card, an alarm shall inform the operator and the software output signals of command shall be forced to a defined value.

.7 Digital Input
.1 Digital input shall be via contacts, normally open or normally closed, energized by the relevant cards.
.2 The card shall be equipped with the indication of the input status on the front panel.
.3 Galvanic separation between system and field is required.
.4 Each input shall be protected from short circuits causing other inputs to fail.
.5 Input filter delay shall not exceed 1.0ms. The Contractor shall declare the insulation level between system and field, as well as between each channel.
.6 Multiplexed acquisitions are not allowed.
.7 In general, inputs shall be suitable for acquisition from mechanical devices as free contacts, as well as from solid state devices.
.8 Digital Input cards shall have the following characteristics:
.1 Capacity: 16 point
.2 Voltage: 24Vdc or 120Vac supplied by the card
.3 Over current and voltage peaks protection
.9 In the case of failure of the card, logic status shall be zero and an alarm shall inform the operator.

.8 Digital Output
.1 Digital output cards shall have the following characteristics:
.2 Capacity: 16-point
.3 Voltage: 24Vdc or 120Vac supplied by the card
.4 Any interposing relay (if required) shall be installed in the proximity of the PLC terminal boards and power supplied by PLC system. Interposing relays power rating depends on the device to be actuated. The relays shall comply with the following minimum requirements:
.1 The relay shall be suitable to drive the solenoid at 120Vac

.2 The relay expected life shall be at least 100,000 operations at rated load
.3 The relays shall be immune to cabinet vibration
.4 Powered outputs to solenoid valves shall be protected by modular circuit breakers (one for each SOV).
.5 In the case of failure of the card, an alarm shall inform the operator and the output contacts shall be open (fail safe position).

2.4 COMMUNICATION MODULES

.1 Communication modules shall have the following characteristics:
.1 Copper Ethernet (for cable distances 91m or less)
.2 Function: Interface PLC system with other network components via copper media
.3 Communication rate: 10/100 Mbps
.4 TCP/IP connections: 128
.5 Connection: Single RJ-45 CAT 5 port
.6 Mounting position: Any slot in chassis

.2 Fiber Ethernet (for cable distances exceeding 91m):
.1 Function: Interface PLC system with other network components via multimode fiber media
.2 Communication rate: 100 Mbps
.3 TCP/IP connections: 128
.4 Connection: LC connectors
.5 Mounting position: Any slot in chassis

2.5 LOCAL HMI

.1 A local HMI graphics display capable of accessing information from programmable controller processor shall be supplied installed in the front side door of the cubicle housing the control equipment.

.2 It shall provide an interactive capability to allow operator to control I/O devices and acknowledge alarms from graphics display. Operator shall be able to change modes between manual and automatic control and change device states between on and off, enter control set-points, timer and counter settings, process variables, and loop information by 1 or 2 keystroke actions.

.3 Security levels shall be accessible by user-defined passwords. Levels shall include engineering configuration of graphic displays and setting system parameters, operator control functions only, and process monitoring only.

.4 Operator interface shall have the following characteristics:
.1 Nominal screen size: minimum 12”
.2 Display type: Color TFT active matrix

.1 Resolution: minimum 1280x1024
.2 Operator interface: Touch screen
.3 Power required: 120Vac
.4 Enclosure rating: NEMA 4X

.3 The local HMI shall have a communication interface with Ethernet/IP communication protocol interfacing between graphics operator interface components and to programmable controller specified.

.4 Contractor shall supply the configuration software of HMI to configure screens for dynamic monitoring and control of process variable data obtained from process controller.

2.6 OPERATOR HMI (PC BASE)

.1 Provide a remote HMI dedicated to the package control shall be provided, to be located at Operator Control desk. The PC base HMI shall be meet the minimum following requirements:

.2 Dual 120-volt ac power feeds.

.3 Monitor Type: Flat panel color LCD.

.4 Size: 21" (525 mm), wide format.

.5 Mouse or trackball.

.6 Alphanumeric keyboard.

.7 Hard drive: 300 GB (minimum).

.8 RAM: 4 GB (minimum).

.9 Drives: CD-RW and DVD.

.10 Operating system: latest version of Microsoft Windows platform on which the stand-alone control system is certified to operate.

2.7 APPLICATION SOFTWARE, OPERATING SYSTEM, AND LICENSES

.1 All software packages, even if not mentioned in this specification, necessary to implement control logics and to perform the package supervision shall be included with the relevant licenses.

.2 The licenses shall not have restriction concerning the number of signals that can be managed. Neither partial licenses (like database licenses with limitation on record number configuration) nor fixed deadline licenses are acceptable.

.3 All system configuration and application developed for project application shall be provided both in compiled and in source version, in order to allow any modification and reload by the Department.

.4 The source files shall be properly commented during the implementation to allow a complete understanding by the maintenance staff.

.5 Detailed operating instruction for programming and configuration shall be supplied by the Contractor.

.6 Standard software license shall be assigned to Department for software provided upon initial installation of each software component. Software licenses shall be issued in Department's name and transferred without restrictions to Department upon completion of Project.

.7 Extend to Department all rights of software purchased including telephone support during warranty period shall be extended to the Department.

.8 Complete software and programming backup package shall be provided by Contractor at the end of the project.

2.8 PERFORMANCE

.1 The control system has to be designed in order to guarantee at least the following performances.

.2 Response Time for Control Loops

.1 The system shall perform a complete control loop within 200ms to 100ms (or better), meaning the time required to digitalize the field inputs, transmit them to the CPU, process the control algorithm, transmit the output signal to the relative card and generate the correct level of the output signal for the actuator, for loops based on hardwired I/O. Longer times are allowed for secondary measure acquisition, which do not interfere in the control nor in the trip logic processing.

.2 The actual timing of each control function shall be independently programmed, according to the process requirement.

.3 Concerning control loops the system shall guarantee bump-less switch between automatic/manual operating control mode of controller.

.3 Response Time for Monitoring and Control Functions

.1 The system shall monitor any change of the input variables and display the updated value for each variable within 1s from the variation of the input (in case of data transmitted through a

serial link, despite of the quantity or type of data to be acquired or any possible delay due to the interface external system, the acquisition time shall be lower than 2s).

.2 The system shall manage any command given by the operator and update the status of the relevant output signal within 1s from the command.

.3 The system shall display any abnormal condition alarm as soon as it occurs (within 1s), independently from the actual graphic page, and record it appropriately.

.4 Refresh Time for Graphic Displays

.1 The system shall guarantee an easy navigation among the control graphic displays guaranteeing an update time lower than 1s on the package HMI, if foreseen, and an update time lower than 1s on the HMI.

2.9 PANEL MOUNTED INSTRUMENTATIONS

.1 Control relays

.1 For general logic hardware interlocks
.2 Type: Plug-in
.3 Construction: Continuous duty
.4 Coil voltage: As applicable
.5 Switch configuration: 3-SPDT
.6 Indication: Mechanical or LED to indicate energized relay
.7 Switch rating: 10A minimum at coil voltage
.8 Mounting: Socket for DIN-rail mounting

.2 Interposing relay for PLC output

.1 Type: Plug-in
.2 Construction: Continuous duty
.3 Coil voltage: As applicable
.4 Switch configuration: 2-SPDT (TBC)
.5 Indication: Mechanical or LED to indicate energized relay
.6 Switch rating: 5A minimum at coil voltage
.7 Mounting: Socket for DIN-rail mounting

.3 Selector Switches

.1 Type: Non-illuminated.
.2 Contact rating: 24Vdc or 120Vac as applicable.
.3 Legend plates: As indicated on the design drawings.

.4 Indication Lights

.1 Type: Standard
.2 Input: Full voltage, 24Vdc or 120Vac as applicable.
.3 Lamp type: LED
.4 Lens color:

.1 Red: Danger, run, or open
.2 Amber: Shutdown, caution, pre-alarm, or abnormal

.3 Green: Stop, closed, or satisfactory
.4 White: Power available, ready
.5 Blue: Status
.5 Legend plates: As indicated on the design drawings.

.5 Pushbuttons:
.1 Type: Non-illuminated
.2 Configuration: Single-operator, number of poles as required for application
.3 Contact rating: 24Vdc or 120Vac as applicable.
.4 Operator:
.1 Flush head: Start applications
.2 Extended head: Stop applications
.3 Mushroom head: Emergency stop applications
.5 Button color:
.1 Red: Danger, run, or open
.2 Green: Stop, closed, or satisfactory
.3 White: Power on
.6 Legend plates: As required for application

.6 Digital display:
.1 Display: 4-digit (-1999 to 9999) red LED, 0.56” high
.2 Decimal point: Up to 3 decimal places
.3 Update rate: 3.7 to 5 times per second
.4 Input signal: 4-20mA, externally powered
.5 Enclosure: 1/8 DIN, high impact plastic
.6 Electrical classification: NEMA 4X, IP65 front
.7 Supply voltage: 24Vdc or 120Vac as applicable.
.8 Electrical connection: Screw terminal blocks
.9 Mounting: Control panel

.7 Signal splitter:
.1 Input signal: 4-20mA, externally powered
.2 Output signals: Dual, independent, 4-20mA, internally powered
.3 Power requirements: 24Vdc
.4 Mounting: DIN rail

.8 Signal convertor:
.1 Type: Universal
.2 Inputs:
.1 Thermocouple
.2 RTD
.3 Resistor. 2-wire, < 8KOhm
.4 Potentiometer: 3-wire, < 8KOhm
.5 Voltage: -20mV to 2400mV
.3 Outputs:
.1 Current: 4-20mA into 500Ohm load
.2 Power required: 18-30Vdc
.3 Mounting: DIN rail

.4 Accessories: Configuration software and cable kit for interconnection

.9 Surge suppressor:
.1 Type: Pluggable surge suppression modules fitting into fixed base with hot swapping capability or within terminal block with integrated knife
.2 Capacity:
.1 Current: Up to 10kA surge total current handling
.2 Peak clamping voltage: <= 45Vdc
.3 Resistance: 3.3Ohm in-line
.3 Analog signals:
.1 Circuits: 1 or 2 - 24Vdc
.2 Signals: Suitable for 4-20mA current, thermocouple or mV
.4 Discrete 24Vdc signals:
.1 Circuits: 2 or 4
.2 Signals: Suitable for 24Vdc discrete circuits
.5 Intrinsically safe barriers:
.1 Function: Isolate instruments installed in hazardous areas
.2 Type: Isolated switching
.3 Hazardous area classifications: Class I, II, III; Division 1, Groups A through G
.4 Power required: 24Vdc
.5 Mounting: Nonhazardous area on DIN rail
.6 Channels: 1

2.10 FACTORY WIRING

.1 Control Power wire:
.1 Rating: 600V, 90°C, PVC insulation/jacket, Type MTW.
.2 Conductors: Stranded copper, 12 AWG.

.2 Analog signal cable:
.1 Configuration: Twisted pair, shielded, and jacketed.
.2 Insulation: 300V, 60°C, PVC, color-coded to permit identification of each conductor.
.3 Conductors: Stranded copper, 18 AWG.
.4 Shield: Metalized foil or tinned copper braid providing 100% coverage against noise together with 20 AWG stranded tinned drain wire.

.3 Discrete signal wire:
.1 Rating: 600V, 90°C, PVC insulation/jacket, Type MTW.
.2 Conductors: Stranded copper, 18 AWG.

.4 Power and discrete signal wire insulation color:
.1 BLK: Line voltage.

.2 BRN: Line voltage/fused.
.3 RED: 120Vac.
.4 ORG: 24Vac.
.5 YEL: Caution/may be live from remote power source.
.6 GRN: Ground.
.7 BLU: Dc negative.
.8 VIO: Dc positive.
.9 WHT: Neutral at GND potential.

.5 Wires and cables shall be grouped and routed from terminal blocks to panel-mounted instruments in separate raceway as follows:
.1 Low-voltage/low current dc analog signals (30V/50mA or lower).
.2 High-voltage dc alarm signals (48V or greater).
.3 Low-voltage ac control signals (120V or lower).
.4 High-voltage ac power signals (greater than 120V).

.6 Provide surge suppressor terminal blocks for analog and discrete signals for field devices not located within the same building structure as the source I/O Modules:
.1 Analog signal blocks: Voltage rating 24Vac/dc.
.2 Discrete signal blocks: Voltage rating 24/120Vac/dc.

.7 Terminal block requirements:
.1 Type: High-density.
.2 Voltage: 600V.
.3 Wire range: 30 AWG to 12 AWG.
.4 Termination: Screw clamp compression with pressure plate equipped with fuse (for digital output signals) and knife-edge. Fuse Blown LED indication shall be available for fused terminals.
.5 Mounting: Rail-mounted with end anchors and barriers. All terminal strips shall be tagged with Multi-cable Tag Number, and each terminal shall be individually identified with a progressive number.
.6 Spare: Provide greater amount of 20% or 6 terminals per terminal strip
.7 Install power distribution blocks to parallel feed to power control devices. Parallel wiring from instrument to instrument is not acceptable.
.8 Provide plug-in strip for ac supply power to devices requiring ac power via power cord.
.9 Circuit protection
.1 Install individual circuit breakers for protection of control panel power supply circuits as identified above.
.2 Group circuit breakers on separate terminal strip away from low-voltage instrumentation circuitry.
.3 Provide fuses for protection of individual instrumentation circuits. Instrumentation circuits for field-

mounted instruments may be combined in logical groupings of no more than 10 devices/signals.

.4 Provide 8 AWG internal copper grounding bus for ground connections.

.5 Wire tags:

.1 Type: Embossed, heat-shrink tubing. Fiber tape tagging not acceptable.

.2 Color: White.

.3 Identify both ends of wires and/or cables with permanent wire marker.

2.11 PANEL AUXILIARY SERVICE EQUIPMENT

.1 Fluorescent lighting fixtures of sufficient size and quantity to provide 30 to 50 foot-candles of illumination within panel. Wire to UL-approved switch mounted inside panel.

.2 Duplex, 120-volt ac, 3-wire grounded type convenience outlets. Provide 1 duplex receptacle per 12 sq ft of subpanel area. Service outlets shall be powered from separate voltage source (non UPS feeding line) than instrumentation and PLC equipment.

2.12 POWER DISTRIBUTION

.1 Electrical power to all systems shall be 120Vac, 60 Hz, single phase with neutral solidly grounded, from redundant Uninterruptable Power Supply (UPS).

.2 Non-UPS 120Vac 60 Hz, single phase, with neutral solidly grounded, from electric board shall be provided for auxiliary power requirement like lighting, service socket, etc. of PLC cabinets.

.3 PLC shall include redundancy of DC power regulators, with automatic back-up, such that microprocessor controller power supply failure shall not affect loop or sequence control.

.4 Control equipment will be powered by 24Vdc derived from redundant 120Vac from UPS.

.5 Control cabinets fan will be powered by redundant 120Vac from normal power supply.

.6 The Contractor shall provide the necessary power supply conditioning for transients and surges resulting from a noisy process environment and shall state limitations of his equipment.

.7 The Contractor shall regulate power individually for all I/O points and within each controller group.

.8 Solenoid valves and equipment such as PC, monitors (i.e. without redundant power feedings) will be supplied by PLC using the third dedicated 120Vac line from UPS.

.9 The PLC shall be capable of monitoring and reporting the status of all supplies within the system. Diagnostic alarm indication for Power supply fault, breaker trips, power failure on motherboard, and cabinet high temperature, identifying the faulty unit, shall be reported for supervision.

2.13 EQUIPMENT IDENTIFICATION

.1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Nameplates for designating the motor control center shall be 8mm minimum height and shall be mounted at the top of the motor control equipment and bridge logic control panel. Nameplates shall be mounted on the door of each control unit and shall be 3/16-mm minimum height capital letters. Nameplates shall be replaceable in nameplate holders and shall be white incised letters on black and white laminated Bakelite. Designations shall be as indicated on the Contract Drawings. Samples shall be submitted to the Department’s Representative for approval.

2.14 FINISHES

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

.2 Paint motor control centre exterior light gray and interiors white.

2.15 SOURCE QUALITY CONTROL

.1 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

.2 Department’s Representative to witness standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.

PART 3 - EXECUITION

3.1 EXAMINATION

.1 Verification of Conditions: verify that the existing conditions are acceptable for PLC installation in accordance with manufacturer's written instructions.

.1 Inform Department’s Representative of unacceptable conditions immediately upon discovery.

.2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Department’s Representative.

3.2 INSTALLATION

.1 The electrical installation work shall be installed as indicated on the Contract Drawings and in accordance with approved shop drawings and manufacturer’s recommendations.

.2 All associated construction and installation work shall be installed using good installation judgement and in accordance with all prevailing national and local codes and ordinances.

3.3 TESTS,INSPECTIONS,AND VERFICATIONS

.1 The Contractor shall be responsible for all the necessary tests of the HPU’s electrical and control system, both Factory Acceptance Test (FAT) and the Site Acceptance Test (SAT). Testing shall include both hardware and software items included in its scope of supply.

.2 Testing shall include all system hardware, communications, back-up and redundancy operations, 100% of I/O points (including spares) with simulated inputs and outputs (hardware I/O simulator with real tag numbers shall be arranged before testing), local panel (if any), and any other external device communications interface. Testing shall also include complete integrated testing of the interfaces including field devices, relay panel(s), machinery control equipment, and operator control console.

.3 Testing shall include functional tests of all logic block diagrams, including all associated interfaces with the operator console and graphic displays. All testing is to be carried out to show that the system operates correctly and in compliance with the provided logic drawings, cause and effect matrix, ladder logics, block diagrams.

.4 In the event testing is interrupted for repairs or modification of the PLC System, the Contractor / Department may require testing be restarted completely.

.5 Contractor shall provide all necessary test equipment and software including any special software or hardware required for a complete functional test of the system.

.6 Contractor shall clear and re-test and approve all punch list items before the PLC system may be released for shipping. In presence of any pending punch list, the advanced shipping may be authorized by the Contractor.

.7 The Contractor shall provide the necessary assistance to co-ordinate the field tests, to supervise the commissioning and start-up activities, to perform the training activities applicable for the package.

.8 Department and Contractor may attend all of the tests. Any limitation on time required for the tests is not accepted: any test is considered ended if and only if completed in every part.

3.4 FACTORY ACCEPTANCE TEST(FAT)

.1 The FAT will concern all the equipment and developed software within Contractor scope of supply, as well as the integration with other subsystem supplied by different sub-contractor.

.2 Schedule and testing procedures shall be submitted to the Contractor/ Department as early in the design as possible, but not less than 60 days prior to test. After schedule approval, at least 4 weeks prior to the start of testing, the Contractor shall provide the following documentation:
.1 Detailed FAT procedure
.2 Full documentation concerning hardware
.3 Full documentation concerning software configuration complete with relevant comments
.4 Records of all tests priory performed by the Contractor
.5 Records of power-up of all PLC system components

.3 This documentation, even if not issued as final review, shall be completed and detailed.

.4 Department /Contractor may ask to postpone the starting date of FAT if any material omissions or relevant errors in the documentation are met.

.5 Prior to the FAT all the necessary equipment shall be fully assembled, wired and connected in order to test all the

functionality of the supply. The Contractor shall provide test documentation for all electronic devices and for the cards before system assembling.

.6 The Contractor shall organize the testing activities and make available all the assistance and equipment necessary so that the testing activity proceeds as quickly as possible. Location, staff and equipment to perform the test are completely at Contractor charge.

.7 Hardware FAT shall be performed before and independently from Software FAT.

.8 During the test, all the mentioned documents shall be available.

.9 The control system shall be installed in its final configuration and mainly the following items shall be tested:

.1 Hardware components and power supply

.2 Visual check in order to verify the equipment quantities and conformity to drawings and contractual characteristics, identification tags, safety coverings, cable run, interconnection between panels, etc.

.3 Project documentation check

.4 Insulation resistance and dielectric test of components

.5 Redundancy systems test

.6 Test of all I/O cards

.7 Test of loss of power and subsequent power up

.8 PLC System diagnostic

.9 Application software

.10 HMI Graphics

.11 Communication

.10 As general statement, 100% of hardware (spares included) and application software shall be tested. In order to facilitate the tests, the Contractor shall provide all the needed equipment to simulate digital/analogue inputs, to check the status of digital/analogue outputs and to simulate serial link communication.

.11 All the application software will be tested by simulation of all I/Os (software simulating the field is accepted).

.12 After the completion of the hardwired FAT, testing procedure shall foresee a complete integrated testing of the bridge control interfaces (System Integration Test). All the necessary hardware components and software application necessary to perform the test will be provided by the Contractor.

.13 Since the Software FAT may be performed after the delivery of the hardware at site, the Contractor shall foresee all the necessary

equipment in order to proceed with software test without any additional cost charged to the Department.

.14 All the anomalies, defections or changes will be reported and corrected by the Contractor before the end of testing or, at least with the Contractor approval, before shipment. Contractor shall re-test and approve all punch list items before the PLC system may be released for shipping. If during the test activity problems occur so that it will be difficult to continue, in the opinion of the Contractor personnel, the testing will be interrupted until the Contractor remedies to these problems. In the event testing is interrupted for repairs or modification of the PLC System, the Department or Contractor may require testing to be restarted from the beginning.

.15 A check list shall be issued during the FAT. Detailed check list shall be prepared by the Contractor and included in the FAT procedure. Other tests can be required according to the project needs and will be defined during detailed engineering.

.16 Positive result in the test does not release the Contractor from his responsibilities to provide a system completely working and to perform all the modification, which could be necessary to assure system correct working in the field.

.17 After successful completion of the FAT, the FAT completion report shall be signed by the equipment vendor and the Contractor.

.18 A final report shall be issued at the end of FAT, highlighting possible reservation as far the Contractor/ Department are concerned; shipment authorization will be generally issued by the Contractor only after the complete solution for the pending reservation.

3.5 SITE ACCEPTANCE TEST(SAT) AND COMMISSIONING ASSISTANCE

.1 The Site Acceptance Test is intended to verify that the system, as accepted at FAT completion, will still perform on site as per specification after the shipment. This test will be performed after erection and wiring completion but jointly with the loop tests on each individual loop.

.2 It shall fully cover all the functionalities of the system that could have been degraded by dismounting, packing, shipping and installing the system on site (i.e. I/O cables connections, power supply connections, HW integrity, etc).

.3 The other checks shall be repeated as “Sample”, with an extent suitable to demonstrate that the system has been properly restarted and the configuration correctly reloaded.

.4 Vendor's technicians shall be on site during field test to perform the test and solve any problem that could arise.

.5 Before performing the test, Contractor is asked to issue and submit for Department approval, a Site Acceptance Test Procedure complete with check-lists identifying each test to be performed.

.6 The tests, start up and commissioning activities at construction site in charge to the Contractor shall at minimum include:

.1 Test without auxiliary voltage and insertion of auxiliary voltage

.2 check of installed equipment (quantity, quality)

.3 check of insulation of cables and equipment electric materials

.4 check of cables for continuity and conformity to drawings

.5 switch on operating voltage to equipment after checking protection settings

.6 Switch on PLC into service

.7 White test (without power voltage)

.8 Calibration of all adjustable monitoring equipment (limit switches, position transducers, level transducers, thermostats, level switches, pressure switches, etc.)

.9 Calibration and proper operation checkout of all field equipment: controls, local commands indicators, actuators both electric and electro-pneumatic

.10 Check of the interface equipment to PLC by checking the corresponding readings (alarms, indicators, measurement readings, etc.)

.11 No load tests (with the machines energized)

.12 Check of direction of rotation of the machines

.13 Check of machine power consumption and protection settings

.14 Calibration and check the proper operation of the electrical and hydraulic machine controls, which are possible only when the machine is running

.15 Test of the entire software with all I/O connected in their final configuration; all the controls, sequences, interlocks and specific functions of the program shall be tested locally from the panel interface (if any) and remotely from the main control room.

.7 Vendor representative shall have at their disposal all the necessary equipment for testing and put the system into service.

.8 The commissioning and system tests include the download of the final hardware/software configuration.

.9 Any software programming change required by Contractor on site and implemented by Vendor personnel shall be considered part of the Site Acceptance Test scope of work.

3.6 WARRANTY

.1 Warranty period: refer to Commercial documentation.

.2 Performance warranty:

.1 If a failure of performance achievement occurs, the Contractor shall provide all the necessary action to satisfy with this specification requirements including addition or replacement of system components, system re-configuration, etc…

.2 Special warranty (to be quoted separately):

.3 Provide extended warranty for software and firmware supplied. Warranty shall provide parts and maintenance for installed system to Department for period extending through start-up and acceptance period of the project and for period extending 5 years beyond that date.

.4 Warranty provisions of license agreement shall cover system software and firmware including any third-party software supplied with system.

.5 Provide telephone support service for period beginning with delivery of equipment and extending throughout software warranty period. Service shall provide telephone consultation services as required on operation, configuration development, trouble shooting, and maintenance of system hardware or software by persons in Contractor’s organization who are thoroughly familiar with equipment and software supplied.

.6 Extended correction period: Provide post-warranty software maintenance program. Program shall provide operating and configuration software upgrades for installed system to client for a period extending through start-up and acceptance period of the project and for a period extending 5 years beyond that date.

3.7 TRAINING

.1 Contractor shall provide training course to instruct the operator and maintenance personnel on the main operation and maintenance acknowledgments for PLC

.1 Operator course to instruct the operators for package management maintenance

.2 The course content shall contain as a minimum:

.1 Introduction to the system hardware and software

.2 System configuration

.3 Programmed Control Logic and Sequence of Operation

.4 Development of graphic displays (where foreseen)

.5 Installation

.6 Routing and Preventive maintenance

.2 The Contractor shall submit the courses contents to the Contractor and the Department for approval priory to be held the training courses.

3.8 CLEANING

.1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
.1 Leave work area clean at end of each day.

.2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

.3 Waste Management: separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 MEASUREMENT AND PAYMENT

.1 No measurement for payment will be made for work under this Section.

.2 Payment for all costs associated with this tender item shall be included with payment item for the Hydraulic Power Unit (HPU) Work Electrical.

END OF SECTION