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| R.109141.001 | | 2020-12-09 |

PROJECT TITLE Burlington Canal Lift Bridge (BCLB)
1157 Beach Boulevard
Skew Control, PLC, UPS and Auxiliary Drive Control
Modification and upgrades

PROJECT NUMBER R.109141.001

PROJECT DATE 2020-12-09

PUBLIC WORKS AND GOVERNMENT SERVICES CANADA
BURLINGTON CANAL LIFT BRIDGE
Skew Control, PLC, UPS and
Auxiliary Drive Control
Modifications and Upgrades

SIGN-OFF SHEET

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M-01 - ABSOLUTE ENCODER INSTALLATION ASSEMBLY AND DETAILS
M-02 - ABSOLUTE ENCODER INSTALLATION DETAILS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Title and description of Work.
- .2 Work Covered by Contract Documents.
- .3 Contract Method.
- .4 Cost Breakdown.
- .5 General Requirements.
- .6 Work sequence.
- .7 Contractor use of premises.
- .8 Work Restrictions.
- .9 Departmental Representative occupancy.

1.2 PRECEDENCE

- .1 Division 01 Sections take precedence over technical specification sections in other Divisions of this Project Manual.

1.3 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Skew Control
The bridge control system is based on PLC logic that controls, manages, monitors, alarms and trips the bridge operating system. The basis of the moving structure longitudinal skew control utilizes the PLC with inputs from motor shaft connected encoders and high-speed counters. This system has proved problematic since its installation and has been the cause of bridge operational issues. The intent of this item is the replacement and upgrade of the skew control system as specified and described on the Contract Drawings to achieve a reliable bridge operating system including but not limited to eliminating the following;
 - 1. Eliminate bridge skew early warning false alarms.
 - 2. Eliminate intermittent false trips occurring in the bridge nearly raised region.
 - 3. Eliminate bridge skew alarm and trip events.

- .2 Reconfigure and re-install the auxiliary drive motor control system to enable them to operate the auxiliary motors located in each tower from one location. Presently this operating functionality is incomplete. Provide all required changes and programming to allow control of auxiliary motors from one location, either the machinery spaces or remotely from the operators control house.
- .3 Bridge Control System PLC
1. Replace the existing power conditioning units associated with control panel CP3 and CP4 uninterruptable power supply (UPS) as described on the Contract Drawings.
 2. Add programming of the modified and upgraded skew control system as specified herein and on the contract documents.
 3. Add programming to alarm and display electric service ground fault relay alarm.
 4. Make PLC software/hardware revisions to implement an operator system lock-out solution on the control console (physical key or software user-login based). Coordinate design solution with the Departmental Representative and Bridge Master.
 5. Perform PLC testing and software/hardware revisions to enable the "gate group raise", individual "gate raise" and "gate lower" functions to send motor stop command / cancel sequence during operation. Coordinate programming with the Departmental Representative and Bridge Master.
 6. Add PLC timeout function to logout automatically out of the maintenance menu after a set time. Coordinate programming with the Departmental Representative and Bridge Master.
 7. Verify and ensure that all PLC alarms logged and displayed include alarm type, cause, issue and location. Modify PLC programming and tags accordingly.
 8. Following the completion of the re-programming and additional programming the control systems vendor shall perform a shop test to demonstrate the PLC functions before uploading the program to the bridge PLCs.

1.4 NOT USED

.1 Not used.

1.5 GENERAL
REQUIREMENTS

- .1 The contractor shall verify existing system configuration, operational status and all dimensions on site related to the Work.
- .2 Prior to beginning of the works, the Contractor shall verify existing system configuration, operational status and all dimensions, levels and site conditions and notify the Departmental Representative of error or omission.
- .3 The Contractor must take into consideration the site conditions and perform work using accepted construction practices and methods to the satisfaction of the Departmental Representative.
- .4 The Contractor shall supply necessary labors, material and equipment for the execution of the work shown on contract drawings.
- .5 During work, the Contractor is responsible for all damages caused to the existing electrical power and control system and bridge properties and shall repair said damage at no cost to the Departmental Representative. The Contractor shall keep the area of work clean and free of any debris at the end of each workday.
- .6 The Contractor shall carefully inspect the site and the bridge operating systems to view and assess features and difficulties that might affect the work. No extra charge due to a mistaken evaluation will be accepted.
- .7 To facilitate commissioning and demolition, road closure may be required and shall be implements per Ontario Traffic Manual Book 7 - Temporary Conditions.
- .8 High angle rescue services may be required for the work that is taking place in the tower and shall be included as part of the work.
- .9 Hoarding and netting to protect pedestrian and traffic due to elevated work taking place at the South Tower shall be included.

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| <u>1.6 WORK SEQUENCE</u> Representative's | .1 | Construct Work in stages to accommodate Departmental continued use of premises during construction. |
| | .2 | Coordinate Progress Schedule and coordinate with Departmental Representative Occupancy during construction. |
| | .3 | Construct Work in stages to provide for continuous public usage. Do not close off public usage of facilities until use of one stage of Work will provide alternate usage. |
| | .4 | Maintain fire access/control. |
| <u>1.7 CONTRACTOR USE OF PREMISES</u> | .1 | Coordinate use of premises under direction of Departmental Representative on site. |
| <u>1.8 WORK RESTRICTIONS</u> | .1 | Carry out Work from Monday to Friday from 0700 hours to 1800 hours. |
| | .2 | Lane closures can take place between 9:00 AM and 3:00 PM and from 7:00 PM to 6:00 AM. Full road closure may be accommodated with a 10 working day advance notice and will be limited to a maximum of 2 days. A Traffic Control Plan prepared in accordance with Ontario Traffic Manual Book 7 shall be prepared for all lane and road closures and shall be deemed to be included as part of the work. |
| | .3 | - The preparation for navigation season begins on March 17th, 2021 and for two weeks from this date no work shall be carried out on site. Full road closure may be accommodated with a 10 working day advance notice and will be limited to a maximum of 2 days. |
| <u>1.9 DEPARTMENTAL REPRESENTATIVE OCCUPANCY</u> | .1 | Departmental Representative will occupy premises during entire construction, testing and commissioning period for execution of normal operations and other construction projects. |

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 Title and Description.
- .2 Administrative.
- .3 Preconstruction Meeting.
- .4 Progress Meeting.

1.2 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 PWGSC shall provide a meeting space at the Burlington Canal Lift Bridge.
- .5 Preside at meetings.
- .6 Record the minutes of meetings. Include significant proceedings and decisions. Identify actions by parties.
- .7 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.3 PRECONSTRUCTION MEETING

- .1 Within 5 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 will be in attendance or the meeting will be held via video conference as agreed with Departmental Representative.
- .3 Establish time and location of meeting and notify parties concerned minimum 2 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: contractor to provide construction schedule.
 - .3 Schedule of submission of shop drawings, samples, mock-ups, colour chips. Submit submittals in accordance with Section 01 33 00.
 - .4 Health and safety in accordance with Section 01 35 29.
 - .5 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
 - .6 Record drawings and specifications in accordance with Sections 01 33 00 and 01 78 00.
 - .7 Maintenance manuals in accordance with Section 01 78 00.
 - .8 Take-over procedures, acceptance, warranties in accordance with Section 01 78 00.
 - .9 Monthly progress claims, administrative procedures, photographs, hold backs.
 - .10 Appointment of inspection and testing agencies or firms.
 - .11 Insurances, transcript of policies.

1.4 PROGRESS MEETINGS

- .1 During course of Work System development, installation, testing and commissioning) and 2 weeks prior to project completion, schedule progress meetings bi-weekly.
- .2 Contractor, major Subcontractors involved in Work, Departmental Representative and Engineer are to be in attendance.
- .3 Notify parties minimum (2) days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within (1) days after meeting.
- .5 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 Review proposed changes for effect on construction schedule and on completion date.
- .11 Other business.

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

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|------------|-------------------------|-----|---|
| <u>1.1</u> | <u>RELATED SECTIONS</u> | .1 | Section 01 45 00 - Quality Control |
| <u>1.2</u> | <u>ADMINISTRATIVE</u> | .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 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 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 minimum one reviewed copy of each submission on site. |

1.3 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 Indicate materials, methods of construction, electrical power and control installation and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of necessary programming, adjustments and sequence of operation and testing of the proposed 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.
- .3 Allow ten (10) days for Departmental Representative's review of each submission.
- .4 Adjustments made on shop drawings by the Engineer or 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.
- .5 Make changes in shop drawings as the Engineer or Departmental Representative may require, consistent with Contract Documents. When resubmitting, notify the Engineer or Departmental Representative in writing of revisions other than those requested.
- .6 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 Other pertinent data.
- .7 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 Details of developed and proposed systems, manufacture, fabrication and factory testing.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating systems.
 - .8 System software and control logic modifications and additions.
 - .9 Wiring and wiring installation diagrams.
 - .10 Single line, schematic diagrams and BOM's.
 - .11 Relationship to adjacent work.
- .8 After Engineer and Departmental Representative's review, distribute copies.
- .9 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Departmental Representative may reasonably request.
- .10 Submit 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.
- .11 Submit 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 that material, product or system are identical to material, product or system to be provided and has been tested in accordance with specified requirements.
- .12 Submit 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.
- .13 Submit electronic copy of manufacturers' 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.
- .14 Submit electronic copy of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Departmental Representative.
- .15 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .16 Submit electronic copy of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Departmental Representative.
- .17 Delete information not applicable to project.
- .18 Supplement standard information to provide details applicable to project.
- .19 If upon review by Departmental Representative, no errors or omissions are discovered or if only minor corrections are made, an electronic copy 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.
- .20 The review of shop drawings by the Departmental Representative is for sole purpose of ascertaining conformance with general concept.
 - .1 Review does 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 to 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.

1.4 PROCEDURES

- .1 Provide procedures required as specified in the Contract documents or as directed by the Departmental Representative.

1.5 OTHER SUBMISSIONS

- .1 Provide all other submissions as required by law and the Contract documents.

1.6 CERTIFICATES
AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .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.

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 National Building Code 2015 (NBC)
 - .1 NBC 2015, Division B, Part 8 Safety Measures at Construction and Demolition Sites.
- .2 National Fire Code 2015 (NFC)
 - .1 NFC 2015, Division B, Part 5 Hazardous Processes and Operations, subsection 5.6.1.3 Fire Safety Plan.
- .3 Province of Ontario
 - .1 Occupational Health and Safety Act Revised Statutes of Ontario 1990, Chapter O.1 as amended, and Regulations for Construction Projects, O. Reg. 213/91 as amended.
 - .2 O. Reg. 490/09, Designated Substances.
 - .3 Workplace Safety and Insurance Act, 1997.
 - .4 Municipal statutes and authorities.
- .4 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§ion=text.

1.2 SUBMITTALS

- .1 Submit in accordance with Section 01 33 00.
- .2 Submit site-specific Health and Safety Plan: Within 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.
- .3 Provide a Rescue Plan: In accordance with current regulations for Working at Heights, provide the Owner and Departmental Representative a rescue plan for workmen in the event of an emergency.
- .4 Provide a COVID-19 Mitigation Plan and a COVID-19 Response Plan: In accordance with current Federal and Provincial health and safety guidelines regarding COVID-19, provide the Owner and Departmental Representative a COVID-19 Mitigation

Plan and a COVID-19 Response plan. The response plan is to include actions which will be taken by the Contractor in the event any of the Contractor's or Sub-contractor's site personnel tests positive for COVID-19. As part of the COVID-19 Mitigation Plan:

- .1 Masks and gloves are mandatory.
- .2 All surfaces must be cleaned or wiped down at the end of the workday including the elevator.
- .3 No access will be provided to meeting rooms or interior bathrooms used by the bridge staff.
- .4 Radios, keys and site safety reviews to be coordinated with the bridge master.
- .5 Provide a Fire Safety Plan, specific to the work location, in accordance with NBC, Division B, Article 8.1.1.1.3 prior to commencement of work. The plan shall be coordinated with, and integrated into, the existing Building, Facility and Tenant's Emergency Procedures and Evacuation Plan in place at the site. Departmental Representative will provide Building, Facility and Tenant's Emergency Procedures and Evacuation Plan. Deliver two copies of the Fire Safety Plan to the Departmental Representative not later than 7 days before commencing work.
- .6 Contractor's and Sub-contractors' Safety Communication Plan.
- .7 Contingency and Emergency Response Plan addressing standard operating procedures specific to the project site to be implemented during emergency situations. Coordinate plan with existing Building, Facility and procedures provided by Departmental Representative.
- .8 Departmental Representative will review Contractor's site-specific Health and Safety Plan and provide comments to Contractor within 3 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Departmental Representative.
- .9 Departmental Representative will review Contractor's COVID-19 Mitigation Plan and COVID-19 Response Plan, and provide comments to Contractor within 3 days after receipt of plan. Revise plan as appropriate and resubmit plan to Departmental Representative within 3 days after receipt of comments from Departmental Representative.

- .10 Departmental Representative's review of Contractor's COVID-19 Mitigation Plan and COVID-19 Response Plan should not be construed as approval and does not reduce the Contractor's overall responsibility for construction Health and Safety.
- .11 Submit names of personnel and alternates responsible for site safety and health.
- .12 Submit records of Contractor's Health and Safety meetings when requested.
- .13 Submit 1 copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative weekly.
- .14 Submit 1 copy of Contractor's authorized representative's work site health and safety inspection reports to Departmental Representative, weekly.
- .15 Submit copies of orders, directions or reports issued by health and safety inspectors of the authorities having jurisdiction.
- .16 Submit copies of incident and accident reports.
- .17 Submit Material Safety Data Sheets (MSDS).
- .18 Submit Workplace Safety and Insurance Board (WSIB)-Experience Rating Report.

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 life of project.

1.4 SAFETY ASSESSMENT

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

1.5 MEETINGS

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

1.6 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 sit

1.7 PROJECT/SITE CONDITIONS

- .1 Work at site will involve contact with:
 - .1 Silica in concrete and concrete block.
 - .2 Guano.
- .2 Contractor to refer to DSS report titled Environmental Compliance Audit - Burlington Lift Bridge, 2018 prepared by Environmental Services - Ontario Region".
- .3 Contractor to review report and become familiar with the contents and conditions affecting the work.
- .4 Where removals of Designated Substances are required, Contractor to follow procedures outlined in the appropriate legislation.

1.8 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.
- .4 Contractor shall have all required Personal Protective Equipment (PPE) while working on site, in accordance with Occupational Health and Safety Act and Regulations for Construction Projects.
 - .1 Contractor shall have all required PPE been applied while working with all electrical replacement and installation.
 - .2 Contractor's personnel shall wear N95 masks, when interacting with the Owner, Departmental Representative, other Contractors or any of the Owner's entities.
- .5 Tower elevator is to be used by one person at a time. Alternatively, tower can be accessed using the ladder. All workers must have front dorsal ring harnesses and fall arrest training.

1.9 COMPLIANCE REQUIREMENTS

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

1.10 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 Contractor to be aware that there will be other contractors on this site during the Work. Contractor to ensure that time and spatial separation is maintained at all time, and where required will co-ordinate with Departmental Representative to ensure spatial separation is maintained.

1.11 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.

1.12 HEALTH AND SAFETY CO-ORDINATOR .1

Employ and assign to Work, competent and authorized representative as Health and Safety Coordinator. In accordance with subsection 1.15.2, Health and Safety Co-Ordinator must:

- .1 Have site-related working experience specific to activities associated with abatement of lead and asbestos containing materials.
- .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 Registered Occupational Hygienist, Certified Industrial Hygienist and site supervisor.

1.13 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 Valid certificate of first aider on duty.
- .12 WSIB "In Case of Injury At Work" poster.
- .13 Location of toilet and cleanup facilities.

1.14 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.

1.15 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 Competent Supervisor to stop or start Work when, at Competent Supervisor's discretion, it is necessary or advisable for reasons of health or safety. Departmental Representative may also stop Work for health and safety considerations.

1.16 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.

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 REFERENCE STANDARDS

- .1 Standard Acquisition Clauses and Conditions Manual (SACC)

1.2 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavorably 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 ACTION AND
INFORMATIONAL SUBMITTALS

- .1 Submit information and documents in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit 2 copies of WHMIS MSDS in accordance with Section 01 35 29 - Health and Safety Requirements.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review 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 Names of persons responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of persons responsible for manifesting hazardous waste to be removed from site.
 - .3 Names and qualifications of person responsible for training site personnel.

- .4 Descriptions of environmental protection personnel training program.
- .5 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use.
- .6 Plan to include measures for marking limits of use areas and methods for protection of features to be preserved with authorized work areas.
- .7 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .8 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .9 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .10 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.

1.4 WORK ADJACENT TO WATERWAY

- .1 Construction equipment to be operated on land only.
- .2 Waterways to be kept free of waste material and debris.

1.5 POLLUTION CONTROL

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

1.6 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 Act 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.

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 00 - Cleaning.
- .1 Leave Work area clean at end of each day.
- .2 Ensure public waterways, storm and sanitary sewers remain free of waste generated by this project.
- .3 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .4 Waste Management: separate waste materials for recycling in accordance with Section 01 74 19 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

| | | |
|---|----|---|
| <u>1.1 REFERENCES AND CODES</u> | .1 | Perform Work in accordance with National Building Code of Canada (NBC) 2015, National Fire Code of Canada (NFC) 2015 and Ontario Building Code (OBC) 2016, 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 | Meet or exceed requirements of: <ul style="list-style-type: none"> .1 Contract documents. .2 Specified standards, codes and referenced documents. |
| <u>1.2 HAZARDOUS MATERIAL DISCOVERY</u> | .1 | Stop work immediately and notify Departmental Representative if materials which may contain designated substances or PCB's, other than those identified in Section 01 35 29 are discovered in course of work. |
| <u>1.3 BUILDING SMOKING ENVIRONMENT</u> | .1 | Comply with smoking restrictions. |
| <u>1.4 RELICS AND ANTIQUITIES</u> | .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 PWGSC. Protect such articles and request directives from Departmental Representative. |
| <u>1.5 IAQ - INDOOR AIR QUALITY</u> | .1 | Comply with CSA-Z204-94(R1999), Guideline for Managing Indoor Air Quality in Office Buildings and CSA B651-12 (R2017). |
| <u>1.6 TAXES</u> | .1 | Pay applicable Federal, Provincial and Municipal taxes. |

1.7 EXAMINATION

- .1 Examine existing conditions and determine conditions affecting work.
- .2 Upon completion of review, provide written report identifying existing conditions that may affect the work for review.
- .3 Failure to provide report, will mean that the contractor has accepted the existing and additional claim for extra costs will not be accepted.

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

- | | | |
|--|----|--|
| <u>1.1 SECTION INCLUDES</u> | .1 | Inspection and testing, administrative and enforcement requirements. |
| | .2 | Tests |
| <u>1.2 INSPECTION</u> | .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 | The Engineer and/or shall Departmental Representative shall be provided sufficient notice of factory testing of system vendor developed control systems and be allowed to, if necessary, attend factory testing and witness and approve factory acceptance testing (FAT). |
| | .3 | Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work. |
| | .4 | 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. |
| | .5 | The Engineer and/or 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. |
| <u>1.3 INDEPENDENT INSPECTION AGENCIES</u> | .1 | Contractor, as specified, should retain an Independent Inspection/Testing Agencies to conduct material and electrical installation testing and confirm material, installation and procedures meeting the specified requirements. All cost of such services shall be Contractor's responsibility. |
| | .2 | Provide equipment required for executing inspection and testing by appointed agencies. |
| | .3 | Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents. |

- .4 If defects are revealed during inspection and/or testing, appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Departmental Representative at no cost to Departmental Representative. Pay costs for retesting and re-inspection.

1.4 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.

1.5 PROCEDURES

- .1 Notify appropriate agency and Departmental Representative in advance of requirement for inspection and tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required as applicable for installation material, inspection and 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 if and as necessary.

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

1.7 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.

1.8 TESTS

- .1 Furnish test results as may be requested.
- .2 The cost of tests beyond those called for in Contract Documents or beyond those required by product requirements shall be appraised by Engineer and Departmental Representative and may be authorized as recoverable.

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 Temporary utilities.

1.2 SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

- .1 Provide temporary utilities controls in order to execute work expeditiously.
- .2 Remove from site all such work after use.

1.4 WATER SUPPLY

- .1 Provide continuous supply of potable water for construction use.
- .2 Arrange for connection with appropriate utility company and pay all costs for installation, maintenance and removal.
- .3 Pay for utility charges at prevailing rates.

1.5 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.

- .4 Maintain temperatures of minimum 10°C in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during Work.
 - .2 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
 - .3 Ventilate storage spaces containing hazardous or volatile materials.
 - .4 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Pay utility charges when temporary heat source is existing building equipment.
- .7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .8 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 TEMPORARY POWER
AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools, to a maximum supply of 230 volts, 30 amps.
- .2 Arrange for connection with appropriate utility company. Pay all costs for installation, maintenance and removal.
- .3 Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

1.7 TEMPORARY
COMMUNICATION
FACILITIES

- .1 Provide and pay for temporary telephone, data hook up, and equipment necessary for own use and use of Departmental Representative.

- 1.8 FIRE PROTECTION
- .1 Provide and maintain temporary fire protection and equipment during performance of Work required by insurance companies having jurisdiction and governing codes, regulations and by laws.
 - .2 Burning rubbish and construction waste materials is not permitted on site.

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 REFERENCES

- .1 Within text of specifications, reference may be made to reference standards.
- .2 Conform to these standards, in whole or in part as specifically requested in specifications.
- .3 If there is question as to whether any product or system is in conformance with applicable standards, Departmental Representative reserves right to have such products or systems tested to prove or disprove conformance.
- .4 The cost for such testing will be borne by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.
- .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.

1.3 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 a 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 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 building.
- .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.

1.4 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 Price or Contract Time.

1.5 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 all electrical equipment specified as part of the contract in an environmentally controlled storage space and in accordance with manufacturer's storage requirements.
- .3 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.
- .4 Store products subject to damage from weather in weatherproof enclosures.
- .5 Remove and replace damaged products at own expense and to satisfaction of Departmental Representative.
- .6 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.

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 Departmental Representative if required Work is such as to make it impractical to produce required results.
- .2 Do not employ anyone unskilled in their required duties. Departmental Representative reserves 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.

1.12 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as appropriate, and where they may impact the work.
- .2 Inform Engineer and Departmental Representative of conflicting installation. Install as directed.

1.13 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.

1.14 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of any part of building, bridge towers and machinery spaces, elevators and associated facilities. Do not cut, drill or sleeve any load bearing structural member, unless specifically indicated without written approval of Departmental Representative.

1.15 EXISTING UTILITIES

- .1 Where Work may affect existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and marine, pedestrian and vehicular traffic. Notification of any and all potential disturbances to marine, pedestrian and vehicular traffic shall be submitted to the Bridge Master and Departmental Representative and approved by them prior to the potentially disrupting work proceeding.
- .2 Protect, relocate or maintain existing active services. When services are encountered or otherwise interfere with the work in this Contract, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

PART 2 - PRODUCTS

| | | |
|---------------------|----|-----------|
| <u>2.1 NOT USED</u> | .1 | Not Used. |
|---------------------|----|-----------|

PART 3 - EXECUTION

| | | |
|---------------------|----|-----------|
| <u>3.1 NOT USED</u> | .1 | Not Used. |
|---------------------|----|-----------|

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Progressive cleaning.
- .2 Final cleaning.

1.2 PROJECT CLEANLINESS AND WASTE REMOVAL

- .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 Provide on-site containers for collection of waste materials and debris.
- .4 Provide and use clearly marked separate bins for recycling. Refer to Section 01 74 19.
- .5 Remove waste material and debris from site and deposit in waste container at end of each working day.
- .6 Dispose of waste materials and debris off site.
- .7 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .8 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.3 FINAL CLEANING

- .1 When Work is Substantially Performed, 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 or other Contractors.

- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by the Engineer and/or Departmental Representative. Do not burn waste materials on site.
- .6 Remove dirt and other disfiguration from exterior surfaces.

PART 2 - PRODUCTS

| | |
|---------------------|--------------|
| <u>2.1 NOT USED</u> | .1 Not Used. |
|---------------------|--------------|

PART 3 - EXECUTION

| | |
|---------------------|--------------|
| <u>3.1 NOT USED</u> | .1 Not Used. |
|---------------------|--------------|

END OF SECTION

PART 1 - GENERAL

1.1 CONSTRUCTION &
DEMOLITION WASTE

- .1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.
- .2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act, Ontario Regulation 102/94 and Ontario Regulation 103/94.
 - .1 Provide facilities for collection, handling and storage of source separated wastes.
 - .2 Source separate the following waste:
 - .1 Brick and Portland cement concrete.
 - .2 Corrugated cardboard.
 - .3 Wood, not including painted or treated wood or laminated wood.
 - .4 Gypsum board, unpainted.
 - .5 Steel.
 - .6 Items indicated in Section 02 42 93, Deconstruction and Waste Products Workplan Summary.
 - .7 Electrical material, wiring and conduit/raceways.
- .3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.
- .4 Submit proof that all waste is being disposed of at a licensed land fill 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 the demolition site.

1.2 WASTE PROCESSING
SITES

- .1 Province of Ontario.
 - .1 Ministry of Environment and Energy, 135 St. Clair Avenue West, Toronto, ON, M4V 1P5.
 - .2 Telephone: 800-565-4923 or 416-323-4321.
 - .3 Fax: 416-323-4682.

- .2 Recycling Council of Ontario: 215 Spadina Avenue, #225, Toronto, ON, M5T 2C7.
 - .1 Telephone: 416-657-2797 or 1-888-501-9637.
 - .2 Fax: 416-960-8053.
 - .3 Email: rco@rco.on.ca.
 - .4 Internet: <http://www.rco.on.ca/>.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 CANADIAN GOVERNMENTAL DEPARTMENTS CHIEF RESPONSIBILITY FOR THE ENVIRONMENT

- .1 Government Chief Responsibility for the Environment.

| Province | Address | General Inquiries | Fax |
|----------|--|---|-------------------|
| Ontario | Ministry of Environment and Energy 135 St Clair Avenue West Toronto, ON M4V 1P5 Environment Canada Toronto, ON | (416) 323-4321 (800) 565-4923 (416) 734-4494 | (416) 323-4682 |

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 As-built drawings, samples, and specifications.
- .2 Product data, materials and finishes, and related information.
- .3 Operation and maintenance data.
- .4 Spare parts, special tools and maintenance materials.
- .5 Warranties and bonds.

1.2 SUBMISSION

- .1 Prepare instructions and data using personnel experienced in maintenance and operation of described products.
- .2 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 (2) weeks prior to Substantial Performance of the Work, submit to the Departmental Representative, four (4) final copies of maintenance manuals and commissioning documentation as specified, as applicable, in English.
- .5 If requested, furnish evidence as to type, source and quality of products provided.
- .6 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .7 Pay costs of transportation.

1.3 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, process flow, 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.

1.4 CONTENTS - EACH
VOLUME

- .1 Table of Contents: provide title of project;
 - .1 Date of submission; names,
 - .2 Addresses, and telephone numbers of 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 Contract Document.

1.5 AS-BUILTS AND
SAMPLES

- .1 In addition to requirements in General Conditions, maintain at the site for Departmental Representative one 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 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.
- .3 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".

1.6 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 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .3 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
 - .1 Field changes of dimension and detail.
 - .2 Changes made by change orders.
 - .3 Details not on original Contract Drawings.
 - .4 References to related shop drawings and modifications.
- .4 Other Documents: maintain manufacturer's certifications, inspection certifications, and field test records, required by individual specifications sections.

1.7 MATERIALS AND
FINISHES

- .1 Building Products, 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 Provide information for re-ordering custom manufactured products.

- .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.

1.8 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.

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

1.10 WARRANTIES AND BONDS

- .1 Separate each warranty or bond with index tabsheets keyed to Table of Contents listing.
- .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principals.
- .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.

PART 2 - PRODUCTS

| | | |
|---------------------|----|-----------|
| <u>2.1 NOT USED</u> | .1 | Not Used. |
|---------------------|----|-----------|

PART 3 - EXECUTION

| | | |
|---------------------|----|-----------|
| <u>3.1 NOT USED</u> | .1 | Not Used. |
|---------------------|----|-----------|

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 Prior to beginning the contracted work, demonstrate the operation of the bridge in coordination with the Engineer, Departmental Representative and Bridge Master and document any deficiencies identified as the bridge operating system baseline conditions.
- .2 The bridge operating system baselining condition shall consist of dynamically testing the operation of the bridge and recording the following operating parameters for each tower;
 - .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 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.
- .3 Following the completion of each stage of construction and installation of the specified systems, demonstrate to the Engineer, Departmental Representative and Bridge Master that the contractor has returned the bridge to an acceptable operating status.
- .4 Demonstrate operation and maintenance of all installed and operational equipment and systems procured and installed under this Contract to the Engineer, Department Representative and Bridge Master as specified in Section 01 91 13 GENERAL COMMISSIONING specification.
- .5 This task shall be performed by experienced and qualified contractor staff approved by the Department Representative to not only instruct maintenance personnel on the maintenance and troubleshooting of the installed equipment and systems but to also provide operations and maintenance demonstration and training of bridge O&M personnel as specified in Section 01 91 13 GENERAL COMMISSIONING specification.

- .6 Department Representative will provide list of names and positions of personnel to receive instructions, and will coordinate personnel to receive instructions, and will coordinate their attendance at agreed-upon times. The contractor shall provide at least 7-days' notice to Department Representative of the scheduled demonstrations and training.
- .7 The demonstrations of the operation of the specified equipment and systems shall be conducted in concert with the training for Department personnel as specified in Section 26 05 00 - Common Work Results for Electrical
- .8 In addition to demonstration and training during the commissioning, the training shall also include the work necessary to mothball the relevant and contracted equipment and systems herein bridge operating systems at the end of the operating season and the work necessary at the beginning of the bridge operating season as specified in Section 01 91 13 GENERAL COMMISSIONING specification.
- .9 The contractor shall arrange all demonstration and training classes on-site at the bridge and provide all necessary material including; relevant sections of the approved O&M Manual and any other required reference material to provide a comprehensive training program for each training module. The demonstrations shall be performed on the actual installed operating equipment and systems to be maintained and actual operation of commissioned under all normal and contingency modes of operation of the bridge.
- .10 At the conclusion of each training module the contractor's instruction team shall assess and document each participant's mastery of the module by the use of a demonstration performance-based test and submit all results to the Department Representative.

1.2 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 demonstration and training schedule as specified herein and in Section 26 05 00 - Common Work Results for Electrical including the time and date for demonstration and training of each item of equipment and each system in accordance with the training plan 30 days prior to designated dates, for Departmental Representative's approval.
- .3 Submit reports within one 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.

1.3 CONDITIONS FOR
DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation in accordance with the related technical specification sections and Section 01 91 13 General Commissioning (Cx).
- .2 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.4 PREPARATION

- .1 Verify that conditions for demonstration and instructions comply with requirements.
- .2 Verify that designated O&M personnel are present.

1.5 DEMONSTRATION
AND INSTRUCTIONS

- .1 In accordance with Section 01 91 13 General Commissioning (Cx) Requirements.
- .2 Demonstrate start-up, operation, control, adjustment, troubleshooting, servicing, and maintenance of each item of equipment at agreed upon times, 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.

1.6 TIME ALLOCATED
FOR INSTRUCTIONS

- .1 Ensure amount of time required for instruction of each item of equipment associated with the movable bridge skew control equipment, PLC, UPS and auxiliary drive control modifications and upgrade operating system: 8 hours of instruction.

PART 2 - PRODUCT

- .1 NOT USED

PART 3- EXECUTION

3.1 MEASUREMENT AND
PAYMENT

- .1 No measurement for payment will be made for work under this Section.
- .2 Payment for all costs associated with demonstration and training shall be included in associated cost item for the Common Work Results-Electrical.

END OF SECTION

Part 1 - GENERAL

1.1 RELATED SECTIONS

Section 01 11 00 - Summary of Work
Section 01 31 19 - Project Meetings
Section 01 33 00 - Submittal Procedures
Section 01 35 29 - Health and Safety Requirements
Section 01 35 43 - Environmental Procedures
Section 01 41 00 - Regulatory Requirements
Section 01 45 00 - Quality Control
Section 01 51 00 - Temporary Utilities
Section 01 61 00 - Common Product Requirements
Section 01 74 00 - Cleaning
Section 01 74 20 - Construction Demolition Waste
Management
Section 01 78 00 - Closeout Submittals
Section 01 79 00 - Demonstration and Training
Section 02 41 99 - Demolition
Section 26 05 00 - Common Work Results for Electrical

1.2 ACRONYMS

- .1 Cx - Commissioning.
- .2 O&M - Operation and Maintenance.
- .3 PI - Product Information.
- .4 PV - Performance Verification.
- .5 TAB - Testing, Adjusting and Balancing of bridge and mechanical systems.

1.3 GENERAL REQUIREMENTS

- .1 Contractor shall develop Testing and Commissioning Plan (Cx) for the project. The Cx Plan shall include as a minimum the following components:
 - .1 Identification of Cx team members and their roles and responsibilities
 - .2 Schedule Cx activities
 - .3 Step-by-step Cx procedures for each of the systems and/or sub systems
 - .4 Formalized forms for documentation of Cx activities completed and not completed or partially completed with outstanding items
 - .5 Applicable pass/fail criteria
 - .6 Signature and/or initial block to confirm successful completion of Cx activities.
 - .7 Prepare maintenance plan for the relevant and bridge integrated electrical systems with the herein described modifications and upgrades.
- .2 Contractor shall conduct testing and commissioning of equipment, sub-system, and system per the requirements and per the Cx Plan.

- .3 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, documented in accordance with the contract and as approved by the Departmental Representative and the Engineer.
- .4 Objectives:
 - .1 To verify installed equipment, systems and integrated systems operate in accordance with contract documents and design criteria and intent of the contract.
 - .2 To ensure appropriate documentation is compiled in accordance with the contract documents, approved and incorporated into the O&M Manual.
- .5 Effectively train O&M staff:
 - .1 Contractor shall be responsible for the overall Cx process, operating equipment and systems, troubleshooting and adjusting as required.
 - .2 Systems shall be operated at full capacity under various modes of operation including as specified and directed contingency modes of operation to determine if they function correctly and consistently at peak efficiency and functionality.
 - .3 Systems shall be interactively operated with each other as intended in accordance with Contract Documents and design criteria.
 - .4 During these checks, adjustments as necessary to be made to enhance performance to meet environmental or user requirements.
 - .5 System performance shall meet all aspect of project functional and operational requirements.
 - .6 Qualified Contractor's Cx Agent to have been responsible for the Cx of at least one moveable bridge.

1.4 COMMISSIONING OVERVIEW

- .1 The commissioning process shall be performed in the following stages:
 - .1 Factory Testing
 - .2 Field Testing
 - .3 Performance Acceptance Testing
 - .4 Endurance test
 - .5 Training

- .2 Cx shall be conducted in concert with activities performed during other, if any, defined stage of project delivery.
- .3 Cx shall identify issues of the contracted power and control systems that they are procured, installed, constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements.
- .4 Cx activities shall include transfer of critical knowledge to the Bridge Master, facility maintenance and operational personnel.
- .5 Contractor shall provide cost as a line item for the Cx with the Endurance Testing cost component broken out separately.
 - .1 Contractor shall effectively train Department staff in every aspect of maintenance and troubleshooting of the contracted and specified systems.
- .6 Departmental Representative will issue Certificate of Substantial Performance after:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Departmental Representative and Engineer.
 - .2 Equipment, components and systems have been commissioned and endurance testing has been completed.
 - .3 O&M manuals have been provided, reviewed and any required review comments have been corrected.
 - .4 O&M training shall be performed and completed.

1.5 PRE-CX REVIEW

- .1 Before Construction/Installation:
 - .1 Review contract documents confirm by writing to Departmental Representative.
- .2 Prior to beginning the contracted work, demonstrate the operation of the bridge in coordination with the Engineer, Departmental Representative and Bridge Master and document any deficiencies identified as the bridge operating system baseline conditions.
- .3 The bridge operating system baselining condition shall consist of dynamically testing the operation of the bridge and recording the following operating parameters for each tower machinery electrical systems:
 - .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 Operating voltages, currents, and power parameters (KVA, KW, KVAR, PF) for bridge machinery equipment.
- .3 Review aspects of design and installation pertinent to success of Cx.
- .4 Ensure adequacy of provisions for Cx.
- .4 During Construction: Co-ordinate provision, location and installation of provisions for Cx.
- .5 Before start of Cx:
 - .1 Have completed Cx Plan and schedule up to date.
 - .2 Submit complete Cx plan documentation to Departmental Representative.
 - .3 Understand completely design criteria and intent and special features.
 - .4 Fully understand Cx requirements and procedures.
 - .5 Ensure that Cx team members understand their roles and responsibilities.
 - .6 Ensure installation of related components, equipment, sub-systems, systems are completed and ready for Cx.
 - .7 Complete TAB procedures on systems, submit TAB reports to Departmental Representative for review and approval.
 - .8 Ensure "As-Built" system schematics are available.
- .6 Inform Engineer and 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.
- .2 Submit no later than 8 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft of the Cx Plan.
 - .3 Preliminary Cx schedule.

- .3 Request in writing to Departmental Representative for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
- .4 Submit proposed Cx procedures to Departmental Representative where not specified and obtain written approval at least 8 weeks prior to start of Cx.
- .5 Provide additional documentation relating to Cx process required by Departmental Representative.

1.8 COMMISSIONING DOCUMENTATION

- .1 Departmental Representative and Engineer to review and approve Cx documentation.
- .2 Provide completed and approved Cx documentation to Departmental Representative and Engineer.

1.9 COMMISSIONING SCHEDULE

- .1 Incorporate Cx schedule into the overall construction schedule.
- .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 Contractor shall conduct Cx meetings to track and report status of the commissioning activities and schedule performance.
- .2 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .3 At 60% construction completion stage. The Contractor shall conduct a Cx scope meeting in present of the Departmental Representative and/or Engineer to review progress, discuss schedule of equipment start-up activities and prepare for Cx.
- .4 The Cx scope meeting agenda as a minimum shall include:
 - .1 Review of Cx Plan.
 - .2 Review roles and responsibilities of Contractor and subcontractors and determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.

- .3 Review current status of schedule as related to Cx activities and determine impacts. Address any potential delays and/or schedule conflicts.
- .4 Action items to be taken to address potential issues.
- .5 Thereafter Cx meetings shall 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 Cx meetings and as required.

1.11 STARTING AND TESTING

- .1 Notify Departmental Representative and Engineer at least 30 days prior to start of Cx.
- .2 Start Cx after elements of bridge affecting start-up and performance verification of systems have been completed.
- .3 Contractor assumes liabilities and costs for commissioning. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 Engineer and Departmental Representative to witness of start-up and testing.
- .3 Contractor's Cx Agent shall be present at tests performed by sub-trades, suppliers and equipment manufacturers. Cx Agent shall be responsible for obtaining test reports from the sub-trades, suppliers and equipment manufacturers, and incorporate them into the final Cx report.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing:
 - .1 Coordinate time and location of testing.
 - .2 Provide factory acceptance test plan for approval by the Departmental Representative and Engineer as required.
 - .3 Arrange for Departmental Representative and/or Engineer to witness tests for equipment requiring factory witness testing per technical specification requirement.

- .2 Factory acceptance test must be completed with all issues resolved, documented, and be approved by Department's Representative and Engineer before factory release of equipment shipment to the project site or changes made to any of the existing bridge control system hardware or software.
- .3 As applicable obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Departmental Representative and Engineer.
- .4 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
- .5 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .6 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.
- .7 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 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Departmental Representative and Engineer 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 of the installed systems and equipment.
 - .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.

1.15 OPERATION OF EQUIPMENT AND SYSTEMS

- .1 The contractor shall start-up and operate equipment and/or systems as directed by equipment/system manufacturer, as specified herein and the approved O&M Manual.

- .2 With assistance of systems vendor, develop written maintenance program revisions and additions to the existing maintenance program to include all work associated with this contract and submit to 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 substantial completion.

1.16 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.

1.17 INSTRUMENTS/ EQUIPMENT

- .1 Submit to Departmental Representative and Engineer 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.

1.18 COMMISSIONING PERFORMANCE VERIFICATION (PV)

- .1 Carry out Cx in accordance with Cx Plan:
 - .1 Under actual operating conditions, over entire operating range, in all modes of operation.
 - .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.

1.19 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 to avoid duplication of tests and to facilitate expedient acceptance of the modified, upgraded and enhanced bridge electrical systems as herein specified.

- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies certificates of approval to Departmental Representative and Engineer within 5 days of test and with Cx report.

1.20 CHECKS,
ADJUSTMENTS AND
TUNING

- .1 Perform static and operational checks as applicable and as required.
- .2 Make necessary adjustments and tunings to optimize system performance as part of the commissioning process.

1.21 DEFICIENCIES,
FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of the Engineer and Departmental Representative.
- .2 Report problems, faults or defects affecting Cx to Departmental Representative in writing. Stop Cx until problems are rectified or interim corrective measures are in place for continuation of Cx in safe manner and without potential damage to equipment. Proceed with written approval from Departmental Representative and Engineer.

1.22 TRAINING

- .1 In accordance with Section 01 79 00.
- .2 O&M training shall be performed by the contractor as specified herein.

1.23 MAINTENANCE
MATERIALS, SPARE
PARTS, SPECIAL TOOLS

- .1 Supply, deliver, and document maintenance materials, spare parts, and special tools as specified in contract.

1.24 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.

1.25 PERFORMANCE
VERIFICATION
TOLERANCES

- .1 Application tolerances:
 - .1 Specified range of acceptable deviations of measured values from specified values or specified design criteria as indicated in technical specifications.
 - .2 Instrument accuracy tolerances: To be of higher order of magnitude than equipment or system being tested.
 - .3 Measurement tolerances during verification: Unless otherwise specified actual values to be within +/-2% of recorded values.

1.26 DEPARTMENT
OPERATIONAL TESTING

- .1 Operational testing of equipment and systems installed under this contract by Departmental Representative will not relieve Contractor from compliance with specified start-up and testing procedures.
- .2 The Department personnel will only perform operational testing of equipment or system after they have received, in writing, that the Performance Acceptance Testing has been completed and correction of all outstanding deficiencies has been satisfactorily completed and the span has been opened to vehicular traffic and is fully operational for marine traffic.

Part 2 - PRODUCT

- .1 NOT USED

Part 3 - EXECUTION

3.1 GENERAL
EXECUTION

- .1 The work under this item is to demonstrate that all specified systems 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 electrical control system vendor and the installing Contractor and his specialty Sub-Contractors.
- .3 The Contractor or the Contractor's Representative shall be present during all test operations.

3.2 FACTORY TESTING

- .1 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 NCC 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, the Consultant and Contractor representative:
 - .1 The integrated testing of motor control center, PLC control system, bridge operator control console and limit switches, and all integrated specified field devices.
 - .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.

3.3 FIELD TESTING

- .1 The Contractor and/or his specialty Sub-Contractors shall adjust, calibrate and test skew control and PLC upgraded sub systems and/or equipment, place the integrated system in service, and test the integrated system using approved test procedures.
- .2 The Contractor shall demonstrate that the completed systems and installed equipment and replaced components function properly. In the case of the reconfigured and upgraded skew control system the demonstration shall include performing at least 10 consecutive complete bridge operation cycles for each mode of operation including simulating bridge

skew conditions as defined by the Engineer to prove the installed systems function to correct bridge longitudinal skew without failure or any adjustments. The Contractor shall provide results of the Contractor's field tests, diagnostics, and calibrations including written certification to the Contracting Agency that the installed complete system has been calibrated, tested, and is ready to begin performance acceptance Testing. The report shall also include a copy of the approved Field-Testing procedure the installed complete system has been calibrated, tested, and is ready to begin Performance Acceptance Testing. The report shall also include a copy of the approved Field-Testing procedure.

- .3 Complete demonstration of system functions in a way that will not interfere with use of the adjacent waterway

3.4 PERFORMANCE ACCEPTANCE TESTING

- .1 Upon successful completion of Field Testing and its acceptance by the Engineer, the Contractor shall demonstrate that the completed electrical work and systems specified under this contract comply with the contract requirements. Using test procedures (submitted by the Contractor and approved by the Engineer), all physical and functional requirements of the project shall be demonstrated. The Performance Acceptance Testing, 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 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 identified as being caused and/or part of this contract work, this shall be regarded as a failure and shall result in termination of the Acceptance Testing until approved by the Departmental Representative to re-start the performance acceptance 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 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. After delivering the

written report, the Contractor shall convene a test review meeting at the bridge performance 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 Acceptance Testing. Based on the Contractor's report and the test review meeting, the Contracting Agency will determine the retest date.

- .3 Upon successful completion of the performance acceptance testing, the Contractor shall provide test reports and other documentation specified to the Department for approval prior to commencing the Endurance Test.

3.5 ENDURANCE TEST

- .1 The endurance testing shall be performed following the successful completion of the acceptance testing as described herein.
- .2 The endurance test shall not be started until the Departmental Representative notifies the Contractor, in writing, that the Performance Acceptance Test above have been completed and correction of all outstanding deficiencies have been satisfactorily completed.
- .3 The testing shall be conducted 2 hours per day for 3 consecutive calendar days, including holidays, for the system specified under this contract and that affects other bridge operating systems. The bridge shall operate as specified without fault or failure. The start date for the test and the opening times shall be as directed by the Bridge Master.
- .4 During testing the bridge will be available for public use and the contractor shall coordinate its testing with the Bridge Master to eliminate any disruption to marine, pedestrian or vehicular traffic associated with the bridge.
- .5 Each day the bridge shall be operated a minimum of 2 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).
- .6 The Contractor shall commence the Endurance Test upon notification from the Departmental Representative. The Departmental Representative may terminate testing at any time if the system fails to perform as specified and the endurance test shall be repeated in full following rectification of the failure.

- .7 Upon successful completion of the Endurance Test, the Contractor shall provide test reports and other documentation specified to the Department prior to acceptance of the system.

3.6 TRAINING

- .1 The contractor proposed training staff shall possess at least ten years' experience of installing, maintaining and troubleshooting similar electrical systems. The experience of the proposed staff must include having performed similar functions on at least three (3) electrically powered highway bridges of which at least one (1) shall have been a tower drive vertical lift bridge.
- .2 The contractor shall submit in resume form, the experience of his maintenance team as part of his tender for Department review and approval. No maintenance shall be performed on the installed system or the bridge by any unapproved maintenance technician.
- .3 The contractor shall submit a comprehensive regular maintenance test plan to the Departmental Representative for review and approval prior to completion of the contracted system installation.
- .4 The bridge operational training shall include all normal and contingency operating scenarios for the systems specified.

3.7 MEASUREMENT AND PAYMENT

- .1 No measurement for payment will be made for work under this Section.
- .2 Payment for all costs associated with general commissioning shall be included in associated cost item for the Common Work Results-Electrical.

END OF SECTION

PART 1 - GENERAL

- 1.1 DESCRIPTION OF WORK .1 This Section covers the requirements for demolition of the related existing skew control equipment, as described in the drawings.
- 1.2 REFERENCES .1 CSA International
.1 CSA S350-M1980(R2003), Code of Practice for Safety in Demolition of Structures.
.2 National Building Code (NBC)
.1 NBC 2015, Part 8 - Safety Measures at Construction and Demolition Sites and local authority having jurisdiction.
.3 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.
- 1.3 SUBMITTALS .1 Submit in accordance with Section 01 33 00 and 01 74 20.
.2 10 calendar days prior to start of demolition and removals work, submit for review, drawings, diagrams or details showing sequence of disassembly work in accordance with authorities having jurisdiction.
.3 Submit for approval, a plan showing impacts, interruptions and delays to Owners operations.
.4 Submit to Departmental Representative, details of where rubble, debris and other materials are to be disposed. Include each disposal/reuse site location, operator's name and business address, type of license under which site operates, and criteria used by site to assess suitability of rubble, debris and other materials for disposal.

1.4 QUALITY ASSURANCE .1

Regulatory Requirements: Prepare waste audits, waste reduction work plans, source separation programs and recycling programs as required by jurisdictional authorities and update programs and implement such programs as required.

- .2 The demolition contractor must engage a registered professional engineer who holds a certificate of authorization and an appropriate level of liability insurance to prepare demolition procedures.

1.5 SITE CONDITIONS .1

Review "Hazardous Products Inventory - Burlington Lift Bridge, 2018" and "Asbestos and Lead Reassessment Survey - Burlington Lift Bridge, 2018" and take precautions to protect environment.

- .2 If 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 Proceed only after receipt of written instructions have been received from Departmental Representative.

- .3 Notify Departmental Representative before disrupting building access or services.

END OF SECTION

PART 1 GENERAL

1.1 ELECTRICAL WORK
DESCRIPTION AND CONTRACTOR
QUALIFICATIONS

- .1 This section describes and includes general and specific 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. Note that this section also includes mechanical, work associated with and required to complete the electrical items herein specified and defined as the electrical work.
- .2 The contract and specified work shall be performed by a contractor with at least five (5) years of experience performing similar work on movable bridges in the Province of Ontario. The contractor shall be qualified and possess the experience to perform the specified work. The contractor shall utilize the services of his own staff and or qualified sub contractors to perform the required specialist trade work as follows;
 - .1 Electrical Installation Contractor Qualifications
 - .1 The electrical work shall be performed by a contractor qualified in all aspects of power distribution, control and drive systems associated with heavy movable structures.
 - .2 The contractor shall have been involved in the construction/installation and/or maintenance of the electrical power and control systems of at least three (3) movable highway bridges over similar navigable waterways carrying similar highway traffic to that of the Burlington Canal Lift Bridge.
 - .3 The electrical contractor shall provide the services of a Master Electrician registered in the Province of Ontario to manage the electrical work as herein specified and in accordance with Electricity Act, Part VIII, 1998 and Licensing of Electrical Contractors & Master Electricians, Regulation 570/05
 - .4 The electrical contractor shall be responsible for; planning and having direct supervision of electrical work carried out, ensuring that the electrical work is carried out in accordance with the contract requirements, including the Electrical Safety Code and the laws relating to health and safety and consumer protection, on behalf of the contractor and for other matters of a similar nature.

- .5 In accordance with the Electricity Act Part VIII and its Regulations a license holder is responsible to conduct themselves with honesty and integrity and in accordance with the principle of protecting consumers and to ensure that all activities are carried out in accordance with all laws including the Consumer Protection Act.
- .6 The electrical contractor shall ensure that his field staff are adequately supported to perform the scope of the work and meet the contract requirements.
- .2 Mechanical Installation Contractor Qualifications
 - .1 The mechanical work shall be performed by a contractor qualified in all aspects of machinery systems associated with heavy movable structures.
 - .2 The contractor shall provide an Ontario qualified journeyman or millwright who has experience and has been involved in the repairs and maintenance of heavy machinery such as open gearing, bearings, couplings, and enclosed gear reducers to perform the required modifications to the existing movable bridge machinery.
 - .3 The qualified journeyman or millwright shall perform the mechanical work described on the contract drawings, indicated herein and as directed by the Departmental Representative.
- .3 Control Systems Vendor
 - .1 The control systems vendor work shall be performed by a contractor qualified in all aspects of control, drive and PLC systems associated with movable heavy structures.
 - .2 The control systems vendor shall have been involved in control systems hardware and software development, procurement of equipment, manufacture, testing and commissioning of at least ten (10) movable highway bridges over similar navigable waterways carrying similar highway traffic to that of the Burlington Canal Lift Bridge.
 - .3 The control systems vendor shall provide the services of an individual who is familiar with the Burlington Canal Lift Bridge existing control system topography, its software, bridge sequence of operation and protective system philosophy.

- .4 The control systems vendor who was responsible for the 2017-2018 rehabilitated bridge control system work (Panatrol Corporation) shall be utilized as the control systems vendor as a sub-contractor to the contractor for this contract.
- .3 Where applicable provide supervision, labor, and assistance to control system vendor's field representatives and/or technical direction for equipment to be installed as a part of this Contract. Follow specified procedures and instructions provided by the Departmental Representative.
- .4 The bridge skew monitoring, alarm and control system shall be modified replaced and reconfigured as part of this contract. This element of the work will be managed, supervised and directed by the Departmental Representative and be procured, programmed, tested and commissioned by the designated control systems vendor.
- .5 The installation as specified under this contract shall be installed, tested and commissioned while the bridge is in service. The contractor shall coordinate his work with the Departmental Representative, the Departmental Representative and the Bridge Master to ensure minimal disruption to bridge operations and no disruption to marine traffic.

1.2 RELATED REQUIREMENTS

Section 01 11 00 - Summary of Work
Section 01 31 19 - Project Meeting
Section 01 33 00 - Submittal Procedures
Section 01 35 29 - Health and Safety Requirements
Section 01 35 43 - Environmental Procedures
Section 01 41 00 - Regulatory Requirements
Section 01 45 00 - Quality Control
Section 01 51 00 - Temporary Utilities
Section 01 61 00 - Common Product Requirements
Section 01 74 00 - Cleaning
Section 01 74 20 - Construction Demolition Waste Management and Disposal
Section 01 78 00 - Closeout Submittals
Section 01 79 00 - Demonstration and Training
Section 01 91 13 - General Commissioning

1.3 REFERENCES

.1 Definitions:

- .1 Electrical and electronic terms, unless otherwise specified or indicated, the terms used in these specifications, and on drawings, are those defined by IEEE SP1122.
- .2 Electrical systems, existing system modifications, replacements and enhancements shall be engineered, manufactured and installed in accordance with the Canadian Electrical Code. The design and engineering of the electrical installation shall satisfy all statutory requirements of the national, Provincial and/or local authorities of Canada and Ontario. The electrical installation shall be suitable for the prevailing site conditions as specified herein. 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 skew control monitoring, alarm and control system shall be modified upgraded and reconfigured in accordance with the contract drawings and the procurement, development, programming, testing and procurement shall be performed by the control systems vendor who was responsible for the supply Panatrol Corporation.

.2 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.

.3 Reference Standards:

.1 CSA Group

- .1 CAN CSA-S6--14 Section 13 Movable Bridges
- .2 CSA C22.1, 2018 Canadian Electrical Code, Part 1 (24th Edition), Safety Standard for Electrical Installations.
- .3 CAN/CSA-C22.2 NO. 0-10 (R2015) - General requirements - Canadian electrical code, part II
- .4 CSA C22.2 NO. 47-13 - Air-cooled transformers (dry type)
- .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 Volts.
 - .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 NMJ-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 Health Canada/ Workplace Hazardous materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).
 - .4 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
 - .5 Standard for Acceptance Testing Specifications for Electrical Power Equipment and Systems
 - .1 ANSI/NETA ATS-2017
 - .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

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 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, system logic and existing logic modifications, 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 have applicable CSA certification for the equipment and material.
 - .3 The skew control monitoring, alarm and control system modifications, upgrades and reconfiguration drawings, Bill-of-Material schematic, wiring, termination drawings, associated PLC re-programming ladder logic diagrams and system testing plans shall be provided by the designated control systems vendor.
 - .4 Several 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 enough 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 all items that interface with the bridge mechanical machinery systems from manufacturers. These items shall be provided to those responsible for the mechanical work. They shall be used by those responsible for the mechanical work to prepare their installation Drawings for their inclusion into the existing bridge machinery systems. The certified drawings shall be submitted in support of the developed Shop Drawings for Departmental Representative approval. The Contractor shall notify the Departmental Representative of any dimension of any specified item that deviates from the Contract Drawings. The electrical items for mechanical installation shall consist of the following:

- .1 Tower Machinery Mounted Absolute Encoders
- .2 Inclinator
- .5 Under no circumstance shall any of the proposed electrical power or control systems specified as part of this contract be procured, fabricated, assembled, or wired directly from the Contract Drawings. The Contractor shall prepare and submit proposals and installation shop drawings that describe the item to be procured, fabricated and how they are being integrated into the bridge existing power and control systems for Departmental Representative review and approval. The shop drawings shall include where and as applicable control and power schematics, PLC control logic and logic changes that affect and interface with the existing bridge control logic, layout, assembly, installation drawings of equipment, components terminal boxes and terminations drawings, point-to-point interconnection wirings with cable tags and termination identification for field installation.

- .6 The Contractor shall identify any constructability issues or conflicts between manufacturers' or control system vendor shop drawings and contract documents (drawings and specifications) 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.
- .7 Comprehensive shop Bills of Material shall be included for each of the proposed items of equipment and systems and sub-systems including elements, replacements and enhancements related to the bridge control panels and associated PLC, bridge operator control console, etc. As appropriate for procured equipment. The computed shipping and operating weights of each piece of electrical equipment shall be stated on the Shop Drawings upon which it is detailed.
- .8 As specified and as applicable for the specified task, complete assembly and installation drawings shall be furnished. These drawings shall clearly indicate how the work is to be performed in the field including mounting details, equipment clearances required for operation and maintenance, access and as required by applicable codes.
- .9 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 as appropriate, its required equipment mountings and any necessary foundations. Each unit shall be cross-referenced to the Shop Drawing on which it is detailed or indicated in physical and functional terms.
- .10 The Contractor shall submit electronic copies of all required shop drawings, unless otherwise directed, that include shop, assembly, installation, construction, schematic and wiring Drawings. Drawings shall be prepared for all electrical and mechanical work, power and control equipment including identifying the bridge existing sub systems they are proposed for and will interface with and shall describe in physical, functional, schematic and wiring terminologies the inclusion of the proposed systems into the existing bridge systems and infrastructure. The configuration of the power and control system shall be clearly described as

well as, how they relate to the existing logic associated with the bridge operating system and the required interfaces. All Installation and construction Drawings shall where applicable conform to the following:

- .1 Manufacturer's Literature - The submittal information shall have annotation of project's equipment identification (name and/or tags) on their respective sheets. Where control systems vendor's standard product data sheets and/or drawings are furnished which cover several 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 Physical Dimensioned Drawings - Provide physical dimensioned drawings as applicable to facilitate installation for Departmental Representative review and understanding of the proposed installation shall be drawn to scale. Outline drawings shall depict graphically and dimensionally the configuration, profile, and limitations of parts and assemblies. Perspectives and reference points shall be indicated clearly for each view as appropriate. 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.
- .3 Equipment Mounting - As applicable anchor bolt drawings shall provide templating dimensions in enough detail to facilitate the preparation of design drawings and to determine the sizes and types of fasteners and other installation devices required. Plans shall provide enough dimensional and configuration details to facilitate design and installation planning by the Contractor. The drawings shall also include the supplier's recommendations for installation methods and materials.
- .4 Wiring Diagrams - Provide applicable changes and modifications to One-Line, Three-Line and schematic diagrams to indicate all wiring, connections and interconnections of the scoped and proposed electrical system

modifications and additions to the existing installation, equipment and/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 in accordance and integrated into the existing bridge electrical installation. If cables are shielded, the shields shall be shown on the drawings. All spare conductors shall be shown on the drawings.

- .11 Submit six (6) copies of 432 x 280 mm minimum size drawings and product data to the Departmental Representative.
- .12 If changes are required, notify Departmental Representative of these changes before they are made.
- .13 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.
- .5 Engineering Data:
 - .1 Provide proposed system hardware Shop Drawings
 - .2 Provide system software and logic Shop Drawings
 - .3 Provide Installation Shop Drawings
 - .4 Provide all applicable bridge and system installation layout Shop Drawings
- .6 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 and as applicable.
 - .5 Submit certificate of acceptance from authority having jurisdiction upon completion of Work to Departmental Representative as applicable.
- .7 Startup and Commissioning Plan and Report
 - .1 Provide Testing, Startup and Commissioning Plan
 - .2 Startup and Commissioning Report

- .8 Test Reports:
 - .1 Provide Factory Test Report for Skew Control Software Development.
 - .2 Provide Electrical Construction Field Testing and Commissioning Report for the bridge electrical modifications, replacements and enhancements to installation.
- .9 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
- .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 the new or replaced electrical equipment and installation for incorporation into the existing manual.
 - .1 The Contractor shall provide individual Operation and Maintenance data for the contracted scoped items and as applicable for addition and integration into the existing bridge O&M manuals. The Departmental Representative will review preliminary copies of the O&M data and the Contractor will incorporate the changes made into the existing bridge O&M manuals. Provide data for each system and principal item of equipment as

specified in technical sections which have been specifically developed for use by bridge operation and maintenance personnel.

- .2 Operating instructions specifically developed for the proposed skew control system and auxiliary motor control their integration into the existing bridge operating system to include following:
 - .1 System description, equipment and functional descriptions, bridge control sequence of operation changes and changes to the existing step-by-step operating procedures.
 - .2 System logic in ladder logic form.
 - .3 Wiring diagrams, control diagrams, and control sequence for the skew control system and each item of associated equipment.
 - .4 Start up and shutdown procedures including proper adjustment, operation, lubrication, state of equipment during shutdown, winterize protection of equipment as applicable.
 - .5 Safety precautions.
 - .6 Procedures to be followed in event of equipment failure.
 - .7 Warranty information.
- .3 Other items of instruction as recommended by manufacturer of each item of equipment and the control systems vendor.
- .4 Final "As-Built" Drawings shall be submitted for review and approval at the completion of the project. Any field modifications 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.

1.6 QUALITY ASSURANCE

- .1 Contractor Review and Acceptance of Shop Drawings.
- .2 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.
 - .1 Regulatory requirements: Perform Work in accordance with National Building Code of Canada (NBC) 2015, National Fire Code of Canada (NFC) 2015 and Ontario Building Code (OBC) 2016, 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 and in accordance with Section 01 41 00.

- .3 Perform electrical construction, installation, programming and testing in accordance with industry acceptable practice and that complies with applicable prevailing codes.
- .4 The work shall comply with the requirements of the CSA C22.1, Canadian Electrical Code, Part 1 (23rd Edition), Safety Standard for Electrical Installations and CAN/CSA-Z462-11, Workplace Electrical Safety.
- .5 The work shall be performed by qualified personnel. Installers 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 Electrical components, equipment and systems shall satisfactorily pass all applicable factory and field tests in accordance with the relevant industry standards and as herein specified. Copies of all test certificates and supporting documentation shall be supplied to the Department Representative as part of submittal requirements or as requested by the Departmental Representative.
- .7 Manufacturer of equipment specified shall be recognized in industry for normally supplying this type of equipment. Manufacturer shall be ISO certified.
- .8 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 component 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.
- .9 Service conditions: Provide equipment and material suitable for intended service and installation at location indicated.
- .10 Parts shall be manufactured to industry standard sizes to facilitate maintenance and interchangeability.
- .11 Contractor shall develop detailed, step by step, testing and commissioning plan for placement of the specified electrical equipment, apparatus, and completed electrical system in service. Contractor shall execute the plan, document the performance and test results. Contractor shall take corrective

actions necessary to bring the failed and/or noncompliance test results into conformance.

- .12 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 consider 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 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. Store and protect equipment from damage from mishandling, dropping or impact. Do not install damaged equipment.
 - .2 Replace defective or damaged materials with new at no cost to the Departmental Representative.
 - .3 Develop Construction Waste Management Plan related to the Work of this Section.

Packaging Waste Management: remove for reuse and return of pallets, crates, padding, packaging materials as specified in Construction Demolition Waste Management Plan in accordance with Section 01 74 20.

PART 2 PRODUCTS

2.1 DESIGN
REQUIREMENTS

- .1 Operating voltages: CAN3-C235-83 (R2015) - Preferred Voltage Levels for AC Systems, 0 to 50,000 Volts
- .2 Where applicable 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,
EQUIPMENT AND
SERVICES

- .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 and/or control systems vendor 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 if required and as indicated on contract drawings and/or as specified and required for the specified and described modifications, replacements and enhancements. Where conduit size is not indicated, provide minimum conduit size in accordance with requirements of the Canadian Electrical Code (CEC).
 - .2 Where indicated on the contract drawings provide conduit type per the applicable locations:
 - .1 Indoor Applications:
 - .1 Exposed non-corrosive environment:
 - .2 Rigid Galvanized Steel Conduit (RGS)
 - .3 Exposed corrosive environment:
 - .4 Reinforced Thermosetting Resin Conduit (RTRC) or Fiberglass Conduit
 - .5 Above grade and concealed inside wall:
 - .6 IMC or RGS Conduit
 - .7 Embedded in concrete:
 - .8 PVC Schedule 40 PVC
 - .9 Connection to electrical equipment subject to vibrations:
 - .10 Liquid-tight Flexible Metallic Conduit
 - .11 Conduit stub-up:
 - .12 Rigid Galvanized Steel Conduit (RGS)
 - .2 Partially Exposed to Outdoor or Outdoor Applications:
 - .1 Exposed non-corrosive environment:
 - .2 Rigid Galvanized Steel Conduit (RGS)
 - .3 Exposed corrosive environment:
 - .4 PVC Coated- Rigid Galvanized Steel Conduit (PVC-RGS). Installer shall be certified by manufacturer to install PVC coated conduit.
 - .5 Direct Buried:
 - .6 PVC Schedule 80
 - .7 Embedded in concrete:
 - .8 PVC Schedule 40 PVC
 - .9 Under Roadway:
 - .10 Steel Reinforced, concrete encased duct bank, PVC Schedule 40 PVC ducts
 - .11 Conduit stub-up:
 - .12 Rigid Galvanized Steel Conduit (RGS)
 - .3 Submersible Applications:
 - .1 Flexible fiberglass composite underwater duct with design pressure strength of three times 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 enough 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
- .7 in the CEC. Unless otherwise indicated, the minimum size conduit shall be 3/4" (19 mm).
- .8 The RGS conduits shall be hot dipped galvanized inside and out with hot dipped galvanized threads.
- .9 Each underground joint shall be sealed and made liquid tight.
- .10 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.
- .11 All conduits shall be secured to outlet boxes, junction boxes or cabinets.
- .12 All conduit terminations shall be equipped with insulating bushings.
- .13 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.
- .14 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. PVC-Coated Rigid Galvanized Steel Conduit
 - .5 PVC-coated raceway shall be installed as a system, which means the fittings, conduit bodies, straps, hangers, boxes, etc., are also coated.
 - .6 Exterior coating shall be a minimum of 40-mil, polyvinyl chloride (PVC) coating over exterior and apply urethane coating uniform and
 - .7 consistent to interior of conduit. Internal coating shall be nominal 2 mil thickness. Conduit threads shall be protected by urethane coating.
 - .8 Use manufacturer acceptable method when threading the PVC coated conduit.
 - .9 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 Non-metallic Conduit
 - .1 Ensure rigid non-metallic 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, instrumentation and wiring junction points required for the installation as described herein and on the Contract drawings shall be installed in enclosures. Enclosures, junction boxes, pull boxes and terminal cabinets shall be stainless steel, 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 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.
- .4 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.
- .5 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.

2.5 Fastening
Materials

- .1 Expansion anchors for fastening equipment to concrete surfaces shall be double, machine bolt expansion shields of stainless steel. Holes for expansion shields shall be drilled to the size recommended by the manufacturer, using carbide-tipped masonry drills.
- .2 Mounting bolts, nuts, washers and other detail parts used for fastening boxes, disconnect switches, limit switches, conduit clamps, cable support, brackets and other electrical equipment shall be bronze or stainless steel.
- .3 Bolt heads and nuts shall be hexagonal and shall be provided with medium series lock washers. Bolts that are smaller than 9.5 mm diameter shall not be used, except as may be necessary to fit the mounting holes in small limit switches, outlet boxes and similar standard devices.

2.6 Conductors

- .1 Conductors shall be soft annealed copper, stranded, Class B.
- .2 Conductor insulation except for changes to control panels (CP's), and Operators Control Console and all other panels indicated herein and on the Contract Drawings shall be moisture and heat resistant cross-linked synthetic polymer, NEC Type XHHW or as otherwise herein indicated or as approved by the Departmental Representative.
- .3 Conductor insulation for wiring changes in the control panels and Operators Control Console and all other panels indicated herein and on the Contract Drawings shall be CSA Type SIS or as otherwise specified herein or as approved by the Departmental Representative.
- .4 Conductors shall not be smaller than No. 12 AWG, or unless otherwise indicated on the Contract Drawings.
- .5 Conductors shall be coded. Each wire shall be coded so that it can be easily identified. Insulated grounding conductors shall be colored green or green with one or more yellow stripes. Color-coding shall be throughout the thickness and length of the conductor. Painting or color marking conductors will not be permitted.
- .6 Control conductors shall be color coded with at least twenty (20) different color and trace combinations used. As far as possible, different colors shall be used in the same conduit. If more than twenty (20) conductors are used in a conduit, repetitive colors may be used which are widely separated in the bundle.
- .7 Each conductor shall be tagged at every termination and connection, and in every pull box through which the conductor passes.
- .8 In-line splices of any conductors will not be permitted unless otherwise indicated herein or on the Contract Drawings or as approved by the Departmental Representative.
- .9 Cables shall be delivered to the project site in original packaging or on factory reels, fully identified with tags or labels, indicating the manufacturer's name and date of manufacture. In addition, the name of the manufacturer, insulation type, voltage rating, and wire size shall be clearly and permanently imprinted throughout the length of each cable.

2.7 Connectors,
Terminals and Tape

- .1 Connectors, terminal lugs and fittings shall be UL 486 with the following additional requirements:
 - .1 For No. 10 AWG and smaller conductor cable shall be pressure type tin-plated copper connectors having non-flammable and self-extinguishing insulation with temperature rating equal to that of the conductor insulation.
 - .2 For No. 8 AWG to 4/0 AWG conductor cable shall be compression type tin-plated copper connectors and termination lugs having conductor insulation grip.
 - .3 For 250 MCM and larger conductor cable shall be long barrel double compression type tin-plated copper connectors and terminal lugs with two-hole pads in accordance with NEMA CC1.
- .2 Bundling Straps shall be self-locking steel barb on one end, with tapered strap of self-extinguishing nylon of minus 54 to 122 degrees Celsius temperature rating. For outdoor use: ultraviolet and ozone resistant nylon strap with the above characteristics.
- .3 Insulating Tape shall consist of the following:
 - .1 Plastic tape: Vinyl plastic with rubber-based pressure sensitive adhesive, pliable at a
 - .2 temperature of minus 18 degrees Celsius and having the following minimum properties when tested in accordance with ASTM, D1000-77:
 - .1 Thickness: 8.5 mils
 - .2 Breaking strength: 3.6 kg per cm (width).
 - .3 Elongation: 200 percent.
 - .4 Dielectric breakdown: 10,000 volts
 - .5 Insulation resistance: 10 Meg-Ohms.
(Indirect method of electrolytic corrosion)
 - .3 Rubber Tape: Silicon rubber tape with silicon pressure sensitive adhesive and having the following minimum properties when tested in accordance with ASTM D1000-77:
 - .1 Thickness: 15 mils
 - .2 Breaking Strength: 2.3 kg per cm (width)
 - .3 Elongation: 525 percent.
 - .4 Dielectric breakdown: 13,000 volts
 - .5 Insulation resistance: 10 Meg-Ohms.
(Indirect method of electrolytic corrosion)
 - .4 Arc proof Tape: Flexible and conformable organic fabric tape, coated one side with flame-retardant flexible elastomeric, self-extinguishing, non-combustible, and having the following minimum properties when tested in accordance with ASTM D1000-77:
 - .1 Thickness: 55 mils

- .2 Breaking strength: 8.9 kg per cm (width)
- .3 Thermal conductivity: 0.00478 BTU per hour per square foot per degree F watts per square meter per degree Celsius.
- .4 Electric arc: withstand 200 amperes arc for 30 seconds.

2.8 HARDWARE

- .1 Provide hardware including, but not limited to, anchor bolts, nuts, washers, expansion anchors, wire nuts needed for installation as required and specified herein.
- .2 Provide corrosive resistance hardware suitable for the environment and compatible with the electrical equipment construction and degree of environment and ingress protection.
- .3 Hardware smaller than 3/4" (19 mm) shall match NEMA standard size bolt holes on motors and electrical equipment.

2.9 EQUIPMENT AND CONTROLS

- .1 Verify installation and coordination responsibilities related to equipment and controls, as indicated on the contract drawings.
- .2 Two absolute encoders to be added and driven off each tower drive machinery system located as indicated on the Contract Drawings.
- .3 A wireless inclinometer located on the moving structure to indicate span skew. The inclinometer to be located as indicated on the Contract Drawings.

2.10 FUSES

- .1 Where fuses are specified to be added or replaced, they shall have the characteristic of the fuses they are replacing or as specified for the application on the contract drawings and in the specifications.
- .2 Fuses shall comply with CAN/CSA-C22.2 No.248.8.

2.11 CIRCUIT BREAKERS

- .1 Where circuit breakers are specified to be added or replaced, they shall have the characteristic of the breakers they are replacing or as specified for the application on the contract drawings and in the specifications.
- .2 The replacement and added circuit breakers shall comply with Standard CSA C22.2 No 5-16 / UL 489,13th Edition/ ANCE NMX-J-ANCE-2016, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures as applicable and specified on the contract drawings and the specifications.

2.12 BRIDGE SKEW
CONTROL,
MODIFICATIONS,
RECONFIGURATION AND
ENHANCEMENTS

- .3 The contractor shall perform the work as specified in Part 3 of this specification.
- .1 As part of the 2017 and 2018 bridge span drives, motors and control system rehabilitation, the bridge skew control was replaced. The replaced skew control has caused operational issues since it was installed.
- .2 The intent of this contract is that the existing skew control system shall be modified, reconfigured and enhanced to provide a reliable means of monitoring and controlling bridge longitudinal skew.
- .3 The design of the modified skew control system shall follow the operating philosophy as described on the Contract Drawings and as herein specified.
- .4 The Contractor shall utilize the services of the control systems vendor Panatrol, who developed the existing bridge control system, provided the control system hardware and software and tested and commissioned the existing system.
- .5 The control system vendor in coordination with the Departmental Representative shall utilize the existing bridge control system design as the basis for the described modifications, reconfiguration and enhancements to eliminate the existing skew control, monitoring and alarm issues reported at the bridge.
- .6 The scope of work for the systems vendor shall include providing detailed drawings, Bills-of-Material and PLC software changes to achieve and optimize the proposed skew control design philosophy.
- .7 The control systems vendor shall work with the Departmental Representative as an integrated team during the development process, procurement, software development, factory testing, bridge implementation, field testing, commissioning and in conjunction with the Departmental Representative acceptance testing and to provide maintenance and operational training for the completed system.
- .8 The modified skew control system shall consist of two new absolute encoders located in each tower, a new inclinometer and miscellaneous materials, panels, communications network extension and equipment all as specified herein and indicated on the Contract Drawings.
- .9 The skew control modified system shall consist of the following requirements, implementation methodology and operating philosophy as follows;
- .1 The modified, reconfigured and enhanced skew control systems shall be implemented at the bridge such that bridge operation is maintained throughout the modification work.

- .2 Install two new absolute encoders in each machinery space. These shall be mechanically coupled to the machinery to provide a measure of span position of the rotation of each main pinion shaft. One to provide the primary function for skew control and the other absolute encoder to provide span height functionality as well as supplemental skew control. These encoders to be procured by the control systems vendor and installed as indicated on the mechanical Contract Drawings.
- .3 As part of the final PLC configuration, the PLC shall be re-programmed to enable both new absolute encoders to be reset through PLC software at the bridge seated position for each bridge cycle of operation. This additional function will eliminate any absolute encoder count discrepancies due to rope slippage and minimize rope slippage skew errors due to accumulated errors over several bridge operating cycles. Additionally, the two new absolute encoders shall be configured through modified PLC programming to backcheck each other for parameter changes during the bridge operation.
- .4 Rewire the existing absolute resolvers in the north and south towers to their respective PLS(AMCI) units located in CP-8 and CP-9. The cabling to be uninterrupted continuous shielded twisted pair (STP) cables. This form of installation is essential and will eliminate EMI interference and signal corruption.
- .5 Rewire the existing PLS(AMCI) units located in CP-8 and CP-9 to the existing splitter and to the PLC. The cabling to be uninterrupted continuous shielded twisted pair (STP) cables. This form of installation is essential and will eliminate EMI interference and signal corruption.
- .6 As an intermediate step, the wiring between the PLS relay outputs and field limit switches in the South Tower shall be modified to eliminate the series configuration to the PLC and run them as independent functions to the PLC I/O's. Note that this will require three additional PLC I/O points in CP-3. The PLC shall be modified to Re-program the PLC logic associated with the PLS (AMCI) units and their PLS limit switch relay outputs to ensure that they are individually monitored by the PLC to enable detection of a switch or device failure in the event of a fault and command an alarm on the HMI.
- .7 The existing AMCI PLS units, as part of the final configuration shall only be used to provide indication readings to the tower panel meters of dynamic span position status to aid in the auxiliary drive control of the bridge. Note that

- the field limit switch connections to the PLC will remain as part of the final configuration.
- .8 Disable and leave in place the existing PLS relay outputs and field limit switches that presently provide direct speed control to span drives. The drive control to be modified for the final configuration to be controlled from the PLC via the network. This shall utilize the field limit switch inputs to the PLC in conjunction with the new absolute encoder set points in the PLC to control the drives. This modification shall be performed in two steps to ensure uninterrupted service of the bridge. This will consist of performing the modifications of one pair of the drives at a time.
 - .9 Install a temperature compensated wireless inclinometer with anti-vibration and damping features and with the required accuracy to provide meaningful output to the bridge control system as input into the PLC.
 - .10 Reconfigure the existing inclinometer wireless setup to provide stable operation and to optimize wireless communications. The Inclinometer shall be used via the PLC for span skew monitoring, as a secondary form of control, alarming and ultimate skew trip for the bridge.
 - .11 Re-tune the span motor drives to operate effectively with the new absolute encoders and their programming to provide optimal bridge control and minimize span operating skew. Modify drive acceleration and deceleration ramp times and shapes to soften the machinery impact loads and minimize the rope slippage which is a contributor to the developed skew condition.
 - .12 Bridge position limit switches shall be adjusted as necessary to conform to all above operating point changes.
 - .13 Revise PLC logic to remove "skew early warning" alarm from the PLC program. The skew early warning alarm function is not considered necessary and creates confusion for the bridge operator.
 - .14 Remove CP-3 and CP-4 existing single turn resolvers.
 - .15 The auxiliary drive control system in the North and South tower machinery spaces and shall be modified and a remote auxiliary drive control panel installed in the operators control house to allow one operator to operate the bridge auxiliary drives from one location, the new operator auxiliary drive control panel in the operator's house or the South or North tower machinery spaces. Note that the work required to complete this modified installation shall consist

of the installation of control functionality between the south and north tower machinery spaces as described on the Contract Drawings.

2.13 AUXILIARY DRIVE
MOTORS

- .1 The bridge is provided with a means of manual operation using auxiliary drive motors located in each bridge tower machinery area.
- .2 The present manual operation of the bridge requires bridge operating staff to be in each tower and in the operators control house to operate the bridge. The intent of this item is that the auxiliary drive motor control system be modified to enable manual operation of the bridge to be performed from a single location; either from the operators control house, the North Tower machinery space or the South Tower machinery space.
- .3 The contractor shall modify the auxiliary motor control and existing monitoring instrumentation in each tower and extend them to a new auxiliary control panel located in the operator's control house, all as indicated on the Contract Drawings.
- .4 Following the completion of the installation, the revised auxiliary drive system shall be tested by the contractor in coordination with the Departmental Representative and the Bridge Master to fully prove the operating system installation and its consistent and reliable operation.
- .5 The contractor shall perform the work as specified in Part 3 of this specification.

2.14 PROGRAMMABLE
LOGIC CONTROLLER
(PLC) RE-PROGRAMMING

- .1 The contractor shall employ the services of the control systems vendor who provided and programmed the existing bridge PLC control system; Panatrol Corporation 161 Tower Dr. Suite D, Burr Ridge, IL 60527 (630) 655-4700 - Contact Mr. Bruce Krebbers.
- .2 In addition to the herein described skew control work the re-programming and additional programming shall also consist of the following;
 - .1 Add programming of the modified and upgraded skew control system as specified herein and on the contract documents.
 - .2 Add programming to alarm and display electric service ground fault relay alarm.
 - .3 Make PLC software/hardware revisions to implement an operator system lock-out solution on the console (physical key or software user-login based). Coordinate design solution with the Departmental Representative and Bridge Master.

- .4 Perform PLC testing and software/hardware revisions to enable the "gate group raise", individual "gate raise" and "gate lower" functions to send motor stop command / cancel sequence during operation. Coordinate programming with the Departmental Representative and Bridge Master.
- .5 Add PLC timeout function to logout automatically out of the maintenance menu after a set time. Coordinate programming with the Departmental Representative and Bridge Master.
- .6 Verify and ensure that all PLC alarms logged and displayed include alarm type, cause, issue and location. Modify PLC programming and tags accordingly.
- .7 Work with the Departmental Representative to correct failures to elements of the traffic control system that were identified and reported in the 2018 Comprehensive Detailed Annual Inspection (CDI) report.
- .8 Following the completion of the re-programming and additional programming the control systems vendor shall perform.
- .3 The control systems vendor shall perform the work as specified in Part 3 of this specification.

2.15 UNINTERRUPTABLE
POWER SUPPLY (UPS)

- .1 The existing bridge control panels CP3 and CP4 are presently provided with power conditioning units but not provide with UPS's.
- .2 It is proposed that the existing power conditioning units for CP3 and CP4 shall be replaced with UPS units.
- .3 UPS output power capacity; 1000 watts/1440 VA max configurable power.
- .4 Nominal output voltage: 120 V and full load efficiency of 97%.
- .5 Output harmonic voltage distortion limited less than 5% total harmonic distortion at full load.
- .6 Output frequency 60Hz with nominal crest factor of up to 5:1 with sine wave output.
- .7 UPS output connections shall be 6x NEMA 5-15R
- .8 Input nominal voltage of 120 V at an input frequency of 60 Hz +/- 3Hz (Auto sensing).
- .9 Battery shall be maintenance-free, sealed lead-acid battery with suspended electrolyte and shall be leak proof.
- .10 Battery shall be capable of providing rated output for 15 minutes and a recharge time from discharge to full charge of 3 hours.

- .11 Interface ports with smart slot shall be provided for communications and management.
- .12 Ambient operating temperature 0 - 40 °C
- .13 The UPS shall be of APC manufacture and be their Smart-UPS RM SMT1500RM2U 1000W/1440VA 2U Rackmount LCD UPS System or approved equal.

2.16 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for copper conductors.

2.17 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
 - .2 core, lettering accurately aligned and engraved into core mechanically attached with self-tapping screws.
 - .3 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: 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.

2.18 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.

2.19 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 |

2.20 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 the modifications, replacements and enhancements to the electrical installation at the bridge in accordance with the herein specified requirements.
 - .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 Provide complete installation of the bridge electrical system modifications, replacements and enhancements as specified herein and in accordance with CSA C22.1 except where specified otherwise.
- .2 Provide 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 The following shall apply to all new conduits to be installed as part of the electrical system modifications, replacements and enhancements as herein specified.
- .2 Install conduit and sleeves prior to pouring of concrete where and if applicable.
- .3 As required sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .4 During the construction and installation 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.
- .5 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.

- .6 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.
- .7 Surface mounted conduits 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.
- .8 Where rigid steel conduit crosses an expansion joint or where significant temperature differentials are anticipated (such as outdoor raceway spans between structures, 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.
- .9 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.
- .10 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.
- .11 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .12 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

- .13 Note that as appropriate and as approved by the Departmental Representative, the Contractor may use TECK 90 cable in lieu of cable in conduit.

3.5 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 where applicable and indicated on the contract drawings at the 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.

3.6 FIELD QUALITY CONTROL

- .1 General Inspection and Electrical Test Requirements
 - .1 Inspection and testing shall be performed on all modified, replacement and enhanced electrical installations specified as part of the contract in accordance with the requirements of this Section. The International Electrical Testing Association (NETA) shall be referred to 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 Inspection of the Installation:
 - .1 Allow Departmental Representative access to the 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 timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Departmental Representative instructions, or law of Place of Work.
- .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, 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.
- .5 Testing of Electrical Installation:
 - .1 The testing of the electrical installation shall be carried out during and following complete installation of the electrical items.
 - .2 The Contractor shall be qualified for the defined and specified testing and commissioning work. The Contractors proposed electrical testing staff shall be experienced in the testing of electrical power, control and instrumentation systems. The Contractor shall furnish all test equipment, materials, labor and technical supervision required to perform all 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.
 - .3 The electrical testing and commissioning shall be in accordance with the above applicable standards.
 - .4 The electrical testing, commissioning, training shall consist of the following sequence and as specified Section 01 91 13 of this contract document:
 - .1 Factory Testing
 - .2 Field Testing
 - .3 Performance Acceptance Testing
 - .4 Endurance Testing
 - .5 Trainingand as specified Section 01 91 13 of this Contract Document.

3.7 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - 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 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse and recycling. Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.8 MEASUREMENT AND
PAYMENT

- .1 No measurement for payment will be made for work under this Section.

END OF SECTION