



City of Courtenay

Request for Proposal R20-16 Fifth Street Bridge Upgrades

November 18, 2020

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SUMMARY OF KEY INFORMATION

RFP Reference	RFP R20-16 Fifth Street Bridge Upgrades
Overview of the Opportunity	<p>The purpose of this RFP is to request proposals from qualified contractors for the following work:</p> <ul style="list-style-type: none"> • Removal and replacement of bridge deck topping and installation of new Cathodic Protection systems; • Section loss repairs to bridge floor beams; • Recoating of handrails; • Removal of rust and existing lead-based coating; • Recoating of structural steel to prevent corrosion; • Traffic control and environmental protection for the duration of the project;
Questions?	Questions are to be submitted in writing quoting the RFP number and name, send to email purchasing@courtenay.ca
Addenda	Proponents are to check the BC Bid and City websites for any updated information and addenda issued, before the Closing Date at the following websites www.bcbid.gov.bc.ca and/or www.courtenay.ca/bids
Closing Date and Time	2:00 pm Pacific Standard Time Tuesday, December 15, 2020
Instructions for Submission	<p>Submissions are to be consolidated into one PDF file and sent electronically to purchasing@courtenay.ca</p> <ol style="list-style-type: none"> 1. In the subject field enter: RFP Number and Name 2. Phone 250-338-1766 Ext. 7629 should assistance be required
Participation	The guidelines for participation that will apply to this RFP are included in the this RFP.
Obtaining RFP Documents	RFP documents are available for download from these websites www.bcbid.gov.bc.ca and/or www.courtenay.ca/bids

1.0 INTENT

This Request for Proposals (the “RFP”) by the City of Courtenay (the “City”) invites proposals from prospective proponents for the provision of labour and equipment to undertake upgrades to the Fifth Street Bridge in Courtenay.

2.0 DOCUMENT AVAILABILITY AND RESPONSIBILITY

This RFP is being issued electronically through the BC Bid website and the City of Courtenay website where interested firms may download the RFP documents directly. No registration, tracking or other recording of RFP documents will be performed by the City. All addenda, amendments or further information will be published on www.bcbid.gov.bc.ca and www.courtenay.ca. It is the sole responsibility of the Proponent to monitor the websites regularly to check for updates.

3.0 DEFINITIONS

“**City**” or “**Owner**” means the City of Courtenay;

“**City Representative**” means personnel, consultants, subconsultants and advisors of the City;

“**Contract**” means a formal written agreement resulting from this RFP awarded to and/or executed by the City and the successful Proponent;

“**Contract Documents**” means the Request for Proposal documents, that part of the Proposal which is accepted by the City, the purchase order and executed agreement, if any, all applicable specifications and drawings including those issued by the City to the Proponent and those submitted by the Proponent during the performance of the work and accepted by the City, whether produced before or after the date of award of the Contract as the same may be modified, amended, substituted or replaced in accordance with the provisions of the Contract from time to time;

“**Contractor**” means a business or person who contracts for and takes responsibility for completing a construction project. The contractor also hires, supervises, and pays all sub-contractors and suppliers.

“**Council**” means the City of Courtenay Council;

“**MMCD**” means the Master Municipal Construction Document Association Platinum Edition, 2009;

“**must**”, “**mandatory**”, “**required**”, “**shall**”, means a requirement that must be met in order for a Proposal to receive consideration;

“**Project**” means the R20-16 Fifth Street Bridge Upgrades project;

“Proponent” means a party, a company or an individual that has obtained a copy of this Request for Proposal and submits, or intends to submit, a Proposal in response to this Request for Proposal;

“Proposal” means the documents of the Proponent delivered to the City offering to perform the work as required under this RFP;

“should” or **“desirable”** means a requirement having a significant degree of importance to the objectives of the RFP; and

“Work” means the meaning set out in Section 6 Scope of Work.

4.0 TYPE OF CONTRACT & SPECIFICATIONS

- 4.1 The successful Proponent will be required to enter into a Master Municipal Construction Documents Platinum Edition, 2009 (“MMCD”) agreement with the City for the provision of the Work which will include Supplementary General Conditions as detailed in this RFP, along with all addenda. It is the City’s intention to enter into the Contract with only one (1) legal entity.
- 4.2 All design and construction specifications refer to MMCD Platinum Edition (2009) and Supplementary Specifications detailed in to this RFP, along with all addenda.
- 4.3 The MMCD Platinum Edition (2009) can be purchased from www.mmcd.net.

5.0 CODES & REGULATIONS

- 5.1 The Work shall be completed in compliance with:
- a) Workers Compensation Act
 - b) City of Courtenay Permits and Licensing
 - c) BC Water Sustainability Act and Natural Resources Best Management Practices
 - d) Ministry of Transportation and Infrastructure Traffic Management Manual for Works on Roadways
 - e) Fisheries Act
 - f) Heritage Conservation Act (Archaeology)

6.0 SCOPE OF WORK

- 6.1 The City requires the services of a Prime Contractor to undertake the required upgrades to the Fifth Street Bridge.

The scope of work for this project is as follows:

- Removal and replacement of bridge deck topping and installation of new Cathodic Protection systems;

- Section loss repairs to bridge floor beams;
- Recoating of handrails;
- Removal of rust and existing lead-based coating;
- Recoating of structural steel to prevent corrosion;
- Recoating of 88.9mm Fortis Gas Main and replacement of support rollers (optional items).

Further detailed information regarding the scope of work and proposed schedule can be found in Schedule B.

7.0 SURETY AND BONDING REQUIREMENTS

- 7.1 Each proposal shall be accompanied by security in the form of a Bid Bond in the amount of 10% of the Proposal Price excluding GST, made payable to the City. The Bid Bond shall be with a Surety company licensed to transact business in the Province of BC.
- 7.2 The City requires that the successful Proponent ensures that it and any of its subcontractors or trade contractors for any construction Work or components thereof shall purchase, provide and maintain, performance bonds being no less than fifty percent (50%) of the contract amount, or an alternative arrangement acceptable to the City, and labour and material payment bonds being no less than fifty percent (50%) of the contract amount, or an alternative arrangement acceptable to the City.
- 7.3 All such bonds, or alternatives, shall be in a form acceptable to the City. Evidence of the existence of such bonds shall be provided to the City on demand.

8.0 NON-MANDATORY SITE TOUR

- 8.1 A non-mandatory site tour is scheduled for Wednesday, December 2, 2020 at 1pm, starting at the Florence Filberg Centre parking lot. The site tour is scheduled to review the site, access, storage and existing restrictions in order for Proponents to offer an informed and competitive proposal.
- 8.2 Proponents are entitled to bring potential sub-trades or potential sub-trades may attend without a potential Proponent in order to facilitate that sub-trades ability to offer sub-trade services to such a Proponent.
- 8.3 This meeting will be subject to City of Courtenay COVID19 Contractor Orientation Guidelines and dependent on the current COVID-19 situation for BC as defined by public health authorities.
- 8.4 Please RSVP to purchasing@courtenay.ca if you plan on attending.

9.0 HEALTH & SAFETY

- 9.1 The Proponent must submit a copy of their company WorkSafe BC compliant COVID-19 Exposure Control Plan that is directly related to the work outlined in this RFP with their submission.
- 9.2 The successful Contractor shall be designated the Prime Contractor in the immediate work area and will be required to sign and submit the attached Prime Contractor Designation form.
- 9.3 The Proponent must submit a copy of their company Safety Program Manual that is directly related to the work outlined in this RFP with their submission.

10.0 INSTRUCTIONS TO PROPONENTS

- 10.1 An electronic submission of the proposal in .pdf format must be submitted to: **"purchasing@courtenay.ca"** no later than 2:00pm PST, Tuesday, December 15, 2020, the RFP closing date. The email subject line should read **"R20-16 Fifth Street Bridge Upgrade"**.

It is the sole responsibility of the Proponent to ensure that their proposal is received by the City within the proper time allocation. Late responses will be rejected by the City. All proposals, including Form of Submission, must be signed by an authorized Proponent representative.

Submission of a proposal indicates acceptance by the Proponent of the conditions contained in this RFP, unless clearly and specifically noted in the proposal submitted.

- 10.2 Questions are to be submitted in writing up to 2 business days prior to the RFP Closing Date quoting the RFP name, number and contact person below, and sent to email purchasing@courtenay.ca.

Bernd Guderjahn
Manager of Purchasing, City of Courtenay
purchasing@courtenay.ca

Any verbal communications will be considered unofficial and non-binding to the City. Proponents should rely only on written statements issued by the contact person listed above.

- 10.3 Bid Protest Mechanism

The Bid Protest Mechanism (BPM) is an administrative review process that provides Proponents submitting bids with a process to avoid disputes and resolve complaints that a specific procurement by a City division was not conducted in compliance with the rules of an applicable

trade agreement or the City's Purchasing Policy. Contact the City's Purchasing Division at 250-338-1525 for further information.

11. SUBMISSION FORMAT

11.1 Please include descriptions and references that support the Proponent's capabilities in providing the required services in the following format. Submissions will consist of a Cover Letter, Overall Corporate Summary, and a delineated Submission Form (see Schedule A), along with supporting information such as sub-contractor information, personnel resumes, project briefs, and legal documentation appended to the submission.

a) Cover Letter

Cover letter (1-page) containing company name, contact name, address, phone number, fax number and email address, RFP title and number and closing date.

b) Overall Corporate Summary

Overall Corporate Summary (10-pages or less) containing an overview of the Proponent. Summary shall contain the company background, structure, and ownership details, along with the annual value and number of relevant assignments typically undertaken.

This section should highlight the Proponent's safe practices and track record, its sustainability and environmental awareness, and its ability to provide or discover value-added services, providing a list of illustrative examples undertaken for specific projects that are quantifiable.

This section should include, but not be limited to, the following:

- Legal business name and names of any national or international affiliations;
- Company's history;
- Number of staff employed;
- Other goods or services provided by your company;
- Current projects/contracts of similar scope;
- Provide a statement confirming the company doesn't have any foreseeable financial difficulties that could potentially inhibit the company from providing the obligations of the contract.

c) Schedule A – Form of Submission

The Schedule A – Form of Submission must be submitted with the Proponent's proposal. The Form of Submission must be signed by an authorized representative of the company.

12.0 EVALUATION CRITERIA

12.1 General

- a) An evaluation committee made up of City staff will be reviewing proposal submissions. The City reserves the right to accept any or none of the proposals submitted and will evaluate proposals based on best value and not the lowest cost.
- b) The City reserves the discretion to verify any statement or claim contained in any proposal or made subsequently in any interview or negotiation. That verification may be made by whatever means the City considers appropriate including contacting the references provided by the Proponent and any proposed subcontractor or partner of the Proponent.
- c) The City’s evaluation of proposals will remain confidential and the City is not obligated to disclose its evaluation of a proposal to any Proponent or to any third party.

12.2 Evaluation Criteria & Weighting

The City reserves the right to accept any or none of the proposals submitted and will evaluate proposal submissions based on “best value” using the following criteria:

Proposal Evaluation Criteria Description	Criteria Weight
<p>1. Experience and Qualifications of Project Team</p> <ul style="list-style-type: none"> • Provide a summary of relevant previous or ongoing project examples that have been completed by the core team. The summary should demonstrate experience with successful delivery of projects of similar size, scope and technical nature. For each project, include contract value; construction value; (original value plus contract amendments); owner; and location; • Provide a project organization chart of the core project team including the roles and specific responsibilities of each team member. Provide resumes for key project personnel as an appendix. • Identify how sub-contractors and/or suppliers will be engaged to provide value during construction. • Provide up to five (5) client references that have been engaged in a relevant and comparable project with your proposed team. With each reference provide: <ul style="list-style-type: none"> i. Name of the organization; ii. Contact person’s name and title; iii. Address; iv. Telephone number; and v. E-mail address. <p>The City reserves the right at their absolute discretion to contact or not contact the references.</p>	35 points
<p>2. Project Plan and Methodology</p> <ul style="list-style-type: none"> • Demonstrate the proposed optimal schedule for construction that will provide the City with the most valuable product while still 	35 points

<p>meeting the scheduling needs of the project.</p> <ul style="list-style-type: none"> • Demonstrate the Proponent’s understanding of the project scope and requirements; identify objectives of the project, key risks and proposed resolutions. Describe proposed steps in delivery of project components or elements. • Describe actions that will be taken to foster a team approach with the consultants, sub-contractors and other members of the City’s team. 	
<p>3. Project Costs</p> <ul style="list-style-type: none"> • Provide information that indicates the expected budget required to complete the project based on the available information in this RFP. • Proponents must submit their pricing according to the formatted table in the Form of Proposal and should be built on the expectation that construction begins on April 1st, 2021. 	20 points
<p>4. Social / Environmental Sustainability</p> <ul style="list-style-type: none"> • Describe any Corporate Social Responsibility policy/initiatives such as participation in apprenticeships or other development programs and/or support for community initiatives / non-profits • Describe any Corporate Environmental program / initiatives such as waste reduction, use of green energy or non-idling policies. 	5 points
<p>5. Value Added Options</p> <ul style="list-style-type: none"> • Describe any additional value added options that the Proponent can offer to the City that is relevant to the RFP along with a quantified effect on the project budget and/or schedule. 	5 points

12.3 Notification of Award & Notice to Proceed

The City shall notify the successful Proponent with the issuance of a Notice of Award and within **10 Days** of receipt of the Notice of Award the successful Proponent shall provide to the City the following:

- a) A Performance Bond and a Labour and Material Payment Bond, each in the amount of 50% of the contract amount, covering the performance of the Work including the successful Proponent’s obligations during the Maintenance Period.
- b) A “clearance letter” indicating the successful Proponent is in WorkSafe BC compliance.
- c) A copy of the insurance policies as specified in the General Conditions Section 24 of the MMCD Platinum Edition (2009) indicating that all insurance coverage is in place.
- d) A copy of a current City of Courtenay or Mid-island inter-municipal business license, valid for the term of the project including the Maintenance Period.
- e) A copy of the successful Proponent’s safety program as specified by Section 9.3 of this RFP.

Subject to the satisfactory receipt of the documentation requested in Section 12.3 above, the City shall provide the successful Proponent with a Notice to Proceed. Within **10 Days** of receipt of the written Notice to Proceed the successful Proponent shall:

- a) Commence the Work
- b) Sign the Contract Documents as required by GC 2.1.2
- c) Detailed Baseline Project Schedule

13.0 GENERAL TERMS & CONDITIONS

13.1 Not a Tender Call

This RFP is not a tender call, and the submission of any response to this RFP does not create a tender process. This RFP is not an invitation for an offer to contract, and it is not an offer to contract made by the City. Proposals will not be opened in public.

13.2 No Obligation to Proceed

- a) Though the City fully intends at this time to proceed through the RFP process in order to select the goods or services, the City is under no obligation to proceed to the purchase, or any other stage. The receipt by the City of any information (including any submissions, ideas, plans, drawings, models or other materials communicated or exhibited by any intended Proponent, or on its behalf) shall not impose any obligations on the City. There is no guarantee by the City, its officers, employees or agents, that the process initiated by the issuance of this RFP will continue, or that this RFP process or any RFP process will result in a contract with the City for the purchase of the product, service or project.
- b) The City reserves the right to accept or reject all or part of the proposal, however the City is not precluded from negotiating with the successful Proponent to modify its proposal to best suit the needs of the City.
- c) The City reserves the right to reject, at the City's sole discretion, any or all proposals if the proposal is either incomplete, obscure, irregular or unrealistic.
- d) Further, a proposal may be rejected on the basis of the Proponents past performance, financial capabilities, completion schedule and non-compliance with federal, provincial and municipal legislation.
- e) The City reserves the right to accept or reject a proposal where only one proposal is received.
- f) Notwithstanding any custom or trade practice to the contrary, the City reserves the right to, at its sole discretion and according to its own judgement of its best interest to waive any technical or formal defect in a proposal and accept that proposal.
- g) The City reserves the right to award the contract to other than the lowest cost Proponent.
- h) Award of any contract resulting from this RFP may be subject to City of Courtenay Council approval, and budget considerations.

i) The City reserves the right to cancel this RFP at any time.

13.3 **Cost of Preparation**

Any cost incurred by the Proponent in the preparation of the proposal will be solely at the expense of the Proponent.

13.4 **Confidentiality and Freedom of Information and Protection of Privacy Act**

The proposal should clearly identify any information that is considered to be confidential or proprietary information (the "Confidential Information"). However, the City is subject to the Freedom of Information and Protection of Privacy Act. As a result, while the Act offers some protection for third party business interests, the City can't guarantee that any Confidential Information provided to the City can be held in confidence if a request for access is made under the Freedom of Information and Protection of Privacy Act.

13.5 **Irrevocability of Proposals**

By submission of a written request, the Proponent may amend or withdraw its proposal prior to the closing date and time. Upon closing time, all proposals become irrevocable and are valid for a minimum of **120 days**. By submission of a proposal the Proponent agrees should the proposal be successful, the Proponent will enter into a contract with the City. Prices will be firm for the entire contract period, unless otherwise agreed to by both parties.

13.6 **Pricing**

Prices are to be quoted in Canadian funds with the Goods and Services Tax (GST) shown as a separate line item, if requested. Prices must be quoted inclusive of all shipping, duty and other applicable costs F.O.B. the location indicated in the RFP.

13.7 **Sub-Contracting**

- a) Under no circumstances may the provision of goods or services, or any part thereof be sub-contracted, transferred, or assigned to another company, person, or other without the prior written approval of the City of Courtenay.
- b) No Key Personnel or Sub-contractors noted in the Proponent's submission will be permitted to be changed on the project without written approval of the City.

13.8 **Accuracy of Information**

The City makes no representation or warranty, either express or implied, with respect to the accuracy or completeness of any information contained or referred to in this RFP.

13.9 **Default**

- a) The City may, by notice of default to the Contractor, terminate the whole or any part of this RFP.
- b) The Contractor shall not be liable for any excess costs under clause 12(a) above if failure to complete the RFP process arises by reason of Force Majeure or acts of the City.

13.10 **Misrepresentation or Solicitation**

If any director, officer or employee or agent of a Proponent makes any representation or solicitation to any Councillor, officer, employee or agent of the City of Courtenay with respect to the RFP, whether before or after the submission of the proposal, the City shall be entitled to reject or not accept the proposal.

13.11 **Applicable Laws and Agreements**

- a) The laws of the Province of B.C. shall govern this request for proposal and any subsequent Contract resulting.
- b) This RFP is subject to the terms and conditions of the Canadian Free Trade Agreement and the New West Partnership Agreement.

13.12 **Ownership of Materials and Copyright**

- a) Any drawings, audio-visual materials, plans, models, designs, specifications, software, reports and other similar documents or products produced by the Contractor for the benefit of the City as a result of the provision of the Services (the “Material”) may be used by the City as part of its operations associated with the Materials provided.
 - 1. All Material shall be transferred and delivered by the Contractor to the City following the expiration or sooner termination of this Agreement, provided that the City may, at any time or times prior to the expiration or sooner termination of this Agreement, give written notice to the Contractor requesting delivery by the Contractor to the City of all or any part of the Material in which event the Contractor shall forthwith comply with such request. All materials created electronically must be provided in electronic format, in a format and in a medium acceptable to the City.
 - 2. The Contractor agrees that the City will own all of the Material and the Contractor irrevocably assigns to the City all of the Contractor’s title in the Material. The Contractor retains ownership of the “Embedded IP”. The Material does not include intellectual property or confidential information that is proprietary to the Contractor and (a) used by the Contractor to prepare, produce or supply the Material, or (b) that is otherwise embedded within the Material (“Embedded IP”).
 - 3. The Contractor hereby represents and warrants that any portion of the Material produced by the Contractor will not infringe any patent or copyright or any other industrial or intellectual property rights including trade secrets.

13.13 **Corporate Climate Action Strategy Requirements**

Vehicle Idling

In the interest of reducing negative impacts on the environment, all Contractors and Consultants working directly or indirectly for the City on City owned property must ensure that when vehicles or equipment are not required to be running for operational purposes every effort is made to reduce or eliminate engine idling.

13.14 Business License and Permits

Contractors are required to acquire and maintain a City of Courtenay Business License or a Central Vancouver Island Inter-municipal Business License prior to the commencement of the work and for the term of the Contract.

13.15 Agreement

The successful Proponent will be required to enter into a formal agreement with the City prior to the Contract commencement, template attached for reference.

14.0 ATTACHMENTS

- a) Schedule A - Form of Submission
- b) Schedule B – Project Description
- c) Schedule C - Standard Contractor Agreement
- d) Schedule D – Prime Contractor Designation Form
- e) Schedule E – Detailed Drawings
- f) Schedule F – Reference Documents

SCHEDULE A
FORM OF SUBMISSION

City of Courtenay
Request for Proposals
No. R20-16

Fifth Street Bridge Upgrades

Submissions will be received on or before 2:00 pm local time
Tuesday, December 15, 2020
("Closing date and time")

INSTRUCTIONS FOR SUBMISSION

Submissions are to be consolidated into one document and delivered to:

City of Courtenay
830 Cliffe Avenue
Courtenay, B.C. V9N 2J7
purchasing@courtenay.ca
Attn: Manager of Purchasing

Respondents are responsible to allow ample time to complete the Submission process. If assistance is required phone 250-334-4441.

SUBMISSION FORM

Complete and return this section
Including Appendices

Submitted By: _____
(Company Name)

Proponent Information & Submission Authorization

Full Legal Name of Proponent:	
Address:	
Office Phone:	
Proponent Project Contact (please print):	
Contact Email & Cell No.:	
Name & Title of Authorized Signatory (please print):	
Authorized Signatory:	
Date:	

The signature above is an authorized representative that can bind the company to statements made in this Submission. For the purpose of this RFP, electronic signatures will be accepted.

Offer

The Proponent has carefully examined the RFP documents and has a clear and comprehensive knowledge of the Work required under the RFP. By submitting a Proposal, the Proponent agrees and consents to the terms, conditions and provisions of the RFP.

Addenda

The Proponent is deemed to have read and accepted the addenda issued by the City prior to the deadline for issuing Addenda. The onus is on the Proponent to make any necessary amendments to the Proposal based on the addenda. The Proponent is requested to confirm that it has received all addenda by listing the addenda numbers on the following line:

Addenda _____

1. Experience and Qualifications of Project Team

Provide detailed descriptions and evidence of relevant previous or ongoing project examples that have been completed by the core team. Provide a maximum of 5 examples of relevant projects.

Project 1 Title and Year	
Project budget	
Project owner/client	
Provide a description of the Project demonstrating the Proponent's understanding of the project scope and requirements and key objectives of the project.	
Key personnel involved with the project.	
Describe why you believe the project was successful and the role your firm had in the success.	
Reference person (client)	
Telephone and email of reference person	

Project 2 Title and Year	
Project budget	
Project owner/client	
Provide a description of the Project demonstrating the Proponent's understanding of the project scope and requirements and key objectives of the project.	
Key personnel involved with the project.	
Describe why you believe the project was successful and the role your firm had in the success.	
Reference person (client)	
Telephone and email of reference person	

Project 3 Title and Year	
Project budget	
Project owner/client	
Provide a description of the Project demonstrating the Proponent's understanding of the project scope and requirements and key objectives of the project.	
Key personnel involved with the project.	
Describe why you believe the project was successful and the role your firm had in the success.	
Reference person (client)	
Telephone and email of reference person	

Project 4 Title and Year	
Project budget	
Project owner/client	
Provide a description of the Project demonstrating the Proponent's understanding of the project scope and requirements and key objectives of the project.	
Key personnel involved with the project.	
Describe why you believe the project was successful and the role your firm had in the success.	
Reference person (client)	
Telephone and email of reference person	

Project 5 Title and Year	
Project budget	
Project owner/client	
Provide a description of the Project demonstrating the Proponent's understanding of the project scope and requirements and key objectives of the project.	
Key personnel involved with the project.	
Describe why you believe the project was successful and the role your firm had in the success.	
Reference person (client)	
Telephone and email of reference person	

3. Key Personnel

List your firm's key personnel who would make up the team that would be working on the assignments. (Add rows as needed). Please include resumes and include as an Attachment to this Submission a maximum of 2 pages per resume, with a maximum of 6 resumes.

Name	Title/Position

List sub-contractors, if any, required to supplement the core team below.

Sub-Contractor	Category	Brief reason as to why the sub-contractor is on your team

2. Project Plan and Methodology

1. Demonstrate the proposed optimal schedule for construction based on the milestones listed in Schedule B. Please use the template below

ACTIVITY	CONSTRUCTION SCHEDULE									
	1	2	3	4	5	6	7	8	9	10

2. Demonstrate the Proponent’s understanding of the project scope and requirements; identify objectives of the project, key risks and proposed resolutions. Describe proposed steps in delivery of project components or elements.

3. Project Costs

SCHEDULE OF QUANTITIES AND PRICES

(All prices and Quotations including the Contract Price shall include all Taxes but shall not include GST. GST shall be shown separately.)

Item	Section	Brief Description See MMCD Master Municipal Specifications and Supplementary Specifications for Additional Details and Descriptions	Unit	Est. Qty.	Unit Price	Amount
Division 1 – General Requirements						
01 53 01 - Mobilization and Demobilization						
1.01	SS 1.9.1	Mobilization and Demobilization	LS	1	\$ -	\$ -
01 55 00 - Traffic Control, Vehicle Access and Parking						
1.02	SS 1.5.1	Traffic Control	LS	1	\$ -	\$ -
01 57 01 - Environmental Protection						
1.03	SS 1.6.1	Environmental Protection	LS	1	\$ -	\$ -
Division 3 – Concrete						
SS 03 32 00 - Concrete Overlays						
3.01	SS 1.3.1	Remove and Replace Concrete Deck Topping	LS	1	\$ -	\$ -
3.02	SS 1.3.2	Partial Depth Repairs	m ²	50	\$ -	\$ -
3.03	SS 1.3.3	Full Depth Deck Repairs	m ²	20	\$ -	\$ -
Division 9 - Structural Steel						
SS 09 00 00 - Recoating of Bridge Steel						
9.01	SS 1.10.1	Recoating of Bridge Steel	LS	1	\$ -	\$ -
9.04	SS 1.10.2	Hot Dip Galvanizing Posts and Railings	LS	1	\$ -	\$ -
SS 09 10 10 - Floor Beam Repairs						
9.05	SS 1.2.1	Beam Section Loss Repairs	Each	20	\$ -	\$ -
Division 26 - Electrical						
SS 26 05 00 - Power Supply						

26.1	SS 1.12.1	Electrical Power Supply and Distribution	LS	1	\$ -	\$ -	
SS 26 42 00 - Cathodic Protection of Concrete							
26.2	SS 1.10.1	Assessment, Sampling and Testing	LS	1	\$ -	\$ -	
26.3	SS 1.10.2	Supply and Installation of Reference Electrodes	Each	21	\$ -	\$ -	
26.4	SS 1.10.3	Supply and Installation of Sheet Anodes on top of Deck	LS	1	\$ -	\$ -	
26.5	SS 1.10.4	Supply and Installation of Ribbon Anodes Below Deck (Optional)	m	180	\$ -	\$ -	
26.6	SS 1.10.5	Supply and Installation of Galvanic Anodes Below Deck (Optional)	m	180	\$ -	\$ -	
26.7	SS 1.10.6	Supply and installation of Ribbon Anodes on Sidewalk (Optional)	m	450	\$ -	\$ -	
26.8	SS 1.10.7	Supply and Installation of Rectifiers	each	2	\$ -	\$ -	
26.9	SS 1.10.8	Supply and Installation of Datalogger and Data Managing System	each	6	\$ -	\$ -	
26.10	SS 1.10.9	Set up, Commissioning, Testing and Training	LS	1	\$ -	\$ -	
						Subtotal	\$ -
						5% GST	\$ -
						Total Price with GST	\$ -

Optional Items*							
SS 09 00 00 - Recoating of Bridge Steel							
O.01	SS 1.10.2	Recoating of 88.9mm Fortis Gas Main (Optional)	LS	1	\$ -	\$ -	
O.02	SS 1.10.3	Replacement of Fortis Gas Main Support Rollers (Optional)	LS	1	\$ -	\$ -	
SS 26 42 00 - Cathodic Protection of Concrete							
O.03	SS 1.10.10	5 Year Maintenance Agreement (Optional)	LS	1	\$ -	\$ -	
						Subtotal	\$ -
						5% GST	\$ -
						Total Price with GST	\$ -

*These items will not be included in the evaluation and the City may opt to include these optional items as part of the work.

4. Value Added Options

1.	Describe and provide examples from past projects where the Proponent has employed innovative construction techniques and approaches that have provided additional value to clients. Identify the scope of any proposed innovative ideas along with a quantified effect on the project budget and/or schedule.

5. Social / Environmental Sustainability

<p>1.</p>	<p>Describe and provide examples from past projects where the Proponent has employed innovative construction techniques and approaches that have provided additional value to clients. Identify the scope of any proposed innovative ideas along with a quantified effect on the project budget and/or schedule.</p>
------------------	--

- End of Submission Form -

SCHEDULE B

PROJECT DESCRIPTION

INTRODUCTION

The City requires the services of a prime contractor to undertake the required upgrades to the Fifth Street Bridge. The intent of this RFP is to select a preferred proponent to undertake the work and enter into an MMCD contract with the City based on the information provided in this RFP.

BACKGROUND AND PROJECT DESCRIPTION

The Fifth Street Bridge plays an important role in the entire Comox Valley transportation network serving 20,000 vehicles, 650 pedestrians and 500 cyclists each day. Completed in 1960, the 72-metre steel truss bridge has two vehicle lanes and 1.5 metre sidewalks on both sides of the bridge. Four important utilities run underneath the bridge, including two water mains, a Fortis gas line and TELUS telecommunications line.

The bridge requires rehabilitation of various elements to maximize its service life to the City of Courtenay. To address the structural condition and safety of the current bridge, the scope of the Fifth Street Rehabilitation Project includes:

- Removal and replacement of bridge deck topping and installation of new Cathodic Protection systems;
- Section loss repairs to bridge floor beams;
- Recoating of handrails;
- Removal of rust and existing lead-based coating;
- Recoating of structural steel to prevent corrosion;
- Recoating of 88.9mm Fortis Gas Main and replacement of support rollers (optional items).

TRAFFIC MANAGEMENT PLAN

Traffic Management for the duration of the project is critical to the success of the project. The bridge is a key link over the river and impacts will be significant. The Contractor will be responsible to prepare and implement a Traffic Management Plan that follow the recommended detours, road closures, lane structures, cyclist and pedestrian movements, and traffic patterns outlined in the project Lane Closure and Detour Plans, dated November 12, 2020. At a high level the strategy for traffic management will include:

- Maintaining single lane alternating traffic across the bridge at all times;
- Maintaining a pedestrian and cyclist link across the bridge at all time;

- Implementing detours on the west side of the bridge to manage traffic queues;
- Implementing priority lanes on either side of the bridge for transit, emergency vehicles and other users; and
- Maintaining access to the park on the east side of the bridge and the connections under the bridge on either side of the river.
- Contents of the plan shall conform to the Ministry of Transportation and Infrastructure requirements for a Category 3 Project set out in the current version of the Traffic Management Manual for Works on Roadways (TMM).

PROPOSED PROJECT SCHEDULE

The proposed schedule is shown below. Contractors should provide their assessment of the required sequences and present any innovative approaches for time or cost savings for the project. Confirmation of Cathodic Protection design as well as the extent of the Deck Repairs should occur very early in the project.

The City expects that impacts to traffic be limited to no more than 6 months.

Milestones	Date
Notice of Award	January 2021
Expected Notice to Proceed	February 2020
Preconstruction Activities (Site investigations, Preliminary Cathodic Protection Design, Shop Drawings, Traffic Management Plan approval, etc.)	February - March 2021
Mobilization	Early April 2021
Traffic Detours Install	Early April 2021
Preliminary Deck Investigations (Deck Topping Removal, Rebar Scan, etc.)	April 2021
Containment And Coating	April – July 2021
Cathodic Protection System Installation/Deck Repairs	July-September 2021
Traffic Detours Removal	Early October 2021
Demobilization	October 2021

NOTE: The City reserves the right to modify any of the above dates.

FORTIS WORK - OPTIONAL

A 88.9 mm steel FortisBC gas main runs along the underside of the bridge. FortisBC has proposed that

pricing be provided to recoat the existing main in place as well as replace the support rollers. FortisBC will supply and store the rollers. The contractor may only be responsible for installation. This is an optional item and the City reserves the right to award this item.

MAINTAINENCE AGREEMENT - OPTIONAL

The City wishes to receive pricing for a 5 year agreement to maintain and operate the Cathodic Protection System. The contractor would follow the inspection schedule laid out in SS26 42 00 Cathodic Protection of Steel in Concrete. The Contractor would be responsible for maintenance and repair to the system. Vandalism of the cathodic protection system and its components will be at the risk of the City. This is an optional item and the City reserves the right to award this item.

SCHEDULE C
STANDARD CONTRACT AGREEMENT

AGREEMENT

BETWEEN OWNER AND CONTRACTOR

THIS AGREEMENT made in duplicate this _____ day of _____, 2021.

Contract: Fifth Street Bridge Upgrades

Reference No. RFP R20-16

BETWEEN:

CITY OF COURTENAY
(the “*Owner*”)

AND:

(the “*Contractor*”)

The *Owner* and the *Contractor* agree as follows:

ARTICLE 1 THE WORK - START/COMPLETION DATES

- 1.1 The *Contractor* will perform all *Work* and provide all labour, equipment and material and do all things strictly as required by the *Contract Documents*.
- 1.2 The *Contractor* will commence the *Work* in accordance with the *Notice to Proceed*. The *Contractor* will proceed with the *Work* diligently, will perform the *Work* generally in accordance with the construction schedules as required by the *Contract Documents* and will achieve *Substantial Performance* of the *Work* on or before **October 1st, 2021** subject to the provisions of the *Contract Documents* for adjustments to the *Contract Time*.
- 1.3 Time shall be of the essence of the *Contract*.

ARTICLE 2 CONTRACT DOCUMENTS

- 2.1 The “*Contract Documents*” consist of the documents listed or referred to in Schedule 1, entitled “Schedule of Contract Documents”, which is attached and forms a part of this Agreement, and includes any and all additional and amending documents issued in accordance with the provisions of the *Contract Documents*. All of the *Contract Documents* shall constitute the entire *Contract* between the *Owner* and the *Contractor*.
- 2.2 The *Contract* supersedes all prior negotiations, representations or agreements, whether written or oral, and the *Contract* may be amended only in strict accordance with the provisions of the *Contract Documents*.

ARTICLE 3 CONTRACT PRICE

- 3.1 The price for the *Work* (“*Contract Price*”) shall be the sum in Canadian dollars of the following:

- 3.1.1 the product of the actual quantities of the items of *Work* listed in the *Schedule of Quantities and Prices* which are incorporated into or made necessary by the *Work* and the unit prices listed in the *Schedule of Quantities and Prices*; plus
 - 3.1.2 all lump sums, if any, as listed in the *Schedule of Quantities and Prices*, for items relating to or incorporated into the *Work*; plus
 - 3.1.3 any adjustments, including any payments owing on account of *Changes* and agreed to *Extra Work*, approved in accordance with the provisions of the *Contract Documents*.
- 3.2 The *Contract Price* shall be the entire compensation owing to the *Contractor* for the *Work* and this compensation shall cover and include all profit and all costs of supervision, labour, material, equipment, overhead, financing, and all other costs and expenses whatsoever incurred in performing the *Work*.

ARTICLE 4 PAYMENT

- 4.1 Subject to applicable legislation and the provisions of the *Contract Documents*, the *Owner* shall make payments to the *Contractor*.

ARTICLE 5 RIGHTS AND REMEDIES

- 5.1 The duties and obligations imposed by the *Contract Documents* and the rights and remedies available thereunder shall be in addition to and not a limitation of any duties, obligations, rights and remedies otherwise imposed or available by law.
- 5.2 Except as specifically set out in the *Contract Documents*, no action or failure to act by the *Owner*, *Contract Administrator* or *Contractor* shall constitute a waiver of any of the parties' rights or duties afforded under the *Contract*, nor shall any such action or failure to act constitute an approval of or acquiescence in any breach under the *Contract*.

ARTICLE 6 NOTICES

- 6.1 Communications among the *Owner*, the *Contract Administrator* and the *Contractor*, including all written notices required by the *Contract Documents*, may be delivered by hand, or by fax, or by pre-paid registered mail to the addresses as set out below:

The *Owner*: City of Courtenay
830 Cliffe Avenue,
Courtenay, B.C. V9N 2J7
Fax: 250-334-4241
Chris Davidson, P.Eng. Director of Engineering

The *Contractor*:

The *Contract Administrator*:

Urban Systems Ltd.
290A England Avenue,
Courtenay, B.C. V9N 6L6
Eric Sears, P.Eng.

- 6.2 A communication or notice that is addressed as above shall be considered to have been received:
 - 6.2.1 immediately upon delivery, if delivered by hand; or
 - 6.2.2 immediately upon transmission if sent and received by fax; or
 - 6.2.3 after 5 Days from date of posting if sent by registered mail.
- 6.3 The *Owner* or the *Contractor* may, at any time, change its address for notice by giving written notice to the other at the address then applicable. Similarly, if the *Contract Administrator* changes its address for notice then the *Owner* will give or cause to be given written notice to the *Contractor*.
- 6.4 The sender of a notice by fax assumes all risk that the fax will be received properly.

ARTICLE 7 GENERAL

- 7.1 This *Contract* shall be construed according to the laws of British Columbia.
- 7.2 The *Contractor* shall not, without the express written consent of the *Owner*, assign this *Contract*, or any portion of this *Contract*.
- 7.3 The headings included in the *Contract Documents* are for convenience only and do not form part of this *Contract* and will not be used to interpret, define or limit the scope or intent of this *Contract* or any of the provisions of the *Contract Documents*.
- 7.4 A word in the *Contract Documents* in the singular includes the plural and, in each case, vice versa.
- 7.5 This agreement shall ensure to the benefit of and be binding upon the parties and their successors, executors, administrators and assigns.

IN WITNESS WHEREOF the parties hereto have executed this Agreement the day and year first written above.

Contractor:

CONTRACTOR

(AUTHORIZED SIGNATORY)

(AUTHORIZED SIGNATORY)

Owner:

CITY OF COURTENAY

(AUTHORIZED SIGNATORY)

(AUTHORIZED SIGNATORY)

AGREEMENT

BETWEEN OWNER AND CONTRACTOR

Schedule 1

Schedule of Contract Documents

The following is an exact and complete list of the *Contract Documents*, as referred to in Article 2.1 of the Agreement.

NOTE: The documents noted with “*” are contained in the “Master Municipal Construction Documents - General Conditions, Specifications and Standard Detail Drawings”, 2009 Platinum edition. All sections of this publication are included in the *Contract Documents*.

- 1 Agreement, including all Schedules;
- 2 General Conditions*;
- 3 Supplementary General Conditions;
- 4 Specifications*;
- 5 Supplementary Specifications;
- 6 City of Courtenay Standard Construction Supplementary Specifications;
- 6 Standard Detail Drawings*;
- 7 Supplementary Standard Detail Drawings;
- 8 Signed Form of Submission including all Schedules;
- 9 *Contract Drawings* listed in Schedule 2 to the Agreement -”List of *Contract Drawings*”;
- 10 Reference Documents;
- 11 The following Addenda: _____

AGREEMENT

BETWEEN OWNER AND CONTRACTOR

Schedule 2

List of Contract Detail Drawings

(Complete listing of all drawings, plans and sketches which are to form a part of this Contract, other than Standard Detail Drawings and Supplementary Standard Detail Drawings.)

TITLE	DRAWING NO.	DATE	REVISION DATE	REVISION NO.

SCHEDULE C
PRIME CONTRACTOR DESIGNATION FORM

PROJECT TITLE: R20-16 FIFTH STREET BRIDGE UPGRADE
WORK DESCRIPTION: Bridge deck replacement and cathodic protection systems
Structural repairs to the steel bridge structure
LOCATION: Courtenay, B.C.
OWNER: City of Courtenay

This declaration is a WorkSafe BC (formally WCB) requirement for work on City-owned properties, projects, and developments. As per the requirements of the Workers' Compensation Act Part 3, Division 3, Section 118 (1-3) which states:

Coordination of multiple-employer workplaces

- 118 (1) In this section:
"multiple-employer workplace" means a workplace where workers of 2 or more employers are working at the same time:
"prime contractor" means in relation to a multiple-employer workplace,
(a) the directing Contractor, employer or other person who enters into a written Agreement with the owner of that workplace to be the prime Contractor for the purposes of this Part, or;
(b) if there is no Agreement referred to in paragraph (a), the owner of the workplace.
- (2) The prime contractor of a multiple-employer workplace must:
(a) ensure that the activities of employers, workers and other persons at the workplace relating to occupational health and safety are coordinated, and;
(b) do everything that is reasonably practicable to establish and maintain a system or process that will ensure compliance with this Part and the regulation in respect to the workplace.
- (3) Each employer of workers at a multiple-employer workplace must give to the prime Contractor the name of the person the employer has designated to supervise the employer's workers at that workplace.

By signing this Agreement, the undersigned accepts all responsibilities of a Prime Contractor as outlined in the Workers' Compensation Act, and WorkSafe BC (OH&S Regulation).

As a Contractor signing this Agreement with the City, you are agreeing that your company, management staff, supervisory staff and workers will comply with the Work Safe B.C. Occupational Health and Safety Regulations OH&S Regulations and the Workers' Compensation (WC) Act.

Any penalties, sanctions or additional costs levied against the City, as a result of the actions of the Prime Contractor are the responsibility of the Prime Contractor.

I, the undersigned, acknowledge having read and understand the information above. By signing this Agreement, I agree as a representative of the firm noted below, to accept all responsibilities of the Prime Contractor for this project.

I fully understand and accept the responsibilities of the Prime Contractor designation in accordance with the Workers' Compensation Act for all work on City-owned property; as described above, and will abide by all WorkSafe BC Regulation requirements.

WorkSafe BC Notice of Project No. (if applicable): _____

Company: _____

Signed: _____ Date: _____
(Authorized Signatory)

SUPPLEMENTARY GENERAL CONDITIONS

(TO BE READ WITH "GENERAL CONDITIONS" CONTAINED IN THE 2009 PLATINUM EDITION OF THE PUBLICATION "MASTER MUNICIPAL CONSTRUCTION DOCUMENTS")

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SUPPLEMENTARY GENERAL CONDITIONS

Contract: Fifth Street Bridge Upgrades

Reference No. R20-16

DEFINITIONS 1

Contract Administrator 1.21 *(delete GC 1.21.1 and replace with the following)‡*

1.21.1 **“Contract Administrator”** means the person appointed by the *Owner* and identified by the *Owner* in writing to the *Contractor*. The *Contract Administrator* may be an officer of the *Owner*, a direct employee of the *Owner*, an officer or employee of the consultant who designed the *Work* for the *Owner*, or an independent consultant.

Deleted Items 1.30 Delete GC 1.30.1 ‡

DOCUMENTS 2

Interpretation 2.2 *(delete GC 2.2.4(1) and replace with the following)*

The *Contract Documents* shall govern and take precedence in the following order with the Agreement taking precedence over all other *Contract Documents*.

- (a) Agreement
- (b) Addenda
- (c) Supplementary General Conditions
- (d) General Conditions
- (e) Supplementary Specifications
- (f) City of Courtenay Standard Construction Supplementary Specifications
- (g) Specifications
- (h) Drawings listed in Schedule 2 of the Agreement
- (i) Supplementary Detail Drawings
- (j) Standard Detail Drawings
- (k) Signed Proposal Form and submission documents
- (k) All other Contract Documents;

CONTRACT ADMINISTRATOR	3	
Contract Administration	3.3	(delete GC 3.3.1 and replace with the following) 3.3.1 The <i>Contract Administrator</i> shall provide administration of the <i>Contract</i> as described in the <i>Contract Documents</i> during all <i>Work</i> , until the end of the <i>Maintenance Period</i> .
Inspection and Site Inspector	3.4	(delete GC 3.4.5 and replace with the following)† 3.4.5 If at any time and for any reason the <i>Contract Administrator</i> determines that inspection or testing of the <i>Work</i> , or portion of the <i>Work</i> , is required that was not called for in the <i>Contract Documents</i> , then the <i>Contract Administrator</i> may direct the <i>Contractor</i> to perform, or have performed, that inspection or testing, as provided in GC 4.12.6.
CONTRACTOR	4	
Safety	4.2	(add new clause 4.2.2 as follows) 4.2.2 Further to GC 4.2.1, the <i>Contractor</i> shall demonstrate and maintain an active safety program, to the satisfaction of the <i>Owner</i> , for the duration of the <i>Contract</i> .
Protection of Work, Property and the Public	4.3	(delete GC 4.3.1 and replace with the following) 4.3.1 In performing the <i>Work</i> the <i>Contractor</i> shall protect the <i>Work</i> , the <i>Owner's</i> property and all other person's property from damage. The <i>Contractor</i> shall, at the <i>Contractor's</i> own expense, make good any such damage and indemnify the <i>Owner</i> and their agents from any loss or expense which arises as a result of the <i>Contractor's</i> operations. The <i>Contractor</i> shall obtain and provide to the <i>Owner</i> written acceptance of any restored damage. (add new clause 4.3.7 as follows) 4.3.7 The <i>Contractor</i> shall locate, mark and protect from damage or disturbance, any and all stakes, survey pins, monuments and markers at the <i>Place of the Work</i> . All survey stakes, pins, monuments or markers which, in the opinion of the <i>Owner</i> , have been damaged or disturbed shall be made good following construction by a registered B.C. Land Surveyor at the <i>Contractor's</i> expense. (add new clause 4.3.8 as follows) 4.3.8 The <i>Contractor</i> shall make themselves aware of the City of Courtenay archeological mapping. A copy of this mapping is available from the <i>Owner</i> directly. When working in areas of significance, as noted on the mapping, the <i>Contractor</i> shall exercise caution in his excavation so as to minimize disruption to any potential items of archeological significance. The <i>Contractor</i> shall, upon exposing any item of potential significance, immediately

suspend his operations and contact the *Contract Administrator*.

**Construction
Schedule**

4.6

(delete GC 4.6.2 and replace with the following)†

4.6.2 The *Contractor* shall update the *Baseline Construction Schedule* monthly to produce an adjusted *Baseline Schedule* (the "Adjusted *Baseline Schedule*") that reflects any adjustments to the *Milestone Date(s)* or the *Contract Time* as provided by the *Contract Documents*, including without limitation if the *Contract Administrator* issues a *Change Order* or other *Contract Document(s)* which adjusts any *Milestone Date(s)*. Each Adjusted *Baseline Schedule* will replace the previous *Baseline Construction Schedule*.

(delete GC 4.6.6 and replace with the following)†

4.6.6 The time for the performance of the *Work* shall commence on the date specified in the *Notice to Proceed*, or if not so specified, on the date the *Notice to Proceed* is issued. Subject to a contrary provision in the *Contract Documents*, the *Owner* shall issue the *Notice to Proceed* within 10 Days of receipt of the documentation required from the *Contractor* in the request for proposal documents. Failure by the *Owner* to issue the *Notice to Proceed* within the 10 Days shall entitle the *Contractor* to a claim for delay under GC 13.1.1.

(add new clause 4.6.8 as follows)

The *Baseline Construction Schedule* and *Adjusted Baseline Schedule* shall be submitted in Microsoft Project format. For every submittal, the *Contractor* shall provide a Microsoft Project file (.mpp), a pdf copy and three (3) hard copies.

All *Construction Schedules* shall be submitted in one of the following formats:

1. A time scaled network diagram with a written narrative which will, as a minimum, include all the operations listed below, logically linking them to show the manner in which the Project will be constructed. These operations will be further divided into subsections within the Work, as also shown below; or
2. A time scaled bar chart, with written narrative, listing all of the same operations and showing graphically the length of time needed for each.

Each page of the network diagram or bar chart shall include a title block showing the Contract name and number, Contractor's name, date of the original schedule, date of current update and a legend containing the symbols used, their definitions, and the time scale, shown graphically.

To ensure readability the network diagram or bar chart shall be drawn on a reasonable size of paper to the satisfaction of the *Owner*.

The list below describes the minimum amount of information that shall be shown on the schedule:

- Mobilization
- Quality Management Plan submittal date
- Traffic Management Plan submittal date

- Environmental Management Plan submittal date
- Traffic Control Set Up
- Scaffolding and Containment
- Detailed Structural Inspection
- Deck Removal and Inspection
- Coating Work
- Railings
- Beam Repairs
- Confirmation of CP Design
- CP Procurement and Coordination
- Installation of Sidewalk Anodes
- Deck CP Work
- Topping
- Commissioning
- Demobilization

Superintendent	4.7	<i>(delete GC 4.7.1 and replace with the following)</i> [‡] 4.7.1 The <i>Contractor</i> shall employ a competent senior representative at the <i>Place of the Work</i> (the “ <i>Superintendent</i> ”) who shall be in attendance at the place of work have the responsibility to ensure that the <i>Work</i> is performed in compliance with the <i>Contract Documents</i> . Unless otherwise permitted in writing by the <i>Owner</i> , the <i>Superintendent</i> shall be the person whose experience was submitted in the request for proposal documents. The <i>Contractor</i> shall also employ necessary assistants for the <i>Superintendent</i> and the <i>Superintendent</i> and assistants shall be in attendance at the <i>Place of the Work</i> while <i>Work</i> is being performed.
Materials	4.9	<i>(add new clause 4.9.3 as follows)</i> 4.9.3 The <i>Contractor</i> will provide documentation to the <i>Contract Administrator</i> upon request which verifies that all materials and products comply with the City of Courtenay’s Subdivision and Development Servicing Bylaw Approved Products List.
Subcontractors	4.11	<i>(Delete GC 4.11.2 and replace with the following)</i> [‡] 4.11.2 The <i>Contractor</i> shall employ only the Subcontractors listed in the request for proposal documents, or others as approved in writing by the <i>Owner</i> , and shall not change or employ additional Subcontractors without the approval of the <i>Owner</i> , which approval shall not be unreasonably withheld.
CHANGES	7	
Changes	7.1	<i>(delete GC 7.1.3 and replace with the following)</i> [‡] 7.1.3 Additional work that the <i>Owner</i> may wish performed that does not satisfy the requirements of subparagraphs (a) and (b) of GC 7.1.1(1) is <i>Extra Work</i> and not a <i>Change</i> . Pursuant to GC 8, <i>Extra Work</i> may be declined by the <i>Contractor</i> or may, upon agreement between the parties, be undertaken as <i>Extra Work</i> .

**VALUATION OF
CHANGES AND
EXTRA WORK** **9**

Quantity Variations 9.4

(delete GC 9.4.1 and replace with the following)†

9.4.1 If for any reason, including an addition or deletion under GC 7.1.1.(1) or GC 7.1.1.(2) respectively, the actual quantity of a unit price item varies by more than plus or minus the *Variance Threshold Percentage* from the estimated quantity for that unit price item as listed in the *Schedule of Quantities and Prices* or as otherwise agreed to pursuant to these *Contract Documents*, then either the *Owner* or the *Contractor* may by written notice request the other party to agree to a revised unit price, considering the change in quantities. A party shall make a request for a revised unit price as soon as reasonably possible after the party concerned becomes aware of the quantity variation.

(delete GC 9.4.2 (2) and replace with the following)†

9.4.2 (2) If there is an overrun in the estimated quantity, GC 9.4.3 (2) shall apply to the overrun.

(delete clause 9.4.3(b))

FORCE ACCOUNT **10**

Force Account Costs 10.1

(delete GC 10.1.1(4) and replace with the following)†

10.1.1 (4) *Force Account Work Performed* by a *Subcontractor* shall be paid for in the lesser of: (i) the amount as provided by subparagraphs (1), (2) and (3) of this GC, plus a markup of 5%, or (ii) the actual amount the *Contractor* pays the *Subcontractor* including a markup of 10% on such actual cost to cover all overhead and profit.

**HAZARDOUS
MATERIALS** **12**

**Discovery of
Hazardous Materials** 12.2

(delete GC 12.2.2 and replace with the following)†

12.2.2 If the *Contract Administrator* observes any materials at the *Place of the Work* that the *Contract Administrator* knows or suspects may be *Hazardous Materials* then the *Contract Administrator* shall immediately give written notice to the *Contractor* and the *Contractor* shall immediately stop the *Work* or portion of the *Work* as required by GC 12.2.1 (1).

DELAYS **13**

**Liquidated Damages
for Late Completion** 13.9

(delete GC 13.9.1 and replace with the following)†

13.9.1 If the *Contractor* fails to meet the *Milestone Date* for *Substantial Performance* as set out in the Agreement or as may be adjusted pursuant to the provisions of the *Contract Documents*, then

the *Owner* may deduct from any monies owing to the *Contractor* for the *Work*:

- (1) as a genuine pre-estimate of the *Owner's* increased costs for the *Contract Administrator* and the *Owner's* own staff caused by such delay an amount of \$2,000 per day or pro rata portion for each *Day* that actual *Substantial Performance* is achieved after the *Substantial Performance Milestone Date*; plus
- (2) all direct out-of-pocket costs, such as costs for safety, security, or equipment rental, reasonably incurred by the *Owner* as a direct result of such delay.

If the monies owing to the *Contractor* are less than the total amount owing by the *Contractor* to the *Owner* under (1) and (2) then any shortfall shall immediately, upon written notice from the *Owner*, and upon *Substantial Performance*, be due and owing by the *Contractor* to the *Owner*.

DISPUTES 17

Referee 17.5 *(delete GC 17.5.2 (2) and replace with the following)†*

- (1) if the parties have not agreed upon a *Referee* within 3 Days of a submission of names by one party to the other as provided by GC 17.5.2 (1), then either party may request in writing the Master Municipal Construction Documents Association to appoint the *Referee*. The Association will have the authority to appoint a *Referee* without further consultation with the parties and the parties shall accept the Association's appointment. If for any reason the Association fails to appoint a *Referee* within 5 Days of the written request then such failure shall be deemed to be an agreement between the parties to omit a review of that *Dispute* by a *Referee* and a party may at the end of the 5 Days request a *Settlement Meeting* and proceed with the remaining steps in the *Dispute* resolution process as described in this GC.

PAYMENT 18

Supporting Documentation	18.2	(delete GC 18.2.2 and replace with the following)‡ 18.2.2 If requested in writing by the <i>Contract Administrator</i> the <i>Contractor</i> shall as a precondition to the issuance of the <i>Payment Certificate</i> provide a sworn declaration in a form acceptable to the <i>Contract Administrator</i> , that as of the date set out in the sworn declaration all amounts which have been incurred directly by the <i>Contractor</i> relating to the <i>Work</i> that are due and owing to third parties have been paid.
Holdbacks	18.4	(delete GC 18.4.2 and replace with the following)‡ 18.4.2 Defects and Deficiencies: In addition to other holdbacks as provided by the <i>Contract Documents</i> , when considering <i>Substantial Performance</i> , the <i>Owner</i> may hold back from payments otherwise due to the <i>Contractor</i> 200% of a reasonable estimate, as determined by the <i>Contract Administrator</i> , on account of deficient or defective <i>Work</i> already paid for. This holdback may be held, without interest, until all deficiencies or defects are remedied. The items of defect or deficiency and the amounts of related holdbacks shall be listed separately on the <i>Payment Certificate</i> . (add SGC 18.4.6 as follows) 18.4.6 At the time of <i>Substantial Performance</i> the <i>Contractor</i> is required to provide record drawing information that meets Section 01 33 01 – Project Record <i>Drawings</i> . Should the <i>Contractor</i> fail to provide the record drawing information, this will be taken to be a deficiency and the <i>Owner</i> may hold back \$10,000 from payments otherwise due to the <i>Contractor</i> . This holdback may be held until record drawing information is submitted and approved by the <i>Contract Administrator</i> , and the conditions of SGC 18.4.2 are met.
Substantial Performance	18.6	(delete GC 18.6.3 (1) and replace with the following)‡ 18.6.3 (1) a sworn declaration in a form in accordance with SGC 18.2.2; and;
LAWS, NOTICES, PERMITS AND FEES	20	
Permits	20.2	(add SGC 20.2.3 as follows) 20.2.3 The <i>Contractor</i> shall obtain a City of Courtenay business license, a copy of which must be submitted to the <i>Contract Administrator</i> prior to issuance of the first <i>Payment Certificate</i> .
Environmental Laws	20.4	(add clause 20.4.2 as follows) 20.4.2 Further to GC 20.4.1, the <i>Contractor</i> shall engage a registered professional skilled and knowledgeable in the appropriate disciplines for production and updating of a Sediment and Erosion Control Plan throughout the duration of the <i>Contract</i> .
INSURANCE	24	
Required Insurance	24.1	(delete GC 24.1.1 (2) and replace with the following)‡ 24.1.1 (2) Commercial General Bodily Injury and Property

Note: ‡ Indicates amendment recommended by MMCD Board

Damage liability Insurance Limits: Bodily Injury and Property damage – inclusive \$5,000,000. The insurance shall include *Contractor's* Contingent Liability and Contractual Liability of sufficient scope to include the liability assumed by the *Contractor* under the terms of this *Contract*, and Completed Operations Liability. The policy shall include the *Owner* and the *Contract Administrator* as additional insured's with a cross liability clause. Any property damage deductible shall be for the account of the *Contractor* and shall not exceed \$10,000.00 for any one occurrence.

(add GC 24.1.1 (5) as follows)†

24.1.1 (5) Boiler and machinery Insurance in the joint names of the *Contractor*, and the *Owner*. The policy shall include as insured's all Subcontractors. The coverage shall be maintained continuously from commencement of use or operation of the boiler and machinery objects insured by the policy and until 10 calendar days after *Substantial Performance*.

(delete GC 24.1.5 and replace with the following)†

24.1.5 All policies referred to in this GC shall provide that thirty (30) days notice of cancellation will be given in writing to each insured, including the *Owner*, otherwise the policies to remain in full force and effect until the *Work* has been completed. Notwithstanding the foregoing, the Commercial General Bodily Injury and Property Damage Liability insurance referred to in GC 24.1.1 (2) shall remain in full force and effect from the commencement of the performance of the *Work* for a period of not less than twelve (12) months following *Total Performance*, and with respect to completed operations coverage for a period of not less than 24 months following *Total Performance*.

(add clause 24.1.7 as follows)

24.1.7 The *Contractor* shall ensure the following are named as additional insured under this *Contract* :

- The City of Courtenay
- Urban Systems Ltd.

SCHEDULE 17.5.3
Letter Agreement with Referee ‡

Add following Schedule 17.5.3 to Supplementary General Conditions:

Schedule 17.5.3
Letter Agreement with Referee

(Name and Address of *Referee*)

Contract:

Reference No.

BETWEEN:

(the "Owner")

AND:

(the "Contractor")

We write to confirm your appointment as a *Referee* under the above *Contract*. The terms of your appointment are as contained in GC 17.5 of the *Contract Documents*. The parties specifically confirm GC 17.5.5, GC 17.5.13 and GC 17.5.14.

We confirm that you agree to review any Disputes in accordance with the *Contract Documents* that may be sent to you by either of the parties, and perform the functions of a *Referee* as described in the *Contract Documents*. The written *Dispute* and related materials, including a copy of the *Contract Documents*, shall be forwarded to you.

Note: ‡ Indicates amendment recommended by MMCD Board

SUPPLEMENTARY SPECIFICATIONS

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SS 01 55 00	Traffic Control, Vehicle Access and Parking	4
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SS 32 17 23	Painted Pavement Markings	9

ADDITIONAL SPECIFICATIONS TO BE ADDED AS COMPLETE SECTIONS

Division 1

SS 01 11 00	Summary of Work
SS 01 77 00	Closeout Procedures

Division 3

	Concrete
SS 03 30 00	Portland Cement Concrete
SS 03 32 00	Concrete Overlays

Division 9

	Structural Steel
SS 09 00 00	Recoating of Structural Steel
SS 09 10 10	Floor Beam Repairs

Division 26

	Electrical
SS 26 00 01	Common Work Results - Electrical
SS 26 05 02	Seismic Restraint
SS 26 05 10	Testing and Commissioning

SS 26 05 20	Wire and Box Connectors (0-1000V)
SS 26 05 21	Wire and Cables (0-1000V)
SS 26 05 28	Grounding - Secondary
SS 26 05 29	Hangers and Supports for Electrical
SS 26 05 31	Splitters, Junction, Pull Boxes and Cabinets
SS 26 05 32	Outlet Boxes, Conduit Boxes and Fittings
SS 26 05 34	Conduits, Conduit Fastenings and Conduit Fittings
SS 26 05 41 01	Installation of Cables in Trenches and in Ducts
SS 26 24 01	Service Equipment
SS 26 24 16 01	Panelboards and Breaker Type
SS 26 27 15	Electrical and Controls Components
SS 26 27 16	Electrical Cabinets and Enclosures
SS 26 27 26	Wiring Devices
SS 26 28 16 02	Molded Circuit Breakers
SS 26 42 00	Cathodic Protection of Steel in Concrete
SS 26 54 00	Heaters and Ventilation

SUPPLEMENTARY SPECIFICATIONS

The following Supplementary Specifications included in this section of the *Contract Documents* are modifications or additions to the Specifications in the Master Municipal Construction Document Volume II (Platinum Edition):

SS 01 42 00 Reference Specifications

1.1 Nomenclature

Delete reference 1.1.26 :‡

.26 NAAPI North American Association of Pipeline Inspectors

1.2 Referenced Specifications

Delete Referenced Specifications 1.2.15.1, .2, .5, .10 and .11‡

Add Referenced Specification: ‡

1.2.18.36 CSA A3000 Cementitious Materials Compendium

SS 01 52 01 Temporary Structures

1.6 Payment

Delete section 1.6.1 and replace with the following:

.1 Payment for site offices, including a *Contract Administrators* office and all other requirements of this Section shall be incidental to payment for work described in other sections.

SS 01 53 01 Temporary Facilities

1.9 Payment

Delete section 1.9.1 and replace with the following:

.1 Payment for mobilization and demobilization includes all costs associated with mobilizing to, and demobilizing from the site, bonding and insurance costs, temporary facilities as described in this section, any temporary structures as required on the Contract Drawings, preparation of laydown areas and remediation of laydown and other areas disturbed by the *Contractor*. 50% of the lump sum will be paid upon mobilization to the site and 50% upon removal of heavy equipment, temporary facilities, and temporary structures from the site as determined by the *Contract Administrator*

SS 01 55 00 Traffic Control, Vehicle Access, and Parking

1.0 General

Delete section 1.0.3 and replace with the following:

During all works requiring traffic disruptions over the bridge, make adequate provisions to accommodate normal vehicle, cyclist and pedestrian traffic on all streets impacted. The traffic control must adhere to but not be limited to the following requirements.

1. Maintaining two-way traffic or single lane alternating traffic across the Fifth Street Bridge at all times during the works that require work on the bridge.
2. Maintaining pedestrian and cyclist traffic over the bridge always during the works. This can be achieved either by using the existing walkways or a dedicated area of the bridge deck.
3. Provide detours, priority lanes, and general traffic movements as shown and described in the "Fifth Street Bridge Lane Closure Plan".
4. The underpass on the east side of the bridge must remain open to traffic during construction. The *Owner* may allow brief closures to accommodate construction if work is deemed unachievable with the underpass closed. Any closure of the underpass must be approved by the *Owner* prior to closure.
5. Maintaining vehicle and pedestrian access to the parks on the east side of the bridge.
6. The pedestrian underpass on the west side of the bridge may be closed during construction if a suitable alternative for crossing Fifth Street is provided.
7. Accommodating transit, emergency, and other large vehicles across the bridge deck at all time.
8. Providing protection from construction impacts to traffic, cyclist and pedestrians crossing the bridge.
9. Providing prioritization for emergency vehicles including the ability to bypass traffic queues and have access to the bridge crossing. Sonic preemption for emergency services will be required if signals are used in lieu of traffic control personnel.
10. Providing pedestrian and vehicle access to all businesses in the vicinity of the project area at all time.

Delete section 1.0.4 and 1.0.5 and replace with the following:

- .4 Give minimum 30 days' notice or as otherwise directed by local bylaws to local police, fire departments, emergency services and municipal works authorities prior to beginning construction and comply in all respects to their requirements.
- .5 Advise in writing all property owners and neighboring residences affected by access, service disruptions and specific construction disturbance 30 days, 14 days and again at least 3 days prior to commencing the Work. The limits of the affected properties are to be confirmed with the *Contract Administrator* prior to issuing notices.

Add sections 1.0.6 as follows:

- .6 Provide weekly written notices two weeks ahead of planned construction activities and schedule to *Contract Administrator*. Advertise on the radio a "Notice of Closure or Disruption", as directed by the *Contract Administrator*.

Add section 1.0.7 and 1.0.8 as follows:

.7 Responsibilities of the *Contractor*:

During the construction, the *Contractor* shall be responsible for the following traffic control elements as detailed in this specification and any provided reference documents:

1. Coordination, set up, oversight, adjustment, maintenance and removal of all temporary detour or bypass requirements and all traffic control devices for the control of traffic for the duration of the works as noted in this specification and the reference materials.
2. Provisions of additional traffic management support and traffic control personnel during the earlier stages of the project to ensure efficient traffic operations as vehicles, cyclists and pedestrians become accustomed to the changes.
3. Coordination, set up, oversight, adjustment, maintenance and removal of all temporary detour or bypass requirement for the control of pedestrians and cyclists for the duration of the works as noted in this specification and the reference materials.
4. Management and control of vehicle, cyclist, and pedestrian traffic over the bridge deck and through the construction site and detours.
5. Provide clear and navigable entrance and exits to the bridge for pedestrians and cyclists.
6. Coordinate with the *Owner* and make happen any adjustments that need to be made to the traffic control plan or signal operations because of the actual traffic conditions that are observed during the works.
7. Provide up to four (4) mobile variable message signs for deployment over the duration of the project at key network locations to be confirmed with the *Owner*.
8. Provide updated communications on a weekly basis to the City regarding traffic control conditions to inform the broader communications plans.
9. Coordinate the removal of parking lanes that are impacted because of the traffic control plan.
10. Reinstatement of all temporary measures put in place during construction at the end of the project.

.8 Responsibilities of the *Owner*

During the construction, the *Owner* shall be responsible for the following traffic control elements as detailed in this specification and the reference documents:

1. Coordination and implementation of any signal timing changes, or other changes or upgrades required to signalized intersections required as part of the traffic control plan.
2. Overall monitoring of the broader traffic network.
3. Liaison with the Ministry of Transportation and Infrastructure,
4. Liaison with BC Transit include coordination of route timing changes and bus stop relocations.
5. Overall public communications regarding education and utilization of the traffic changes
6. Implementation of any park and ride, ride share programs or other mode shift initiatives proposed in the Traffic Management Strategy.

1.4 Traffic Control

Delete section 1.4.2 and replace with the following:

- .2 All traffic management plans must follow the recommended detours, road closures, lane structures, cyclist and pedestrian movements, and traffic patterns outlined in the project Lane Closure and Detour Plans, dated November 12, 2020. The *Contractor* will be responsible to ensure plans are followed for the entire duration of the project including durations or inactivity.

Delete section 1.4.10.3 and replace with the following: †

- .3 When workmen or equipment are employed on travelled way over brow of hills, around sharp curves or at other locations where oncoming traffic would not otherwise have adequate warning.

Add sections 1.4.14 to 1.4.17 as follows:

- .14 Submit a Traffic Management Plan to the *Contract Administrator* 45 days prior to the Pre-Construction Meeting. Contents of the plan shall conform to the Ministry of Transportation and Infrastructure requirements set out in the current version of the Traffic Management Manual for Works on Roadways (TMM).

The Traffic Management plan shall include the following documents:

- (a) Traffic Control Plan
- (b) Incident Management Plan
- (c) Public Information Plan
- (d) Implementation Plan

- .15 For the purposes of this plan the project is considered a Category 3 as defined in Section 3: Traffic Management Plans of the TMM.

- .16 The Traffic Control Plan will be required to be approved by The City and a road permit will be issued, prior to performing any work. Obtaining the approval will be the sole responsibility of the *Contractor*. Content of the plan shall include but not be limited to:

- .1 Hours of work and periods of inactivity
- .2 Work zones, location, and staging through the course of construction
- .3 Access locations for equipment and materials to the work site.
- .4 Traffic control layouts for each specific approach to the bridge. Traffic control layouts must be specific to the road network and not direct copies of generic layouts.
- .5 Detour routes and signage.
- .6 Details and demarcations of priority lanes.
- .7 Pedestrian and Cyclist detour routes and signage.

- .17 The Incident Management Plan shall include:

- public
 - .1 A communications plan describing the procedures for informing the on any changes in traffic,
 - .2 An alternate route detail plan in the event of an incident that requires the shutdown of either bridge approach,
 - .3 Access for emergency vehicles through or around the Site; and
 - .4 Any other health and safety considerations.

Add sections 1.4.18 as follows

.18 Traffic Control Geometry

- .1 For the purposes of the Traffic Control Plans the following dimensions shall be considered
 - .1 Lanes used by transit vehicles shall be a minimum width of 3.4 m.
 - .2 Lanes used by general traffic only shall be a minimum width o of 3.2 m.
 - 3. Minimum height clearance for all traffic routes, including over the bridge deck shall be 3.6 m.
 - 4. Travel lanes dedicated to cyclists and pedestrians shall be a minimum of 3.0 m width.
 - .5 Walkways for pedestrians only shall be a minimum of 1.5 m width.
 - .6 Temporary line painting in lieu of delineated lanes may be considered for longer term control elements. Approval from the *Owner* to use temporary line paint is required and reinstatement of pre-existing conditions will be required upon removal.

1.5 Payment

Delete section 1.5.1 and replace with the following:

- .1 Payment will be a lump sum item and paid equally across the contract based on the *Contractor's* schedule

SS 01 57 01 Environmental Protection

1.0 General

Add sections 1.0.3, 1.0.4 and 1.0.5 as follows:

- .3 Environmental protection for the project shall comply with but not be limited to the recommendations outline in the project specific Environmental Management Plan Dated June 9th, 2020.
- .4 Submit an erosion and sediment control plan to the Contract. Content of the plan shall include but not be limited to:
 - .1 Erosion and control risks
 - .2 Temporary drainage measures
 - .3 Locations and details of control measures and monitoring needs

- .5 The *Contractor* shall submit an Environmental Protection Plan for review 30 days prior to the pre-construction meeting. Contents of the plan shall include but not be limited to:
- .1 Erosion and sediment control plans
 - .2 Fuel storage and handling procedures
 - .3 Debris and waste containment measures
 - .4 Air quality considerations
 - .5 Emergency response plan
 - .6 Plans for protection of the public; and
 - .7 Monitoring plans

1.2 Temporary Erosion and Sedimentation Controls

Delete section 1.2.2.2 and replace with the following: ‡

- .2 Do not operate construction equipment in watercourses.

1.4 Environmental Protection

Add section 1.4.4 as follows

1.4.4 Coating Containment

- .1 The coatings on this structure contain red lead pigments. This pigment is considered toxic to workers and the environment. The *Contractor* shall implement measures to safely contain and dispose of these and any other deleterious materials generated by his work so that no material be released into the environment.
- .2 It is suggested that containment be based on SSPC - Guide 6, Guide for Containing Debris Generated During Paint Removal Operations. Actual containment may be dependent on the operations being performed, but will be regulated by BC Ministry of Environment, WorkSafe BC, Fisheries and Oceans Canada and such other bodies as may have regulatory authority.

1.6 Payment

Delete section 1.6.1 and replace with the following:

- .1 Payment will be a lump sum item and paid equally across the contract based on the *Contractor's* schedule.

Add section 1.9 as follows:

1.9 Construction Mitigation Measures

.3 Water

- .1 Do not pump sediment laden water into nearby waterbodies or allow dewatering to enter nearby waterbodies via overland transfer.

- .2 Do not dump soil within waterbodies or allow soil or runoff to migrate into waterbodies.
 - .3 Have a spill response plan and materials in place prior to project initiation.
 - .4 Establish a staging area for fueling and maintenance of equipment away from waterbodies, and ensure all equipment is clean and leak-free prior to project initiation.
 - .5 Restrict the operation of heavy machinery to designated areas that are 30 m or more from surface water.
- .4 Erosion and Soil
- .1 Implement erosion control measures (e.g. silt fencing) at edge of project when surface flows occur, or around surface waters and riparian habitats, prior to development.
 - .2 Do not use plant materials, including straw or hay bales, as a form of sediment control.
 - .3 Soil material must not be removed from the property.
 - .4 Sediment fences will be placed where required to minimize sediment transport. Fence stakes will be installed to a depth of 30 to 60 cm with stakes on the downslope side of the fence. The filter fabric of the fence will then be buried in a 150 mm by 150 mm trench.
 - .5 The EM will monitor the effectiveness of the *Contractor's* erosion and sediment control (ESC) measures. Sandbags, sediment fencing, and other erosion and sediment control measures will be kept on-site during the construction period and used if needed.
 - .6 Delay construction during high precipitation events, if necessary.
 - .7 Erosion and sediment control measures will be inspected regularly during the construction period and removed upon completion of construction.

Add section 1.10 as follow

1.10 Monitoring

- .1 Monitoring shall be sufficient to ensure that no material is released to the environment and that levels of contaminants in the surrounding environment have not increased during the course of the work. This shall include environmental sampling before and after the remediation work, as well as quality control of emissions during the work.
- .2 The *Contractor* shall be responsible for all costs should remediation be necessary to return the environment to its original condition.

- .3 The *Contractor* shall test spent abrasive material and any other effluent generated by paint remediation operations to determine whether or not it requires special handling as hazardous waste. All material generated hazardous waste or not, shall be disposed of in accordance with existing Environmental Regulations. The *Contractor* shall provide a written record of the safe disposal or recycling of all waste streams.
- .4 Fugitive emissions shall be strictly controlled during washing, cleaning and painting operations. This structure is in an urban environment and it is suggested that the *Contractor* consider collection of background level information of possible pre-existing air, water and soil contamination prior to commencing work.

SS 32 17 23 Painted Pavement Markings

1.5 Measurement and Payment

Delete Section 1.5.2 and replace with the following

- .2 Reinstatement of permanent painted pavement markings covers supplying all materials and reinstating all permanent painted pavement markings visible within the project area prior to the works. The reinstatement of the paint markings removed or damaged as part of the work shall be considered incidental to the work.

END OF SUPPLEMENTARY SPECIFICATIONS

5th Street Bridge Rehabilitation Lane Closure Plan

2020-11-13



Potential turn restrictions (right-in/right out) at all driveways/accesses on Ryan Rd, including Puntledge Rd

Re-allocate centre turn lane to general purpose traffic

Centre lane (previous left-turn lane) becomes priority lane for buses (and potentially high occupancy vehicles)

Curb lane remains for all vehicles turning right

Re-allocate centre turn lane to general purpose traffic

Curb lane becomes priority lane for buses (and potentially high occupancy vehicles)

Becomes full movement intersection

5th Street Bridge Rehabilitation Lane Closure Plan

2020-11-13



Re-allocate centre turn lane to general purpose traffic

Curb lane becomes priority lane for buses (and potentially high occupancy vehicles)

Becomes full movement intersection

Driveway to be right-in/right-out only

Curb lane is priority lane for buses (and potentially HOV)

Intersection to be right-in/right-out only

Curb lane is priority lane for buses (and potentially HOV)

Curb lane to be shared through and right-turn lane

5th Street Bridge Rehabilitation Lane Closure Plan

2020-11-13

Curb lane is priority lane for buses (and potentially HOV)

Curb lane to be shared through and right-turn lane

No right-out

Access under bridge to be maintained for peds/cyclists and vehicles. When not possible to maintain under bridge access, additional traffic control required to facilitate peds/cyclists crossing Old Island Hwy and vehicle access to/from the parking lots

Park Access



TCP to control single-lane alternating traffic. Potential to use temporary signals overnight/off-peak

Single lane alternating traffic across the bridge, with separate dedicated lane for peds/cyclists



5th Street Bridge Rehabilitation Lane Closure Plan

2020-11-13



Curb lane for bridge traffic

Laneway to be one-way for use by bridge traffic



Centre lane is priority lane for buses, local residents, and Filberg Centre

Local traffic and buses only beyond this point. (All general purpose traffic to the bridge to use the laneway)



All general purpose bridge traffic to turn right on 3rd St and use the laneway to access Anderton Ave



Northbound lane for traffic from residences and Filberg Centre

TCP to control single-lane alternating traffic. Potential to use temporary signals overnight/off-peak

Change to left-out (no right-in)



Traffic signal modifications to accommodate changed traffic patterns

Trucks permitted to access bridge from the south on Anderton (to avoid travelling down 3rd St to the laneway)

No bridge access from 5th St. All traffic to access the bridge via Anderton Ave



5th Street Bridge Rehabilitation Lane Closure Plan

2020-11-13

Centre lane is priority lane for buses, local residents, and Filberg Centre



Curb lane for bridge traffic

Northbound lane for traffic from residences and Filberg Centre

Laneway to be one-way for use by bridge traffic



No parking on either side of Anderton Ave

Local traffic and buses only beyond this point. (All general purpose traffic to the bridge to use the laneway)



All general purpose bridge traffic to turn right on 3rd St and use the laneway to access Anderton Ave



TCP to control single-lane alternating traffic. Potential to use temporary signals overnight/off-peak

Change to left-out (no right-in)



Traffic signal modifications to accommodate changed traffic patterns

No bridge access from 5th St. All traffic to access the bridge via Anderton Ave



SUMMARY OF WORK

1.0 GENERAL

- 1.1 The *Work* in this contract includes, but is not limited to, construction, equipment purchase, installation and commissioning of one project within the City of Courtenay and includes but may not be limited to the elements noted in Section 1.7. This specification must be referenced to, and interpreted simultaneously with, all other sections pertinent to the *Work* described herein.
- 1.2 This summary of the *Work* is provided for ease of reference only and does not in any way limit the total scope of the *Work* which is set forth on the drawings and/or the *Contract* documents.
- 1.3 The *Work* under all sections of these documents, and unless otherwise stated, shall include supply of all labour, equipment, materials, and services necessary to supply, construct and complete the *Work* as specified herein.
- 1.4 The intent of the specifications is that a complete job is called for, and that the *Work* shall not be deemed complete until the *Works* are proven to be operating satisfactorily and accepted by the *Contract Administrator*.
- 1.5 For convenience of reference only, the specifications are separated into titled sections (see Table of Contents). Sections are identified by a title and a digit numbering system in General conformity with Master format 2014.
- 1.6 In the case of ambiguity or of a dispute the *Contract Administrator* will decide under which section of these specifications any item of work is to be performed.
- 1.7 The major items of work are:
- **Bridge Structural Steel Repairs**
 - Section loss repairs of the floor beams including removal of corrosion and epoxy coating of areas of section loss prior to coating.
 - **Removal and Replacement of Bridge Coating**
 - Erection of scaffolding and containment needs
 - Protection of surfaces and utilities
 - Removal and replacement of bridge steel coating
 - Quality management
 - **Galvanizing of walkway railing and posts**
 - Washing, cleaning and galvanizing of railing and posts on the bridge walkways.
 - **Removal and Replacement of Concrete Deck Topping**
 - Removal and replacement of the existing concrete overlay
 - Removal of topping to below bond line

SUMMARY OF WORK

- Optional, as required, removal and replacement of delaminated concrete
- **Supply and installation of Cathodic Protection System**
 - All labour and materials necessary to install an impressed current cathodic protection system on the top of the structural slab, the top of the sidewalks, and the underside of the bridge.
 - BC Hydro connection and power supply works.
- **Traffic control and Environmental Protection During the Works**
 - All traffic control requirements necessary to provide bypasses and traffic flow to accommodate Single Lane Alternating Traffic for the duration of the works.
 - All necessary environmental protection efforts during construction of the works.

2.0 PRODUCTS – NOT USED

3.0 EXECUTION – NOT USED

END OF SECTION

CLOSEOUT PROCEDURES

1.0 GENERAL

1.1 Section 01 77 00 refers to those portions of the Work that are unique to the closeout procedures for the project. This Section must be referenced to and interpreted simultaneously with all other Sections pertinent to the Work as described herein.

1.2 Measurement and Payment

- .1 Payment for the Closeout Procedures shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

2.0 PRODUCTS NOT USED

3.0 EXECUTION

3.1 FINAL CLEANING

- .1 Prior to *Substantial Performance* of the Work, remove surplus products, tools, construction machinery and equipment not required for the performance of the remaining Work.
- .2 Remove waste products and debris and leave the Work clean and suitable for use by *Owner*.
- .3 Prior to *Total Performance*, remove surplus products, tools, construction machinery, equipment, waste products and debris.
- .4 Leave the Work clean before the final inspection process commences.
- .5 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, floors, and ceilings.
- .6 Inspect finishes, fitments, and equipment and ensure specified workmanship and operation.
- .7 Broom clean and wash exterior walks, steps and surfaces.
- .8 Remove dirt and other disfigurations from surfaces.
- .9 Sweep and wash clean site paved areas.
- .10 Remove all traffic control elements erected for the project unless otherwise directed by the *Contract Administrator*

CLOSEOUT PROCEDURES

3.3 DOCUMENTS

- .1 Review for completeness and submit maintenance manual contents (operating, maintenance instructions, record "as-built" drawings, spare parts, materials).
- .2 Submit required documentation, statutory declarations, Workers' Compensation Certificates, warranties, certificates of approval or acceptance from regulating bodies.
- .3 Collect and compile reviewed submittals and assemble documents completed by *Subcontractors*, Suppliers, and Manufacturers.
- .4 Provide warranties fully executed and notarized.
- .5 Execute transition of Performance and Labour and Materials Payment Bond to warranty period requirements.

3.4 REMOVAL OF TEMPORARY FACILITIES

- .1 Prior to application for *Substantial Performance* of the *Work* remove all temporary offices and furniture, hoardings, fencing, tree and plant protection and all other items used to aid the performance of the *Work*.

3.5 PROJECT COMMISSIONING

- .1 Refer to specifications for details of system commissioning.
- .2 Expedite and complete deficiencies and defects identified by the *Contract Administrator*.
- .3 Coordinate and lead "end-of-work" testing and start-up/commissioning demonstrations.
- .4 Provide draft commissioning plan to *Contract Administrator* no later than 4 weeks prior to commissioning for review. The commissioning plan shall include the sequence of testing required in the specifications for any of the works.
- .5 Review inspection and testing reports to verify conformance to the intent of the documents and that changes, repairs or replacements have been completed.
- .6 Co-ordinate completion testing approvals.
- .7 Review condition of equipment which has been used in the course of the *Work* to ensure all equipment is in "as new condition" with warranties dated and certified from date of *Substantial Performance* of the *Work*.
- .8 Arrange and co-ordinate instruction of *Owner* staff in care, maintenance and operation of systems and finishes by suppliers or *Subcontractors*.

CLOSEOUT PROCEDURES

- .9 When partial occupancy of an uncompleted *Project* is required by the *Owner*, coordinate *Owner's* uses, requirements, access, with *Contractor's* requirements to complete the *Work*.
- .10 Provide on-going review, inspection and attendance to call-back, maintenance, and repair problems during the Warranty Period.

3.6 INSPECTION/TAKEOVER PROCEDURES

- .1 During the final inspection, a list of deficiencies and defects will be tabulated and shall be corrected.

END OF SECTION

PORTLAND CEMENT CONCRETE

1.0 General

1.1 Section SS 03 30 00 refers to those portions of the work that are unique use of Portland Cement Concrete. This section must be referenced and interpreted simultaneously with all other section pertinent to the work.

1.2 Related Work

03 32 00	Concrete Overlays
26 42 00	Cathodic Protection of Steel in Concrete

1.3 Reference Materials

- 1.3.1** All reference documents are to be the latest edition of that document.
- 1.3.1.1 CAN/CSA A23.1 - Concrete materials and methods of concrete construction
 - 1.3.1.2 CAN/CSA A23.2 – Test Methods and standard practices for concrete.
 - 1.3.1.3 CAN/CSA A3000 - Cementitious Materials Compendium.
 - 1.3.1.4 CAN/CSA – S269.3 – Concrete Formwork
 - 1.3.1.5 CAN/CSA A283 – Qualifications Code for Concrete Testing Laboratories
 - 1.3.1.6 Section 211 – Standard Specifications for Highway Construction. Province of British Columbia – Portland Cement Concrete
 - 1.3.1.7 Section 413 - Standard Specifications for Highway Construction. Province of British Columbia – Bridge Deck and Concrete Overlays

1.4 Submittals

1.4.1 Mix Design and Trial Mixes

- 1.4.1.1 The *Contractor* shall submit a report for approval outlining the proposed mix design for each classification of concrete to the *Contract Administrator* for review and acceptance at least 12 weeks in advance of when concrete production is scheduled to commence. The mix shall be designed and sealed by a Professional Materials Engineer registered to practice in the province of British Columbia.
- 1.4.1.2 Acceptance of the mix design does not constitute acceptance of the concrete. Acceptance of the concrete will be based on the test results and the performance and quality of the concrete and concrete components placed on the project. No concrete shall be placed prior to receiving acceptance of the mix design.
- 1.4.1.3 Each mix design submittal shall include all of the following:
 - Project Specifics
 - Name and location of the proposed supplier
 - Distance and expected travel time from batch plant location to project Site.
 - Expected method of batching, transporting and placing concrete.

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- Specified mix parameter requirements as listed or referenced in the project's Special Provisions.
- Name and contact information of certified quality control testing laboratory and certified testing personnel. Certification shall be in accordance with the requirements of CSA A23.1. Materials
- Cementitious Materials – Types and source of each material including mill test reports and manufacturer's certificates of compliance.
- Aggregates – Type and source of all individual aggregate products including individual gradations and all other aggregate quality testing as described in Table 3 for each product and each aggregate source.
- Admixtures – Type and source of all admixtures, including expected dosage rates, point of addition to the mix, compatibility documentation, and individual technical data sheets.
- Water – The source of mixing water. (depending on the source, the *Contract Administrator* may request additional test documentation).
- Miscellaneous – Documentation for all other materials proposed for the mix, showing conformance with applicable *Owner* requirements and manufacturer/industry guidelines and standards.
- The concrete proportions expressed in terms of quantity of each component.
- Fresh and hardened concrete properties.
- The mass of materials in kilograms (kg) and the absolute volume in cubic metre (m³) contributed by each material in the mixture.
- The quantity of each individual cementitious material added in a powder state shall be expressed as kilograms per cubic metre (kg/m³).
- Materials added in slurry shall have their respective solid and water contents expressed as kilograms per cubic metre (kg/m³).
- The quantity of each separately batched size of coarse aggregate and fine aggregate shall be expressed as kilograms per cubic metre (kg/m³) in a saturated-surface dry (SSD) condition.
- The quantity of water shall be the maximum amount allowed based on the maximum specified water to cementitious material ratio (W/Cm), corrected to account for any additional water that may be contributed by other materials used in the proposed mix.
- The quantity of water shall be expressed as kilograms (or Litres) per cubic metre (kg/m³ or L/m³). If ice is used for temperature control, it shall be expressed in incremental units (sacks, bags, or pails, etc.) and kilograms per cubic metre (kg/m³) and shall be included in the maximum allowable water quantity.
- Admixtures dispensed as liquids shall be expressed as Litres per cubic metre (L/m³) and where applicable, expected dosage range stated.
- The quantity of any pre-measured, pre-packaged additives, such as fibres, shall be expressed in incremental units (sacks, bags, or pails, etc.) and kilograms per cubic metre (kg/m³).
- The absolute volume of each material, air content and the total sum of the absolute volumes of all materials shall be provided in cubic metres (m³).

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- Slump, unit weight, air content, strength characteristics, and any other specified characteristic shall be reported for each set of mixture proportions intended for use.

1.4.1.4 The *Contractor* shall produce test batches of 4.0 m³ volumes on all proposed bridge deck mix designs. The *Contractor* shall produce test batches of 4.0 m³ volumes on other mix designs where deemed necessary by the *Contract Administrator*. Point of discharge sampling and testing shall be carried out by the *Contractor* to verify the pertinent parameters of the proposed mix design. If placement is by pump, concrete shall be sampled and fully tested at both the truck chute discharge and at the pump discharge locations. Sampling and testing shall be in accordance with clause 5.0 and Table 5. For concretes containing superplasticizers or high range WRDA or supplementary cementing materials then sampling and testing in accordance with Table 6 shall also apply. Test parameters include all required properties of the fresh and hardened concrete, workability and finishability of the mix, strength gain characteristics, including 7 and 28-day compressive strengths, and any other additional testing of the hardened concrete that may be required by the Contract. Batching, haul times and conveyance procedures used for the test batch must emulate the procedures expected during the actual concrete placement. The *Contractor* shall be fully responsible for all costs associated with the test batches. Test batch trials that do not meet requirements shall be repeated.

1.4.1.5 The *Contractor* shall additionally prepare a “test section” a minimum of 8 weeks prior to installation to show that the proposed material and installation methods are capable of fully encompassing the sheet anode and meet the adhesion requirements for the overlay on a prepared concrete substrate. The *Contractor* shall prepare a mock-up with the following parameters for review by the *Contract Administrator*.

Slab on Grade

- Dimensions: 2 m x 2 m x 400 mm height,
 - CSA A23.1 class C-1 concrete,
 - Maximum aggregate size 20 mm,
 - Minimum Compressive Strength at 28 days: 35 MPa,
Cured for a minimum of 7 days with burlap,
 - Prepared to achieve surface as per Section SS Contractor 00.
- Anode
- Install sheet anode as per Section SS 26 42 00.
- Topping
- Install topping as per Section SS 03 32 00.

1.4.1.6 The *Owner* shall perform adhesion testing of the topping on the substrate and evaluate the extent of encapsulation around the anode material. The substrate concrete shall be at an age of a minimum of 28 days prior to

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testing of adhesion of the topping. Test sections that do not meet the requirements of the specification shall be repeated.

1.4.1.7 If, during the progress of the work, the mix design is found to be unsatisfactory, the *Contractor* shall make the necessary adjustments. Adjustments shall be accepted by the *Contract Administrator* prior to subsequent concrete placement. Notwithstanding the *Contract Administrator's* review and acceptance of the proposed mix design, it remains the *Contractor's* responsibility that the concrete meets all Contract requirements.

1.5 Concrete Performance Requirements

The Overlay concrete shall meet the following requirements:

- Minimum specified compressive strength at 28 days – 45 MPa
- Minimum specified compressive strength at 7 days – 25 MPa.
- Nominal maximum aggregate size – 14 mm
- Fresh concrete air content – 5-8%
- Maximum / water cementing materials – 0.35
- Maximum shrinkage at 28 days (CSA A23.2-21, 75mm prism) – 0.04%
- Plasticized slump of – 80 ± 20 mm
- Chloride content - less than 0.1% by weight of cement.
- Alkali content - less than 3 kg/m³,
- Air void spacing factor - maximum 0.2 mm,
- Maximum temperature at placement - 17C,
- Chloride Ion Permeability at 91 days (ASTM C1202) – 1000 Coulombs,

1.6 Measurement and Payment

1.6.1 Payment for all work performed under this section shall be considered incidental to payment for work described as other section unless shown otherwise in the Schedule of Quantities and Prices.

2.0 Products and Materials

2.1 Materials

2.1.1 All material properties used in concrete production shall conform to CSA A23.1, unless otherwise specified in these specifications. Laboratory testing shall be carried out by a testing laboratory certified in accordance with the requirements of CSA standard A283. Field test procedures shall be undertaken by experienced personnel certified in accordance with CSA A23.1.

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- 2.2 Cementations Materials** - The *Contractor* shall obtain, from the supplier, a mill test report and a manufacturer's certificate of compliance representing each type of cementitious material for each month period representing the delivered shipment.
- 2.3 Portland Cement** -Unless otherwise specified, the *Contractor* shall use Type GU (General Use) Portland Cement in all concrete. Cement shall conform to the requirements of CSA Standard A3000, Cementitious Materials Compendium. The total alkali content [Na₂O equivalent, (Na₂O + (0.658 x K₂O))] of the Type GU Portland Cement shall not exceed 0.60% by mass.
- 2.4 Fly Ash** - All fly ash shall conform to the requirements of CSA Standard A3000 Cementitious Materials Compendium for Type F fly ash. Fly ash application rates shall not exceed 25% by mass of cementing materials in substructure concrete. Fly ash shall not be used in bridge deck concrete without the acceptance of the *Contract Administrator*. Upon such acceptance the application rate shall not exceed 15% by mass of cementing material.
- 2.5 Blended Hydraulic Cement** - Blended Hydraulic Cement shall not be used without the acceptance of the *Contract Administrator*.
- 2.6 Water** - Water to be used for mixing concrete or mortar and for curing shall conform to the requirements of CSA Standard A23.1 and shall be free from contamination by oil, acid, alkali, organic matter, sediment or other deleterious substances. The *Contractor* shall not use water from shallow, stagnant or marshy sources.
- 2.7 Admixtures**
- 2.7.1** All admixtures shall conform to CSA A23.1.
- 2.7.2** Admixtures shall not be incorporated into the mix design and/or added to the concrete without the acceptance of the *Contract Administrator*.
- 2.7.3** unless otherwise specified, all concrete shall contain Air Entraining Admixtures. Air-Entraining Admixtures shall conform to ASTM C260.
- 2.7.4** Chemical admixtures shall conform to ASTM C494.
- 2.7.5** Type F High Range Water Reducer (superplasticizer) shall be used when concrete contains silica fume.
- 2.7.6** All accepted admixtures shall be compatible with all other admixtures and constituents used in the mix.
- 2.7.7** Type B, Retarding or Type D, Water-Reducing and Retarding (Hydration Stabilizing)
- 2.7.8** Calcium chloride or any admixture containing chloride ions shall not be used. If requested, a written statement from the manufacturer stating that the admixture contains no intentionally added calcium chloride shall be provided.

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2.8 Aggregates - All aggregates are to be natural, processed or manufactured granular material composed of hard, sound and durable particles, free of adherent coatings, shale, clay, organic materials and other soft or disintegrated pieces.

2.9 Coarse Aggregate - All coarse aggregate materials shall conform to the following requirements:

- Sampling shall be according to CSA Test Method A23.2-1A.
- Gradation shall be determined in accordance with CSA Test Method A23.2-2A and 5A. (All gradations shall be based on a washed sieve analysis, see Table 3 Footnote 1).
- Gradation of the coarse aggregate shall be within the limits shown in Table 1 for the particular size range or nominal maximum size of coarse aggregate specified.
- The maximum Petrographic Number (PN) of coarse aggregate shall not exceed 125, and shall be determined in accordance with CSA A23.2-15A.
- Limits of deleterious substances and physical properties of aggregates shall be as prescribed in Table 4.
- Frequency of aggregates testing shall be consistent with requirements specified in Table 3 below.

2.10 Fine Aggregate - Fine aggregate shall conform to the following requirements:

- Sampling shall be according to CSA Test Method A23.2-1A.
- Grading shall be within the limits given in Table 2 when tested in accordance with CSA Test Method A23.2-2A and 5A. (All gradations shall be based on a washed sieve analysis).
- Fineness modulus shall be between 2.3 and 3.1.
- A maximum 45% shall be retained between any two consecutive sieves.
- Limits for deleterious substances and physical properties of fine aggregate shall be as prescribed in Table 4.
- Frequency of aggregates testing shall be consistent with requirements specified in Table 3 below.

TABLE 1 GRADATION REQUIREMENTS FOR COARSE AGGREGATES

NMS A ⁽¹⁾ mm	Product Size mm	TOTAL PASSING EACH SIEVE, PERCENTAGE BY MASS								
		56m m	40mm	28mm	20mm	14mm	10mm	5m m	2.5mm	1.25mm
40	40-5 ⁽²⁾	100	95-100	-	35-70	-	10-30	0-5	-	-
28	28-5 ⁽²⁾	-	100	95-100	63-68	30-65	-	0-10	0-5	-
20	20-5	-	-	100	90-100	50-90	25-60	0-10	0-5	-
14	14-5	-	-	-	100	90-100	45-75	0-15	0-5	-

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10	10-2.5	-	-	-	-	100	85-100	10-30	0-10	0-5
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(1) NMSA- nominal maximum size of course aggregate. Definition: The standard Sieve size opening immediately smaller than the smallest through which all of the aggregate must pass.

(2) To prevent segregation, aggregates that make up the above gradings shall be stockpiled and batched in two or more separate sizes as per CSA A23 .1

TABLE 2 GRADATION REQUIREMENTS FOR FINE AGGREGATES

SIEVE SIZE mm	TOTAL CUMULATIVE PASSING EACH SIEVE, PERCENTAGE BY MASS	SIEVE SIZE mm	TOTAL CUMULATIVE PASSING EACH SIEVE, PERCENTAGE BY MASS
10	100	0.630	25-65
5	95-100	0.315	10-35
2.5	80-100	0.160	2-10
1.25	50-90		

2.11 **Steel Fibres – Use of steel fibres** is not permitted.

2.12 **Storage and Handling of Materials - General** - The storage and handling of all materials used in the production of concrete shall conform to CSA A23 .1, unless otherwise specified herein. All materials shall be stored and handled in a manner that will prevent contamination or deterioration, otherwise they shall be rejected. Access shall be provided to the storage facilities to allow for inspection and sampling. Where applicable, materials shall be identified by MSD sheets.

2.13 **Cementitious Material** - All cementitious materials shall be stored in a suitable weather-tight structure capable of protecting the materials from dampness, hydration and contamination, otherwise they shall be rejected. Materials shall be free of lumps at all times during their use in the work.

Tanks used for storing and/or hauling, concrete mixing and curing water shall be free from contamination by oil, acid, alkali, organic matter, sediment, rust or other deleterious substances.

2.14 **Admixtures** -All admixtures shall be stored in manufacturers' original labelled containers with clearly legible labels and be kept above freezing at all times and in accordance with the manufacturers' technical data sheets. Admixtures damaged by any cause shall be rejected.

TABLE 3 REQUIRED AGGREGATE TESTING FOR NORMAL DENSITY COARSE AND FINE AGGREGATE (PER INDIVIDUAL PRODUCT & AGGREGATE SOURCE)

Test Method	Test Description	Test Data Validity ⁽⁵⁾
CSA A23.2-2A ⁽¹⁾	Sieve Analysis of Fine and Coarse Aggregate Amount of Material finer than 80 µm in Aggregate	Within 90 days ⁽⁶⁾
CSA A23.2-5A ⁽²⁾		Within 90 days ⁽⁶⁾
CSA A23.2-3A	Clay lumps in Natural Aggregate	Within 3 years

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CSA A23.2-4A	Low Density Granular Material in Aggregate	Within 3 years
CSA A23.26A, 12A	Relative Density and Absorption of Fine and Coarse Aggregate	Within 1 year
CSA A23.2-7A	Test for Organic Impurities in Fine Aggregates for Concrete	Within 2 years
CSA A23.2-8A ⁽³⁾	Measuring Mortar-Strength Properties of Fine Aggregate	Within 2 years
CSA A23.2-9A ⁽²⁾	Soundness of Aggregate by Use of Magnesium Sulphate	Within 3 years
CSA A23.2-13A	Flat and Elongated Particles in Coarse Aggregate – Procedure A (Length to Width Ration 4:1)	Within 3 years ⁽⁶⁾
CSA A23.2-14A ⁽⁹⁾	Potential Expansivity of Aggregates (Procedure for Length Change Due to Alkali-Aggregate Reaction in Concrete Prisms @ 38°C	Within 3 years
CSA A23.2-15A ⁽⁴⁾	Petrographic Analysis of Coarse & Fine Aggregate specific for use as concrete aggregate; and Determination of the Petrographic Number	Within 3 years
CSA A23.2-23A ⁽⁷⁾	Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine	Within 3 years
CSA A23.2-23A ⁽²⁾	Test Method for the Resistance of Fine Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus	Within 3 years
CSA A23.2-24A ⁽⁸⁾	Test Method for the Resistance of Unconfined Coarse Aggregate to Freezing and Thawing	Within 3 years
CSA A23.2-25A	Test Method for Detection of Alkali-Silica Reactive Aggregates by Accelerated Expansion of Mortar Bars	Within 3 years
CSA A23.2-29A ⁽²⁾	Test Method for the Resistance of Coarse Aggregate to Degradation by Abrasion in the Micro-Deval Apparatus	Within 3 years

(1) Each aggregate product that may be used as a component of the proposed ID1X must have a washed sieved analysis performed showing the cumulative percent passing for each of the following sieve sizes; 56, 40, 28, 20, 14, 10, 5, 2.5, 1.25, 0.630, 0.315, 0.160 and 0.080 mm. Sieve analysis reports are to include all relevant sampling information (date/sampled by/location/field sample size) and include the actual test specimen sample mass.

(2) Subject to approval by the *Contract Administrator*, Test Method A23.2-9A can be performed as an alternative to performing Test Method A23.2-23A and A23.2-29A. Refer to CSA A23.1, Section 4.2, Table 12 for further information.

(3) Test Method A23.2-8A is required only if the aggregate fails to meet the requirements of Test Method A23.2-7 A as described in CSA A23.1 Section 4.2.3.3.3.2

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(4) Petrographic Assessment of Aggregates: The *Contractor* shall submit the results of the Petrographic Analysis, certified by a qualified professional registered with the Association of Professional Engineers and Geoscientists of B.C. and indicating the aggregate's suitability for its intended use.

The petrographic analysis shall not be used to forfeit the requirement of performing other necessary aggregate quality testing.

(5) Test data validity requirements are based on time periods prior to the expected initial date of concrete production. The *Contract Administrator*, based on submitted test data and/or visual observations, may waive or alter the above listed time periods.

(6) Quality control during aggregate production shall include the following test methods at the specified test frequencies: CSA A23.2-2A & A23.2-5A (1 per 300 tonnes).

(7) Subject to approval by the *Contract Administrator*, Test Method CSA A23.2-16A can be waived if CSA A23.2-29A test results meet the specified criteria.

(8) This test shall be required should any of Test Methods 4A, 9A, 16A or 29A fail to satisfy the allowable limits.

(9) Testing is waived if CSA A23.2-25A test results classify the aggregates as non-reactive.

TABLE 4 LIMITS FOR DELETERIOUS SUBSTANCES IN PHYSICAL PROPERTIES OF AGGREGATES

Test Method	Substance of Property	Maximum Percentage by Mass of Total Sample	
		Coarse Aggregate	Fine Aggregate
CSA A23.2-3A	Clay Lumps	0.30	1.0
CSA A23.2-4A	Low-Density Granular Materials	0.5	0.5
CSA A23.2-5A	Material Finer than 0.08 mm for Concrete Subject to Wear	1.0	3.0
	Material Finer than 0.08 mm for Other Concrete	1.0	5.0
CSA A23.2-9A	Magnesium Sulphate Soundness Loss	12	16
CSA A23.2-16A,	Los Angeles Abrasion Loss for Concrete Subject to Wear	50 (35) (all concrete)	N/A
CSA A23.2-23A-29A	Micro-Deval Abrasion Loss	17	20
CSA A23.2-12A	Absorption Percentage	1.75	N/A
CSA A23.2-7A	Organic Impurities in Fine Aggregate	N/A	Standard colour or lighter
CSA A23.2-13A	Flat and Elongated Particles in Coarse Aggregate - Procedure A (Length to Width Ratio 4:1)	20	N/A
CSA A23.2-24A	Test Method for the Resistance of Unconfined Coarse Aggregate to Freezing and Thawing	6	N/A

2.15 Other Materials - Other materials, such as steel fibres, etc. shall be stored and handled in accordance with the manufacturer's recommendations and instructions.

2.16 Aggregates - Each nominal size of aggregate, including coarse and fine shall be stockpiled separately, stored and handled in a manner that will prevent contamination, intermixing and segregation. A minimum of 10 m³ of each aggregate size, in excess of the

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requirements of the daily concrete, shall be maintained in identifiable stockpile at the batch site in order to ensure proper continuity of the work with approved aggregates.

NOTE: stockpiled aggregate, which is segregated, contaminated or intermixed with foreign matter of any kind, shall be rejected. Separate batch plant storage bins shall be provided for each size of aggregate to be batched. Precautions shall be taken when moving, handling and transferring aggregates to prevent contamination, segregation or degradation in accordance with the following recommendations:

- Aggregate blanket 150 mm thick should be left on the ground as stockpiles are depleted.
- Aggregate transfer over stockpiles or storage bins of other sized aggregates should be avoided.
- Storage bins should be filled only to 150 mm from the top unless a suitable extension rim is provided to prevent contamination.
- Front-end loader buckets should be filled by raising them vertically up the face of the stockpile, not by thrusting into the stockpile in one place.
- Depositing aggregates into the batch plant storage bins should be made directly over the bins' outlet.
- Storage bins should be kept as full as possible during batching to minimize segregation as the aggregates are withdrawn from the bins.
- Acceptable and uniform aggregate moisture content shall be obtained and maintained by necessary means to include the following:
- Washed or wetted aggregates should remain in stockpiles for a minimum of 12 hours to permit a uniform moisture content throughout the stockpile to be reached before aggregate transfer to batch plant storage bins.
- After each day's concrete production during wet weather, fine aggregate bins should be either emptied or covered with a suitable waterproof covering.

3.0 Execution

3.1 Batching

3.1.1 Batching equipment, such as weighing mechanisms, gates, water lines and dispensing systems, shall be maintained in good working order. Batching bins shall be completely emptied of all material before the first and succeeding batches are measured.

Batching equipment shall have the following capabilities and facilities:

- bins or silos for storage of aggregates, silos for storage of cement and pozzolan.

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- free movement of each type or size of material to discharge openings without contamination.
- design of storage and hauling facilities to prevent:
- loss or intermingling of different sizes and types of materials.
- contamination by deleterious substances.
- harmful segregation and breakage.
- covers to stockpiles of fine aggregates to ensure constant moisture content.
- all fulcrums, clevises and similar working parts maintained in clean condition.
- provision made, in remote control plants and/or where batch cycles are timed, for the complete filling and discharge of the measuring unit for each batch.

3.1.2 Batch Charging Mechanism - Batch Charging Mechanism requirements shall be as follows:

- material flow control within the specified tolerances.
- hopper construction to eliminate material accumulation and to permit the complete discharge of every batch.
- cement weighing hopper:
- self-cleaning and properly ventilated to allow air to escape.
- Accessible for inspection
- Dust sealed between the charging mechanism and the hopper to maintain weighting accuracy.

3.1.3 Scales and Dispensing Mechanism - Scales and Dispensing Mechanisms shall conform to the following requirements:

- beam type or springless dial type.
- other methods of weighing (electric, hydraulic, load cells, etc.) are acceptable provided the specified weighing tolerances and accuracy requirements are met.
- all accurate to $\pm 0.4\%$ of the total capacity of the scale when static load tested.
- zero balance adjustment capability.
- unaffected by binding or vibration due to vibrators or other appurtenances.
- working range between 10% and 90% of the scale reading.
- equipped with prominent markers with individual batch weight setting capabilities for dial scales.
- calibration facilities including an adequate number of standard test masses.
- beam type scales with provision for indicating to the operator that the required load in the hopper is being approached; the device shall indicate at least the last 100 kg of the load.
- all weighing and indicating devices shall be in full view of the operator while charging the hopper, and the operator shall have convenient access to all controls.

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3.1.4 Volumetric Devices for Water Measurement -Volumetric devices for water measurement shall be:

- fitted with such valves and connections as are necessary to divert the water measured for a batch to easily verify the accuracy of measurement.
- arranged so that measurements will be unaffected by variable pressures in the water supply line.
- calibrated to an accuracy of 2% of the batch volume.

3.1.5 Dispensing Systems for Liquid Admixtures - Dispensing systems for liquid admixtures, other than weigh systems, shall have the following capabilities:

- visual, volumetric measuring or readout units located as close as possible to eye level for easy reading by the operator.
- positioned in such a manner that discharge into the batch is observed by the operator from a normal working position.
- volumetric measuring unit for periodic check of dispenser accuracy where a positive displacement system is used.
- visual measuring unit for an accurate visual check of increments of 30 mL of air entraining agent or of chemical required to treat a maximum of 25 kg of cement.

3.1.6 Certificate or Report of Inspection - A certificate or report of inspection, from a Weights and Measures approved, independent testing authority, and which is not more than one year old for the plant in its present position, shall be on display in the plant at all times. The certificate or report will be accepted as proof of accuracy of the scales or weighing devices. Where there is reasonable doubt concerning the accuracy of the scales or weighing devices the *Contract Administrator* may require their recalibration and recertification at the *Contractor's* expense, during progress of the work. Plant relocation or major alterations shall require such recalibration and recertification.

3.1.7 Batching of Materials - Material may be weigh-batched separately or cumulatively. Aggregates shall be batched by mass, cement and mineral admixtures in the powder form by mass or bag.

The mass of any ingredient to be batched shall not be less than 10% nor greater than 90% of the scale capacity.

When batched by 40 kg bags, only full and sealed bags of cement shall be used with no fractional bags permitted. Cement batched by mass shall be to an accuracy of $\pm 1\%$ for batch quantities between 30% and 90% of the scale capacity. When the mass of cement being batched is between 10% and 30% of the scale capacity, the mass of cement batched shall not be less than the required mass nor more than 4% in excess. Intermediate bulk cement shall be weighed to an accuracy of $\pm 1\%$.

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When aggregates are measured by mass, batch masses shall be based on the required mass of saturated surface dry aggregate corrected for the moisture conditions of the aggregate at the time of batching. Field determination of free moisture in the aggregates shall be made by any proven method such as CSA A23.2-11A or by the use of a device such as the "Speedy Moisture" gauge. Where doubt exists as to the accuracy of such methods, total moisture in the aggregate shall be determined in accordance with ASTM C566. When individual aggregate weigh batchers are used, the scale reading for each material shall be within 2% of the specified mass. In a cumulative aggregate weigh batcher, the cumulative mass after each measurement shall be within 1 % of the required cumulative amount when the scale is used in excess of 30% of its capacity. For cumulative measurement less than 30% of scale capacity, the allowable variation shall be $\pm 0.3\%$ of scale capacity or $\pm 3.0\%$ of the required cumulative mass, whichever is less.

Mixing water shall be measured by mass or volume to an accuracy of $\pm 1\%$. Adjustments for free water contained in batched materials, such as free water in the aggregates, water contained in admixture solutions, shall be made to the quantity of water to be batched. The total amount of mixing water in the batch obtained from all sources shall be within $\pm 3\%$ of the specified quantity and shall not vary the designed water-to-cementing material ratio of the mix by more than ± 0.02 . Mixers shall be completely emptied of all water prior to the loading of a concrete batch.

Admixtures shall be batched in liquid form by either mass or volume; in powdered form by mass or bag. Volumetric measurements of admixtures or air entraining agents shall be to an accuracy of $\pm 3\%$ of the required amount or 30 mL, whichever is greater. Measurement by mass shall be to an accuracy of $\pm 3\%$ of the required amount.

The addition of cement to a fully-batched load of aggregates will not be accepted.

3.2 Mixing

3.2.1 General - Sufficient plant capacity and transporting equipment shall be provided by the *Contractor* to ensure continuous delivery of concrete at the rate required with the necessary intervals between batches, for the proper placing and finishing of the concrete without the formation of cold joints in the finished concrete.

3.2.2 Concrete Mixers

3.2.2.1 General - Concrete mixers shall conform to the following requirements:

- manufacturer's rating plate carried in a prominent position, indicating rated mixing capacity, and recommended speed of mixing which must be in the range of not less than 4 nor more than 18 rpm.

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- demonstrated capability of operating satisfactorily at the recommended mixing speed.
- number of revolutions of the drum or blades registered with a counter in working condition.
- charge and discharge openings and chute free from appreciable accumulations of cement or concrete, and hopper and chute surfaces clean and smooth.
- batch water measuring equipment in good operating condition.

3.2.2.2 Volumetric Mobile Mixers - Volumetric mobile mixers shall conform to the following requirements:

- Shall be auger type mixers.
- The mobile mixers shall be calibrated with the actual cement and aggregate products used in the concrete mix. Calibration tables and curves shall be submitted to the *Contract Administrator*. The volume of the concrete produced shall be confirmed and shall be within 2%.
- Mobile mixers shall have separate flow-controlled supply hoppers for each individual aggregate gradation and cementitious constituent material to be added volumetrically.
- May be used provided that the accuracy of batching and uniformity of concrete is as required by CSA A23 .1.
- Cement flow rates shall be checked before (during if required) each placing operation.
- The scale being used to calibrate the mobiles shall have a minimum capacity of 50 kg.
- The water tank shall have a standpipe showing the amount of water in the tank.
- The mobiles shall have individual flow meters and admixture tanks for each admixture to be used as part of an admixture injection system.
- The mobiles shall be able to advance backwards and forwards from controls located at the back of the mobile.
- The mixer auger shall be maintained at minimum of a 25° angle from horizontal when mixing and discharging, unless otherwise indicated by the manufacturer.

3.2.3 Mixing Concrete - Mixing drums shall be clean and empty before being charged. The drum shall be rotated at the manufacturers' recommended mixing speed during charging and mixing. Concrete shall be mixed to the uniformity requirements of CSA A23.1, Section 5.2.3.5. When a satisfactory mixing time is established it shall be maintained for all batches of the same design, mixed with the same equipment.

3.3 Delivery

3.3.1 General - Off-site mixed concrete shall, after being mixed, be transported to the Site in either truck agitators or truck mixers operating at the speed designated by the manufacturer of the equipment as agitating speed.

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When concrete is being mixed in mixer trucks while in transit, the speed of the mixing drum shall be reduced to agitating speed once the mixing time has elapsed. Delivery of mixed concrete in non-agitating equipment will not be permitted.

- 3.3.2 Time of Placement** - All other concrete shall be fully discharged and placed within 60 minutes after initial mixing.

Time of placement extension will be considered on a case by case basis and may require the use of Hydration Stabilizing Admixtures (HSA's) conforming to the requirements of ASTM C494 Type B, Retarding or Type D, Water-Reducing and Retarding Admixtures.

- 3.3.3 Temperature Control** - Concrete shall not have a maximum temperature in excess of 17° C at time of placement. Methods used for maintaining temperature controls shall not diminish the quality of the concrete and shall not alter nor exceed the specified maximum water to cement ratio.

Prior to the placement of the overlay concrete, when the ambient air temperature is at or above 15°C, or when there is a probability of its rising to 20°C or above during the placement period (as forecast by the nearest official meteorological office), the *Contractor* shall submit the proposed placing workplan complying with the requirements for hot weather concreting.

When the ambient air temperature is at or above 15°C, or when there is a probability of its rising to 20°C or above during the placement period (as forecast by the nearest official meteorological office), the overlay shall be cast when daily air temperatures are forecast to be a minimum (normally between 12:00 midnight and 9:00 AM).

- 3.3.4 Addition of Water** - No water shall be added after the initial introduction of the mixing water for the mix, except at the start of discharge within the initial 10% of the total load volume, and when the specified water/cement ratio is not exceeded.

An amount not exceeding 16 L of water per cubic metre of concrete or 10% of the mix design water whichever is less may be added. After addition of water, the drum or blades shall be turned an additional 30 revolutions or more if necessary, at mixing speed. The amount of water added shall be recorded on the delivery ticket. Water shall not be added to the batch at any later time. The *Contractor* assumes full responsibility for the on-site addition of water and its subsequent effect on the quality of the concrete.

- 3.3.5 Addition of Superplasticizer (HRWR)** - When superplasticized concrete falls below the designated slump due to delay, it shall be re-tempered with superplasticizing admixtures only, not water, and shall only receive a maximum of one re-tempering. The amount of superplasticizer added shall be recorded on the delivery ticket. The *Contractor* assumes full responsibility for the on-site addition of superplasticizer and its subsequent effect on the quality of the concrete. The use of superplasticizers shall not be used for extending the time of placement requirements described in clause 4.2.

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3.3.6 Control of Air Content on the Site - The air content of the concrete shall, if necessary, be brought up to the specified range by the addition of an air-entraining agent in the field. Mixing shall follow to ensure proper dispersion and upon completion of mixing, the air content shall be retested. The amount of admixture added shall be recorded on the delivery ticket. The *Contractor* assumes full responsibility for the on-site addition of the air entraining agent and its subsequent effect on the quality of the concrete.

3.3.7 Delivery Ticket - Concrete delivered to the Site shall be accompanied by a ticket providing the *Contractor* and *Contract Administrator* with legible information, as follows:

- serial number of ticket
- date, name and location of concrete supplier.
- name of the *Contractor*.
- specific job designation (name and location).
- specific designation of concrete mix design.
- truck number and volume of concrete in cubic metres.
- addition of any materials added at the Site, at the request of the *Contractor* including but not limited to water and all chemical admixtures.
- time concrete was batched, arrived at Site, and completely discharged.
- amount of water added during batching including free moisture in aggregate, the maximum allowable amount of water that can be added at the site to maintain the specified maximum W / C_m ratio.

3.4 Quality Control Inspection, Testing and Acceptance

3.4.1 General -The *Contractor* shall be fully responsible for hiring, scheduling, overseeing, performing and documenting all quality control testing and inspection in full compliance with the Contract.

The *Owner* may perform on-site sampling and testing as a function of the *Owner's* quality assurance and/or audit. *Owner* quality testing shall not relieve the *Contractor* of responsibility for providing quality control.

3.4.2 Sampling and Testing - Laboratory testing shall be carried out by a testing laboratory certified in accordance with the requirements of CSA Standard A283. Field test procedures shall be undertaken by experienced personnel. All testing personnel shall be certified under CSA Standard A283 or certified as an ACI Concrete Field Testing Technician - Grade 1 (Minimum). Field inspectors shall have extensive experience in on-site quality control testing of concrete, with the applicable admixtures being used, and with on-site batch adjustments. Testing personnel shall be on-site and available to test concrete for the complete duration of any concrete placement operation. Sampling and testing shall be in accordance with the test methods and minimum frequency levels as listed in Table 5 and Table 6 (if applicable). Any test outside the specified range shall be immediately reported to the *Contractor* and *Contract Administrator*. Copies of all test results shall be received by the *Contract Administrator* and the concrete supplier within 1 day of the test date.

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3.4.3 Sampling - Point of Acceptance - Determination of concrete properties for acceptance will be made based on samples taken at the final discharge end of the placement system. The *Contract Administrator* may accept sampling at the truck discharge end provided that testing during the test batches confirm that the concrete mix parameters are within the stated specification requirements at the actual placement point. The *Contract Administrator* may require additional testing to be performed at the point of placement at a predetermined frequency throughout the placement period. Such additional testing, including all costs shall be deemed to be part of the *Contractor's* quality control program.

3.4.4 Strength Tests - Unless otherwise specified, a strength test shall be the average 28-day strength of three standard 100 mm x 200 mm test cylinders, sampled, cast, cured, transported, and tested in accordance with CSA A23.2- 3C and 9C. The cylinder size shall however, meet the aggregate size limitations specified in Clause 6.2 of CSA Test Method A23.2-3C. For each strength test, a fourth cylinder shall be cast for a 7-day strength determination, and if requested by the *Contract Administrator*, a fifth cylinder shall be cast for a 56-day strength determination. If one specimen in a strength test, in the opinion of the testing agency shows evidence of improper sampling, casting, or testing, including damage from improper handling and transporting (and if agreed to by the *Contract Administrator*), it shall be discarded and the remaining two specimen strengths averaged. Additional cylinders may be cast, at the discretion of the *Contract Administrator* or *Contractor*.

The strength of each classification of concrete shall be considered satisfactory if:

- the averages of all sets of three consecutive strength tests equal or exceed the specified strength.
- no individual test shows strengths less than 90% of the specified strength.

TABLE 5 STANDARD TEST METHODS FOR SAMPLING AND TESTING

Test Methodology	Test Description	Minimum Test Frequency
CSA A23.2-1C	Sampling Plastic Concrete	As stated below
CSA A23.2-3C	Making and Curing Concrete Compression and Flexural Test Specimens	One set for every 35 m ³ or portion thereafter for each classification of concrete placed within an individual structural element or component, and placed on any one-calendar day from a single supplier. The <i>Contract Administrator</i> may request additional sets.
CSA A23.2-9C	Compressive Strength of Cylindrical Concrete Specimens	
CSA A23.2-9C	Air Content of Plastic Concrete by the Pressure Method	Every individual load unless approved otherwise by the <i>Contract Administrator</i>
CSA A23.2-4C	Slump and slump flow of Concrete	Retests shall be performed following any load adjustments.

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ASTM C1064	Temperature of Fresh Concrete	
CSA A23.2-6C	Density, Yield, and Cementing Materials Factor of Plastic Concrete	Density and Yield tests shall be performed with every air test and strength test.

TABLE 6 ADDITIONAL TEST METHODS

Test Methodology	Test Description	Minimum Test Frequency
ASTM C457	Microscopic Determination of Parameters of the Air-Void System in Hardened Concrete {Modified Point Count Method at 100 times magnification)	One test per individual test batch for deck concrete. Acceptance criteria shall be in accordance with CSA A23.1 Section 4.3.3.2 and 4.3.3.3. Further testing, during scheduled concrete pours may be required, as directed by the <i>Contract Administrator</i> .
ASTM C1202	Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration (Test age at 28 days)	One test per individual test batch for deck concrete. Acceptance criteria shall be a coulomb rating not exceeding 1000 coulombs. Further testing, during scheduled concrete pours may be required, as directed by the <i>Contract Administrator</i> .
CSA A23.1-21C	Length Change of Hardened Hydraulic-Cement Mortar and Concrete {Drying shall commence after 7 days of curing and shrinkage determined after 28 days of drying)	One test per individual test batch for deck concrete. Sampling to be at final point of discharge.

Each "classification of concrete" will be taken as all of the concrete in one pay item in the Schedule 7. Where fewer than three strength tests are taken, the results of one test or the average of two will be used.

- 3.5 Test Cylinders** - Making and curing concrete test cylinders shall be carried out in accordance with CSA A23.2-3C. The test cylinders shall be cast by the *Contractor* using standard CSA approved moulds. The *Contractor* shall provide properly designed temperature-controlled storage boxes for test cylinder storage, for a period of at least 20 hours, and further protection from adverse weather and mishandling before and during delivery to the testing laboratory for curing and testing. The *Contractor* shall provide a maximum-1mm thermometer for each storage box and record site curing temperatures for all test cylinders. Storage in a portable building which will be used by *Contractor's* personnel or the concrete testing personnel during the first 24 hour storage period will not be permitted. Storage facilities shall be provided, installed, and accepted before any concrete is placed.

The *Contractor* shall deliver the test cylinders to a CSA certified testing laboratory. Handling and transporting of the cylinders shall be in accordance with CSA A23.2-3C. No extra laboratory curing time will be allowed for cylinders that are delivered late to the laboratory. A copy of the test results shall be forwarded to the *Contract Administrator*

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within 2 days of each individual strength test date. Test results shall include all information as described in CSA A23.2, Annex B, Form for Reporting Compressive Strength of Concrete Test Cylinders.

- 3.6 Field Cured Test Cylinders** - The *Contract Administrator* may require field cured test cylinders be cast to check the adequacy of the *Contractor's* curing or cold weather protection. The *Contractor* may also cast field cured test cylinders for determining interim strengths that may be required for further work progress approval such as opening to traffic, formwork removal and/or erection, etc.

Casting, handling, transporting and testing shall be in accordance with CSA A23.2-3C and 9C.

Test cylinders shall be stored as near as possible to the point in the structure that the test cylinders represent and shall be afforded the same temperature protection and moisture environment as the structure.

At the end of the curing period the test cylinders shall be left in place, exposed to the weather in the same manner as the structure.

Test results on field cured test cylinders shall not be used as a basis for acceptance or rejection of the concrete.

3.7 Failure to Meet Minimum Strength Specifications

- 3.7.1 Low Average** - where the average of the strength tests is low, but no test shows less than 90% of the specified strength, the concrete will be accepted at a reduced price (see clause 13.2).

- 3.7.2 Understrength Concrete** - where testing shows lower strengths, the *Contract Administrator* may order replacement or reinforcing, at the *Contractor's* expense, of portions of the structure. Alternatively, at the *Contract Administrator's* discretion, the understrength concrete may be accepted at a reduced price (see clause 13.2).

- 3.7.3 Coring** - the coring of concrete, to verify its strength, will be allowed only for concrete, which is otherwise to be replaced or reinforced. Coring will not be allowed for concrete for which reduced payment is to be made for understrength. When coring is allowed, cores shall be taken at locations directed by the *Contract Administrator*, who shall be present during the coring.

Where coring is allowed, it shall be carried out at the *Contractor's* expense by an independent qualified testing firm. Three cores shall be obtained and tested in accordance with CSA A23.2-14C "Obtaining and Testing Drilled Cores for Compressive Strength Testing" at each test location. Concrete in the area represented by the core tests may be considered structurally adequate if:

- the average strength test result of each set of three cores from the portion of the structure in question is equal to at least 100% of the specified strength
- the strength test result of any single core is not less than 80% of the specified strength

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Notwithstanding the final result, the *Contractor* will be responsible for all costs associated with the coring operation and testing and shall not be reimbursed for inconvenience and other associated costs.

- 3.7.4 Failure to Meet Slump or Air Content Specifications** - In the event that the slump and/or air content are outside the specified limits, the *Contract Administrator* may accept adjustments to correct the deficient condition as an alternative to rejection. In such cases, adjustments must be completed within the maximum time allowed as specified in clause 4.2 and additional testing shall be required to verify specification compliance. If compliance is not achieved, the concrete shall be rejected.

3.8 Placing of Concrete

- 3.8.1 General** - Equipment for conveying concrete at the Site, such as buggies, buckets, hoppers, chutes, belts and pumps, shall be of such design, size and condition to deposit a continuous and adequate supply of concrete of the specified mix and consistency without segregation at the required locations.
- 3.8.2 Buggies** - Buggies shall have inflatable rubber tires. Inner surfaces of the bucket shall be smooth with filleted comers, mortar-tight and free of any excessive accumulation of hardened concrete, obstructions or deterioration interfering with the proper discharge of concrete. Grade and ramp-way surfaces shall be sufficiently smooth to prevent segregation of concrete being carried in buggies.
- 3.8.3 Bottom-dump Buckets and Hoppers** Bottom-dump buckets and hoppers shall have side slopes not less than 60° from the horizontal and shall be equipped with wide free-working and tight-closing discharge gates. The discharge gates shall be constructed to regulate the concrete flow, spring loaded to ensure complete closure and be capable of immediate closure at any time during discharge. Buckets and hoppers shall be cleaned of any accumulation of partially hardened or hardened concrete before and during concrete placement. Gate control mechanisms shall be cleaned and lubricated before being used. In the use of crane and bucket, segregation of concrete from jarring or shaking shall be prevented. Side-dump buckets shall be used whenever necessary to avoid conflict with extended reinforcing steel or formwork.
- 3.8.4 Chutes** - Chutes shall be of rounded cross section to avoid the accumulation of concrete in comers; be capable of slope adjustment sufficiently steep to permit flow without requiring a slump greater than that specified or required for placement (slope normally required is 1 vertical to 2 or 2½ horizontal). Baffles and changes in direction may be used to control flow, but not vibration, paddling or water spray. Chutes or belts shall be rigidly supported but sufficiently mobile to permit discharge as close as possible to the placement location as it progresses. Any long line of chutes or belts shall be covered during hot, dry or windy weather to prevent drying of concrete and excessive slump loss.

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- 3.8.5 Conveyor Operation Rate** - Conveyor operation rate shall be dependent on the proper placement and consolidation of the concrete with the belt inclination such that no segregation occurs from any sliding or roll-back of the concrete.
- 3.8.6 Hoppers** - Hoppers, set approximately level, shall be supported on specially framed bearers transmitting only vertical loads to the top of the formwork.
- 3.8.7 Pumps** - Pumps shall be of sufficient capacity to supply un-segregated concrete, using the design mix proportions at the design slump, to meet the required placement volume at the forms. Satisfactory operation and performance of the proposed pumping equipment with the concrete materials and mixes otherwise suitable and appropriate for the job, along with the line layout and grate size opening, shall be demonstrated to the *Contract Administrator's* satisfaction and acceptance.
Any necessary priming of the concrete pump shall be done with a water/cement or water/cement/sand slurry. The prime slurry followed by approximately 0.25 cubic meters of concrete shall not be included in the concrete placement. No other pump aid type admixtures will be permitted.

3.9 Consolidation

- 3.9.1 Vibrators - General** - The number, type, design and operation of vibrators will be subject to the acceptance of the *Contract Administrator*.

Vibrators shall have the following capabilities and requirements:

- diameter and frequency of vibrators shall conform to Table 7.
- vibration transmission to the concrete at frequencies not less than 130 Hz.
- vibration intensity sufficient to be visually observed on concrete with not more than 25 mm slump over a radius of at least 450 mm.
- sufficient number of vibrators available to properly compact each 8 m³ batch within 15 minutes after it is placed in forms, with at least two vibrators provided for each concrete placing unit.
- stand-by vibrator and generator available on the job at all times in case of breakdown.

- 3.9.2 Mechanical Vibrators** - Mechanical vibrators shall thoroughly consolidate concrete immediately after placing.

Vibrator usage shall be as follows:

- not inserted between reinforcing steel and formwork nor directly on to the reinforcing steel.
- inserted vertically at a rate of 75 mm per second and penetrating into the preceding layer at least 50 mm.
- withdrawn at a rate of 150 mm per second.
- grid pattern movement starting 100 mm from a formed surface and at a maximum spacing of 300 mm thereafter.

TABLE 7 REQUIREMENTS FOR DIAMETER AND FREQUENCY OF VIBRATORS

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Diameter (mm)	Frequency (Hz)	Rate of Placement of Concrete Per Vibrator (m ³ /h)	Application
20-40	170-250	1-4	Very thin members
30-60	150-225	2-8	Walls and slabs 200-300mm
50-90	130-200	5-15	Larger members

3.9.3 Hot Weather Concreting

When ambient air temperature is 25°C or higher or there is a probability of it rising to 25°C during the placing period (as forecast by the nearest official meteorological office), hot weather concreting procedures as outlined below, shall be used, for all concrete other than deck concrete.

Prior to the placement of concrete, the *Contractor* shall submit to the *Contract Administrator* for acceptance, the proposed placing operations complying with the requirements for hot weather concreting.

Curing shall be accomplished by water spray or by using saturated absorptive material, such as burlap.

Formwork, reinforcement and concreting equipment shall be protected from the direct rays of the sun or cooled by fogging and evaporation.

Concrete for piers, abutments and footings of bridges shall not have a temperature greater than 25°C at any time prior to placement and curing. The initial temperature of concrete prior to placement may be estimated from the temperatures of its ingredients by using the following equation:

$$T = \frac{0.22(T_a M_a + T_c M_c) + T_w M_w + T_{wa} M_{wa}}{0.22(M_a + M_c) + M_w + M_{wa}}$$

Where Ta' Tc' Tw and Twa
 = temperature in °C of aggregates, cementing materials, and adding mixing water, and free water on aggregates, respectively

Where Ma, Mc, Mw and Mwa
 = mass in kilograms of aggregates, cementing materials, adding mixing water, and free water on aggregates, respectively

If deemed necessary, the *Contractor* shall employ the following hot weather concreting procedures to reduce the concrete temperature:

3.9.4 Mixing Water

- Shading of storage tanks and water supply lines;
- Refrigeration of mixing water; and/or

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- Adding cubed, shaved or chipped ice directly to the concrete mixer drum, and ensuring ice is of a particle size to be completely melted before the concrete is discharged from the mixer drum for placement.

3.9.5 Cement

Maintain all cementing material to below a maximum temperature of 50°C

3.9.6 Aggregate

- Shading of coarse and fine aggregate stockpiles; and/or
- Wetting of coarse aggregate and allowing time for drainage of free water.
- Note that wetting down of stockpiles of fine aggregate is not permitted.

3.9.7 Mixing - Mixing time should be kept to a minimum, allowing adequate time for complete mixing of the concrete. The external surface of the mixing drum should be frequently wetted down.

3.9.8 Placing - Production of concrete during hot weather shall be scheduled for a continuous supply of concrete at the Site. Adequate manpower, equipment and standby provisions shall be provided in order to place and consolidate the delivered concrete within 45 minutes after initial mixing. Further, the time interval between placing batches shall not exceed 30 minutes.

Time of placement extensions during hot weather concreting may be considered by the *Contract Administrator* and may require the use of Hydration Stabilizing Admixtures (HSA's) conforming to the requirements of ASTM C494 Type B, Retarding or Type D, Water-Reducing and Retarding Admixtures. Use of HSA's shall be in accordance with clause 4.2.

For large unformed surfaces, the quantity and rate of placing of concrete shall be dependent upon the rate of finishing and climatic condition.

When the rate of evaporation from unformed surfaces as estimated from Drawing SP211-01 "Surface Evaporation Rate" exceeds 1.0 kg/m²/hr, either concrete operations shall cease or, upon acceptance of the *Contract Administrator*, necessary precautions taken to prevent plastic shrinkage as detailed in CSA A23.1 Section 7.4.2.2.

3.9.9 Curing during hot weather shall be commenced as soon as possible. Forms shall be kept moist and loosened as soon as this can be done without structural damage, with a flow of water introduced and allowed to run down inside.

Newly exposed concrete surfaces shall be protected from premature drying by the application of pre-wetted curing materials or a continuous water spray as the forms are removed.

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Large exposures of concrete require special precautions as follows:

- burlap application commenced as soon as the surface will support the mass without excessive deformation, with this surface kept continuously wet by fog spraying until a waterproof barrier is securely in place.
- concrete under the curing blanket is not allowed to dry out for a minimum of seven days from the time of initial covering, necessitating frequent checking and soaking by the addition of water under the top evaporation barrier.
- wet curing followed by the removal of the evap-oration barrier only under such conditions that the wetted burlap is permitted to dry slowly before removal and the surface is exposed to prevent excessive thermal shock.

3.9.10 Cold Weather Concreting - Cold weather concreting procedures shall be used when the ambient temperature is, or is forecast to be, below 5°C during placement, and/or is forecast to fall below 5°C during the first seven days after placing. The *Contractor* shall be fully responsible for the protection of concrete during cold and adverse weather conditions and shall maintain a minimum concrete temperature of 10°C for a minimum of seven continuous days. Prior to the placement of concrete, the *Contractor* shall submit to the *Contract Administrator* for acceptance, the proposed placing operations complying with the requirements for cold weather concreting. The following provisions for cold weather concreting shall apply:

3.9.10.1 The temperature of the combined water and aggregates shall not exceed 40°C when combined with the cement. The temperature of the concrete shall be between 10°C and 25°C at the time of placement.

3.9.10.2 Aggregates shall be heated to eliminate frozen lumps, ice and snow without overheating or excessive drying. Aggregates shall not be heated above 65°C, and all lumps of frozen aggregate shall be excluded from the mix.

3.9.10.3 Formwork, Reinforcing Steel: Before any concrete is placed, all ice, snow or frost shall be completely removed from the forms and the temperature of contact surfaces raised to a minimum of 5°C, with such minimum established and maintained for at least one hour prior to placement.

Heat shall be applied uniformly and at a rate which will not induce excessive thermal stresses in the section being heated. Ambient air temperatures shall not exceed concrete temperatures by more than 13°C and shall be raised at a maximum rate of 2°C/hr.

Projecting reinforcing steel shall be insulated when temperatures are between 0°C and -10°C for a minimum of 300 mm away from the fresh concrete and for a minimum of 600 mm when temperatures are below -10°C.

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END OF SECTION

CONCRETE OVERLAYS

1. General

This Subsection describes requirements for construction of a concrete overlay, including the construction practices, materials and equipment required to place acceptable concrete overlay. This work is shall be carried out on one-half of the deck at a time, while traffic is maintained on the other half.

1.1 Related Work

03 30 00	Portland Cement Concrete
26 42 00	Cathodic Protection of Steel in Concrete

1.2 **Gradelines** - The *Contractor* shall survey and reference profiles of the existing bridge deck and approaches prior to scarification as follows:

- Longitudinally the profiles shall be taken at 1 to 2 m stations for the entire length of the structure, including 21 m on each end, with additional shots taken at the back of ballast walls and all existing or proposed new joint locations.
- Transversely the number of profiles required will be determined by:
 - A maximum spacing between elevation points of 3m.
 - Profiles are required 500 mm from each curb or parapet face.
 - Profiles are required 300 mm (inside area to be concreted) from longitudinal overlay construction joint lines requiring adjustable screed rails. In general, longitudinal overlay construction joints shall be located at the center of a lane or between lanes. The final location of the longitudinal construction joints is subject to the acceptance of the *Contract Administrator*.
 - A profile is required at hinge point of crown.
- Elevation points are to be laid out in cross section ninety degrees to centerline of roadway on straight structures and radial to centerline of roadway on curved or spiraled structures.
- Profile elevation points shall be laid out to an accuracy of ± 20 mm horizontally and elevations taken to an accuracy of ± 3 mm vertically and be referenced such that they can be re-established within ± 25 mm from their original location.

The *Contractor* shall provide the *Contract Administrator* with the gradeline profiles plotted at a scale of 1 : 10 vertical and 1 :50 horizontal and a spreadsheet showing actual original elevations for all points surveyed.

In the case of old decks, subsequent to scarifying and cleaning of the deck surface, the *Contractor* shall re-establish the original elevation points, take new elevations for the points to the nearest millimeter and submit these elevations along with plotted profiles to the *Contract Administrator*.

The Ministry will provide the *Contractor* with design finished grade profiles and elevations for the survey points as originally laid out by the *Contractor*. These profiles and elevations shall be used by the *Contractor* to set the screed rails for the deck-finishing machine, checking of overlay thickness during the dry run of the deck machine and for calculating the volume of overlay concrete required.

The *Contractor* is responsible for properly setting the screed rails to match the design gradeline provided by the *Contract Administrator*. Depressions creating ponded water, or localized high

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spots in the concrete surface, resulting from deficient finishing procedures shall be repaired at the *Contractor's* expense.

At completion of the deck overlay, the *Contractor* shall re-establish the original elevation points, take as built elevations for the points to the nearest millimeter, and submit these elevations along with plotted profiles to the *Contract Administrator*.

1.3 Measurement and Payment

1.3.1 Measurement and payment for removal and replacement of the concrete deck overlay shall be a lump sum cost and include all necessary works and materials to remove the overlay prior to commencing any deck work and replacement of the concrete overlay after installation of the cathodic protection system. The cost of the work shall include but not be limited to all elements in this section and reference section of the contract and detailed design drawings.

1.3.2 Payment for Partial or Full Depth Concrete Repair of the sub deck will be made at the Unit Price per square metre bid. Payment shall be for all labour, materials and equipment to break out the concrete, including inspections, sounding, cleaning of mildly corroded reinforcing, abrasive blast cleaning of the existing concrete surfaces within the repair areas, saw cutting, and containment and disposal of all debris. Payment shall also include the supply, installation and removal of all required formwork. The cost of the work shall include but not be limited to all elements in this section and reference section of the contract and detailed design drawings.

1.3.2.1 Measurement of partial depth repair areas will be completed in the field by the *Contract Administrator*. Length and width shall be measured to the nearest 25 mm. The unit rate price for concrete repair shall be based on an average repair depth of 75 mm. Minor deviation from the 75 mm repair depth shall not be grounds for renegotiation of the unit rate price.

1.3.2.2 Measurement of full depth repair areas will be completed in the field by the *Contract Administrator*. Length and width shall be measured to the nearest 25 mm.

2.0 Products

2.1 Concrete – Concrete mix design, production and delivery shall be in accordance with 03 30 00 “Portland Cement Concrete”. Concrete shall be produced either by a qualified concrete batch plant or at the bridge site using pre-bagged concrete mix and mixer trucks. All equipment shall be provided in good working condition.

2.2 Equipment – Acceptable finishing machines are Bidwell model 4800, Gomaco model CA450 or alternate acceptable to the *Contract Administrator*. Finishing machines shall be capable of forward and reverse motion under positive control and with provision for raising screeds to clear previously screeded surfaces while traveling in reverse.

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The *Contractor* shall provide steel rail mounted mechanical deck concrete finishing equipment of adequate size and design to permit the complete placement and finishing of a single lane section from abutment to abutment with the prescribed surface finish, without forming any cold joints.

The *Contractor* is responsible for properly setting the screed rails to ensure longitudinal and transverse drainage from the deck without ponded areas or "bird baths".

Sufficient screed guide rails will be set out for the full length of the anticipated section to be cast plus 6 m length at each end for run in and run out of the deck machine, adjusted for height and accepted by the *Contract Administrator* prior to the pour as follows:

- Screed guide rails, upon which the finished machine will be placed outside the area to be concreted, will be horizontally and vertically stable. Rails shall be installed with fully adjustable supports at 350 mm maximum spacing
- The finishing machine and guide rails will be adjusted so that the height of the screed above the existing subdeck at each point meets the *Contract Administrator's* requirements. To confirm the adjustment of the machine and guide rails, the screed will be "dry-run" and clearance measurements taken at 3 m intervals and provided to the *Contract Administrator* for acceptance. The minimum overlay thickness shall be 50 mm. Resetting of the machine and/or guide rails will be done as necessary to obtain an acceptable "dry-run". Adjustments to the machine or the rails will not be permitted after an acceptable "dry-run" is complete.

Work bridges shall be provided to facilitate bull floating, edge finishing with hand tools, correction of defects in machine finished concrete and tining and fog curing.

Rigid forms made of wood or steel shall be installed at longitudinal bulkheads in a manner that will maintain the desired shape during concrete placement, consolidation and finishing. The longitudinal bulkhead will be installed at the centerline or lane lines of the bridge deck. The top of the longitudinal bulkhead will be set at the finished deck elevation. Any honeycombing or poorly consolidated concrete after stripping the longitudinal bulkhead will be cut back into the new overlay a minimum of 150 mm.

The overlay shall be placed in strips with longitudinal joints near lane markings. Each strip shall be placed continuously between joints; adjacent strips shall not be cast for 24 hours.

- 2.3 Bonding Agent-** The *Contractor* shall apply a pre-approved cementitious bonding slurry to the prepared sub-deck. The prepared concrete sub deck shall be in a saturated surface dry (SSD) state for a minimum of 24 hours prior to slurry placement. The *Contractor* shall supply the necessary equipment such as water hoses and vacuum or oil free compressed air.

The cementitious bonding slurry is to consist of type GU or GUL Portland cement mixed with a water/cement ratio not exceeding 0.38 by mass. The slurry must not exceed 3 mm in depth and be scrubbed into the substrate surface with coarse brooms; in particular, no pooling will be permitted. The bonding slurry is to be applied immediately ahead of the overlay concrete placement and in a timely fashion so as not allow drying or setting up of the slurry prior to the placement of overlay concrete. Any areas to which the slurry has been applied, that in the opinion of the *Contract*

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Administrator exhibit drying or setting shall be cleaned of the bonding slurry and re-coated prior to the placement of deck overlay concrete.

3.0 Execution

- 3.1 Removal of Existing Concrete Deck Surface** - The existing concrete overlay shall be removed by use of ultra-high-pressure water jetting (hydro-demolition). The depth of concrete removal shall be greater than the depth of the existing overlay, to ensure that the concrete is removed below the existing overlay/bridge deck interface. The depth of concrete removal is estimated to be around 80 mm below the top surface of the existing overlay.

Alternatively, upper 40 mm of the overlay could be removed by use of scarification (roto-milling) followed by removal of remaining 40 mm by use of ultra-high-pressure water jetting (hydro-demolition). In localized areas the depth of concrete removal might be increased slightly to ensure complete removal of the overlay.

If scarification is used, equipment shall be capable of concrete removal to an accuracy of ± 5 mm. The scarifying equipment shall produce a surface that does not exceed 10 mm in amplitude for roughness. The maximum cut will be to within 10 mm of the reinforcing steel. All areas inaccessible to the scarification equipment shall be prepared by hydro-demolition, grinders or by jackhammers with weight limited to a maximum 18 kg.

The *Contractor* shall monitor the concrete cover over the top mat of reinforcing steel using a pachometer or alternative methods. Readings shall be taken at regular intervals ahead of the concrete removal operations. The *Contractor* shall adjust the rate and depth of concrete removal to ensure that the structural concrete of the bridge deck is not removed to within 20 mm of the reinforcing steel. If removal of concrete results in less than 15 mm of cover to the reinforcing steel, then the surface shall be prepared to reinstate at least 15 mm of cover by means and methods acceptable to the *Contract Administrator*. Care must be taken not to damage the existing deck drains. The *Contractor* will be required to repair or replace any damaged drains at the *Contractor's* expense. Drains are to be plugged to insure containment of debris.

- 3.2 Concrete Substrate Inspection** - The exposed deck concrete surface shall be inspected by the *Contract Administrator* after concrete removal is completed. The inspection shall include the following:

- Visual inspection to generally assess the quality of bridge deck concrete and document concrete distress (if any).
- Concrete delamination survey by conducting soundings in accordance with Standard Practice ASTM D4580. Hollow sounding areas shall be delineated in the field and recorded on plan view drawings.
- Pull-off test at four locations on the exposed concrete surface in accordance with test procedure ASTM C1588. The test locations shall be selected by the *Contract Administrator* during the site visit. Direct tensile strength of the concrete substrate shall be equal or greater than 1.25 MPa.

All cracks wider than 0.4 mm, concrete delaminations and other defects identified during the inspection by the *Contract Administrator* shall be repaired by the *Contractor* by a method approved by the *Owner*.

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- 3.3 Preparation of Sub Deck** - The *Contractor* shall high pressure (minimum 110 MPa/15000 psi using a rotating head) water blast the surface of the entire concrete subdeck including both parapet or curb faces 50 mm up from original deck elevation and abutment ballast walls, no earlier than 10 days before placing the overlay concrete.

The water blasting equipment shall effectively remove laitance, loose materials, bruised concrete, dust, slurry, oil, or other contaminants (as applicable) that are detrimental to the concrete overlay bond and shall leave behind a sound concrete surface, thoroughly cleaned and roughened to partially expose the coarse aggregate. The *Contractor* shall provide full containment and disposal of all debris, contaminants, etc., and shall comply with all applicable environmental and Workers Compensation Act, Occupational Health and Safety Regulation BC, requirements. The *Contractor* shall provide adequate guards to contain over spray and flying debris during the scarification, water blasting, deck washing and chipping process. The *Contractor* shall take all means necessary to reduce and contain the amount of dust produced throughout the entire project.

For the period between water blasting and placement of overlay concrete the sub-deck shall be protected from contaminants.

Water blasting equipment shall always travel downhill, keeping all waste material ahead of the equipment and preventing the waste material from rehydrating on the previously cleaned surface. The prepared concrete surface texture shall meet ICRI Concrete Surface Profile (CSP) 6 or higher, which is acceptable for placement of a concrete overlay.

3.4 Partial Depth Repair

- .1 Concrete repairs shall be carried out to reinstate debonded concrete. Repairs shall only be carried out after delineation of the debonded repair areas has been confirmed with the *Contract Administrator*.
- .2 The general areas of repair locations are to be marked on record drawings. Estimates of anticipated repair quantities have been provided in the schedule of unit prices.
- .3 Actual areas to be repaired will be marked in the field by the *Contract Administrator* prior to commencement of the Work.
- .4 All deteriorated and/or delaminated concrete shall be removed until a sound substrate is achieved.
- .5 All repair materials from previous installations and other materials with significantly different electrical resistivity from the parent concrete (half to twice the parent concrete value) shall be broken out. This includes epoxy-based repair materials and bonding agents or concrete repair material with fibres.
- .6 Concrete removal shall not extend beyond the areas designated by the *Contract Administrator*. If rebar is corroded beyond the delaminated and spalled concrete, concrete removal beyond the marked areas shall be as instructed by the *Contract Administrator*. The *Contractor* shall not chase corrosion of reinforcement without prior approval by the *Contract Administrator*.
- .7 Inform *Contract Administrator* when concrete removal is complete to schedule field reviews. Provide at least 24 hours notice to *Contract Administrator*.

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- .8 After removal by mechanical chipping, the exposed concrete and rebar surfaces shall be prepared by thoroughly sandblasting or hydro-milling to remove all loose, deteriorated concrete and corrosion products from the reinforcing steel. Mechanical methods will not be accepted as alternate to sandblasting of the concrete substrate. Wire wheels or brushes are not acceptable for surface preparation of the rebar.
- .9 Steel surfaces shall be cleaned to remove loose corrosion products to ensure good contact between the steel and the repair material.
- .10 Prepared concrete surface shall have a rough and open texture meeting ICRI Concrete Surface Profile CSP 5 or 6.
- .11 Prepared concrete surfaces shall support a minimum bond strength to new concrete of 1.25 MPa when tested in accordance with CSA-A23.2-6B.
- .12 The *Contractor* shall provide at least 24 hours notice to the *Contract Administrator* to review the surface preparation. The *Contractor* shall not commence with installing concrete material without approval by the *Contract Administrator*.
- .13 Do not place repair material until the *Contract Administrator* has reviewed and approved the surface preparation.
- .14 Concrete substrates shall be saturated surface dry (SSD) at the time of patching unless noted otherwise by the manufacturer of the repair material.
- .15 Bonding agents and coatings on the steel and within partial depth repairs are not permitted. A bonding agent consisting of neat cement slurry or cream skimmed from the bagged product, scrubbed onto the prepared surface immediately ahead of the patch material shall be applied provided it is approved by the manufacturer.
- .16 Curing of repaired concrete shall be completed in accordance with manufacturers requirements and shall as a minimum be completed by installation of 6 mil polyethylene sheeting sealed around the perimeter of the repair area. Proprietary curing membranes shall not be used prior to subsequent anode installation over the repair area.
- .17 Curing temperatures shall be maintained in the space as required by CSA A23.1 for a period of 3 days following material installation.

3.5 Full Depth Repair

- .1 In the event that concrete removal results in penetration through the deck the *Contractor* shall notify the *Contract Administrator*.
- .2 The *Contract Administrator* shall delineate the extent of additional concrete removal. Concrete removal shall not extend beyond the areas designated by the *Contract Administrator*. If rebar is corroded beyond the delaminated and spalled concrete, concrete removal beyond the marked areas shall be as instructed by the *Contract Administrator*. The *Contractor* shall not chase corrosion of reinforcement without prior approval by the *Contract Administrator*.
- .3 The *Contractor* shall provide formwork on the underside of the deck to support the repair concrete.
- .4 The general areas of repair locations are to be marked on record drawings. Estimates of anticipated repair quantities have been provided in the schedule of unit prices.

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- .5 Actual areas to be repaired will be marked in the field by the *Contract Administrator* prior to commencement of the Work.
- .6 Inform *Contract Administrator* when concrete removal is complete to schedule field reviews. Provide at least 24 hours notice to *Contract Administrator*.
- .7 After removal by mechanical chipping, the exposed concrete and rebar surfaces shall be prepared by thoroughly sandblasting or hydro-milling to remove all loose, deteriorated concrete and corrosion products from the reinforcing steel. Mechanical methods will not be accepted as alternate to sandblasting of the concrete substrate. Wire wheels or brushes are not acceptable for surface preparation of the rebar.
- .8 Steel surfaces shall be cleaned to remove loose corrosion products to ensure good contact between the steel and the repair material.
- .9 Prepared concrete surface shall have a rough and open texture meeting ICRI Concrete Surface Profile CSP 5 or 6.
- .10 Prepared concrete surfaces shall support a minimum bond strength to new concrete of 1.25 MPa when tested in accordance with CSA-A23.2-6B.
- .11 The *Contractor* shall provide at least 24 hours notice to the *Contract Administrator* to review the surface preparation. The *Contractor* shall not commence with installing concrete material without approval by the *Contract Administrator*.
- .12 Do not place repair material until the *Contract Administrator* has reviewed and approved the surface preparation.
- .13 Concrete substrates shall be saturated surface dry (SSD) at the time of patching unless noted otherwise by the manufacturer of the repair material.
- .14 Bonding agents and coatings on the steel and within partial depth repairs are not permitted. A bonding agent consisting of neat cement slurry or cream skimmed from the bagged product, scrubbed onto the prepared surface immediately ahead of the patch material shall be applied provided it is approved by the manufacturer.
- .15 Curing of repaired concrete shall be completed in accordance with manufacturers requirements and shall as a minimum be completed by installation of 6 mil polyethylene sheeting sealed around the perimeter of the repair area. Proprietary curing membranes shall not be used prior to subsequent anode installation over the repair area.
- .16 Curing temperatures shall be maintained in the space as required by CSA A23.1 for a period of 3 days following material installation.

3.6 Concrete Overlay Placement – All concrete works will be governed by the requirements of 03 30 00 - Portland Cement Concrete except as otherwise specified in this Section.

The *Contractor* shall be responsible for quality control of each component of the concreting operation, including aggregate and component quality, batching, mixing, transporting, placing, consolidating, finishing, curing and testing.

The *Contractor* shall submit a detailed Overlay Placement plan that details equipment and manpower to be used for placement and curing of the concrete overlay a minimum of 14 days prior to the scheduled placement dates for the acceptance of the *Contract Administrator*. The plan shall

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also contain details such as: water source, the distribution system, the collection and run-off control system, person(s) responsible for quality control, and staff to maintain the system. All review concerns raised by the *Contract Administrator* shall be addressed to the satisfaction of the *Contract Administrator*.

Concrete substrate surface shall be free of all bond-inhibiting materials and in a saturated-surface dry (SSD) condition for at least 24 hours prior to application of a bonding agent. Prepared concrete surface shall be reviewed by a Professional Engineer immediately prior to application of a bonding agent.

The placement of each longitudinal section of the overlay shall be continuous between expansion joints (no transverse joint). The longitudinal joint shall be established by saw cutting 150 mm back into the previously placed section of the overlay. Adjacent section of the overlay shall not be cast for a minimum 24 hours.

- 3.7 Concrete Overlay Finishing** – The overlay shall be finished by a drum-type deck finishing machine compliant with requirements specified in Section 2.2 above. There shall be no disturbance of the concrete finished by the deck finishing machine. The surface behind the finisher shall be floated transversely to eliminate ridges and open texture. Areas, which cannot be machine-finished, shall be hand screeded and floated to conform to the machine-finished deck.

Prior to final surface texturing, the deck surfaces shall be repeatedly checked for accuracy of deck slab thickness and alignment. The *Contractor* shall measure and record the deck slab thickness at a frequency of at least one measurement per interior bay and overhang bay, at a maximum of 2000 mm centers longitudinally.

Overlay final surface texturing shall be by tining. The tining shall create transverse grooves 3 mm wide by 1.5 mm to 3 mm deep at 20 mm centre-to-centre spacing.

- 3.8 Concrete Overlay Curing** – the overlay shall be wet-cured as per guidelines provided in Section 03 30 00. The overlay shall undergo a minimum 30-day air-drying period at the mean ambient temperature of above 4°C, prior to being subjected to freezing temperatures.

Burlap, used for concrete curing, shall be pre-soaked by immersing it in water for a period of at least 24 hours immediately prior to placing.

Two layers of burlap shall be applied to the surface of the concrete. Strips must overlap 150 mm and must be held in place without marring the surface of the concrete. Two layers of burlap shall be applied immediately after finishing of the concrete surface within 2 to 4 meters of the final surface texturing operation (no more than 20 minutes) and shall be maintained in a saturated condition in a manner, which does not damage the finished concrete surface. The burlap shall be maintained in a continuously wet condition throughout the curing period and a continuous film of free water on the surfaces of the areas noted herein shall be maintained by means of soaker hoses, sprinklers, etc. The temperature of the concrete being cured must be monitored to ensure maximum and minimum temperature requirements in accordance with Section 03 30 00 are met.

Overlay shall attain a minimum strength of at least 30 MPa before removal of the burlap and opening to traffic. All other requirements of seven-day curing shall be adhered to.

The interim strength tests shall be determined using field cured test cylinders cured in accordance with Clause 9.3.4 of CSA A23.2-3C.

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- 3.9 Post-Construction Assessment and Testing** – upon completion of the concrete curing, the visual examination of the overlay wearing surface shall be conducted by the *Contract Administrator*. All concrete defects noted during the examination shall be recorded, along with the severity of the defects, and repaired by the *Contractor*, if deemed necessary by the *Contract Administrator*.

To ensure that the adequate bond between new overlay and the bridge deck concrete was achieved, pull-off testing shall be conducted in accordance with test procedure ASTM C1588. The test locations shall be selected by the *Contract Administrator*. Pull-off test shall be performed a frequency of not less than one test per 200 m². The minimum bond strength shall be equal or greater than 1.25 MPa at 28 days.

END OF SECTION

RECOATING OF STRUCTURAL STEEL

1.0 GENERAL

1.1 WORK INCLUDED

- .1 Provide all labour, materials, equipment, and supervision necessary to clean and recoat structural steel on the 5th Street Bridge. The work includes recoating the entire structure after removing the existing coating. Note the structure contains lead paint.
- .2 Hot dip galvanizing of the removable railing sections shall be included in the costs as a separate item. Metallizing of non-removable fence posts shall be included in the costs as a separate cost item.
- .3 Utilities under the bridge are not to be coated but shall be protected from damage except for the 88.9 mm FORTIS line which shall be recoated along with the bridge structure.

1.2 REFERENCE DOCUMENTS

- .1 All reference documents are to be the latest edition of that document.
 - .1 ASTM – American Society for the Testing of Materials
 - .1 ASTM A-123/A 123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel
 - .2 CAN/CSA – Canadian Standards Association
 - .1 Can/CSA G164 - Hot Dip Galvanizing of Irregularly Shaped Articles Metals and Metal Products
 - .3 NACE International
 - .1 NACE No. 1 / SSPC-SP5 White Metal Blast Cleaning
 - .2 NACE No. 3 / SSPC-SP6 Commercial Blast Cleaning
 - .3 NACE No. 4 / SSPC-SP7 Brush-off Blast Cleaning
 - .4 NACE No. 5 / SSPC-SP12 Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating
 - .5 NACE No. 6 / SSPC-SP13 Surface Preparation of Concrete
 - .6 NACE No. 7 / SSPC-VIS 4 Interim Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting
 - .7 NACE No. 8 / SSPC-SP 14-SG, Industrial Blast Cleaning
 - .8 NACE No. 9 / SSPC-VIS 5, Guide and Reference Photographs for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning
 - .4 SSPC – Society for Protective Coatings
 - .1 SSPC-SP COM Surface Preparation Commentary for Steel and Concrete Substrates
 - .2 Guide to SSPC-VIS 1, Visual Standard for Abrasive Blast Cleaned Steel
 - .3 Guide to SSPC-VIS 2 Standard Method of Evaluating Degree of Rusting on Painted Steel Surfaces
 - .4 Guide to SSPC-VIS 3 Visual Standard for Power and Hand Tool Cleaned Steel
 - .5 Guide to SSPC-VIS 4/NACE No. 7 Guide and Visual Reference Photographs for Steel Cleaned by Water Jetting

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- .6 SSPC-VIS 5/NACE VIS 9 Guide and Reference Photographs for Steel Surfaces Prepared by Wet Abrasive Blast Cleaning
- .7 SSPC-SP 1 Solvent Cleaning
- .8 SSPC-SP 2 Hand Tool Cleaning
- .9 SSPC-SP 3 Power Tool Cleaning
- .10 SSPC-SP 5 / NACE No. 1 White Metal Blast Cleaning
- .11 SSPC-SP 6 / NACE No. 3 Commercial Blast Cleaning
- .12 SSPC-SP 7 / NACE No. 4 Brush-off Blast Cleaning
- .13 SSPC-SP 10 / NACE No. 2 Near-White Blast Cleaning
- .14 SSPC-SP 11 Power Tool Cleaning to Bare Metal
- .15 SSPC SP 12 / NACE No. 5 Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating
- .16 SSPC-SP 13 / NACE No. 6 Surface Preparation of Concrete
- .17 SSPC-SP 14 / NACE No. 8 Industrial Blast Cleaning
- .18 SSPC-SP15 Commercial Grade Power Tool Cleaning
- .19 SSPC-AB 1 Mineral and Slag Abrasives
- .20 SSPC-AB 2 Cleanliness of Recycled Ferrous Metallic Abrasives
- .21 SSPC-AB 3 Newly Manufactured or Remanufactured Steel
- .22 SSPC-PA COM Commentary on Paint Application
- .23 SSPC-PA 1 Shop, Field and Maintenance Painting of Steel
- .24 SSPC-PA 2 Measurement of Dry Film Coating Thickness with Magnetic Gauges
- .25 SSPC-QP1 Field Application to Complex Industrial and Marine Structures
- .26 SSPC-QP2 Field Removal of Hazardous Coatings
- .27 SSPC-QP3 Shop Painting Certification Program
- .28 SSPC-Guide 6 Guide for Containing Debris Generated During Paint Removal Operations
- .29 SSPC-Guide 15, Field Methods for Retrieval and Analysis of Soluble Salts on Steel and Other Nonporous Substrates
- .30 SSPC-TU 3 Overcoating
- .31 SSPC-TU 4 Field Methods for Retrieval and Analysis of Soluble Salts on Substrates
- .32 SSPC-TU 6 Chemical Stripping of Organic Coatings from Steel Surfaces
- .33 SSPC-TU 7 Conducting Ambient Air, Soil, and Water Sampling During Surface Preparation and Paint Disturbance Activities

1.3 CONTRACTOR QUALIFICATIONS

- .1 The *Contractor* and any *Subcontractors* undertaking any field coating work shall have certification in good standing with the SSPC under SSPC-QP1.
- .2 The *Contractor* and any *Subcontractors* undertaking any field cleaning and coating removal shall have certification in good standing with the SSPC under SSPC-QP2.
- .3 The *Contractor* and any *Subcontractors* undertaking any shop coating work shall employ NACE CIP certified coating inspectors.
- .4 The *Contractor* and any *Subcontractors* personnel carrying out any quality control work

RECOATING OF STRUCTURAL STEEL

related to the coating work, shall be certified and in good standing in accordance with the NACE Coating Inspector Program to level CIP 2 or 3.

1.4 SUBMITTALS

- .1 The *Contractor* shall submit to the *Contract Administrator* the following a minimum of 4 weeks prior to commencing any re-coating work:
 - a) Proof of contractor qualifications.
 - b) Lead Health and Safety Program (LHASP) Plan.
 - c) Environmental Management Plan (EMP).
 - d) Containment Design. – sealed by P.Eng. registered in British Columbia.
 - e) Drawing of utilities with identification of proposed coating / protection of said utility (BC Hydro cables, CRD Water Main, Fortis BC Pipes, Shaw Conduit, Telus Conduit, City of Courtenay Electrical Conduit.)
 - f) Quality Control Plan (QC Plan).
 - g) Coating sample plates.
 - h) Datasheets for proposed materials to be used on site.

1.5 WORK SITE HEALTH AND SAFETY

- .1 The *Contractor* is fully responsible for the protection of their employees and any sub-*Contractor's* personnel, as well as site visitors and the *Owner's* inspection personnel from exposure to lead. This work as well, includes but is not limited to working at heights and dealing with toxic substances.
- .2 Lead Health and Safety Program
 - .1 The coating on this bridge contains lead.
 - .2 The *Contractor* shall develop and implement a Lead Health and Safety Program (LHASP) that meets all the requirements of the Occupational Health and Safety Act and Regulations) and all other Municipal, Provincial or Federal Regulations that may apply when working in a hazardous environment.
 - .3 The *Contractor* shall provide shower and change facilities for the work force in accordance with governing regulations and ordinances. The facilities shall be freely available for use by all personnel associated with the Contract.
 - .4 Respirators shall be furnished by the *Contractor* and used when such equipment is necessary to protect the health of employees.
 - .5 Respirators shall be donned before entering the work area and shall not be removed until the worker has left the work area or has entered a decontamination area. Selection of the respirator type shall be based on the ability of the respirator to adequately filter air which is at the maximum air-lead level monitored in the locations where the worker may be exposed.

RECOATING OF STRUCTURAL STEEL

- .6 Extra clean respirators shall be kept on the job for use by visitors wishing to access the work site. No visitors shall be allowed without adequate protection.
- .7 The *Contractor* shall supply employees, who are potentially exposed to lead, with clean, dry, protective work clothing and equipment, and with appropriate changing facilities. Appropriate protective work clothing can include coveralls or similar full body work clothing, gloves, hats, shoes or disposable shoe coverlets, face shields or vented goggles and, if applicable, blasting helmets.
- .8 Extra protective clothing shall be available for use by inspectors and visitors to the work site.
- .9 The *Contractor* shall designate a Health and Safety officer, to act as the primary on site monitor of the program, to ensure that the LHASP is implemented on a daily basis and to confirm that all work on the site is in compliance with the LHASP.

1.6 CONTAINMENT

.1 General

- .1 This bridge coating contains lead. The intent of the containment is to stop the escape of paint chips, dust debris, paint spray and any other deleterious material to the environment.
- .2 Containment is considered an engineered structure. The *Contractor* shall ensure the containment drawings are stamped by a Professional Engineer as structurally sound and are within the safety load limits for the bridge structure.
- .3 The amount of spent abrasive that can be safely held in the containment expressed both as total mass and the equivalent average depth of abrasive on the floor of the containment shall be included on the stamped drawings.
- .4 Safe and secure disposal of the debris collected above according to BC Ministry of Environment, WorkSafe BC, Fisheries and Oceans Canada and such other bodies as may have regulatory authority.
- .5 Considerations for traffic and pedestrian movements through the bridge shall be included in the containment design.

.2 Containment

- .1 Containment shall follow the general recommendations of SSPC Guide 6. Containment shall be designed to meet anticipated loads. Design and shop drawings to be sealed by professional engineer registered in the Province of British Columbia.
- .2 Specific details shall be as follows:
 - .1 Abrasive Blasting
 - .1 The *Contractor* shall erect Class 1A containment. Containment shall be A1, Flexible Walls; B1, Air Impermeable; C1, Rigid Support Structure; D1, Fully Sealed Joints; E2, Resealable Doors; F1,

RECOATING OF STRUCTURAL STEEL

Controlled Air Make-up; G1, Forced Air Input; H2 Visual Verification of Air Pressure; I1, Minimum Specified Air Movement; and J1, Dust Filtration. *Contractor* may be permitted to relax the specification to Class A2 if it can be shown to the pertinent regulatory bodies that F2, Open Air Make-up and G2, Natural Input Air Flow will still contain the coating works debris.

- .2 Water Washing
 - .1 Containment must also meet Class 1W for the washing of the structure prior to cleaning. All the liquid waste stream shall be collected and properly disposed of.

1.7 PROTECTION OF EXISTING SURFACES

- .1 The *Contractor* shall protect and maintain the painted surfaces until acceptance of the entire project.
- .2 The *Contractor* shall take due precaution against damaging or disfiguring any portion of the bridge with: spatter, spray fog, splashes, smirches of paint or associated painting materials including the fuel and lubricants used with their equipment
- .3 The *Contractor* shall protect deck, sidewalks, piers, abutments, slope protection and other portions of the structure adjacent to areas being painted and subject to paint or other damage. Protection shall include the cathodic protection anodes and fixtures being installed in the deck.
- .4 Any damage or disfigurement which may occur by reason of the *Contractor's* operations shall be repaired to the satisfaction of the *Contract Administrator* at the *Contractor's* expense.

1.8 PROTECTION OF UTILITIES

- .1 Work will be done on and adjacent to utilities that cross the water on the bridge. The *Contractor* shall prepare a plan which will describe means and methods to minimize any damage to the utilities, and which will detail repair to any areas accidentally damaged. Damage if any, shall be repaired at the *Contractor's* expense. Utilities include: BC Hydro cables, CRD Water Main, Fortis BC Pipes, Shaw Conduit, Telus Conduit, City of Courtenay Electrical Conduit. The plan shall be submitted to the *Contract Administrator* a minimum of 4 weeks prior to commencing any recoating work.

1.9 QUALITY MANAGEMENT

- .1 Quality Management Responsibilities
 - .1 Quality Control
 - .1 Quality Control is the process of checking work done to determine whether or not specification requirements have been met and identifying ways to eliminate deficiencies in the work performed.
 - .2 The *Contractor* shall be responsible for quality control of all works for the project.

RECOATING OF STRUCTURAL STEEL

- .2 Quality Assurance
 - .1 Quality assurance is the process of assessing overall performance to ensure that the work meets specification requirements.
 - .2 The *Owner* shall be responsible for Quality Assurance of all works on the project.

- .2 Quality Management Plan
 - .1 The *Contractor* shall create a Quality Control Plan (QC Plan) for the coating work to include but not necessarily to be limited to the following sections:
 - .1 Management Responsibilities
 - .2 Document and Data Control
 - .3 Purchasing of Material, Services and Labour
 - .4 Product identification including traceability
 - .5 Process Control
 - .6 Inspection and Testing
 - .7 Control and Calibration of inspecting, measuring, and testing equipment
 - .8 Control of Non-conforming product
 - .9 Corrective and Preventative actions
 - .10 Handling, storage, and delivery of Materials
 - .11 Control of quality records

- .3 Quality Control Staff
 - .1 The *Contractor* shall take all actions necessary to ensure:
 - .1 They provide sufficient qualified inspection or testing staff with suitable equipment and sufficient training to perform the QC function in a timely and accurate manner.
 - .2 The *Contractor's* and any *Subcontractors'* QC staff performing quality control work related to shop and field painting shall be certified to level 2 or 3 in accordance with the NACE International Coating inspector program (NACE CIP 2 or CIP 3). Alternate qualifications subject to review by *Contract Administrator*.
 - .3 All testing instruments and equipment are to be properly maintained, calibrated and in good operating condition. Testing and inspection are carried out in accordance with requirements set out in NACE and SSPC Standard Specifications. SSPC PA-1, Shop, Field, and Maintenance Painting of Steel, and SSPC-PA 2 Measurement of Dry Film Coating Thickness with Magnetic Gauges are followed. Where it is impractical to follow these standards, a more practical approach will be worked out with the *Contract Administrator*. The *Contract Administrator* will unilaterally decide whether or not a particular standard is applicable and practical.
 - .2 The *Contractor* shall designate a Quality Control (QC) Manager who is responsible for the implementation of the Quality Management Plan. The QC Manager shall not be the Project Manager or the Project Superintendent.

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- .3 The QC Manager shall:
- .1 Be a person with knowledge, skills and abilities acceptable to the *Owner*. NACE Level 2 Coating Inspector or equivalent is an appropriate level of expertise.
 - .2 Be responsible for all facets of the contract quality.
 - .3 Ensure that all workers on the project understand the quality management plan and especially the part(s) that directly affect their work.
 - .4 Receive all test and inspection results, review and sign the information, pass it on to the *Owner* for their information and store the information until the project end.
 - .5 Stop work when deficiencies occur, and when the problem is corrected re-test to ensure compliance.
 - .6 Consult with field staff and the *Contract Administrator* to resolve problems or disputes as they arise.
 - .7 Submit inspection reports stating compliance or non-conformance within 48 hours of the testing/inspection and shall maintain records with the raw data supporting those claims should questions arise. At the end of the project, all these records will be transferred to the custody of the *Owner*.
- .5 Quality Assurance
- .1 The *Owner* will designate a Coating Quality Assurance Manager.
 - .2 The Coating Quality Assurance Manager will liaise with the *Contractor's* QC Manager to assure quality, to review QC Reports, to check the accuracy of the reports, to monitor the *Contractor's* operations and the effectiveness of the Quality Management Plan to identify, and to resolve problems.
 - .3 Testing done by the Quality Assurance Manager will generally be a subset of that done by the *Contractor's* QC Manager, but the *Owner* reserves the right to decide on the frequency of testing.
 - .4 Testing by the *Contract Administrator* does not relieve the *Contractor* of any Quality Control responsibilities.
 - .5 The Quality Assurance Manager will be allowed unrestricted access to the Site and to all work activities.
 - .6 If the Quality Assurance inspection/testing indicates non-compliance, a report will be issued to the QC Manager.
 - .7 The *Contractor* shall establish the following hold points for the coating work to allow access for inspection and testing. The Contractor shall provide five (5) days notice in advance of hold points or witness points to all for adequate notice.
 - .1 Post installation of scaffolding and other accesses
 - .2 Post installation of containment
 - .3 After washing prior to cleaning
 - .4 After cleaning, prior to the application of coating
 - .5 After each required coat of paint. Note that the stripe coat is considered a separate coat of paint.

RECOATING OF STRUCTURAL STEEL

- .8 The hold points indicated in 1.5.7 are verification points identified by the *Owner* beyond which work may not advance until review and verification by the *Contract Administrator* in writing. Any verification will not form an acceptance of the works by the *Owner*.
- .9 The *Owner* may add additional hold points at any time by written notification to the *Contractor*.
- .10 In some areas, a mixture of old and new paint may make it difficult to use a dry film thickness gauge to judge thickness of new paint. The *Contract Administrator* may, on a limited basis, require destructive tests (Tooke gauge readings) to be done. The *Contractor* shall repair these areas with a brush coat of midcoat, followed by a brush coat of topcoat. Each of the repair coats shall overlap the damaged area or midcoat by 25 mm or more. As the quality of coating in these areas is assessed, the frequency of the destructive tests will be adjusted to reflect that quality.
- .11 The *Contractor* shall prepare a steel plate prepared in the same manner as the substrate for each coating system and apply the specified coating systems during the work to act as a representative sample of the work being done. Each layer shall be masked off in order to show the subsequent layers of the coating system (prepared steel, primer, basecoat, mid-coat, etc.). The steel plate shall measure 12 inches x 12 inches x ¼ inch. The plate shall remain in the enclosure during the work and be provided to the *Contract Administrator* for adhesion testing.
- .12 The *Contractor* shall be responsible for the costs of repair.
- .13 The cost of Quality Assurance will be paid by the *Owner*, but where additional testing is required for re-inspection of non-conforming areas, the *Owner* reserves the right to pass this additional cost along to the *Contractor*.

1.10 MEASUREMENT AND PAYMENT

- .1 Measurement and payment for recoating of the bridge steel shall be a lump sum price and shall include the preparation, supply and installation of all elements required to provide a fully re-coated structure as per the requirements of this specification and the design drawings. Works shall include but not be limited to site preparations, scaffolding and containment requirements, cleaning of all surfaces, protection of utilities and other elements, recoating, quality control, cleanup, warranty elements and all other items required to provide a new bridge coating as required.
- .2 Measurement and payment for recoating of the 88.9 mm FORTIS gas line underneath the bridge shall be a lump sum price and shall include all elements included in 1.10.1 and other elements included in this specification required to prepare and fully recoat the line in the same process as the bridge.
- .3 Measurement and payment for the replacement of existing pipe rollers with *Owner* supplied rollers during the works shall be a lump sum price and include all coordination and labor necessary to replace 13 pipe rollers supporting the FORTIS gas line on the underside of the bridge. The roller and any materials shall be provided to the contractor by the *Owner*.

RECOATING OF STRUCTURAL STEEL

- .4 Measurement and payment for cleaning and galvanizing and treatment of the bridge posts and railings shall be a lump sum price and shall include the preparation, supply and installation of all elements required to provide a fully recoated railing and post system as per the requirements of this specification and the design drawings.

2.0 PRODUCTS

2.1 SUPPLY

- .1 The Contractor shall supply all materials to satisfactorily complete the work. Materials, particularly coatings and related material, shall be securely stored and kept within the storage temperatures published by the Manufacturers for those products.

2.2 BLAST MEDIA

- .1 Blast grit shall be free from contaminants, moisture and oils, greases and other materials that will interfere with the adhesion or longevity of the coating system to be applied.
- .2 Blast media additives if used, shall be approved by the *Contract Administrator* prior to use. Typically, this approval would require a letter from the Paint Manufacturer to the effect that the blast additive is compatible with their coating material at the concentration to be used and any additional conditions that may be required for the use of that additive.
- .3 The blast media chosen shall produce a sharp profile with the required depth, and leave a clean surface once blown-down.
- .4 Coating materials shall be applied and cured according to the current Manufacturer's product data sheets. If specified otherwise, herein, this specification shall be considered correct.

2.3 COATING MATERIALS TO BE USED

- .1 Table 1 lists the Manufacturer's coating systems that are acceptable for use on the 5th Street Bridge. No other systems will be accepted. The *Contractor* shall choose one system from the table listed below and this system shall be used exclusively on the bridge.

Table 1 Coating Systems

Manufacturer	Primer	Stripe Coat	Midcoat	Topcoat
Amercoat Canada	Amercoat 68HS	Amercoat 240	Amercoat 240	Amercoat 450H
Carboline	Carbozinc 859	Carboguard 825	Carboguard 825	Carbothane 133LH
Cloverdale Paint Inc.	Clovazinc 3 83003	Clovagard 83150	Clovagard 83150	Armourshield 839 Series
Cloverdale Paint Inc.	Clovazinc 7 83007	Clovagard 83150	Clovagard 83150	Armourshield 839 Series
AkzoNobel-Devoe	Cathacoat 315	Bar Rust 231	Bar Rust 231	Devthane 349

RECOATING OF STRUCTURAL STEEL

International Paint	Interzinc 315B	Intergard 475HS	Intergard 475HS	Interthane 870UHS
Sherwin Williams	Zinc Clad III HS	Macropoxy 646 Fast Cure	Macropoxy 646 Fast Cure	Acrolon 218 HS Polyurethane

- .2 Each layer of coating shall be tinted or coloured to differentiate it from the layers above and/or below. Each application of paint; primer, penetrating sealer, stripe coat, midcoat and/or topcoat is considered a separate layer of coating for this specification.
- .3 The *Contractor* shall submit a color palette to the *Owner* for review and confirmation of all coating colors.
- .4 The use of "quick cure" components for faster curing is not permitted.
- .5 Topcoat colour on both the top hand rails, hand rail posts and the underdeck coating colour shall be Federal Spec 595B - #36176 Dark Gull Grey or approved equal. Pigment shall be ground-in rather than tinted. The topcoat shall have a gloss finish.
- .6 Horizontal hand rails (excluding top hand rail) shall be galvanized (unpainted)
- .7 Coating materials shall be delivered to site in sealed, original, labeled containers, bearing the Manufacturer's name, type of paint, brand name, colour designation, batch number and instructions for mixing, thinning, and curing. Each batch of coating shall be accompanied by product/application data sheets, and MSDS.
- .8 Epoxy patch material for corroded steel shall be compatible with coating system.
- .9 Submit large scale (3'x3') paint mock-ups of colour and two equivalent grey colours for review and final approval by *Contract Administrator*. A minimum of 6 weeks prior to commencing any recoating work.

3.0 EXECUTION

3.1 GENERAL

- .1 NOTE: This structure contains lead paint.
- .2 The current project involves recoating the entire structure after removing the existing paint. The recoating will include a stripe coat after the primer is cured and before the midcoat is applied for a total of four coats of paint.
- .3 Note that part of the structural rehabilitation involves installing a cathodic protection system. Painting works shall work in cooperation with cathodic protection works, so as not to impede or damage the other work.
- .4 Each application of paint; primer, penetrating sealer, stripe coat, midcoat and/or topcoat is considered a separate layer of coating for this specification.
- .5 The work shall be completed in accordance with these specifications and the coating manufacturers requirements. In the case of a discrepancy the more stringent requirement shall apply.

3.2 GOOD PAINTING PRACTICE

- .1 All paint works shall use the principles in SSPC-PA COM Commentary on Paint Application and SSPC-PA 1 Shop, Field and Maintenance Painting of Steel to establish methodology and measure acceptable performance.

RECOATING OF STRUCTURAL STEEL

- .2 Where this specification contradicts the above methodology, this specification shall be considered correct.

3.3 ACCEPTANCE OF PAINT WORKS

- .1 The following defects will be cause for rejection.
- .1 Under or over thickness as judged by SSPC PA2 level 3.
 - .2 Runs, sags, holidays or shadowing.
 - .3 Evidence of poor coverage at bolts, plate edges, lap joints, crevices, pockets, corners and re-entrant angles.
 - .4 Surfaces which have been struck, scraped, spotted by rain or otherwise damaged.
 - .5 Surfaces which exhibit an objectionable texture such as orange peel, mud cracking, fish eyes or uneven gloss.
 - .6 Surfaces damaged by over spray.
 - .7 Other defects that will in the judgment of the *Contract Administrator* reduce the effectiveness or longevity of the coating system.

3.4 REPAIR OF SUBSTANDARD COATING WORKS

- .1 Once a repair is indicated, the *Contractor* shall propose a remediation for the area in question that will bring the area into specification compliance. The *Contract Administrator* will unilaterally decide if the proposed repair is adequate or not. The *Contractor* shall carry out the repairs at his own expense.

3.5 INCIDENTAL BLAST DAMAGE

- .1 Parts of the structure not to be coated or already coated shall be protected from over blast. Where unintended blasting causes damage, the *Contractor* shall repair these areas as per Section 2.4 above. These damaged areas are not included in the provisional area. The *Contractor* shall repair these areas at his expense.

3.6 GENERAL STEEL

- .1 Description
- .1 This specification includes all bridge structural steel. It does not include railings, railing posts or utilities mounted under the bridge.
- .2 General Information
- .1 The bridge coating to be removed shall be washed to remove chlorides, cleaned to bare metal with abrasive blasting, and coated with the three-coat system.
- .3 Washing
- .1 This area shall be washed to SSPC-SP WJ-4/NACE WJ-4, using LP WC to produce a surface that meets NV-2 levels for chloride contaminants.
- .4 Cleaning
- .1 This surface shall be abrasive blast cleaned to SSPC-SP 6/NACE No.3, Commercial Blast Cleaning. Surface profile shall be 35 to 65 μm (1.5-2.5 mils)

RECOATING OF STRUCTURAL STEEL

- and sharp. Pack rusted areas shall be cleaned at least 10mm into the packed crevice.
- .5 Coating
- .1 Prior to coating, repair corrosion damage to ends of the structural steel beams as shown on the drawings. Repair Epoxy shall be compatible with coating system.
- .2 Immediately prior to coating, the surface shall meet the washing and cleaning criteria outlined above.
- .3 Surface shall be coated with primer and cured according to Manufacturer's Product Data Sheet (PDS) instructions. Thickness shall be within the Manufacture's range as measured by SSPC-PA 2, Restriction Level 3.
- .4 After curing, pack rusted areas shall be treated with thinned Midcoat material.
- .5 After curing, a stripe coat shall be brushed-in to all sharp edges, bolts, threads, rivets, laps, seams and joins. The stripe coat shall lap the area to be coated by a minimum 25 mm. Stripe coat materials may be applied by spray, but must be brushed in. The stripe coat shall be the midcoat material applied at and cured as per Manufacturer's instructions.
- .6 After curing, a midcoat shall be applied and cured as per Manufacturer's Product Data Sheet instructions. Thickness shall be within the Manufacture's range as measured by SSPC-PA 2, Restriction Level 3.
- .7 After curing a topcoat shall be applied as per Manufacturer's Product Data Sheet instructions. Thickness shall be within the Manufacturer PDS range as measured by SSPC-PA 2, Restriction Level 3.
- .8 Each layer of coating shall be tinted or coloured to differentiate it from the layers above and/or below. Each application of paint; primer, penetrating sealer, stripe coat, midcoat and/or topcoat is considered a separate layer of coating for this specification.
- .6 Lapping Existing Paint
- .1 When lapping the existing coating, the existing coating shall be feathered, then the zinc primer shall be applied up to the existing coating, then the midcoat shall be applied to lap the existing coating by 25 to 50 mm and the topcoat shall be applied to lap the midcoat a further 25 to 50 mm.

3.7 RECOATING OF UTILTES

- .1 The 88.9 mm Steel FORTIS gas line shall be recoated as per Section 3.6.4 to 3.6.8
- .2 Pipe hangers shall be adjusted to allow for recoating of the steel under the hangers.
- .3 During the works new pipe rollers shall be installed by the contractor. The pipe rollers will be supplied by the *Owner* and installed by the *Contractor*.
- .4 The adjustment of the pipe hangers and replacement of the rollers will require pipe support. Any piping support shall be reviewed by the *Contract Administrator* prior to installation.

RECOATING OF STRUCTURAL STEEL

3.8 HOT DIP GALVANIZED BRACING UNDERDECK

- .1 Description
 - .1 The diagonal bracing underdeck that is hot dip galvanized does not need a primer coat. Rather it shall be washed, stripe coated with midcoat material, then midcoated, and then topcoated.
- .2 Washing
 - .1 The HDG bracing shall be washed to SSPC-SP WJ-4/NACE WJ-4, using LP WC to produce a surface that meets NV-2 levels for chloride contaminants.
- .3 Cleaning
 - .1 This surface shall be abrasive blast cleaned to SSPC SP16, leaving a 1.0 to 2.5 mil profile.
- .4 Coating
 - .1 Immediately prior to coating, the surface shall meet the washing and cleaning criteria outlined above.
 - .2 Surface shall be stripe coated.
 - .3 After curing the surface shall be coated with midcoat material to the Manufacturer's recommendations and cured according to Manufacturer's Product Data Sheet (PDS) instructions. Thickness shall be within the Manufacturer's range as measured by SSPC-PA 2, Restriction Level 3.
 - .4 After curing a topcoat shall be applied as per Manufacturer's Product Data Sheet instructions. Thickness shall be within the Manufacturer PDS range as measured by SSPC-PA 2, Restriction Level 3.
 - .5 Each layer of coating shall be tinted or coloured to differentiate it from the layers above and/or below.
- .5 Payment
 - .1 Payment shall be at the Recoating lump sum price for that area.

3.9 RAILINGS – REMOVE AND GALVANIZE

- .1 Description
 - .1 This section includes the two railings either side of the sidewalk on the bridge. The railings shall be removed and cleaned off site in a shop prior to hot dip galvanizing.
- .2 Washing
 - .1 The existing removable railing sections are currently coated. They shall be washed to SSPC-SP WJ-4/NACE WJ-4, using LP WC to produce a surface that meets NV-2 levels for chloride contaminants.
- .3 Cleaning
 - .1 The coating shall be removed by abrasive blasting to SSPC SP6, then the steel processed through the hot dip galvanizing pre-cleaning steps prior to hot dip galvanizing.
- .4 Galvanizing
 - .1 Immediately prior to coating, the surface shall meet the washing and cleaning criteria outlined above.
 - .2 Each removable railing section shall be hot dip galvanized to meet ASTM A123/A 123M.

RECOATING OF STRUCTURAL STEEL

- .5 Payment
 - .1 Payment shall be at the Handrail Hot Dip Galvanizing lump sum price.

3.10 POSTS – METALLIZE IN PLACE

- .1 Description
 - .1 This section includes the posts between the railing sections on either side of the sidewalk on the bridge. Posts shall remain in place.
- .2 Washing
 - .1 The existing removable railing sections are currently coated. They shall be washed to SSPC-SP WJ-4/NACE WJ-4, using LP WC to produce a surface that meets NV-2 levels for chloride contaminants.
- .3 Cleaning
 - .1 The coating shall be removed by abrasive blasting to SSPC SP5, leaving a 1.5 to 2.5 mil profile.
- .4 Metallizing
 - .1 Immediately prior to metallizing, the surface shall meet the washing and cleaning criteria outlined above.
 - .2 Plasma arc metallizing shall be applied to a thickness of 10-12 mils. Metallizing alloy shall be Zn:Al::85:15. Metallizing shall be applied as per SSPC-PA 18.
- .5 Coating
 - .1 Posts shall then be coated with a coat of midcoat material thinned to allow filling of voids in the metallizing.
 - .2 After curing the post shall be stripe coated, cured, followed by a full coat of midcoat. Then, after curing, a coat of topcoat applied as per Manufacturer PDS instructions.
 - .3 Thickness shall be within the Manufacture's range as measured by SSPC-PA 2, Restriction Level 3.
- .5 Payment
 - .1 Payment shall be at the Railing Post Treatment lump sum price.

3.11 SITE CLEAN-UP AND DISPOSAL OF WASTE MATERIALS

- .1 Site Condition
 - .1 The *Contractor* shall leave the bridge site and the surrounding environment in the same condition as it was before the coating rehabilitation prior to final payment.
- .2 Waste Materials
 - .1 Waste materials, including, but not limited to special waste or lead containing waste shall be disposed of in an environmentally acceptable manner, approved by the regulatory bodies involved. The *Contractor* shall dispose of waste materials, document the disposal according to regulations and provide written proof of correct disposal to the *Owner* prior to Total Completion.

RECOATING OF STRUCTURAL STEEL

4.0 WARRANTY

4.1 WARRANTY

.1 The Coating Manufacturer, the General Contractor and the Painting Contractor shall jointly warrant the coating and its application against all defects in material and workmanship for a period of five years. The warranty period will commence on the date of the final acceptance of the completed painting contract.

.2 Agreement

.1 The Contractor and the Manufacturer shall jointly execute the form entitled, Agreement to Provide a 5 Year Bridge Painting Warranty, enclosed in Appendix A. The completed form shall be provided, prior to award of contract.

.3 Inspection of Coating Prior to Expiry of Warranty

.1 During the warranty period the Owner will inspect the coating system, at least sixty days prior to warranty expiration, and will advise the Contractor(s), the Manufacturer, and the Surety in writing of any defects or repairs that are required. Intermediate inspections may be made, and warranty repairs claimed and completed by the Contractor each year of the 5-year warranty period.

.4 Definition of Failure

.1 Failure of the coating system shall include but not be limited to: Any de-bonding or failure of adhesion of the coating either to the structural steel or lack of inter-coat adhesion; the appearance of any rust stains on the structure due to loss of paint or due to leaking from joints between structural members; excessive chalking, any loss of normal gloss or rapid change of colour of the coating, blistering or undercutting. Damage to the coating due to vehicle impact or snow removal equipment will not constitute failure of the system.

.2 In addition, the following defects shall be less than the respective values in the table below for each of the first 5 years:

Table 3 Condition Table	Year				
	1	2	3	4	5
Coating Defects ASTM D-610/SSPC Vis2	<9	<9	<8	<8	<8
Corrosion ASTM D-610/SSPC Vis2	<9	<9	<9	<8	<7
Gloss Loss Percent from original measurement	<5	<5	<10	<15	<20
Colour Change ΔE from original measurement	<3	<3	<5	<6	<7

.3 The defects listed in the table above are to be evaluated using the methodology below:

.4 Warranty Coating Defects

.1 Coating defects shall include disbondment or loss of adhesion, blistering, undercutting, checking and cracking and excess wear. Areas of sags/runs or over thickness shall not be considered defects unless they result in the coating defects mentioned immediately above.

RECOATING OF STRUCTURAL STEEL

- .2 Where there are localized defects they shall be repaired. Where the defects are more spread-out and uniform, then the general area for averaging shall be 3 x 3 metres (10 x 10 feet). Should that area not be practical, then the *Contractor* and the *Contract Administrator* shall decide on a practical way to measure the defects. Those areas shall be judged against the ASTM D610/SSPC VIS 2 standards.
- .5 Corrosion
- .1 Corrosion defects typically occur after the coating is damaged. It is evidenced by such things as staining, rusting, undercutting, delamination, blistering and scaling. All this is to do with loss of steel, as opposed to actual coating damage.
- .2 Where there is localized corrosion it shall be repaired. Where the defects are more spread-out and uniform, then the general area for averaging shall be 3 x 3 metres (10 x 10 feet). Should that area not be practical, then the *Contractor* and the *Contract Administrator* shall decide on a practical way to measure the defects. Those areas shall be judged against the ASTM D610/SSPC VIS 2 standards.
- .6 Gloss
- .1 Gloss shall be 60-degree specular gloss measured according to ASTM D523-14. Area to be measured shall be marked at the initial measurement and shall be south facing and fully exposed to sunlight. For example, a loss of gloss from an initial 95% to 75% is considered a 20% loss of gloss.
- .2 Cleaning of dirt prior to measurement shall be done with water, detergent, and a soft brush to remove dirt. Area shall be washed, rinsed, and allowed to dry prior to measurement. An average of 10 representative measurements shall be taken over the cleaned surface initially after coating, then at the yearly intervals in Table 1.
- .3 Other areas on the structure showing increased loss of gloss may also be measured and compared to the initial readings as necessary.
- .7 Colour Change
- .1 Colour Change: Colour change shall be measured according to ASTM D2244-16, except that the colour difference ΔE shall be calculated from CIE 1976 L^* , a^* , and b^* D_{65} 45/0 geometry.
- .2 Colour difference is calculated as the square root of the sum of the squares of each value. i.e.

$$\Delta E = \sqrt{L^{*2} + a^{*2} + b^{*2}}$$

- .3 Cleaning of dirt prior to measurement shall be done with water, detergent, and a soft brush to remove the dirt. Area shall be washed, rinsed and allowed to dry prior to measurement. An average of 10 representative measurements shall be taken over the cleaned surface initially after coating, then at the yearly intervals in Table 3. Other areas on the structure showing increased colour change may also be measured and compared to the initial readings as necessary.

RECOATING OF STRUCTURAL STEEL

4.2 REMEDIAL WORK UNDER WARRANTY

- .1 Repair
 - .1 Repair under warranty includes the cost to supply material, labour, and equipment necessary to restore the coating to acceptable condition as judged by the *Owner*. Acceptability of repair is the unilateral decision of the *Contract Administrator*.
- .2 Time Limit for Completion of Repairs
 - .1 Warranty repairs shall be completed within 45 days of notification, or if this would place the repair work in winter weather conditions, by May 30 of the following year.

END OF SECTION

Fifth Street Bridge
Courtenay, BC

AGREEMENT TO PROVIDE A 5-YEAR BRIDGE PAINTING WARRANTY

(Name of Paint Manufacturer)
manufacturer of

(Paint System Component Names)
And

(Contractor/Applicator/Company Name)

who is an approved paint Applicator of the paint system, hereby certify that in the event that the Contractor is awarded the painting contract for

(Contract Number)

(Bridge File Number and Name)

the undersigned parties jointly agree to provide a 5-year warranty for the work. Warranty period will commence at the completion of the work. The Warranty shall include all repair costs needed within the 5-year period.

MANUFACTURER:

(Name of Company Officer) (Corporate Position) (Signature of Company Officer)

(Name of Witness) (Signature of Witness) (Date)

CONTRACTOR/APPLICATOR:

(Name of Company Officer) (Corporate Position) (Signature of Company Officer)

FLOOR BEAM REPAIRS

1.0 GENERAL

1.1 Summary

- 1.1.1 This references work required to repair the bridge floor beams resulting from section loss due to corrosion and the installation of steel shrouds over the openings above the floor beam ends.

1.2 Measurement and Payment

- 1.2.1 The payment for beam section loss repairs shall be paid on a unit rate basis for each floor beam end requiring rehabilitation. Payment shall include all preparation, products and works necessary to carry out the rehabilitation of the floor beam sections including, but not limited to, removing existing corrosion, documentation of section losses, filling of corroded areas and installing shrouds on the openings above the floor beam ends.

2.0 PRODUCTS

- 2.1 As per Detailed Design Drawings

3.0 INSTALLATION

- 3.1 As per Detailed Design Drawings

END OF SECTION

COMMON WORK RESULTS

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Revision History

Rev. No.	Date	Description of Revisions	Prep. By	Rev. By
-	November 12, 2020	Issued for Tender	MS	IN

COMMON WORK RESULTS

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.

1.1 RELATED SECTIONS

- .1 Technical Specification 26 05 00 Certifications Page for Technical Specifications
- .2 Technical Specification 26 05 02 Seismic Restraint
- .3 Technical Specification 26 05 10 Testing and Commissioning
- .4 Technical Specification 26 05 20 Wire and Box Connectors (0-1000V)
- .5 Technical Specification 26 05 21 Wires and Cables (0-1000V)
- .6 Technical Specification 26 05 28 Grounding - Secondary
- .7 Technical Specification 26 05 29 Hangers and Supports for Electrical Systems
- .8 Technical Specification 26 05 31 Splitters, Junction, Pull Boxes and Cabinets
- .9 Technical Specification 26 05 32 Outlet Boxes, Conduit Boxes and Fittings
- .10 Technical Specification 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings
- .11 Technical Specification 26 05 43 01 Installation of Cables in Trenches and in Ducts
- .12 Technical Specification 26 24 01 Service Equipment
- .13 Technical Specification 26 24 16 01 Panelboards Breaker Type
- .14 Technical Specification 26 27 15 Electrical and Controls Components
- .15 Technical Specification 26 27 16 Electrical Cabinets and Enclosures
- .16 Technical Specification 26 27 26 Wiring Devices
- .17 Technical Specification 26 28 16 02 Molded Case Circuit Breakers
- .18 Technical Specification 26 54 00 Heaters and Ventilation

1.2 REGULATORY REQUIREMENTS

- .1 Definitions:

COMMON WORK RESULTS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in this Technical Specification, and on Contract Drawings, are those defined by IEEE SP1122.
- .2 Reference Standards:
 - .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.
 - .2 CSA C22.2 No. 1-10, General Requirements - Canadian Electrical Code, Part 2.
 - .3 CAN3-C235-83, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
 - .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).

1.3 TECHNICAL SPECIFICATION INCLUDES

- .1 This Technical Specification covers items common to the Divisions 26 Technical Specifications. This Technical Specification supplements requirements of Division 1.
- .2 This Technical Specification 26 05 00 refers to those portions of the Work that are unique to the supply and installation of all electrical, control, and instrumentation and related appurtenances. This Technical Specification must be referred to and interpreted simultaneously with all other Technical Specifications pertinent to the works described herein.

1.4 SCOPE

- .1 This project involves the construction of a cathodic protection system for the 5th Street Bridge in Courtenay British Columbia.
- .2 The electrical scope of the cathodic protection system includes, but is not limited to, the following items of work:

COMMON WORK RESULTS

- .1 Coordination with BC Hydro for removal of existing Leased Light BC Hydro Service and supply and installation of new BC Hydro 120/240V 1 phase 100A service, including service disconnect and meter socket.
 - .1 BC Hydro will remove and replace conduit and existing service junction box and stub out conduit for contractor to connect to. BC Hydro will provide all conductors from utility pole to utility meter. Contractor shall supply and install conduit between stub out from new service junction box and kiosk.
 - .2 Coordinate with City of Courtenay staff to transfer leased light equipment to new BC Hydro service once new BC Hydro service established.
- .2 Supply and installation of concrete pads for electrical kiosk including gaskets between pad and enclosure. Refer to Contract Drawings for foundation details.
- .3 Supply and installation of electrical kiosk equipped with electrical controls and power distribution equipment.
- .4 Supply and installation of cathodic protection rectifiers, net mesh anodes, strip anodes, ribbon anodes and reference electrodes. Coordinate scope with other trades. Refer to Contract Drawings.
- .5 Remove existing under bridge lighting service panel. Install 300mm x 300mm lockable RPVC junction box with removable cover. Splice new circuit feeders to existing field wiring.
- .6 Install two new GFCI weatherproof receptacles beside new junction box to replace cord ends from existing lighting service panel.
- .7 Trenching and backfilling for underground electrical duct work.
- .8 Supply and installation of underground electrical conduits.
- .9 Supply and installation of electrical grounding systems.
- .10 Provide testing and commissioning of the electrical services and systems provided under the Contract Documents.
- .11 Provide site commissioning services.
- .12 Provide electrical assistance during the commissioning of the cathodic protection system.

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- .13 Provide programming and testing services for miscellaneous items including data loggers and other configurable components.
- .14 Provide all permits, licenses and fees required by applicable Governmental Authorities having jurisdiction.
- .15 All work described herein shall be performed by qualified personnel.
- .16 Preparation of operations and maintenance manuals.
- .17 Provision of training for the operation and maintenance teams.

1.5 MATERIALS SUPPLIED BY OTHERS

- .1 Not used.

1.6 REMOVAL OF REDUNDANT MATERIAL AND EQUIPMENT

- .1 Modification of existing lighting service panel / junction box. Refer to Contract Drawings.

1.7 DEFINITIONS

- .1 The word 'Install' means the Supply, delivery, and installation of device or equipment referenced to the level required to be complete and operational including unloading, unpacking, assembling, erecting, applying, finishing, protecting, and cleaning.
- .2 The word 'Supply' means to obtain and deliver to the Site, ready for unpacking, assembly, and installation.
- .3 AHJ: Governmental Authority having jurisdiction.

1.8 DRAWINGS, MEASUREMENTS, AND NOTATIONS

- .1 Contract Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work.
- .2 The Contract Drawings show approximate locations of equipment and apparatus, but the right is reserved to make such changes in location before installation or performance of the work as may be necessary to meet the exigencies of construction in any way. No extra will be allowed and conversely, no credit shall be expected for such changes unless for each item of work the distance moved exceeds 3m prior to final installation of same.

COMMON WORK RESULTS

- .3 Take field measurements where equipment and material dimensions are dependent upon building dimensions.
- .4 The Contractor shall supply and install all electrical equipment. Standard notations are used on the Contract Drawings to assist the Contractor in identifying what work needs to be done. These standard notations are defined as follows:
 - .1 “All equipment is proposed unless noted otherwise” – This notation is used on Contract Drawings where the majority of the equipment on the drawing is to be supplied and installed by the Contractor. The notation means that the Contractor shall perform all work shown on the Contract Drawing except for equipment shown as existing (i.e. to remain).
 - .2 “All equipment is existing unless noted otherwise”: - This notation is used on Contract Drawings where the majority of the equipment is existing. The notation means that the Contractor shall perform only the Work identified on the Contract Drawings.

1.9 RESPONSIBILITY AND COORDINATION

- .1 Provide all labour, materials, equipment, tools, and incidentals necessary to provide a complete electrical installation as indicated on the Contract Drawings and as set out in these Technical Specifications.
- .2 Without relieving the Contractor of his responsibilities, the Technical Specifications have been divided into approximate trade sections for convenience. The use of these sections do not, however, limit the responsibility of the Contractor or any Subcontractor or Supplier. The onus of defining the extent of the Subcontractors' work remains with the Contractor, who, when awarding subcontracts, will ensure that the area of responsibility of any particular Subcontractor is set out in full detail.
- .3 The Contractor shall advise the Contract Administrator of any specified material or equipment which is either no longer available from manufacturers or whose delivery is likely to exceed the requirements of the anticipated Work Schedule. Failure of the Contractor to perform the above shall cause the Contractor to supply, at his own expense, alternate material or equipment as selected by the Contract Administrator at a later date. Alternatively, the Contractor shall procure the specified material or equipment at his own additional expense by means of air freight or other special means of transportation.

COMMON WORK RESULTS

- .4 Advise the Contract Administrator of any specified equipment, material, or installation of same which appears inadequate or unsuitable or which is in violation of Laws, ordinances, rules, or regulations of Governmental Authorities having jurisdiction. Provide all labour and materials which are obviously necessary or reasonably implied to be necessary to complete the work as if the work was shown on the Drawings and/or described in the Specifications.
- .5 Check drawings of all trades and coordinate the installation of all material and equipment to ensure adequate space and free access and to maintain headroom limitations for all proposed and indicated future work. Work out jointly, with all Subcontractors on the Site, solutions to interference problems. Coordinate all work before fabricating or installing any material or equipment. It is incumbent on all Subcontractors on the Site to ensure that all materials and equipment fit into the allocated spaces and that all equipment can be properly inspected, serviced, and replaced if and when required. Advise the Contract Administrator of space problems before fabricating or installing any material or equipment. Demonstrate to the Contract Administrator on completion of its work that all equipment and material installed by the Contractor can be properly and safely serviced and replaced. Make no deviations from the intent of the design, or any involving additional cost, without the Contract Administrator's written direction.
- .6 Ensure that any building structure loaded during the installation is adequate to carry such load.
- .7 Testing in accordance with Technical Specification 26 05 10 Testing and Commissioning.
- .8 A contractor is entitled to engage in the regulated work for which the contractor is licensed.
 - .1 A licensed contractor must not:
 - .1 Manage or do regulated work that is:
 - .1 Outside the scope of the license,
 - .2 Contrary to any term or condition of the license, or
 - .3 Contrary to any term or condition imposed by the regulations on the use of the license, or
 - .2 Permit regulated work to be undertaken by persons under the control of the licensed contractor if they are not authorized.
 - .2 A licensed contractor must:

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- .1 Maintain current knowledge of the Applicable Laws, relevant regulations, relevant directives, relevant safety orders and any other relevant material that the minister makes publicly available, and
- .2 Ensure that individuals who do regulated work for the licensed contractor maintain similar current knowledge.

1.10 PERMITS, FEES, AND INSPECTIONS

- .1 Before commencing work obtain and pay for all necessary approvals and permits. The Contract Administrator shall provide any documents required by the Authority Having Jurisdiction to obtain such permits.
- .2 Arrange for inspection of the work at rough-in completion, prior to Substantial Completion, and as otherwise required by all applicable Authorities Having Jurisdiction.
 - .1 Notify Contract Administrator of any changes required by the Authorities Having Jurisdiction prior to proceeding with changes.
- .3 Provide Contract Administrator with a certificate of unconditional approval for all electrical work from the appropriate Authorities Having Jurisdiction. Final payment to the Contractor shall not be made prior to submission of the inspection certificate.

1.11 EVALUATION OF CONTRACT CHANGES

- .1 In accordance with Division 1 specifications.

1.12 MEASUREMENT AND PAYMENT

- .1 Measurement and payment for electrical works shall be on a lump sum basis and include power supply works, BC Hydro connection requirements, control kiosk, wiring and junctions boxes, site grounding, new lighting service panel, underground infrastructure including conduits and wiring, kiosk foundation and site works and all other elements noted on the electrical plans and specifications required to provide a fully commissioned electrical system for the project. The lump sum costs shall include all materials and labour required to undertake the works unless specified under separate clauses.

1.13 REVIEW OF WORK

- .1 In accordance with Division 1 specifications.

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1.14 SCHEDULING OF WORK

- .1 Work shall be scheduled as required to coordinate with other Divisions and Owner's work restrictions.

1.15 ACTION AND INFORMATIONAL SUBMITTALS

- .1 In accordance with Division 1 specifications.

1.16 SHOP DRAWINGS

- .1 Submit Shop Drawings to the Contract Administrator in accordance with Division 1 Technical Specifications. Provide shop drawings in electronic format, Adobe Acrobat "pdf." The Shop Drawing will be retained by the Contract Administrator for their office use and a copy will be marked and returned to the Contractor for correction if necessary, further reproduction, and distribution as required.
- .2 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.
- .3 Where specifically noted in other Technical Specifications in Division 26, submit drawings stamped and signed by Professional Engineer registered or licensed in British Columbia, Canada.
- .4 Contractor shall review all Shop Drawings prior to submittal. All Shop Drawings shall be stamped and signed by the electrical Subcontractor engaged by the Contractor. Unstamped drawings will be marked "re-submit" (R3) without comment.
- .5 All Shop Drawings shall use metric dimensions. Scaled drawings shall use metric scale.
- .6 Each Shop Drawing shall clearly indicate the equipment ID and equipment type (e.g. Luminaire Type 'A', Panelboard SD-A) where applicable.

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- .7 Where manufactures' brochures that include multiple equipment or device models are submitted, they shall be clearly labelled with the equipment model and options to be supplied. Submit relevant sections of manufacturer's catalogues only. Submissions of complete catalogues will be rejected.
- .8 Submit wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to ensure co-ordinated installation.
- .9 Identify on wiring diagrams circuit terminals and indicate internal wiring for each item of equipment and interconnection between each item of equipment.
- .10 Indicate on Shop Drawings clearance requirements for: operation, maintenance, and replacement of operating equipment devices.
- .11 Submit complete Shop Drawing packages for each system. Partial submissions will be returned without comment.
- .12 Review of Shop Drawings by the Contract Administrator is for the sole purpose of ascertaining conformance with the general design intent. The review shall not mean approval of the detail design inherent in the Shop Drawings, responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of its responsibility for errors or omissions in the Shop Drawings or of its responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction and installation and for coordination of the work of all sub-trades.
- .13 Ensure that copies of all accepted Shop Drawings are available at the job site.

1.17 CLOSEOUT SUBMITTALS

- .1 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .2 Operation and Maintenance Manuals:
 - .1 Provide draft version of Operations and Maintenance Manual to Contract Administrator two weeks prior to Substantial Performance Review.
- .3 Upon completion of all electrical, control, and instrumentation work, submit Record Drawings, including all as-built information and changes.

1.18 AS-BUILT DOCUMENTS AND SAMPLES

COMMON WORK RESULTS

- .1 Maintain at Site for Contract Administrator one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction in secure location.
- .3 Label record documents and file in accordance with section number listings in list of contents of this project manual.
- .4 Maintain as-built and record documents in clean, dry and legible condition.
 - .1
- .5 Keep record documents and samples available for inspection by Contract Administrator.
- .6 Obtain and pay for three sets of white prints. As the project progresses, mark these prints to accurately indicate installed work. Have the white prints available for inspection at the Site at all times and present for scrutiny at each project meeting.
- .7 Show on the as-built drawings the installed inverts of all services entering and leaving the building and the property. Dimension underground services at key points of every run in relation to the structure and building.
- .8 Indicate exact location of all services for future work. Show and dimension all work embedded in the structure.
- .9 Maintain in the site office in up-to-date condition, one (1) complete set of whiteprints of each of the electrical Contract Drawings and one (1) set of Technical Specifications, including revisions to the Contract Drawings, marked clearly and indelibly in red, indicating as-built conditions where such conditions deviate from the original directions of the Contract Documents, and indicating final installation of feeders and branch circuits.
- .10 "As-Built" markings shall include the following:

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- .1 All changes in circuiting.
- .2 Size and routing of all conduits for branch circuits including power, lighting, and systems. Note that branch circuit wiring is generally not shown on Contract Drawings. Accurately record on "As-Built" drawings the size and routing of all installed raceways and cables.
- .3 Number and size of conductors in raceways and cables
- .4 Location of all junction and pull boxes
- .5 Location of all access panels
- .6 Location of all conduit or duct stubs, installed equipment, devices, and fixtures
- .7 All changes to electrical installation resulting from Addenda, Change Orders, and Field Instructions (Architectural / Engineering Instructions)
- .8 Exact location of all services left for future work
- .9 Location by accurate horizontal and vertical dimensions of the routes and terminations of all raceways and cables installed underground beyond the building.
- .10 Exact labeling of each communication system cable at each data outlet location. Locate label numbers adjacent each communication outlet indicated on Contract Drawings. Label numbers to match those at the communication room cable end.
- .11 Where extensive changes have been made to an area to the point where it is not practical to update the original Contract Drawing, the area in question shall be enclosed with a heavy dotted line and reference made to the applicable Change Order, Instruction, and/or associated Revision Drawing.
- .12 For each and every "As-Built" drawing, reference shall be neatly drawn inside the framed space above the title block, listing all Contemplated Change Orders, Instructions, and Revision Drawing Numbers applicable to the particular "As-Built" drawing in question.
- .13 Each "As-Built" drawing as defined above shall bear the Contractor's identification and signature, the date of record, and the notation: "We hereby certify that these drawings represent the work as built."

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- .14 All Addenda and Revision Drawings not having their details transferred onto the submitted "As-Built" drawings shall be included in the submission using the same drawing format as previously described.
- .11 Recording Information on Project Record Documents.
 - .1 Record information on set of Contract Drawings.
 - .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
 - .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
 - .4 Contract Drawings and Shop Drawings: mark each item to record actual construction, including:
 - .1 Changes made by Change Orders.
 - .2 Details not on original Contract Drawings.
 - .3 References to related Shop Drawings and modifications.
 - .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and Change Orders.
 - .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, as required by Technical Specifications.
 - .7 Provide digital photos, if requested, for site records.

1.19 OPERATION AND MAINTENANCE MANUAL

- .1 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 Contract Administrator's comments.
 - .3 Revise content of documents as required prior to final submittal.

COMMON WORK RESULTS

- .4 As a condition of Substantial Completion submit to the Contract Administrator, four final copies of operating and maintenance manuals in English.
 - .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
 - .6 If requested, furnish evidence as to type, source and quality of products provided.
 - .7 Defective products will be rejected, regardless of previous inspections. The Contractor shall replace products at their own expense, with no increase to the Contract Price.
 - .8 Pay costs of transportation.
- .2 Format
- .1 Organize data in the form of an instructional manual.
 - .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
 - .3 When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.
 - .4 Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
 - .5 Arrange content by systems under Technical Specification 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.
- .3 Contents – Each Volume:
- .1 Table of Contents: provide title of Project;
 - .1 Date of submission; names,

COMMON WORK RESULTS

- .2 Addresses, and telephone numbers of Engineer and Contractor with name of responsible parties;
- .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of Subcontractors and Suppliers, including local source of supplies and replacement parts.
- .3 Product Data
 - .1 Mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings
 - .1 Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text
 - .1 As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- .6 Guarantees, Warrantees and Bonds
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List Subcontractor, Supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by Subcontractors, Suppliers, and manufacturers, within ten days after completion of the applicable item of work.
 - .4 Except for items put into use with Owner's permission, leave the date of when the warranty begins blank until the Substantial Completion Date is determined. The beginning date of the warranty will then be updated to state the Substantial Completion Date.

COMMON WORK RESULTS

- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .7 Equipment and Systems:
 - .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
 - .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
 - .3 Include installed colour coded wiring diagrams.
 - .4 Operating Procedures: include start up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - .5 Maintenance Requirements: include routine procedures and guide for trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - .6 Provide servicing and lubrication schedule, and list of lubricants required.
 - .7 Include manufacturer's printed operation and maintenance instructions.
 - .8 Include sequence of operation by controls manufacturer.
 - .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
 - .10 Provide installed control diagrams by controls manufacturer.
 - .11 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
 - .12 Additional requirements: As specified in the Contract Documents.

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1.20 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to Site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .1 Except for equipment intended for installation outdoors, store equipment indoors in dry location.
 - .2 Store and protect equipment and materials from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .3 Packaging Waste Management: remove and dispose of all packaging waste materials.
 - .1 Where possible, return packaging materials to supplier for re-use.
 - .2 Divert all recyclable materials from landfill.

1.21 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with the Contract and the Division 01 Technical Specifications.
- .2 Qualifications: electrical work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license or apprentices in accordance with authorities having jurisdiction as per the conditions of Electrical Safety Regulation within the Electrical Safety Act and the Building Code and By-Laws.
 - .1 Employees registered in provincial apprentices' program: permitted, under direct supervision of qualified licensed electrician, to perform installation tasks.
 - .2 Submit list showing names and qualifications of key supervisory personnel.

1.22 SAFETY AND PRECAUTION

- .1 Safety practices shall include the following requirements:
 - .1 Compliance with safety requirements provided in the Contract Documents

COMMON WORK RESULTS

- .2 Workers' Compensation Board Regulations
 - .3 Municipal By-Laws
 - .4 Canadian Electrical Code
 - .5 Electrical Safety Act of BC
 - .6 Municipal, Provincial and Canadian Building Code
- .2 Tests shall be performed with apparatus de-energized unless otherwise specified (e.g., rotation, phasing).
 - .3 Power circuits shall have conductors shorted to ground by an approved hotline grounded device.
 - .4 In all cases, work shall not proceed until the Contractor's safety representative has determined that it is safe to do so.
 - .5 The Contractor shall have sufficient protective barriers and warning signs available, where necessary, to conduct specified tests safely.
 - .6 The Project safety procedures shall be reviewed and accepted by the Contractor and all sub-trades.

1.23 CARE, OPERATION, AND START-UP

- .1 Instruct Contract Administrator and operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.

1.24 APPROVALS

- .1 Without limiting or restricting the contents of the Contract Documents, requests for approval of the substitution of materials pertaining to electrical work must be submitted to the Contract Administrator and the Owner in accordance with the Review Procedure.
- .2 All submissions shall include the following information:
 - .1 Name and identification of specified item.
 - .2 Manufacturer, brand name, and catalogue number of the alternative item proposed.

COMMON WORK RESULTS

- .3 Detailed technical data and characteristics of alternative item such as dimensions, voltage, power requirements, performance characteristics, etc.
 - .4 Request for lighting fixture substitutions must be followed by photometric data and Shop Drawings.
 - .5 A list of any and all changes to the installation which may be required as a result of the substitution.
- .3 Materials, equipment, apparatus, light fixtures, or other products specified by manufacturers' brand name, type, or catalogue number are so specified in one of two ways:
- .1 Specified item followed by the words "or equal" or "approved equal" or preceded by the words "equivalent to" or "equal to"; when the Technical Specification is so worded, it is intended to establish a specific standard of quality and style but the item may be substituted for, provided the Contract Administrator provides its written approval. It is the responsibility of the Contractor to assure the Contract Administrator that all features of the specified items are supplied as part of the substitute item. If the Contract Administrator does not provide its written approval for a substitute item, the item shall be supplied precisely as specified in the Contract Documents.
 - .2 Specified items not followed or preceded by any such qualifying phrases: When the Technical Specification is so worded, the item shall be supplied as specified and no approved equals or equivalents will be allowed.
- .4 Review by the Contract Administrator of alternate materials as permitted above is only a general approval in principal and shall not relieve the Contractor of its responsibility to ensure that any approved alternate materials perform in the same manner and with the same intent as the originally specified material would have otherwise performed.
- .5 Where such substitutions alter the design or space requirements indicated on the Contract Drawings, include all material, labour, design, and engineering costs for the revised design and construction including costs of all other trades affected and those incurred by the Owner and Contract Administrator.

COMMON WORK RESULTS

- .6 It is the Contractor's responsibility to ensure substituted products are approved and that Suppliers have written approval indicating conditions of any such approval. Alternate manufacturers who do not have such approval shall not be used in the work. If requested by the Contract Administrator, the Contractor for Division 26 shall submit for inspection, samples of both the specified and the proposed substitute items on short notice.

Part 2 Products

2.0 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
- .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in English.

2.1 MATERIALS AND EQUIPMENT

- .1 Equipment and material shall be new and certified by a certification body accredited by the Standards Council of Canada (SCC). Where there is no alternative to supplying equipment which is not certified, obtain special approval and pay all associated fees. Notify Contract Administrator prior to supplying material that is not SCC approved.
- .2 Factory assemble control panels and component assemblies.
- .3 Substitution of Products
- .1 After acceptance of the list of products, no substitution of any item will be permitted unless the approved item cannot be delivered in time to comply with the work schedule and the Contract Administrator accepts the change in items.
- .2 To receive acceptance, proposed substitutes must equal or exceed the quality, finish and performance of those specified in the Contract Documents and/or shown in the Contract Drawings, and must not exceed the space requirements allotted on the Contract Drawings.

COMMON WORK RESULTS

- .3 Provide to the Contract Administrator documentary proof of equality, difference in price (if any) and delivery dates, in the form of certified quotations from suppliers of both specified items and proposed substitutions.
- .4 Include costs for any required revisions to other structures and products to accommodate such substitutions.

2.2 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Verify installation and co-ordination responsibilities related to motors, equipment and controls, as indicated in the Technical Specifications and Contract Drawings.

2.3 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authority having jurisdiction and Contract Administrator.
- .2 Decal signs, minimum size 175 x 250 mm.

2.4 WIRING TERMINATIONS

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

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify equipment cabinets with nameplates as follows:
 - .1 Nameplates:
 - .1 Lamicoid 3 mm thick plastic engraving sheet, lettering accurately aligned and engraved into core, mechanically attached with self-tapping screws or permanent self-adhesive.
 - .2 Nameplate colours as follows:
 - .1 Normal Power Systems: black face, white core
 - .2 Emergency/Standby Power Systems: red face, white core
 - .3 Life Safety Systems: red face, white core
 - .4 Colours for other equipment as specified by the Contract Administrator.
 - .2 Sizes as follows:

COMMON WORK RESULTS

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

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- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise in the Contract Drawings.
- .3 Wording on nameplates to be approved by Contract Administrator prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, primary and secondary voltages.

2.6 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of cable.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Wire Labeling:
 - .1 Low voltage single and three phase power conductors shall be tagged with the following format: XXXX-X#, where:
 - .1 XXXX – Equipment tag number that is being supplied
 - .2 -X – L (for phase conductors) or N (for Neutral)
 - .3 # - Sequential Number, if necessary.
 - .4 Examples:
 - .1 VFD301-L1: VFD301 power conductor (black phase)
 - .2 VFD301-L2: VFD301 power conductor (red phase)
 - .3 VFD301-L3: VFD301 power conductor (blue phase)
 - .4 P1-L: Single-phase Pump 1 line conductor
 - .5 P1-N: Single-phase Pump 1 neutral conductor

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- .2 Field instrument and control wires shall be tagged with the following format: XXX###-XX##, where:
 - .1 XXX### – Field equipment tag number
 - .2 –XX## – Sequential Number or Voltage Identifier
 - .3 Examples:
 - .1 FIT110-2: Instrument field wiring to Flow Indicator Transmitter 110
 - .2 LSH003-1: Field control wire from Level Switch LSH003
- .3 Panel wiring shall be tagged with the following format: XXX###-##XXX, where:
 - .1 XXX### – Upstream equipment tag
 - .2 –##XXX – PLC channel identifier, or Voltage Identifier and sequential number
 - .3 Panel wiring suffixes (xxx):
 - .1 24V – 24VDC Control Supply
 - .2 12V – 12VDC Control Supply
 - .3 0V – ELV return wire
 - .4 GND/SHD – Field instrument wire ground (or shield)
 - .5 AI+/AI- - Analog Signal wiring (control panel terminal to PLC/RTU)
 - .6 DI – Digital Input wiring (control panel terminal to PLC/RTU)
 - .7 DO – Digital output wiring (control panel terminal to PLC/RTU)
 - .4 Examples:
 - .1 LCP101-24V13: 24VDC supply wire in Local Control Panel 101
 - .2 PLC101-03AI+: Analog input signal wiring to PLC101, Channel 3

COMMON WORK RESULTS

- .3 RTU801-02DI: Digital (discrete) input signal wiring to RTU801, Channel 2

2.7 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code 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 |
|-----------------------|-------|-----------|
| Communication Systems | Green | Blue |
| Security Systems | Red | Yellow |
- .4 Cable Labeling:
- .1 Cable tags as follows: ##-SSSS/##-DDDD-X#, where:
- .1 ## - Area Code (can be omitted in smaller facilities with only a single process or facility area).
- .2 SSSS – Equipment tag of cable source.
- .3 DDDD – Equipment tag of cable destination.
- .4 X – Cable Type
- .1 A – Field Instrument Analog signal cable
- .2 C – Discrete signal control cable
- .3 F – Fibre Optic Cable
- .4 P – Power cable
- .5 GND – Ground cable
- .5 # – Sequential Number, if necessary.

2.8 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

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- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.
- .4 Repair or replace any equipment or structures damaged by the Work, to its original condition at no cost to the Owner.

Part 3 Execution

3.0 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Technical Specifications are acceptable for installation in accordance with manufacturer's written instructions.
- .2 Visually inspect substrate in presence of Contract Administrator.
- .3 Inform Contract Administrator of unacceptable conditions immediately upon discovery.
- .4 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Contract Administrator.

3.1 INSTALLATION

- .1 Complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CAN/CSA-C22.3 No.1 except where specified otherwise in the Contract Drawings.

3.2 NAMPLATES AND LABELS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

3.3 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete.
 - .1 Sleeves through concrete: schedule 40 plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings embedded or plastered over, close to building structure so furring can be kept to minimum.

COMMON WORK RESULTS

3.4 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise in the Contract Drawings.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.5 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.

3.6 FIELD QUALITY CONTROL

- .1 Refer to Technical Specification 26 05 10 Testing & Commissioning.

3.7 SUBSTANTIAL PERFORMANCE REVIEW

- .1 Prior to the Contractor submitting an Application for Substantial Completion, the Contractor will submit written confirmation that:
 - .1 All wiring devices, cover plates, motor controls, lighting fixtures, and other equipment are operational, plumb, clean, and correctly labelled.
 - .2 All distribution equipment (cabinets, panels, distribution transformers, etc.) has been cleaned and vacuumed.
 - .3 All test reports have been submitted.
 - .4 All auxiliary systems have been tested as required and are in good and proper working order.
 - .5 All certificates of final acceptance from the authorities having jurisdiction have been received and submitted to the Contract Administrator.
 - .6 Factory finished equipment has been cleaned, touched up, or refinished as necessary to present a new appearance.
 - .7 All sealing of conduits, cables, cable trays, wireways, etc. at wall, ceiling, and floor penetrations have been completed.
 - .8 All lighting fixtures including lenses and reflectors have been properly cleaned as specified in the Contract Drawings.

COMMON WORK RESULTS

- .9 All loose equipment including spare parts and replacement parts have been turned over to the Owner and receipts obtained for same.
- .10 The operations and maintenance manuals have been submitted.
- .11 All demonstrations and instructions to the Owner have been completed.
- .12 Verification letter from Seismic Engineer has been submitted.
- .2 Provision of the above shall not be construed as compliance with all administrative documentation required.
- .3 Notwithstanding any other provisions of the Contract, failure if the Contractor fails to complete all of the requirements in this section 3.7 the Contract Administrator may refuse to issue a Certificate of Substantial Completion.

3.8 SYSTEM START-UP

- .1 Arrange and pay for services of manufacturer's factory service representative to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .2 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with aspects of its care and operation.

3.9 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Where work is performed in a phased manner, or Owner will take partial occupancy of the area of Work, perform final cleaning at the end of each Phase or prior to Owner taking occupancy of each area.
- .4 Waste Management: separate waste materials for reuse and recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END SECTION

SEISMIC RESTRAINT

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Revision History

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SEISMIC RESTRAINT

Part 2 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 29 Hangers and Supports for Electrical Systems
- .3 Technical Specification 26 24 02 Service Entrance Board

1.2 REGULATORY REQUIREMENTS

- .1 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.
- .2 The Contractor's seismic consultant shall submit original signed BC Building Code Letters of Assurance Schedules S-B and S-C to the Contract Administrator together with Shop Drawings submission.
- .3 Importance Factor: 1.5.
- .4 Use the Electrical Contractors Association of BC details in the absence of any local requirements.
- .5 The above requirements shall not restrict or supplant the requirements of any Applicable Laws, including local bylaws, codes, or other certified agencies which may have jurisdiction over all or part of the installation.

1.3 SCOPE

- .1 It is the responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .2 Manufacturer's shop drawings to be submitted with seismic information on equipment structure, bracing and internal components and as required by the Specifications.
- .3 Provide restraint on all equipment and machinery, which is part of the cathodic protection system, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.

SEISMIC RESTRAINT

- .4 The Contractor will ensure that the total electrical seismic restraint design and field review and inspection will be by a B.C. registered professional structural engineer who specializes in the restraint of building elements (the "Seismic Consultant"). Contractor to allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Consultant. The Seismic Consultant will provide normal engineering functions as they pertain to seismic restraint of electrical installations.
- .5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the Project. Any changes in conditions will not result in an increase to the Contract Price, unless otherwise state in the Contract Documents
- .6 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the Project Binder.
- .7 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.
- .8 The Seismic Consultant shall provide inspections during and after installation. The Contractor shall correct any deficiencies in accordance with Section 21.1 of the Contract.

1.4 SHOP DRAWINGS & SUBMITTALS

- .1 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the Seismic Consultant.
- .2 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

1.5 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 SLACK CABLE SYSTEMS

- .1 Slack cable restraint systems shall be as designed and supplied by Vibra-Sonic Control or approved equal.

SEISMIC RESTRAINT

- .2 Slack cable systems to allow normal maintenance of equipment and shall not create additional hazard by their location or configurations. Contractor shall rectify any such installations at no additional cost, all to the satisfaction of the engineer and inspection authority having jurisdiction.
- .3 Coordinate requirements of slack cables with suppliers prior to installation.

Part 3 Execution

3.1 GENERAL

- .1 All seismic restraints systems shall conform to Governmental Authorities, including local authority having jurisdiction and all Applicable Laws and applicable code requirements.

3.2 CONDUITS

- .1 Provide restraint installation information and details on conduit and equipment as indicated in Section 3.2 of this Technical Specification:
- .2 Vertical Conduit
 - .1 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .2 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m o.c.
 - .3 Riser joints shall be braced or stabilized between floors.
- .3 Horizontal Conduits
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.
- .4 Do not brace conduit runs against each other. Use separate support and restraint system.
- .5 Support all conduits in accordance with the capability of the pipe to resist seismic load requirements indicated.
- .6 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.

SEISMIC RESTRAINT

- .7 A conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake. Examples: wall and a roof; solid concrete wall and a metal deck with lightweight concrete fill.
- .8 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with firestopping where required.
- .9 The Contractor will ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on Shop Drawings. The Contractor will review the Shop Drawings with Seismic Consultant and submit Shop Drawings to Contract Administrator for their reference.

3.3 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, (including transformers, kiosks, switchgear, generators, motor control centres, free standing panelboards, control panels, capacitor banks) to the structure. Seismic Consultant shall design anchors and bolts.

END SECTION

TESTING AND COMMISSIONING

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TESTING AND COMMISSIONING

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 – Common Work Results – Electrical
- .2 Technical Specification 26 27 15 – Electrical and Controls Components

1.2 REFERENCES

- .1 All inspections and tests shall be in accordance with, but not limited to, the following applicable codes and standards except as provided otherwise in this Technical Specification.
 - .1 International Electrical Testing Association - NETA
 - .2 National Electrical Manufacturer's Association – NEMA
 - .3 Canadian Electrical Manufacturers Association - CEMA
 - .4 American Society for Testing and Materials - ASTM
 - .5 Institute of Electrical and Electronic Engineers – IEEE
 - .6 1584-2018, Guide for Performing Arc-Flash Hazard Calculations
 - .7 American National Standards Institute – ANSI
 - .8 ANSI Z535.4-2011, Product Safety Signs and Labels
 - .9 Canadian Electrical Code - Parts 1 and 2
 - .10 Canadian Standards Association – CSA
 - .11 CSA Z462-18, Workplace electrical safety, provides assistance in determining the severity of potential exposure, planning safe work practices, and selecting personal protective equipment to protect against shock and arc flash hazards.
 - .12 Insulated Power Cable Engineers Association - IPCEA
 - .13 National Fire Protection Association - NFPA
 - .14 ANSI/NFPA 70B: Electrical Equipment Maintenance
 - .15 WCB Regulations

TESTING AND COMMISSIONING

- .16 CANICSA-B72-M87: Lightning Protection Code
- .17 Municipal By-Laws

1.3 SUMMARY

- .1 Provide testing and commissioning services and equipment to assure that all electrical equipment is operational within industry manufacturers' tolerances, calibrated per the power system studies, complies with all applicable codes, is installed in accordance with the Contract Documents, and functions in the system in the manner designed and in accordance with the Contract Document requirements.
- .2 All tests shall be tabulated, signed and incorporated into the Project Binder.
- .3 All testing and commissioning to be carried out in accordance with the terms of this Contract.
- .4 The inspections and testing activities shall be divided among the following groups, as specified in this Technical Specification:
 - .1 Ensure the original equipment manufacturer's authorized service representative shall provide special equipment, labour, and technical supervision to perform inspections, calibrations and acceptance tests, when required, in addition to what is supplied by the Contractor.
 - .2 Inspections, calibrations, and acceptance tests for equipment and systems not requiring the services of the manufacturer's representative shall be performed by the Contractor.
 - .3 In cases where the equipment and systems require the involvement of two or more of the manufacturer, Supplier, Contractor or others (excluding the Owner), the parties mentioned above shall coordinate and perform all inspection and testing requirements. The Contractor shall be responsible for coordination of the work and ensuring that the requirements of this Section are met.
- .5 Procedures and tests outlined below are electrical tests required in addition to normal visual and mechanical inspections which must be carried out prior to placing equipment in service.

TESTING AND COMMISSIONING

1.4 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 NOT USED

Part 3 Execution

3.1 GENERAL

- .1 Contractor shall coordinate and pay for all testing required by the Contract Documents including any additional testing required by authorities having jurisdiction.
- .2 All deficient equipment/devices shall be replaced and retested.
- .3 Testing for each system shall be performed after the system installation is complete and prior to the system being put into continuous operation.
- .4 Advise the Contract Administrator a minimum of five (5) Business Days in advance of each test and carry out tests in the presence of the Contract Administrator.
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of Work.
- .6 Submit detailed typewritten test reports to the Contract Administrator within five (5) Business Days after the completion of each test. Include all test reports in the Project Binder.
 - .1 Test reports shall clearly indicate each component that has been individually tested, test results, and whether the results are within acceptable limits.
 - .2 Each test report shall be accompanied by a cover sheet outlining the test and summarizing any items that have failed the tests.
 - .3 Cover sheet shall include names, signatures, and contact information of the individuals who conducted the tests.
- .7 Protective Device Setting and Testing
 - .1 All work shall conform to NETA standards.

TESTING AND COMMISSIONING

- .2 Ensure circuit protective devices including overcurrent trips, relays, and fuses are installed to required values per protection and coordination study.

3.2 CONTRACTOR TESTING:

- .1 Infra-Red Scanning
 - .1 Perform infrared scan of all distribution equipment under loaded conditions (new and existing).
- .2 Load Balance
 - .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance; adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
 - .2 Measure phase voltages at connected loads under fully load conditions and adjust transformer taps to within 2% of rated voltage of equipment.
 - .3 Provide upon completion of the work specified herein, load balance report, phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load, as well as hour and date on which each load was measured, and voltage at time of test.
- .3 Insulation resistance testing
 - .1 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .4 Switchgear and Switchboard Enclosures
 - .1 Carry out visual inspection of enclosure and verify nameplate data against Supplier's as-built drawings and specifications.
 - .2 Torque and ductor test all bus connections and torque test all wire terminations to recommend manufacturer's data. All torqued connections to be sealed with red lacquer.
 - .3 Carry out electrical continuity phasing check of all bus work per three line diagram from incoming end to each termination or take-off point.

TESTING AND COMMISSIONING

- .4 Carry out insulation resistance test of all phases to ground and between phases of main bus work. Record results in megohms.
- .5 Contact resistance if applicable.
- .5 Breakers and Load Break Switches
 - .1 Adjust and set in accordance with power system study.
 - .2 Clean and lubricate.
 - .3 Visual inspection.
 - .4 Manual function test.
 - .5 Torque test.
 - .6 Contact resistant test (100 amp resistance tester).
 - .7 Electrical function test.
 - .8 Function trip test of all protective relay device.
- .6 Breakers - Molded Case Breakers 150 Amp Frame and Larger:
 - .1 Visually inspect.
 - .2 Ductor test.
 - .3 Megger test.
 - .4 Mechanical function test.
 - .5 Set all units with adjustable magnetic trip units.
 - .6 Where solid state protection is provided with large breakers, test units as follows:
 - .1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.
 - .2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instruction.
 - .3 If manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.
 - .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test trip operation.
 - .5 Check C/T and P/T ratios and compare to coordination data.
- .7 Fused or Unfused Disconnect Switches:
 - .1 Visually inspect and clean.

TESTING AND COMMISSIONING

- .2 Ductor test across switch blade contact surfaces.
- .3 Megger test.
- .4 Mechanical function test.
- .8 Transformers
 - .1 Visual inspection of enclosure and all accessories.
 - .2 Torque test all bus connections and cable terminations and seal with red lacquer.
 - .3 Megger test.
 - .4 Dielectric power factor test.
 - .5 Core ground test.
 - .6 Ratio test in all tap positions.
 - .7 Test operation of temperature and operation of all associated alarm contacts.
 - .8 Test and calibrate ground fault relays and function test to trip associated breakers.
 - .9 Make voltage and power factor checks throughout building. If directed by the Contract Administrator, adjust transformer tap settings. Readings taken at this time to be logged, tabulated and any adjustments made to be suitably logged and incorporated in the Project Binders.
- .9 Microprocessor Type Relays
 - .1 Mechanical Inspection:
 - .1 Remove cover from relay case carefully. Trip circuit is live circuit and on some relays it is possible to cause an instantaneous trip while removing relay cover. Inspect cover gasket. Check glass for tightness and cracks.
 - .2 Eliminate unwanted tripping, short-circuit current transformer secondary by careful removal of relay test plug or operation of appropriate current blocks.
 - .3 Check connections, circuit boards and modules for tightness.
 - .4 Check output relay coils for signs of overheating and brittle insulation.
 - .2 Cleaning:

TESTING AND COMMISSIONING

- .1 Clean glass inside and out.
- .2 Clean relay compartment as required. Clean relay plug in contacts if applicable, using proper tools.
- .3 Remove dust and foreign materials from interior of relay using small brush or low pressure 3.2 kg blower of nitrogen.
- .4 Inspect for any signs of moisture and corrosion.
- .5 Clean relay output contacts with burnishing tool or non-residue contact cleaner.
- .3 Electrical Testing: Function tests for typical overcurrent relays include:
 - .1 Energize relay from an appropriate DC power source and check "ON" indication.
 - .2 Time-current function test and trip flag operation.
 - .3 Instantaneous pickup functional trip and flag operation.
 - .4 Use tests listed above for most microprocessor overcurrent type relays.
 - .5 Check C/T and P/T ratios and compare to coordination data.
- .10 Solid State Relays
 - .1 Inspect and test in accordance with manufacturer's most recent installation and maintenance brochure.
 - .2 Perform tests using manufacturer's relay test unit as applicable, with corresponding test instructions.
 - .3 If manufacturer's tester is not available, use an approved relay tester unit with proper test data and test accessories.
 - .4 Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of relay circuit to test the trip operation.
 - .5 Check C/T and P/T ratios and compare to coordination data.
- .11 Bus Duct - Low Voltage
 - .1 Visually inspect.
 - .2 Torque test all bolted connections and seal with red lacquer.
 - .3 Megger test.
 - .4 Contact resistance test on total bus duct.

TESTING AND COMMISSIONING

- .12 Devices
 - .1 Test all receptacles for proper polarity, circuitry and grounding.
- .13 Grounding Systems
 - .1 Verify that neutrals are grounded only at the main service by removing the service neutral grounding conductor and meggering the neutral bus.
 - .2 Perform point-to-point tests to determine the resistance between the main grounding system and all major electrical equipment frames, system-neutral, and/or derived neutral points. Investigate resistance values, which exceed 0.5 ohm. If this resistance cannot be obtained with the ground system, notify the Contractor and, in turn, the Contract Administrator for further instruction.
 - .3 The resistance to ground between the equipment enclosures and the grounding grid shall be tested. In soils of low conductivity, additional ground rods, ground plates, and ground wires shall be added, as required. Ground measurements shall not exceed 25 ohms. Measurements shall be undertaken under dry soil conditions, and when frost penetration has not exceeded 150mm. Test results shall be documented by the Contractor and copies given to the Contract Administrator.
 - .1 Test Method: 3-Point (Fall-of-Potential) Method per IEEE Standard 81.
- .14 Heating and Ventilation Systems
 - .1 Purpose to ensure that systems are functional. Verification includes:
 - .1 Confirmation of thermostat settings for heating and cooling.
 - .2 Confirmation of operation of heaters and fans.
- .15 Lighting Systems
 - .1 Purpose to ensure that systems are functional. Verification includes:
 - .1 Confirmation that lighting within each enclosure is activated by the associated door switch.
 - .2 Confirmation that site lighting is activated by associated light switch.
- .16 Cathodic Protection Systems

TESTING AND COMMISSIONING

- .1 Purpose to ensure that systems are functional.
- .2 System verification per Technical Specification Section 26 42 00
Cathodic Protection of Concrete.

TESTING AND COMMISSIONING

3.3 MANUFACTURER'S FIELD SERVICES:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit manufacturer's field reports to Contract Administrator for review. Include field reports in Project Binders.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Obtain manufacturer's field services for commissioning of equipment as required in other Sections of Division 26 Technical Specifications.
- .4 Conduct additional testing as required in other Sections in Division 26 Technical Specifications.

3.4 STANDARDS

- .1 The following tests shall be conducted in accordance with latest CSA, ASTM, IEEE and IPCEA standards, recommendations for power cable and equipment testing and standards of the authority having jurisdiction. Notwithstanding the test levels listed in these standards, in no case shall the maximum DC test level exceed manufacturer's factory test AC level for that equipment.
- .2 Where production tests are required by EEMAC or CSA for manufactured equipment, provide records of these tests. All tests shall be completed in accordance with manufacturer's published instructions. If these instructions do not conform to the test requirements as specified herein inform the Contract Administrator prior to proceeding with the test.

3.5 TEST APPARATUS AND INSPECTION REPORT

- .1 The Contractor is responsible for furnishing all apparatus and labour required for the test operations.
- .2 Inspection and test results to be recorded on a suitable form which shall be furnished by the Contractor. The inspection and report forms shall be submitted to the Contract Administrator. Each form to be signed by the test technician. Space to be provided for noting approved items and their disposition.
- .3 The Contractor will submit full commissioning reports and information for as-built drawings and acceptance documents signed by test technician.
- .4 Upon completion of the Work, the Contractor will assemble complete sets of inspection/test results/reports to be placed in the operating and maintenance manuals. Reports shall include the following:
 - .1 Summary of project

TESTING AND COMMISSIONING

- .2 Description of equipment tested
- .3 Description of test
- .4 Test results including re-testing results
- .5 Test dates
- .6 Tester's name
- .7 Witnesses (when required)
- .8 Corrective work
- .9 Acceptance criteria
- .10 Conclusions and recommendations
- .11 Appendix, including appropriate test forms

3.6 DEMONSTRATION

- .1 Demonstrate and instruct the Owner's personnel on operating and maintenance procedures for all electrical systems using the assistance of specialist sub-trades and manufacturer's representatives for instruction. Systems to be demonstrated and trained on shall include the following:
 - .1 Entire power distribution systems (primary and backup).
 - .2 Operation of circuit breakers, interlocking schemes, etc.
 - .3 Instrumentation and field monitoring/control devices.
 - .4 Continuity between field devices and the datalogger.
 - .5 Datalogger information logging and trending.
 - .6 Alarming.
 - .7 Routing and installation of major feeders, grounding and raceways.
 - .8 Labeling and identification schemes.
 - .9 Use of the operations and maintenance manuals.

3.7 TRAINING

- .1 Arrange an acceptable time with the Owner and the Contract Administrator and submit a program of instruction and demonstration for the Owner's approval. Assume that the Owner's staff are not familiar with any of the special equipment and/or systems installed.

TESTING AND COMMISSIONING

- .2 As a condition of Substantial Completion, submit to the Contract Administrator complete list of systems demonstrated and training completed, and state for each system:
- .1 Date that instructions were given to the Owner's staff.
 - .2 Duration of instruction.
 - .3 Names of persons instructed.
 - .4 Other parties present (manufacturer's representative, Contract Administrator, etc.).
 - .5 Signature of the Owner's staff stating that they properly understood the system installation, operation, and maintenance requirements and identifying any systems or equipment which were not demonstrated to their satisfaction and which must be re-demonstrated

3.8 SYSTEM ACCEPTANCES

- .1 Prior to requesting inspection, submit, for review by the Contract Administrator letters from the manufacturers of equipment and systems indicating the their technical service representatives have inspected and tested the equipment and systems and are satisfied with the methods of installation, connections and operation.
- .2 Such acceptance letters shall be submitted for the following:
- .1 Switchboards.
 - .2 Distribution and Power Panels.
 - .3 Datalogger
 - .4 Rectifiers

END SECTION

WIRING AND BOX CONNECTORS (0-1000V)

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WIRING AND BOX CONNECTORS (0-1000V)

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 21 Wires and Cables (0-1000V)

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No.18.1 13, Metallic Outlet Boxes
 - .2 CAN/CSA C22.2 No.18.2 06, Nonmetallic Outlet Boxes
 - .3 CAN/CSA C22.2 No.18.3 12, Conduit, Tubing, and Cable Fittings
 - .4 CAN/CSA C22.2 No.18.4-04, Hardware for the Support of Conduit, Tubing
 - .5 CSA C22.2 No.65 13 (R2008), Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y 2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .3 National Electrical Manufacturers Association (NEMA)

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

WIRING AND BOX CONNECTORS (0-1000V)

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y 2 to consist of:
 - .1 Connector body and stud clamp for copper conductors.
 - .2 Clamp for stranded copper conductors.
 - .3 Stud clamp bolts.
 - .4 Bolts for copper conductors.
 - .5 Sized for conductors as indicated.
- .4 Clamps or connectors for armoured cable and flexible conduit as required to comply with CAN/CSA C22.2No.18 (all subsections).

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for wire and box connectors installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant or provide photographic evidence of areas of concern.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
- .2 Proceed with installation only after unacceptable conditions have been remedied.

3.2 INSTALLATION

WIRING AND BOX CONNECTORS (0-1000V)

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2 No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with EEMAC 1Y-2.

END SECTION

WIRE AND CABLES (0-1000V)

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WIRE AND CABLES (0-1000V)

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation for wire and cables.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 20 Wire and Box Connectors (0-1000V)
- .3 Technical Specification 26 05 43 01 Installation of Cables in Trenches and Ducts
- .4 Technical Specification 26 27 16 Electrical Kiosk

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA C22.2 No .0.3 09 (R2014), Test Methods for Electrical Wires and Cables
 - .2 CAN/CSA C22.2 No. 38-14, Thermoset-insulated wires and cables
 - .3 CAN/CSA C22.2 No. 75, Thermoplastic insulated wires
 - .4 CAN/CSA C22.2 No. 127-15, Equipment and lead wires
 - .5 CAN/CSA C22.2 No. 131 14 (R2014), Type TECK 90 Cable

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

WIRE AND CABLES (0-1000V)

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 BUILDING WIRES

- .1 Conductors: stranded for 10 AWG and larger. Minimum size: 12 AWG, unless noted otherwise.
- .2 Wire: to CAN/CSA C22.2 No. 38.
- .3 Copper conductors: size as indicated, with 600 V insulation of cross-linked thermosetting polyethylene material rated RW90 XLPE, Jacketed.
- .4 Grounding conductors to be in accordance with requirements in Technical Specification 26 05 28 Grounding - Secondary.

2.1 TECK 90 CABLE

- .1 Cable: to CAN/CSA C22.2 No. 131.
- .2 Conductors:
- .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
- .1 Cross-linked thermosetting polyethylene rated type RW90 XLPE.
 - .2 Rating: 1000V
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride.
- .7 Connectors:
- .1 Watertight approved for Teck Cable.

2.2 CONTROL AND INSTRUMENTATION CABLE

- .1 Internal cabinet control wiring shall be TEW (tinned).
- .1 Wire: to CAN/CSA C22.2 No. 127-15.
 - .2 Size

WIRE AND CABLES (0-1000V)

- .1 120VAC: 14AWG.
- .2 24VDC: 18AWG.
- .3 Color Code
 - .1 AC Hot: Black
 - .2 AC Neutral: White
 - .3 DC Positive: Red
 - .4 DC Negative: Brown
 - .5 Ground: Green
- .2 Analog instrumentation wiring:
 - .1 Cable: to CAN/CSA-C22.2 No. 75.
 - .2 Conductors:
 - .1 Circuit conductors: 7 strand tinned copper.
 - .3 Insulation:
 - .1 Cross-linked thermosetting polyethylene rated type RW90 XLPE.
 - .2 Rating: 300V and 600V, as required.
 - .4 Jacket: polyvinyl chloride material.
 - .5 Shield:
 - .1 Individual Foil
 - .2 Tinned copper drain wiring under and in contact with foil.

2.3 ETHERNET CABLES

- .1 CAT6 (250MHz) rated, compatible with 1000BaseT networks, harsh industrial environments.
- .2 Outdoor rated, installation in conduit approved, UV resistance.
- .3 Conductors:
 - .1 8 x 23 AWG solid copper conductors, arranged in 4 twisted pairs.
 - .2 RJ45 Termination: TIA 568A
 - .3 Straight-through (non-crossover) wiring, unless noted otherwise.
- .4 Jacket:
 - .1 Oil and sunlight resistant PVC.

WIRE AND CABLES (0-1000V)

.2 Colour: Blue

2.4 ETHERNET PATCH CABLES

- .1 CAT6 (250MHz) rated, compatible with 1000BaseT networks.
- .2 8 x 23 AWG solid copper conductors, arranged in 4 twisted pairs.
- .3 Straight-through (non-crossover) wiring, unless noted otherwise.
- .4 RJ45 male connectors with molded boots.
 - .1 Termination: TIA 568A
- .5 Colour: Blue

2.5 ARMoured CONTROL AND INSTRUMENTATION CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 239-09.
- .2 Conductors:
 - .1 Circuit conductors: 7 strand tinned copper.
- .3 Insulation:
 - .1 Cross-linked thermosetting polyethylene rated type RW90 XLPE.
 - .2 Rating: 300V and 600V, as required.
- .4 Inner jacket: polyvinyl chloride material.
- .5 Armour: interlocking aluminum.
- .6 Overall covering: thermoplastic polyvinyl chloride.
- .7 Certification:
 - .1 FT-4 Flame Rated
 - .2 Temperature: 105°C dry, 75°C wet, and -40°C
 - .3 Suitable for installation in Class I, Zone 1 and Zone 2, and Class II, Division 1 and 2 Hazardous Locations.
- .8 Connectors:
 - .1 Watertight approved for armoured control and instrumentation cable.

2.6 CATHODIC PROTECTION CABLING

- .1 Contractor to confirm cable type with cathodic protection vendor. Submit cabling to Contract Administrator for review.

WIRE AND CABLES (0-1000V)

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Technical Specification 26 05 43 01 Installation of Cables in Trenches and in Ducts.
- .2 Terminate cables in accordance with Technical Specification 26 05 20 Wire and Box Connectors - (0-1000 V).
- .3 Cable Colour Coding: to Technical Specification 26 05 00 Common Work Results for Electrical.
- .4 Conductor length for parallel feeders to be identical.
- .5 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.

3.3 INSTALLATION OF BUILDING WIRES

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Technical Specification 26 05 43 01 Installation of Cables in Trenches and in Ducts.

3.4 INSTALLATION OF TECK90 CABLE (0-1000V)

- .1 Install cabling as follows:
 - .1 In conduit systems in accordance with Technical Specification 26 05 43 01 Installation of Cables in Trenches and in Ducts.
 - .2 Install cable exposed, securely supported by straps or hangers.
 - .1 Group cables wherever possible on channels, individually strapped.

3.5 INSTALLATION OF ARMoured CABLE

WIRE AND CABLES (0-1000V)

- .1 Install cabling as follows:
 - .1 In conduit systems in accordance with Technical Specification 26 05 43 01 Installation of Cables in Trenches and in Ducts.
- .2 Install cable exposed, securely supported by straps or hangers.
 - .1 Group cables wherever possible on channels.

3.6 INSTALLATION OF CONTROL AND INSTRUMENTATION CABLE

- .1 Ground control cable shield at control cabinet only.
- .2 Cut and heatshrink shield at terminations to field devices.

3.7 INSTALLATION OF ARMOURED CONTROL AND INSTRUMENTATION CABLE

- .1 Install cabling as follows:
 - .1 In conduit systems in accordance with Technical Specification 26 05 43 01 Installation of Cables in Trenches and in Ducts.
- .2 Install cable exposed, securely supported by straps or hangers.
 - .1 Group cables wherever possible on channels.

3.8 INSTALLATION OF CATHODIC PROTECTION CABLE

- .1 Install cabling as follows:
 - .1 In conduit systems in accordance with Technical Specification 26 05 43 01 Installation of Cables in Trenches and in Ducts.
- .2 Install cable exposed, securely supported by straps or hangers.
 - .1 Group cables wherever possible on channels.
- .3 Install cable per manufacturer's requirements.

END SECTION

GROUNDING – SECONDARY

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GROUNDING – SECONDARY

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation for secondary grounding.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 24 01 Service Equipment

1.3 REFERENCE STANDARDS

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding.

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 EQUIPMENT

- .1 Rod electrodes: copper 19mm dia. by 3 m long.

GROUNDING – SECONDARY

- .2 Plate electrodes: In accordance with the CEC.
- .3 Grounding conductors: medium hard drawn, 7 strand, bare stranded copper, size as indicated.
- .4 Insulated grounding conductors: green, size as indicated.
- .5 Ground bus: copper, size as indicated, complete with insulated supports, fastenings, connectors.
- .6 Grounding rod inspection well:
 - .1 High density polyethylene construction
 - .2 Minimum 250mm top opening.
 - .3 Bolt down cover with skid resistant surface.
- .7 Non corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps.
 - .5 Pressure wire connectors.

Part 3 Execution

3.1 GENERAL INSTALLATION

- .1 Install exterior buried grounding loop system as indicated on the drawings.
- .2 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where EMT is used, run ground wire in conduit.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.

GROUNDING – SECONDARY

- .8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Install flexible ground straps for bus duct enclosure joints, where such bonding is not inherently provided with equipment.
- .10 Connect building structural steel and metal siding to ground by welding copper to steel.
- .11 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- .12 Bond single conductor, metallic armoured cables to cabinet at supply end.

3.2 INSPECTION WELL

- .1 Install grounding stud, electrode, size as indicated stranded copper conductor in each inspection well as indicated on Contract Drawings.
- .2 Install ground rod in each inspection well so that top projects through bottom of maintenance hole. Provide with lug to which grounding connection can be made. Confirm ground resistance meets or exceeds Canadian Electrical Code minimum requirements (25 Ohms).

3.3 ELECTRODES

- .1 Install rod electrodes and make grounding connections within inspection wells.
- .2 Bond separate, multiple electrodes together.
- .3 Size copper conductors for connections to electrodes, sized as indicated on Contract Drawings.
- .4 Make special provision for installing electrodes that will give acceptable resistance to ground value where rock or sand terrain prevails. Ground as indicated.

3.4 SYSTEM AND CIRCUIT GROUNDING

- .1 Install system and circuit grounding connections to neutral secondary 120V system.

3.5 EQUIPMENT GROUNDING

GROUNDING – SECONDARY

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list. Service equipment, transformers, switchgear, duct systems, frames of motors, motor control centres, starters, control panels, building steel work, generators, elevators and escalators, distribution panels, outdoor lighting.

3.6 JUNCTION BOXES AND VAULTS

- .1 Bond lids of in-ground junction boxes and vaults.

3.7 MASTER GROUND BUS

- .1 Install copper grounding bus mounted on insulated supports on wall of electrical kiosk.
- .2 Ground items of electrical equipment in electrical kiosk to ground bus with individual copper connections, sized as indicated on the Contract Drawings.
- .3 Ground items of water system to ground bus with copper connections, sized as indicated on the Contract Drawings.

3.8 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Technical Specification 26 05 00 Common Work Results – Electrical and Technical Specification 26 05 10 Testing and Commissioning.
- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Contract Administrator and Government Authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Disconnect ground fault indicator during tests.

END SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

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HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with the Contract Documents.

1.1 SECTION INCLUDES

- .1 Materials and installation for hangers and supports for electrical systems.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 02 Seismic Restraint

1.3 REFERENCES

- .1 American National Standards Institute (ANSI)/Institute of Electrical and Electronics Engineers (IEEE)
 - .1 ANSI/IEEE 837-02, Qualifying Permanent Connections Used in Substation Grounding.

1.4 SUBMITTALS

- .1 Submit Shop Drawings in accordance with Section 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 SUPPORT CHANNELS AND STANCHIONS

- .1 Select channel as indicated in the Contract Drawings:

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

- .1 U shape, stainless steel, size 41 x 41 mm, 2.5 mm thick, surface mounted and suspended with stainless steel hardware.
- .2 All materials to assemble stanchions shall be from same manufacturer.
- .2 Wire and cable ties: nylon 'Ty-rap' or approved equal for wiring and control cable. Velcro cable wraps for data cables.

Part 3 Execution

3.1 INSTALLATION

- .1 Refer to Technical Specification 26 05 02 – Seismic Restraint.
- .2 Contractor to note that the intent of this Technical Specification is for the Contractor to provide under the base contract all seismic restraint of electrical equipment.
- .3 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.
 - .1 One-hole stainless steel straps to secure surface conduits and cables 53 mm and smaller.
 - .2 Two-hole stainless steel straps for conduits and cables larger than 53 mm.
- .4 For surface mounting of two or more conduits use channels at 1500 mm on centre spacing.
- .5 Provide metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.
- .6 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.
- .7 Do not use wire lashing or perforated strap to support or secure raceways or cables.
- .8 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Contract Administrator.
- .9 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

END SECTION

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

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SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation for splitters, junction, pull boxes, and cabinets.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 27 15 Electrical and Controls Components
- .3 Technical Specification 26 54 00 Heaters and Ventilation
- .4 Technical Specification 26 32 13 01 Power Generation – Diesel

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 JUNCTION AND PULL BOXES

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

- .1 RPVC construction sized to suit. Screw on flat covers. All mounting hardware to be stainless steel.
- .2 Junction boxes to be lockable with continuously hinged cover.
- .3 Junction boxes to be rated to CSA Type 3R.

EXPLOSION PROOF JUNCTION BOXES

- .4 Not Used

2.1 ENCLOSURES

- .1 Application:
 - .1 House electrical equipment within electrical kiosks providing a degree of protection from falling dirt, dust, oil, and water.
 - .2 House electrical equipment at remote monitoring sites providing a degree of protection against ingress of water.
- .2 Enclosures shall be rigid, wall or pole mounted. Outdoor enclosures shall be rated CSA Type 3R. CSA Type 1 is acceptable for indoor enclosures.
- .3 Construction:
 - .1 Outdoor enclosures shall be fabricated from marine grade aluminum. Steel enclosures are acceptable for indoor areas.
 - .2 Smooth, continuously welded seams without knockouts, cutouts, or holes.
 - .3 Welded brackets for enclosure mounting.
 - .4 Formed lip on door and enclosure to prevent ingress of flowing liquids and contaminants.
 - .5 Continuously hinged door with provision for removal by pulling hinge pin.
 - .6 Door secured with multi-point latch system including provision for padlocking.
 - .7 Permanently secured continuous gasket around door.
 - .8 Removable inner back and side panels, as required.
 - .9 Bonding studs on door, enclosure, and panels.
 - .10 Literature pocket located on inside of door.
 - .11 Heating and ventilation per the Contract Drawings.
- .4 Finish:

SPLITTERS, JUNCTION, PULL BOXES AND CABINETS

- .1 Door and enclosure shall be finished in recoatable smooth ANSI 61 gray powder coating inside and out.
- .2 Inner panels shall be finished with white powder coating.
- .5 Enclosure dimensions on Contract Drawings are approximate only. Contractor to determine final enclosure dimensions to layout all of proposed equipment.
- .6 All enclosure assemblies shall be from the same manufacturer, shall bear the CSA seal of approval, or other certification mark acceptable in the Province of British Columbia, and be manufactured by an electrical control panel manufacturer regularly engaged in this type of work.
- .7 Shop Drawings for the electrical enclosures are to be submitted in accordance with Technical Specification 26 05 00 Common Work Results - Electrical.
- .8 Standard of acceptance: Valid Manufacturing, or equivalent.

Part 3 Execution

3.0 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor, unless otherwise indicated.
- .3 Install pole mount enclosures as indicated.
- .4 Install equipment and terminal blocks as indicated in cabinets.
- .5 Only main junction and pull boxes are indicated. Install additional pull boxes as required by CSA C22.1.

3.1 IDENTIFICATION

- .1 Provide equipment identification in accordance with Technical Specification 26 05 00 Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage, and phase.

END SECTION

OUTLET BOXES, CONDUIT BOXES, AND FITTINGS

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OUTLET BOXES, CONDUIT BOXES, AND FITTINGS

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation for outlet boxes, conduit boxes, and fittings.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Blank cover plates for boxes without wiring devices.

OUTLET BOXES, CONDUIT BOXES, AND FITTINGS

- .5 240V outlet boxes for 240V switching devices.
- .6 Combination boxes with barriers where outlets for more than one system are grouped.
- .7 Provide clear while-in-use gasketed cover for interior outlets, where indicated in Contract Drawings.

2.1 CONDUIT BOXES

- .1 FD NEMA 4X RPVC boxes with factory-threaded hubs, mounting feet, and gasketed covers, where indicated in Contract Drawings.
- .2 Provide clear while-in-use gasketed cover for interior outlets, where indicated in Contract Drawings.

2.2 WEATHER-PROOF OUTLET BOXES

- .1 RPVC boxes for outlets rated for outdoor environments.
- .2 Connected to teck 90 cables as required, minimum size 102 x 54 x 48 mm.
- .3 Provide weather proof clear lockable while-in-use covers for all GFI locations, where indicated.

2.3 HAZARDOUS AREA OUTLET BOXES

- .1 Certification: Class I, Divisions 1 and 2.
- .2 Material: copper-free aluminum body and cover
- .3 Finish: Aluminum
- .4 Size: as required.
- .5 Mounting: elevated mounting feet to allow cable connector termination and removal when surface mounted.
- .6 Standard of Acceptance: Eaton Crouse-Hinds GRUE Series

OUTLET BOXES, CONDUIT BOXES, AND FITTINGS

2.4 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.

Part 3 Execution

3.0 INSTALLATION

- .1 Recess mount lighting and outlet boxes located on building exterior.
- .2 Surface mount boxes located in building interior.
- .3 Support boxes independently of connecting conduits.
- .4 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of the work.
- .5 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .6 Vacuum clean interior of outlet boxes before installation of wiring devices.

3.1 IDENTIFICATION

- .1 Provide equipment identification in accordance with Technical Specification 26 05 00 Common Work Results - Electrical.
- .2 Install identification labels indicating circuit, voltage, and phase.

END SECTION

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

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CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

Part 1 General

1.0 DOCUMENTS

- .1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation for conduits, conduit fastenings and conduit fittings.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 27 16 Electrical Kiosk

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.
 - .2 CAN/CSA C22.2 No.18.3 12, Conduit, Tubing, and Cable Fittings
 - .3 CAN/CSA C22.2 No.18.4-04, Hardware for the Support of Conduit, Tubing and Cable
 - .4 CSA C22.2 No. 56 13, Flexible Metal Conduit and Liquid Tight Flexible Metal Conduit.
 - .5 CSA C22.2 No. 45.2-08, Electrical Rigid Metal Conduit – Aluminum, Red Brass, and Stainless Steel.
 - .6 CSA C22.2 No. 83-M1985 – Electrical Metallic Tubing
 - .7 CSA C22.2 No. 211.2 06, Rigid PVC (Unplasticized) Conduit.
 - .8 CAN/CSA C22.2 No. 227.2.1-04, Liquid Tight Flexible Nonmetallic Conduit.

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.
- .2 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

- .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
- .3 Instructions: submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 CONDUITS

- .1 Rigid aluminum conduit: to CSA C22.2 No. 45.2.
- .2 Rigid PVC conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid-tight flexible metal.
- .4 Flexible PVC conduit: to CAN/CSA-C22.2 No. 227.2.1.

2.1 CONDUIT FASTENINGS

- .1 One hole stainless steel straps to secure surface conduits 53 mm and smaller. Two hole stainless steel straps for conduits larger than 53 mm.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1500 mm oc.
- .4 Threaded rods, 6 mm diameter, to support suspended channels.

2.2 CONDUIT FITTINGS

- .1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.
- .2 Factory "ells" where 90 degree bends are required for 27 mm and larger conduits.

2.3 EXPANSION FITTINGS FOR RIGID CONDUIT

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

- .1 Weatherproof expansion fittings with internal bonding assembly suitable for 100 mm linear expansion.
- .2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm deflection.
- .3 Weatherproof expansion fittings for linear expansion at entry to panel.

2.4 EYS FITTINGS

- .1 Provide explosion proof EYS fittings as indicated.

2.5 FISH CORD

- .1 Polypropylene
 - .1 Minimum tensile strength of 1.1kN.

Part 3 Execution

3.0 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Use rigid PVC conduit underground.
- .3 Use liquid tight flexible metal conduit for connection to devices, motors, or vibrating equipment with the exception of connections made using armoured cable.
- .4 Install conduit sealing fittings in hazardous areas.
 - .1 Fill with compound.
- .5 Minimum conduit size for lighting and power circuits: 21mm
- .6 Bend conduit cold:
 - .1 Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .7 Mechanically bend steel conduit over 21 mm diameter.
- .8 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

- .9 Install polypropylene fish cord in empty conduits.
- .10 Remove and replace blocked conduit sections.
 - .1 Do not use liquids to clean out conduits.
- .11 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Group conduits wherever possible on suspended or surface channels.
- .3 Do not pass conduits through structural members except as indicated.

CONDUITS, CONDUIT FASTENINGS AND CONDUIT FITTINGS

3.3 CONDUITS UNDERGROUND

- .1 The Contractor shall provide and install all necessary bends, couplings, reducers, bell end fittings, plugs, caps and adaptors of the same product material as the conduit to ensure a complete installation.
- .2 All conduits shall drain towards junction boxes. Spacing between power and communications conduits for longitudinal runs shall be 300mm (unless concrete encased). The spacing may be reduced to 50mm at crossover points and where the conduits enter and exit junction boxes and pull pits.
- .3 The Contractor shall not use any factory bends in the conduit runs except where shown on the Contract Drawings or as approved by the Contract Administrator. Where factory 90 degree bends are approved, the radius shall be greater than 900mm.
- .4 All conduits shall be verified and cleaned using the following procedure:
 - .1 To verify integrity of conduit, pull through each conduit duct a hard rubber mandrel, not less than 300mm long and of a diameter 6mm less than the internal diameter of the duct, preceded by a swab of suitable diameter to remove sand, earth and other foreign materials.
 - .2 Notify Contract Administrator in the event of conduit failure.
 - .3 Clean ducts before laying. Cap both ends during Construction and after installation to prevent entry of any foreign materials.
 - .4 Install pull line.
 - .5 Terminate conduit ends in the junction box.
 - .6 Clean and vacuum junction boxes.
 - .7 Locations shall be laid out by the Contractor and field reviewed by the Contract Administrator prior to installation.
- .5 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END SECTION

INSTALLATION OF CABLES IN TRENCHES AND DUCTS

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INSTALLATION OF CABLES IN TRENCHES AND DUCTS

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Installation of cables in trenches and in ducts.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 28 Grounding – Secondary

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.
- .2 Quality assurance submittals:
 - .1 Test reports: submit certified test reports.
 - .2 Certificates: submit certificates signed by manufacturer certifying that materials comply with specified performance characteristics and physical properties.
 - .3 Instructions: submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

INSTALLATION OF CABLES IN TRENCHES AND DUCTS

Part 2 Products

2.0 NOT USED

Part 3 Execution

3.0 CABLE INSTALLATION IN DUCTS

- .1 Install cables in ducts as indicated in Contract Drawings.
- .2 Do not pull spliced cables inside ducts.
- .3 Install multiple cables in duct simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .6 Before pulling cable into ducts and until cables are properly terminated, seal ends of lead covered cables with wiping solder; seal ends of non-leaded cables with moisture seal tape.
- .7 After installation of cables, seal duct ends with duct sealing compound.
- .8 Compliance: comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Technical Specification 26 05 00 Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms.
- .5 Pre acceptance tests.
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with 1000V megger on each phase conductor.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Acceptance Tests

INSTALLATION OF CABLES IN TRENCHES AND DUCTS

- .1 Ensure that terminations and accessory equipment are disconnected.
- .2 Ground shields, ground wires, metallic armour and conductors not under test.
- .3 High Potential (Hipot) Testing.
 - .1 Conduct hipot testing at voltage recommended by manufacturer.
 - .2 Raise voltage in steps from zero to maximum values as specified by manufacturer for type of cable being tested.
 - .3 Hold maximum voltage for specified time period by manufacturer.
 - .4 Record leakage current at each step.
- .7 Provide Contract Administrator with list of test results showing location at which each test was made, circuit tested and result of each test.
- .8 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END SECTION

SERVICE EQUIPMENT

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SERVICE EQUIPMENT

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 SCOPE

- .1 Materials and installation of service equipment.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 28 Grounding - Secondary

1.3 REGULATORY REQUIREMENTS

- .1 BC Hydro
 - .1 Refer to BC Hydro Requirements for Secondary Voltage Revenue Metering
(<https://www.bchydro.com/content/dam/BCHydro/customer-portal/documents/distribution/standards/ds-rmr-secondary-voltage-750v-and-less.pdf>)

1.4 SHOP DRAWINGS AND SUBMITTALS

- .1 Submit in accordance with Section 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

Part 2 Products

2.0 METER SOCKET

- .1 Service Kiosk: 1-phase, 100A, 120/240V, CSA Type 3R, supplied with screw type ring.
- .2 Include provision for exterior antenna per BC Hydro Revenue metering bulletin dated January 2016.

SERVICE EQUIPMENT

2.1 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Technical Specification 26 05 00 - Common Work Results for Electrical.
- .2 Label size: 2.
- .3 Nameplate shall include equipment name, voltage, and phase.
 - .1 Confirm nameplate wording with Contract Administrator prior to manufacture.

Part 3 Execution

3.0 INSTALLATION

- .1 Install service equipment in Service Kiosk. For kiosk see Technical Specification 26 27 16 – Electrical Cabinets and Enclosures.
- .2 Connect to incoming service.
- .3 Connect to outgoing load circuits.
- .4 Make grounding connections in accordance with Technical Specification 26 05 28 Grounding - Secondary
- .5 Make provision for BC Hydro's metering.
- .6 Allow for BC Hydro coordination, supply and delivery of materials.

END SECTION

PANELBOARDS BREAKER TYPE

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PANELBOARDS BREAKER TYPE

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation of panelboards and circuit breakers.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 28 16 02 Molded Case Circuit Breakers

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2No.29-11, Panelboards and enclosed Panelboards.

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 PANELBOARDS

- .1 Panelboards based on CSA C22.2 No. 29.
- .2 Product of one manufacturer.

PANELBOARDS BREAKER TYPE

- .1 Install circuit breakers in panelboards before shipment.
- .2 In addition to CSA requirements manufacturer's nameplate must show fault current that panel including breakers has been built to withstand.
- .3 Bus and breakers rated as indicated on the Contract Drawings. Symmetrical interrupting capacity as indicated on Contract Drawings but not less than 10kA.
- .4 Sequence phase bussing with odd numbered breakers on the left and even numbered breakers on the right, with each breaker identified by permanent number identification as to circuit number and phase.
- .5 Panelboards: mains, number of circuits, and number and size of branch circuit breakers as indicated.
- .6 Minimum of 2 flush locks for each panelboard.
- .7 Two keys for each panelboard and key panelboards alike.
- .8 Copper bus with neutral of same ampere rating as mains.
- .9 Mains: suitable for bolt-on breakers.
- .10 Trim with concealed front bolts and hinges.
- .11 Trim and door finish: baked grey enamel.
- .12 Isolated ground bus.
- .13 Include grounding busbar with 3 of terminals for bonding conductor equal to breaker capacity of the panel board.
- .14 Provide minimum additional space for future breakers in panelboards as follows:
 - .1 Panelboards 240V, up to 225A: minimum 10% space and 10% spare 15A breakers or as noted on the Contract Drawings

2.1 SURGE PROTECTION DEVICE

- .1 Provide integrated transient voltage surge suppression as indicated on the drawings.
- .2 Short Circuit Current Ratings:
 - .1 120/240V Panel – 100kA per Phase
- .3 Standard of acceptance: same manufacturer as panelboard.

2.2 BREAKERS

- .1 Breakers: in accordance with Technical Specification 26 28 16 02 Molded Case Circuit Breakers.

PANELBOARDS BREAKER TYPE

- .2 Breakers with thermal and magnetic tripping in panelboards except as indicated otherwise.
- .3 Main breaker (where applicable): separately mounted on top or bottom of panel to suit cable entry. When mounted vertically, down position should open breaker.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Technical Specification 26 05 00 Common Work Results for Electrical.
- .2 Label size: 2.
- .3 Nameplate shall include equipment name, voltage, and phase.
 - .1 Confirm nameplate wording with Contract Administrator prior to manufacture.
- .4 Complete circuit directory with typewritten legend showing location and load of each circuit.

Part 3 Execution

3.0 INSTALLATION

- .1 Locate panelboards as indicated and mount securely, plumb, true and square, to adjoining surfaces.
- .2 Mount panelboards to height specified in Technical Specification 26 05 00 Common Work Results – Electrical or as indicated.
- .3 Connect loads to circuits.
- .4 Connect neutral conductors to common neutral bus.

END SECTION

ELECTRICAL AND CONTROLS COMPONENTS

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ELECTRICAL AND CONTROLS COMPONENTS

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation of components located inside controls cabinet.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 10 Testing and Commissioning
- .3 Technical Specification 26 05 31 Splitters, Junction, Pull Boxes and Cabinets
- .4 Technical Specification 26 28 16 02 Molded Case Circuit Breakers
- .5 Technical Specification 26 28 23 Disconnect Switches
- .6 Technical Specification 26 50 00 Lighting
- .7 Technical Specification 26 42 00 Cathodic Protection of Concrete

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.
- .2 BC Ministry of Transportation and Infrastructure
 - .1 Standard Specifications for Highway Construction, 2016

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

ELECTRICAL AND CONTROLS COMPONENTS

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 CONTROLS CABINET

- .1 Kiosk:
- .1 Provide controls cabinet within electrical kiosk in accordance with Technical Specification 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
 - .2 Equipment layouts shown on the Contract Drawings represent approximate locations only, Contractor shall provide Shop Drawings for all Controls Cabinets including detailed equipment layouts, panel dimensions, and wiring diagrams.
 - .3 Refer to Contract Drawings for specific component requirements at each location.

2.1 CONTROLS CABINET COMPONENTS

- .1 PLC/RTU/Data Logging Equipment:
- .1 Power: 16-32 VDC
 - .2 Standard of Acceptance: Campbell Scientific CR6
- .2 24VDC Power Supply and Diode Module
- .1 Standard of Acceptance: Phoenix Contact QUINT4-PS/1AC/24DC/20
- .3 UPS
- .1 Standard of Acceptance: Always On GES-N-Series
 - .2 Capacity: 700VA
 - .3 Voltage In/Out: 115VAC
 - .4 Input Plug: 5-15P
 - .5 Output Receptacles: 5-15R
 - .6 Include wall/panel mount bracket kit
- .4 Terminals and Interconnect Wiring:
- .1 In accordance with Technical Specification 26 05 00 Common Work Results - Electrical.

ELECTRICAL AND CONTROLS COMPONENTS

- .2 DIN rail mounted terminals complete with dividers and end stops as required. Provide 10 spare terminals on each section and additional spare terminals as noted on the Contract Drawings.
- .3 Utilize plastic finger wiring ducts for organization of all interior and field wiring. Ducts are to be filled to no more than 50% of capacity.
- .4 Use ferrules at termination points on stranded wires.
- .5 A space of 200 mm must be kept clear for field wiring. All wiring labels must be clearly visible at completion.

2.2 EXTERNAL CONTROL COMPONENTS

- .1 Rectifier:
 - .1 Refer to Mechanical Specifications for additional information.

Part 3 Execution

3.0 INSTALLATION

- .1 Install control panel as indicated in the Contract Drawings.
- .2 Apply touch up paint as required.
- .3 Make field power and control connections as indicated.
- .4 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and datasheet.
- .5 Supply all necessary equipment and wiring to provide the points connected to the equipment as indicated on the Contract Drawings.
- .6 Supply, install, and connect external sensors and components as shown on the Contract Drawings.

3.1 CONTROLS

- .1 Data logger to monitor:
 - .1 Reference voltage per zone.
 - .2 Rectifier current draw per zone

3.2 MAINTENANCE MATERIALS

- .1 Provide:
 - .1 Any components which the Contractor recommends to be kept as spares.

ELECTRICAL AND CONTROLS COMPONENTS

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate system to prove satisfactory performance of complete system during 72 hour period.

END SECTION

ELECTRICAL CABINETS AND ENCLOSURES

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ELECTRICAL CABINETS AND ENCLOSURES

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 05 10 Testing and Commissioning
- .3 Technical Specification 26 05 31 Splitters, Junction, Pull Boxes and Cabinets
- .4 Technical Specification 26 24 01 Service Equipment
- .5 Technical Specification 26 28 16 02 Molded Case Circuit Breakers
- .6 Technical Specification 26 28 23 Disconnect Switches
- .7 Technical Specification 26 29 03 Control Devices
- .8 Technical Specification 26 50 00 Lighting

1.2 REGULATORY REQUIREMENTS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1, Canadian Electrical Code, Part 1, Current Edition.
 - .2 C22.2 NO. 94.1-15 - Enclosures for electrical equipment, non-environmental considerations
 - .3 C22.2 NO. 94.2-15 - Enclosures for electrical equipment, environmental considerations.
- .2 National Electrical Manufacturers Association (NEMA)
 - .1 NEMA 250-2008, Enclosures for Electrical Equipment (1000 Volts Maximum).

1.3 SCOPE

- .1 Materials and installation for equipment and components housed in cabinets and enclosures.

1.4 SHOP DRAWINGS AND SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

ELECTRICAL CABINETS AND ENCLOSURES

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 CONTROLS CABINET

- .1 Provide controls cabinet within electrical kiosk in accordance with Technical Specification 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets.
- .2 Equipment layouts shown on the Contract Drawings represent approximate locations only, Contractor shall provide Shop Drawings for all Controls Cabinets including detailed equipment layouts, panel dimensions, and wiring diagrams.
- .3 Refer to Contract Drawings for specific component requirements.

2.1 ELECTRICAL KIOSK

- .1 Electrical Kiosk shall be a one-section, rigid, free-standing, vandal resistant kiosk, rated CSA Type 3R and certified to CAN/CSA C22.2 No. 94.1-15 and CAN/CSA C22.2 No. 94.2-15.
- .2 Kiosk dimensions on Contract Drawings are approximate only. Contractor to determine final kiosk dimensions to layout all of proposed equipment.
- .3 All kiosk assemblies shall be from the same manufacturer, shall bear the CSA seal of approval, or other certification mark acceptable in the Province of British Columbia, and be manufactured by an electrical control panel manufacturer regularly engaged in this type of work.
- .4 General Material Requirements:
 - .1 All materials shall be new.
 - .2 Equipment shall be fabricated from marine grade 5052-H32 sheet aluminum of a least 3.2 mm (1/8 in.) thickness.
 - .3 Use stainless steel hardware, unless otherwise noted.
- .5 Connecting Hardware:

ELECTRICAL CABINETS AND ENCLOSURES

- .1 Miscellaneous hardware other than screws, nuts, bolts and washers shall be stainless steel.
- .2 Connecting hardware (i.e. screws, nuts, bolts and washers) 3/8" diameter or smaller and shall conform to the following:
 - .1 All hardware shall have unified national thread form (ANSI) and shall be stainless steel.
 - .2 All nuts and bolts 1/4-20 and large shall have unified national threads and hexagon heads, and shall bear suitable markings to identify their grade and origin of manufacture.
 - .3 All machine screws smaller than 1/4-20 (ex. 8-32 UNC, 10-24 UNC) shall be Robertson pan-head. All screw heads shall be sized so only one screwdriver is required when working on the panels.
 - .4 No sheet metal or self-tapping screws shall be used.
- .6 Fabrication Mechanical Requirements
 - .1 The kiosk shall be fabricated with sufficient bracing to form a structure capable of withstanding transportation, wind, snow and ice loading. The kiosk manufacturer is responsible for obtaining certification from EGBC registered professional engineer.
 - .2 Recommended anchor locations shall be provided on Shop Drawings.
 - .3 Anchor requirements shall be provided based on wind, snow and seismic loading criteria for the geographic location of the installation.
 - .4 Importance factor of one (1) shall be considered for the installation.
 - .1 All exterior corners shall be rounded to a radius of 3.17mm (1/8 inch) minimum.
 - .2 All sharp edges shall be de-burred to a radius of 0.4mm (1/64 inch) minimum in order to reduce hazards to service personnel.
 - .5 Welding:
 - .1 All welds shall be in accordance with CAN/CSA W59.2 – Welded Aluminum Construction.
 - .2 All welding to be performed by Canadian Welding Bureau certified welders.

ELECTRICAL CABINETS AND ENCLOSURES

- .3 The Supplier shall have suitable credentials to weld aluminum and shall adhere to all applicable ANSI standards. Project references shall be made available upon request.
- .4 All exterior seams shall be of continuously welded construction. Exterior seams shall not be visible. All exterior welds shall be ground smooth.
- .5 All welds shall be free of slag and spatter.
- .6 Roof:
 - .1 The roof shall have a minimum 75 mm overhang with continuous rain gutters.
 - .2 Lifting eyes shall be secured to the frame or the kiosk on reinforced material and be removable after installation.
- .7 Doors:
 - .1 Doors shall have internal bracing when required to prevent excessive distortion.
 - .2 Doors shall be at least 100mm above concrete pad.
 - .3 All kiosk doors are to be lockable. The latches must contain minimum 13 mm diameter hole to receive padlock. Door handles must contain provision for double padlock capability.
 - .4 All double doors to be overlapping with no center mullion.
 - .5 The door handle shall be galvanized steel and powder coated the same colour as the kiosk. Latch handle shall swing towards hinge side of door.
 - .6 Doors shall have three point latching devices with vertical bars that are riveted to actuator bar.
 - .7 Handles, latches and padlocks shall be installed recessed in a pocket such that they cannot be struck off or cut with a standard hacksaw.
 - .8 Handle shall not protrude from recessed pocket during operation.
 - .9 Door hardware to be mounted with tamper resistant hardware.
 - .10 Each door shall have a hydraulic dampener to hold the door in the open position at 90 degrees.

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- .11 Hinges shall be hidden and not accessible from the outside with the door closed. Hinge body to be aluminum with stainless steel hinge pin. Hinges to be of permanently lubricated design
- .8 Viewing Window:
 - .1 1/2 inch thick lexan meter viewing window
- .9 Door Gaskets:
 - .1 The gasket shall be of one continuous piece per side (ex. four strips per opening) and shall be permanently bonded to the metal.
 - .2 The gasket shall be of an appropriate length so as not to have gaps at gasket joints or to shrink over time.
 - .3 The surface of the gasket shall be covered with a silicon lubricant to prevent sticking to the mating surface.
 - .4 The hinge shall be designed to prevent binding of the gasket.
- .10 Plan Pouch and Laptop Shelf
 - .1 Kiosk shall include a waterproof plan pouch (400mm high x 300mm wide minimum) on inside of door in the controls compartment. The pouch shall be secured using stainless steel fasteners.
 - .2 Kiosk shall include fold down door-mounted equipment/laptop shelf in the controls compartment. Shelf shall be mounted such that top of shelf is located 1100mm (36") above the top of finished grade.
- .7 Kiosk Finish
 - .1 General Requirements:
 - .1 The powder coating process shall be tested on at least one piece from a given batch of aluminum components to ensure a high quality coating for that type of component before the complete batch is powder coated. If there is uncertainty about the quality or appearance of the powder coating, the Contractor shall obtain the Owner's approval on the powder coating.
 - .2 Items to be powder coated shall be free of dents, scratches, weld burns, ripples, pits, and abrasion before powder coating.

ELECTRICAL CABINETS AND ENCLOSURES

- .3 Removable components which may be damaged by the powder coating process shall be removed before powder coating and reassembled after powder coating.
- .4 Mask all threaded hardware and tapped holes, as required.
- .2 Pre-Treatment:
 - .1 The powder coating pre-treatment shall include the following steps in sequential order:
 - .1 Alkaline cleaning, or equivalent as required, to remove process oil, grease, and dirt.
 - .2 Rinsing, as required.
 - .3 Multi-metal iron phosphate coating or dried in place pre-treatment to increase corrosion resistance and improve paint adhesion. Follow chemical supplier's specifications. Chemical concentration, temperature, and timing specifications must be followed precisely.
 - .4 Rinsing, as required.
 - .5 Non-chrome, or equivalent, sealing coating to provide additional corrosion protection. Follow chemical supplier's specifications. Chemical concentration, temperature, and timing specifications must be followed precisely.
- .3 Drying / Pre-Heating:
 - .1 All items to be powder coated must be completely dry and pre-heated as required to help prevent out-gassing before powder coat application.
- .4 Application:
 - .1 Powder coat shall be of type Polyester-TGIC.
 - .2 Powder coat colour: Moss Green - RAL 6005.
 - .3 For porous castings, a powder coat type shall be selected to help prevent out-gassing.
 - .4 Powder coat must be applied to meet the powder coat manufacturer's specifications.
 - .5 Powder coat thickness shall be applied to a total 2.5-3.5 mils thickness.
 - .6 Full-coverage of interior and exterior surfaces is required, with no light spots allowed on exterior surfaces.

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- .5 Final Appearance:
 - .1 All powder coatings shall be smooth, substantially free of contamination, flow lines, light spots, powder build-up, powder washout, streaks, sagging, runs, blisters, and other defects that would in any way impair serviceability or detract from the general appearance.
 - .2 The final product shall be free of thickness variations, poor adhesion, orange peel, blistering, pinholes, craters, powder puffs, drips, colour variations, clouding or grainy/wavy flow, dents, scratches, weld burns and abrasions harmful to its strength and general appearance.

- .8 Equipment Mounting Panels:
 - .1 The kiosk shall be provided with full height inside mounting panels.
 - .2 Panels shall be minimum 14 gauge galvanized steel painted white.
 - .3 Panels shall be removable and suitable for drilling and tapping in order to mount internal components.

- .9 Kiosk Environmental Requirements
 - .1 General:
 - .1 The Supplier shall provide heaters of suitable wattage and fans of suitable CFM for the volume and internal heat generation of the components inside of the enclosure to prevent condensation from -20 to +50 degrees Celsius under all prevailing temperature and humidity conditions.
 - .2 Provide sufficient airflow to keep equipment temperature to below +32 degrees Celsius to prevent overheating of the equipment under all prevailing temperature conditions for the area in which it will be installed.
 - .3 Provide positive pressure ventilation to ensure that dust does not enter the cabinets.
 - .2 Insulation:
 - .1 The Supplier shall insulate all sides, doors, and roof of the kiosk.
 - .2 Insulation shall be 25mm Polyisocyanurate Insulation Sheathing. All edges and seams to be sealed with foil tape.

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- .3 The insulation shall have a minimum R-rating of 4.5.
- .4 On doors, insulation shall be concealed by full height 20-gauge aluminum plates.
- .5 On sides and roof, insulation shall be located between outer shell and mounting panels.
- .3 Ventilation:
 - .1 Ventilating louvers shall be vermin, insect and rainproof with easily replaceable fiberglass, non-circular automotive type filters.
 - .2 Ventilation louvres shall be adequately sized and die punched.
 - .3 The controls compartment of the kiosk shall be equipped with one or more 120VAC exhaust fans. The number of fans and louvers will vary according to the kiosk size, prevailing temperature conditions and kiosk equipment heat load.
 - .4 Electrical connections shall be by two insulated spade connectors.
 - .5 There shall be no exposed electrical parts.
 - .6 Fans shall be covered with a protective guard.
 - .7 Fans shall be serviceable and replaceable without having to remove any other component in the kiosk.
- .4 Kiosk Heating:
 - .1 The power distribution and control compartments shall be equipped with 120VAC heaters in accordance with Technical Specification 26 54 00 Heaters and Ventilation.
 - .2 Heaters shall be serviceable and replaceable without removing any component in the kiosk. Heaters shall be located to prevent burning of adjacent components.
 - .3 Heaters shall be suitably shielded to prevent accidental burning.
 - .4 There shall be no exposed electrical parts.
- .5 Thermostat:
 - .1 Kiosks shall be equipped with one or more 120/240VAC thermostats in accordance with the requirements under Technical Specification 26 54 00 Heaters and Ventilation.

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- .2 Thermostats shall be serviceable and replaceable without removing any component in the kiosk.
 - .3 There shall be no exposed electrical parts.
 - .4 Control of heater shall be from a thermostat integral to heater enclosure.
 - .5 Control of fan shall be from a wall-mount thermostat.
- .10 Kiosk Lighting:
- .1 Kiosk lights shall be LED in accordance with the requirements under Technical Specification 26 50 00 Lighting.
 - .2 Provide door switch in accordance with Technical Specification 26 27 26 Wiring Devices.
- .11 Conduit and Wiring:
- .1 Wiring between components within the kiosk shall be in EMT.
 - .2 Conduit to be in accordance with the requirements under Technical Specification 26 05 34 Conduits, Conduit Fastenings and Conduit Fittings.
 - .3 Wiring to be in accordance with the requirements under Technical Specification 26 05 21 Wires and Cables (0-1000V)
- .12 Electrical Assemblies:
- .1 Equipment within the kiosk shall be within enclosures in accordance with the requirements under Technical Specification 26 05 31 Splitters, Junction, Pull Boxes and Cabinets.
 - .2 Enclosures shall be gray powder coat finish inside and out over pretreated surfaces.
 - .3 Additional equipment are listed in the Contract Drawings and in the electrical Technical Specifications.

2.2 CONTROLS CABINET COMPONENTS

- .1 PLC/RTU Equipment:
- .1 Refer to Technical Specification 26 27 15 Electrical and Controls Components.
- .2 24VDC Power Supply
- .1 Refer to Technical Specification 26 27 15 Electrical and Controls Components.

ELECTRICAL CABINETS AND ENCLOSURES

- .3 UPS
 - .1 Refer to Technical Specification 26 27 15 Electrical and Controls Components.
- .4 Terminals and Interconnect Wiring:
 - .1 In accordance with Technical Specification 26 05 00 Common Work Results - Electrical.
 - .2 DIN rail mounted terminals complete with dividers and end stops as required. Provide 10 spare terminals on each section and additional spare terminals as noted on the Contract Drawings.
 - .3 Utilize plastic finger wiring ducts for organization of all interior and field wiring. Ducts are to be filled to no more than 50% of capacity.
 - .4 Use ferrules at termination points on stranded wires.
 - .5 A space of 200 mm must be kept clear for field wiring. All wiring labels must be clearly visible at completion.

2.3 EXTERNAL CONTROL COMPONENTS

- .1 Not Used

Part 3 Execution

3.0 INSTALLATION

- .1 Install control panel as indicated in the Contract Drawings.
- .2 Apply touch up paint as required.
- .3 Make field power and control connections as indicated.
- .4 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and datasheet.
- .5 Supply all necessary equipment and wiring to provide the points connected to the equipment as indicated on the Contract Drawings.
- .6 Assemble the control cabinets to include the components identified within the Contract Documents and indicated on the Contract Drawings.
- .7 Supply, install, and connect external sensors and components as shown on the Contract Drawings.

3.1 MAINTENANCE MATERIALS

- .1 Provide:

ELECTRICAL CABINETS AND ENCLOSURES

- .1 Ten (10) spare fuses of each type used in the panel, as required.
- .2 Any other components which the Contractor recommends to be kept as spares.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.
- .2 Ensure moving and working parts are lubricated where required.
- .3 Operate system to prove satisfactory performance of complete system during 24 hour period.

END SECTION

WIRING DEVICES

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Revision History

Rev. No.	Date	Description of Revisions	Prep. By	Rev. By
-	November 12, 2020	Issued Tender	MS	IN

WIRING DEVICES

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Switches, receptacles, wiring devices, cover plates and their installation.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 Common Work Results – Electrical
- .2 Technical Specification 26 27 16 Electrical Kiosk

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.42 10, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA C22.2 No.42.1 13, Cover Plates for Flush Mounted Wiring Devices (Bi national standard, with UL 514D).
 - .3 CSA C22.2 No.55 15, Special Use Switches.
 - .4 CSA C22.2 No.111 10, General Use Snap Switches (Bi national standard, with UL 20).
 - .5 CSA-C22.2 No. 177-13, Clock-operated Switches
 - .6 CSA-C22.2 No. 184-15, Solid-State Lighting Controls

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

WIRING DEVICES

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 SWITCHES

- .1 15A, 120 V, single pole, specification grade switches to: CSA-C22.2 No.55 and CSA-C22.2 No.111.
- .2 Manually-operated general purpose ac switches with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle.
- .3 Toggle operated fully rated for tungsten filament, fluorescent, and LED lamps, and up to 80% of rated capacity of motor loads.
- .4 Provide switches with occupancy sensors for control of interior lighting.
- .5 Switches will be of one manufacturer throughout the Project.

2.1 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R/20R as indicated, 125 V, 15/20 A as indicated, U ground, to: CSA-C22.2 No.42 with following features:
 - .1 White urea moulded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
- .2 Other receptacles with ampacity and voltage as indicated in Contract Drawings.
- .3 Receptacles will be of one manufacturer throughout the Project.
- .4 Ground fault interrupting capabilities as indicated in Contract Drawings.

2.2 COVER PLATES

WIRING DEVICES

- .1 Cover plates for wiring devices to: CSA-C22.2 No.42.
- .2 Cover plates will be of one manufacturer throughout the Project.
- .3 Stainless steel.
- .4 Weatherproof RPVC cover plates for surface-mounted FS or FD Type boxes.
- .5 Weatherproof clear, lockable, while-in-use cover plates for all GFI locations, as indicated in Contract Drawings.

2.3 DOOR SWITCHES

- .1 Provide a door switch mounted to the kiosk such that actuation occurs when the outer door with handle is opened, the switch is triggered.
- .2 Provide a door switch mounted to the generator enclosure such that actuation occurs when each door with handle is opened.
- .3 Door switch shall have a lever type actuation with 1 normally open and 1 normally closed set of contacts.
- .4 Door switch shall be rated for hazardous application locations including gasses (explosion), dust environment, NEMA Types 2, 4, 6P, 7, 9, 13.
- .5 Standard of Acceptance: Telemecanique "XCKP Class 9007 Type C" or approved equal.

2.4 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.
- .2 Install identification labels indicating circuit, voltage, and phase.

Part 3 Execution

3.0 INSTALLATION

- .1 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.
 - .2 Install switches in gang type outlet box when more than one switch is required in one location.
 - .3 Mount toggle switches at height in accordance with Technical Specification 26 05 00 Common Work Results – Electrical or as indicated on the Contract Drawings.

WIRING DEVICES

- .2 Receptacles:
 - .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .2 Mount receptacles at height in accordance with Technical Specification 26 05 00 Common Work Results – Electrical or as indicated on the Contract Drawings.
 - .3 Where split receptacle has one portion switched, mount vertically and switch upper portion.
 - .4 Install GFI type receptacles as indicated on Contract Drawings.
- .3 Cover plates:
 - .1 Install suitable common cover plates where wiring devices are grouped.
 - .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

3.1 PROTECTION

- .1 Protect installed products and components from damage during Construction.
- .2 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
- .3 Repair damage to adjacent materials caused by wiring device installation.

END SECTION

MOLDED CASE CIRCUIT BREAKERS

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Revision History

Rev. No.	Date	Description of Revisions	Prep. By	Rev. By
-	November 12, 2020	Issued for Tender	MS	IN

MOLDED CASE CIRCUIT BREAKERS

Part 1 General

1.0 DOCUMENTS

- .1 This Section of the Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 SECTION INCLUDES

- .1 Materials for moulded-case circuit breakers.

1.2 RELATED SECTIONS

- .1 Section 26 05 00 – Common Work Results for Electrical.
- .2 Section 26 24 01 – Service Equipment
- .3 Section 26 24 02 – Service Entrance Board
- .4 Section 26 24 16 01 – Panelboards Breaker Type

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5-13, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489 and NMX-J-266-ANCE).

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 In accordance with Section 26 05 00 – Common Work Results – Electrical.

1.5 PRODUCT DATA

- .1 Submit product data in accordance with Section 26 05 00 – Common Work Results for Electrical.
- .2 Include time-current characteristic curves for breakers.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

MOLDED CASE CIRCUIT BREAKERS

Part 2 Products

2.0 BREAKERS GENERAL

- .1 Molded case circuit breakers based on CSA C22.2 No.5.
- .2 Bolt-on molded case circuit breaker: quick- make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg C ambient.
- .3 Common-trip breakers: with single handle for multi-pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .5 Circuit breakers in Panelboards to have minimum interrupting capacity ratings as indicated on the drawings.

2.1 THERMAL MAGNETIC BREAKERS

- .1 Molded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.2 ENCLOSURE

- .1 In accordance with Technical Specification 26 24 16 01 Panelboards Breaker Type.

Part 3 Execution

3.0 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

CATHODIC PROTECTION OF STEEL IN CONCRETE

1.0 GENERAL

1.1 WORK INCLUDED

- .1 Provide all labour, materials, equipment, design services and supervision necessary to install an impressed current and or sacrificial anode cathodic protection system on the top structural bridge slab and on the top of the sidewalks and the underside of the bridge at the I-Beam/Deck Interface. Work includes installation of cabling, data logger, electrical connections and other equipment necessary for modulating and monitoring the system, including half-cell potential, anode current output, verification of performance and initial operations and maintenance training.

1.2 Related Work

03 30 00	Portland Cement Concrete
03 32 00	Concrete Overlays
Division 26	Electrical

1.3 REFERENCE DOCUMENTS

- .1 All reference documents are to be the latest edition of that document.
- | | | |
|-----|----------------------|---|
| .1 | ASTM B265 | Standard Specification for Titanium and Titanium Alloy Strip, Sheet, and Plate |
| .2 | ASTM C876 | Standard Test Method for Corrosion Potentials of Uncoated Reinforcing Steel in Concrete |
| .3 | ASTM C1152 / C1152M | Standard Test Method for Acid-Soluble Chloride in Mortar and Concrete |
| .4 | ASTM D4580 / D4580M | Standard Practice for Measuring Delaminations in Concrete Bridge Decks by Sounding |
| .5 | CSA-A23.1 | Concrete Materials and Methods of Concrete Construction |
| .6 | CSA-A23.2 | Methods of Test for Concrete |
| .7 | CSA A3000 | Cementitious materials compendium |
| .8 | CSA C22.1 | Canadian Electrical Code |
| .9 | EN 1504 | Products and systems for the protection and repair of concrete structures: Definitions, requirements, quality control and evaluation of conformity. |
| .10 | FM 5-578 | Florida Method of Test for Concrete Resistivity as an Electrical Indicator of its Permeability |
| .11 | ICRI Guideline 03730 | Surface Preparation for Repair or Deteriorated Concrete Resulting from Reinforcing Steel Corrosion |
| .12 | IEC 60502-1 | Power cables with extruded insulation and their accessories for rated voltages |

CATHODIC PROTECTION OF STEEL IN CONCRETE

	from 1 kV (Um = 1,2 kV) up to 30 kV (Um = 36 kV) – Part 1
.13 IEC 60529	International Electrical Standard – Degrees of protection provided by enclosures (IP Code)
.14 IEC 62262	Degrees of Protection Provided By Enclosures For Electrical Equipment Against External Mechanical Impacts (IK Code)
.15 NACE No. 3/ SSPC- SP6	Commercial Blast Cleaning
.16 RILEM CPC-18	Measurement of hardened concrete depth of carbonation
.17 ISO 12696	Cathodic Protection of Steel in Concrete
.18 NACE SP0290-2007	Standard Practice: Impressed Current Cathodic Protection of Reinforcing Steel in Atmospherically Exposed Concrete Structures.
.19 NACE/TM 0294	Testing of embeddable impressed current anodes for use in cathodic protection of atmospherically exposed reinforced-concrete

1.4 DEFINITIONS

- .1 Definitions as per Section 2 of NACE SP0290.

1.5 CONTRACTOR SUBMITTALS

- .1 The *Contractor* shall submit to the *Contract Administrator* a quality control plan outlining details of the proposed quality control testing and tracking that will be undertaken in order to comply with the requirements of this specification or other project quality control needs.
- .2 The *Contractor* shall submit to the *Contract Administrator* for approval Manufacturer's product data sheets and specifications for the following products a minimum of four weeks prior to commencement of the cathodic protection work:
- .1 Anode systems.
 - .2 Monitoring sensors.
 - .3 Monitoring instruments
 - .4 Data management system.
 - .5 Direct current cables.
 - .6 Junction Boxes.
 - .7 Power supplies.
 - .8 Transformer-rectifiers.
 - .9 Miscellaneous accessories.
- .3 The *Contractor* shall prepare and submit sample documents / reports for the following, a minimum of four weeks prior to commencing installation work of cathodic protection system:

CATHODIC PROTECTION OF STEEL IN CONCRETE

- .1 Proposed installation procedures.
- .2 Commissioning procedures.
- .3 System Records and Documentation Manual.
- .4 Operation and Maintenance Procedures Manual.
- .3 The Operations and Maintenance Procedures Manual shall include:
 - .1 System description (including operation, function).
 - .2 Intervals of inspection with associated tasks to be performed.
 - .3 Instructions for remote data access and manual on site access to system data.
 - .4 Formulas required for operation, function and system review.
 - .5 Troubleshooting steps in case of irregular or non-compliant system operation.
 - .6 Maintenance and repair procedures with contact information for replacement part distributors and contacts for technical assistance.
- .4 The *Contractor* shall carry out calculations and prepare shop drawings to confirm that their design meets the intent of the specification. The calculations and shop drawings shall be signed and sealed by a professional engineer registered to practice in the province of British Columbia. The *Contractor* shall submit the following for review, a minimum of ten (10) weeks prior to commencing installation work of cathodic protection system:
 - .1 Calculations showing required current distribution and estimated current demand based on exposure, concrete chloride content, resistivity, moisture content and reinforcement/steel surface area for each protection zone.
 - .2 Detailed calculation to determine steel surface area in each square metre of the structure. Calculation to include reinforcement and all additional steel surface areas to be protected.
 - .3 Calculations detailing local cathode current demand per square metre of surface area.
 - .4 Calculations confirming anode sizing, and locations.
 - .5 Shop drawings showing proposed location of anodes, connection details to anodes proposed location monitoring sensors, cabling plan showing configuration of wires, transformer-rectifier locations.
 - .6 Plan drawing showing cathodic protection zones with calculations of the feeder spacing to ensure that local cathode current density requirements are met and to minimize the voltage and anode current density differentials within zones due to anode and cable resistances.
 - .7 Primary anode material and cross-section, its distribution and primary anode "positive cable" connections shall be selected to provide the required redundancy and to minimize voltage drops.
 - .8 A letter subject to acceptance by the *Contract Administrator* that summarizes the justification for selection of the cathodic protection zones and their associated anticipated current demand.

CATHODIC PROTECTION OF STEEL IN CONCRETE

- .9 Documents as listed in 1.7.12.
- .5 The *Contractor* shall submit a test report for anode with accelerated testing to demonstrate that the anode life is equivalent to the design life at the maximum design anode current density plus any safety margin determined necessary by the design in respect of possible non-uniform distribution of current. Information to be submitted four weeks prior to installation of the anodes.
- .6 The *Contractor* shall submit a letter from the anode manufacturer confirming compatibility of the anodes with the prebagged repair mortar and overlay concrete prior to installation of the anodes prior to installation of anodes on site.
- .7 The *Contractor* shall submit a letter from the anode manufacturer confirming acceptance of the proposed installation procedures for the anode installation prior to installation of the anodes.
- .8 The *Contractor* shall submit certificates of qualification for personnel as required by this specification four weeks prior to commencing work on site.
- .9 The *Contractor* shall submit test reports to show that the materials in Part 2 have been met.
- .10 The *Contractor* shall complete testing during the installation of the anode system as described in Part 3. The *Contractor* shall submit the results of the testing within two working Days to the *Contract Administrator*.
- .11 Prior to substantial completion of the work the *Contractor* shall submit updated record drawings detailing any changes to the design submittal that reflect the as-built condition of the work.
- .12 The *Contractor* shall submit electrical design drawings showing details of rectifier connection to power and power distribution routing to anodes with connection details. Electrical drawings to be signed and sealed by an electrical engineer registered to practice in the Province of British Columbia.
- .13 The *Contractor* shall submit the results of testing and survey work as listed in Section 3.

1.6 Reliance on Provided Information

- .1 The *Owner* has made available condition assessment reports which include chloride profiling, reinforcement potential surveys, depth of cover measurements. These specifications include steel layouts that have been interpolated from previous field investigations. The *Contractor* can rely on this information at their own risk. No guarantee of accuracy of information is implied.

1.7 System Verification Requirements by the Contractor

- .1 The design and/or the selection of the anode material shall consider likely variations in cathode current density requirements, steel distribution, concrete electrical resistivity and any other factors likely to result in uneven distribution of current demand or current discharge from the anode and the possibility of this resulting in an early failure of isolated parts of the anode system.
- .2 The *Contractor's* design shall be based on exposure condition, concrete chloride content,

CATHODIC PROTECTION OF STEEL IN CONCRETE

- concrete resistivity, expected moisture content and reinforcement/steel surface area.
- .3 Zone anode current density shall be designed to be uniform to within 10 % of the nominal anode current density at all locations within the zone; cable and anode voltage drops should be calculated and designed to ensure such uniformity.
 - .4 The system shall be designed to limit the maximum sustained current density at the effective surface contact area between the anode and the concrete to levels below 108 mA/m² (10 mA/ft²).
 - .5 Voltage and current attenuation along the anode and its connecting wire in distributed anode impressed current systems shall be evaluated.
 - .6 Rectifiers shall be selected to provide adequate allowance for anticipated changes in current requirements and circuit resistance with time.
 - .7 System design shall provide safe step-and-touch potentials.
 - .8 Tolerances shall be stated and shown on drawings.
 - .9 Electrical isolation and avoidance of stray currents corrosion of metal items mounted on, in, or adjacent to the protected elements shall be addressed in the cathodic protection system design. It is likely that the drains, joints, railings, lighting fixtures are electrically continuous with the rebar. This shall be considered for the cathodic protection system design.
 - .10 Redundancy of current output, circuitry, and monitoring components and the capacity to readily isolate sections of the impressed current cathodic protection system shall be provided.
 - .11 The design shall be carried out by an experienced design professional that with demonstrated impressed current cathodic protection design experience using mixed metal-oxide-coated titanium (MMO/Ti) anodes and sacrificial galvanic anodes for atmospherically exposed reinforced concrete. The designer shall have completed training through the NACE Cathodic Protection Program and achieved a level 2 certification or above.
 - .12 The design shall, as a minimum, include the following:
 - a) detailed calculations;
 - b) detailed installation drawings;
 - c) detailed material and equipment specifications;
 - d) detailed method statements or specifications for installation, testing, energizing, commissioning and operation;
 - e) Circuit resistance values.
 - f) Positioning of anodes, sensors and connections to anodes and steel shall be clearly shown on record drawings.

1.8 Performance Criteria

- .1 The design, installation and operation of the cathodic protection system shall be in general conformance with the provisions of this specification and the requirements of ISO 12696.
- .2 The intent of the cathodic protection system is to provide a 40 year service life extension to the reinforced concrete elements of the structure.

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- .3 Anode life = minimum 50 years continuous operation.
- .4 For the structure, any representative steel in concrete location shall meet any one of the criteria given in items a) to c):
 - a) an "Instantaneous OFF" potential more negative than -720 mV and more positive than -1100 mV with respect to Ag/AgCl/0,5 M KCl.
 - b) a potential decay over a maximum of 24 h of at least 100 mV (mean value) and maximum 250 mV (mean value) with all individual values above 80 mV from "Instantaneous OFF".
 - c) a potential decay over an extended period (typically 24 h or longer) of at least 150 mV from the instant off subject to a continuing decay and the use of reference electrodes (not potential decay probes) for the measurement extended beyond 24 h.
- NOTE: It is not necessary to meet more than one item of a), b) or c).
- .5 No instant off steel/concrete potential more negative than -1100 mV with respect to Ag/AgCl/0,5 M KCl shall be permitted for plain reinforcing steel..
- .6 The monitoring system shall be capable of verifying the cathodic protection system performance in accordance with this section. The system performance shall be determined by measuring the steel/concrete potential, using reference electrodes.
- .7 The entire cathodic protection system shall be designed, installed and tested to be suitable for its intended life in its intended environment.
- .8 For anodes embedded into or applied to the surface of the concrete, the anode current density shall conform to the design and shall not exceed such values resulting in a performance reduction of either:
 - a) the concrete at the anode/concrete interface, or
 - b) the anode, during the design life of the anode.

1.9 Data Management

- .1 A computerized data-based management system shall be provided to collate, order, sort and present the performance data arising from the cathodic protection system.
- .2 The system shall contain the following data as a minimum:
 - a) Anode-zone layouts;
 - b) sensor type and location;
 - c) direct current power unit rating;
 - d) initial (pre-commissioning) sensor readings;
 - e) commissioning data;
 - f) sensor data obtained since commissioning (at time intervals conforming to this specification);
 - g) direct current power supply output data since commissioning;
 - h) event record (i.e. inspection dates, changes in system operation, etc.).
- .3 Sensor data obtained and recorded shall be compatible with, and sufficient to enable conformity to, the performance criteria.

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- .4 Computer database management systems shall be provided with full documentation. Facilities for automatic data back-up and archiving shall be incorporated.
- .5 The system shall be capable of presenting data/information in both tabular and graphical form.
- .6 The system shall be capable of identifying data points outside pre-set (user definable) limits on request.
- .7 The datalogger shall be preprogrammed to run depolarization trials on the system at set intervals of every 4-months. The system shall be re-energized after a 24-hour period of depolarization. The depolarization trials shall be stored on internal memory until the data is downloaded either remotely or manually. Data shall be stored on the datalogger. If memory is fully consumed, then the oldest readings shall be overwritten in preference to the latest data.

1.10 Measurement and Payment

- .1 Payment for all assessment, sampling and testing shall include facilitation and preparation of all assessment, tests, sampling and verifications of the elements noted in Section 3 of this specification which are required for final system verification including preparation and approval process for all shop drawings and relevant required details. Payment shall be based on a lump sum price.
- .2 Payment for supply and installation of Reference Electrodes shall be paid on a unit rate basis per Reference Electrode and shall include the supply and installation of electrodes and all associated works as per Section 2 and Section 3 of this specification, including all wiring and electrical requirements of providing a working system.
- .3 Payment for supply and installation of Sheet Anodes shall include supply and installation of anodes as per Section 2 and Section 3 of this specification and the detailed design drawings, including all wiring and electrical requirements of providing a working system.
- .4 Payment for supply and installation of Ribbon Anodes below the deck shall be paid on a unit rate basis and shall include the supply and installation of anodes as per Section 2 and Section 3 of this specification and the detailed design drawings, including all wiring and electrical requirements of providing a working system.
- .5 Payment for supply and installation of Galvanic Anodes below the deck shall be paid on a unit rate basis and shall include the supply and installation of anodes as per Section 2 and Section 3 of this specification and the detailed design drawings, including all wiring and electrical requirements of providing a working system.
- .6 Payment for supply and installation of Ribbon Anodes in the sidewalk shall be paid on a unit rate basis and shall include the supply and installation of anodes as per Section 2 and Section 3 of this specification and the detailed design drawings, including all wiring and electrical requirements of providing a working system.
- .7 Supply and installation of Rectifiers shall be for each rectifier required and include supply and installation of the rectifiers, cabinets, mounting requirements and wiring and electrical connections to the rectifiers and anode systems and all other elements required to provide a working system.

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- .8 Supply and installation of Dataloggers shall include supply and installation of the datalogger and cabinets, wiring and electrical connections to the rectifiers and anode systems and all other elements required to provide a working system.
- .9 Commissioning, testing and training of City personnel shall be paid on a lump sum basis and include final testing, verification, commissioning and training of the completed protection system including all anode systems, rectifiers, dataloggers and electrical connections. Works shall include but not be limited to all elements required in part of Section 3 of this specification and other elements required to provide a functioning system.
- .10 Payment for the 5-year maintenance agreement shall include all elements outlined in section 3.20 for a period of 5 years from the Substantial Completion date. Payment shall be a lump sum cost with payments being claimed on a yearly basis based on 20% of the lump sum cost per year and be claimable upon submission and acceptance of the report outlined in 3.20.4.

2.0 PRODUCTS

2.1 General

- .1 The cathodic protection system shall include an anode system intended to distribute the cathodic protection current to the surfaces of the embedded steel to be protected. Impressed current cathodic protection (ICCP) systems and sacrificial anode cathodic protection (SACP) shall further incorporate positive and negative direct current cables between the anode and the steel, respectively, and the DC power supply, which is the source of the cathodic protection current.
- .2 Reference electrodes, other electrodes and other sensors are key elements of cathodic protection systems and constitute the performance monitoring system within cathodic protection systems.
- .3 The products for the cathodic protection system shall meet the requirements of ISO 12696 unless there is a more stringent requirement applicable due to local regulations.
- .4 The electrical safety regulations of Canada and British Columbia shall govern.
- .5 Monitoring instrumentation shall be used to interrogate monitoring sensors installed to determine the performance of the cathodic protection system and the operating condition of the direct current power supply.
- .6 All instrumentation shall be constructed in accordance with relevant national or international standards relating to electronic and measurement equipment and shall be provided with a valid calibration certificate. All equipment shall be handled, installed, commissioned and operated in accordance with the manufacturer's recommendations.

2.2 Anodes

- .1 The ICCP anodes shall be mixed metal-oxide-coated titanium (MMO/Ti) anodes with a Titanium Grade of 1 (ASTM B265). The SACP anodes shall have a zinc core in compliance with ASTM B418 Type II and be encased in an activated cementitious mortar with pH of 14 or greater. The anodes shall have a zinc mass of minimum 65g. Alternates subject to

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approval by *Contract Administrator*.

- .2 The expected design life of the MMO/Ti anodes shall be demonstrated by trials and/or laboratory testing. NACE/TM 0294 is a suitable test method to verify performance.
- .3 The anodes shall take the form of a mesh or grid for the topside application on the structural bridge slab.
- .4 The anodes shall take the form of a ribbon for the underside installation at the I-Beam / Slab interface.
- .5 The anodes shall take the form of a ribbon anode for the installation into recesses in the concrete sidewalk.
- .6 Anode life = minimum 50 years continuous operation.
- .7 Preapproved manufacturer: De Nora. Alternates to be approved by *Contract Administrator*.

2.3 Prebagged concrete repair materials

- .1 Repair concrete constituents to meet the requirements of CSA-A23.1 and CSA A3000.
- .2 Repair materials shall have an electrical resistivity between 5,000 to 15,000 ohm-cm. When tested in accordance with FM 5-578.
- .3 The repair mortar shall not contain latent hydraulic additions (pozzolans).
- .4 The polymer component of the mortar shall be limited to: polymer / cement (content by weight) less than 0.1.
- .5 Repair materials containing metal (either fibre or powder) shall not be used.
- .6 Repair concrete shall be selected from the BC Ministry of Transportation Recognized Product List 2020 edition Subject to 2.3.1 through 2.3.5.

2.4 Monitoring Sensors

- .1 Suitable reference electrodes for permanent embedding in concrete include double junction Ag/AgCl/KCl and Mn/MnO₂/0,5 M NaOH electrodes.
- .2 Reference electrodes shall have an electrode potential within ± 10 mV of their theoretical value and any batch of reference electrodes shall all have electrode potentials within ± 5 mV of their calibration certificates.
- .3 Reference electrodes shall be calibrated with respect to a pair of clean and fully maintained laboratory or mapping electrodes in order to demonstrate the above electrode potential accuracy prior to installation. Records of calibration to be submitted to *Contract Administrator*.
- .4 All sensors shall be sufficiently robust for installation and permanent exposure in highly alkaline conditions.
- .5 The expected service life of the reference electrodes shall be > 50 years.
- .6 The cables and cable connections to sensors shall be similarly robust and alkaline resistant and acid resistant if in contact with, or close to, the anode system.

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- .7 Reference electrode wires shall be of sufficient length to reach the monitoring station without splicing.

2.5 Data Logger

- .1 The permanently installed data loggers shall have suitable multi-channel input or multiplexers to enable all channels selected for data logging to be measured and recorded.
- .2 Data loggers shall operate under a real date-time clock which shall be included in all measurement units. Data loggers shall have a minimum input impedance of 10 MΩ and a resolution of at least 1 mV in a range of at least 2 000 mV and an accuracy of ±5 mV or better.
- .3 Data loggers shall be supplied with software allowing test locations, sensors, direct current power systems, anode zones to be identified.
- .4 Permanently installed data loggers shall be located in an enclosure suitable for the environment and climate conditions at the site.
- .1 Refer to Specification SS 26 27 16 Electrical Cabinets and Enclosures
- .5 Permanently installed data loggers shall be hardwired to relevant sensors, direct current power supplies.
- .6 Each permanently installed data logger shall have a unique identification reference number.
- .7 The data acquisition unit specification must be capable of operating in the following conditions:
- a) Temperature -20°C to +70°C
- .8 The data acquisition unit shall be fully programable with differential and single ended data acquisition channels.
- .9 The data acquisition unit shall be programed to record the following measurements:
- a) Current shut with differential channel
b) Reference electrode with differential channel
c) Temperature
- .10 The data acquisition unit shall be outfitted with a battery backup in case of a power outage.
- .11 Dataloggers shall be programmed to collect data for select intervals. Datalogger shall be capable of transmitting summary data automatically and on request.
- .12 Preapproved product: Campbell Scientific CR6. Alternates to be approved by *Contract Administrator*.

2.6 Enclosure

- .1 Provide NEMA rated enclosure suitable for the space intended to house sensitive electrical equipment such as dataloggers.
- .1 Refer to Technical Specification SS 26 27 16 Electrical Cabinets and Enclosures.

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2.7 Cabling

- .1 Direct current cables shall be colour coded according to their function as follows:
 - a) Brown (or alternatively red) from positive DC power to anode / cable connection;
 - b) Black from negative DC power to reinforcement steel/cable connection;
 - c) Grey for monitoring test (reinforcement connection for monitoring) cable.
 - d) Blue (or alternatively yellow) for reference electrode cable.
- .2 Direct current cables shall be routed to rectifier / data logger without splices.
- .3 Cabling for anodes to be monitored for current and half cells to be installed in PVC conduit.
- .4 All cables shall be identified in junction boxes and at their points of connection to monitoring equipment and power supplies. The identification shall be by proprietary cable markers and the identification shall be fully detailed (i.e. any code explained) in each junction box, monitoring unit and power supply unit. The identification and the cable colours shall be fully documented on the as-built drawings and manuals.
- .5 Cables shall meet the following requirements:
 - a) carry the design current +25 % within permissible temperature increases allowed under IEC 60502-1 or the Canadian Electrical Code (whichever is more stringent), as appropriate to the maximum environmental temperatures;
 - b) limit the voltage drop at 125 % of the designed maximum current in the cathodic protection system circuit to a value compatible with the power supply voltage output and the anode/cathode voltage requirements and provide uniform zone current distribution.
- .6 Minimum core sizes of multi-core cables for mechanical purposes, with all cables encapsulated in concrete, or in conduit or trunking shall be as follows:
 - a) DC positive and negative supplies 1,0 mm²;
 - b) monitoring cable 0,5 mm²;
 - c) data networking in accordance with network standards.
- .7 If single-core cables are used, the minimum core size for mechanical purposes shall be 2,5 mm².
- .8 All cable cores shall have a minimum of seven strands.
- .9 All cables shall have a minimum of a single layer of insulation and a single layer of sheathing which shall conform to IEC 60502-1 or the Canadian Electrical Code (whichever is more stringent). The selection of insulation and sheath shall take due account of the proposed installation and functional requirements. Cable to be installed in contact with anode material shall be suitable for long-term exposure to acidic conditions, typically pH = 2, and those to be installed in concrete for long-term exposure to alkaline conditions, typically pH = 13.
- .10 Conduit sizing and material properties to meet applicable electrical standards.
- .11 Refer to Technical Specification SS 26 05 21 Wire and Cables (0-1000V)

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2.8 Junction Boxes

- .1 Junction boxes shall be rated in accordance with IEC 60529 and IEC 62262 or the Canadian Electrical Code (whichever is more stringent) to render appropriate protection against the environment, taking into account the type of connections made within the box and the worst case external environmental and mechanical exposure to which the box is to be subjected.
- .2 All junction boxes shall be non-metallic and conform to IEC 60529 classification IP 66 or better when exposed to external environments.
- .3 Refer to Technical Specification SS 26 05 31 Splitters, Junction, Pull Boxes and Cabinets.

2.9 Power Supplies

- .1 Direct current power supply shall be provided by transformer-rectifiers or switch mode rectifiers.
- .2 All power supplies shall be constructed in accordance with relevant national or international standards relating to electronic and measurement equipment and shall be provided with a valid calibration certificate. All equipment shall be handled, installed, commissioned and operated in accordance with the manufacturer's recommendations.
- .3 Power supplies shall be integrated with monitoring instrumentation and communication facilities in order to provide remote monitoring of d.c power supply parameters and the cathodic protection system performance. This integrated monitoring and power supply system shall provide for remote control of the power supply direct current output.

2.10 Transformer-rectifiers

- .1 The transformer-rectifier units shall be continuously rated, self-contained and suitable for the environment in which they are to operate.
- .2 The unit shall be housed in a robust enclosure suitable for wall mounting, as applicable. The enclosure shall provide protection against the worst-case environment in accordance with IEC 60529.
- .3 The incoming alternating current supply shall be terminated in accordance with the electricity supplier's requirements and national and/or international standards.
- .4 The mains transformer shall be an isolating transformer conforming to IEC 61558-1, IEC 61558-2-1, IEC 61558-2-2 and IEC 61558-2-4 continuously rated and suitable for connection to the low voltage alternating current supply. The transformer-rectifier output shall not exceed 50 V DC with a ripple content not exceeding 100 mV RMS with a minimum frequency of 100 Hz.
- .5 The mains transformer shall be rated to minimum 96% efficient with class H temperature rated.
- .6 Equipment, which does not conform to the relevant parts of IEC 61558 because it is required by environment or service to operate above an ambient temperature of 30 °C or to utilize oil or forced air cooling, shall in all other aspects conform to IEC 61558-1, IEC 61558-2-1, IEC 61558-2-2 and IEC 61558-2-4. Equipment utilizing auto transformers shall

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- conform to IEC 61558-2-13 and equipment utilizing switch mode power supplies shall conform to IEC 61558-2-16.
- .7 The rectifier shall conform to appropriate national or International Standards with suitable alternating current and direct current surge protection. Rectifiers shall be rated for continuous operation at the specified outputs with a peak inverse voltage of at least 600 V. Varistors shall be compatible with the rectifier peak inverse voltage levels. The direct current circuits shall be separated from those of any other system (e.g. the incoming alternating current supply). For cathodic protection systems placed in locations accessible to persons or animals, and where preventative measures, such as barriers, obstacles or electrical insulation, are not provided, the output from the transformer rectifier unit shall not exceed 24 V DC with a ripple content not exceeding 100 mV RMS.
 - .8 The output shall be controlled to provide 25 output steps with terminal block adjustment.
 - .9 A direct current relay system interrupting the output shall be provided to facilitate "instantaneous off" potential measurement.
 - .10 Facilities shall be provided to enable portable instrumentation to be used for measurement of the following:
 - a) output voltages;
 - b) output currents (by voltage drop across a shunt resistor with an accuracy of $\pm 0,5$ % or better);
 - c) steel/concrete potential with respect to the reference electrodes.
 - .11 The function and rating of all sockets and the multiplying factor of all shunts shall be clearly marked. All fuses shall be labelled with circuit designation and fuse characteristics.
 - .12 A minimum of one positive and one negative terminal for cable connections shall be provided. All output terminals shall be fully insulated from any metal within the box.
 - .13 The connectors shall be clearly marked, e.g. "+ ANODE" and "- STEEL".
 - .14 The positive and negative terminals shall be of different sizes in order to avoid transposition of cables.
 - .15 LEDs (light emitting diodes) or other means of indicating alternating current power supply "on" and direct current output "operating" shall be provided.
 - .16 For equipment with multiple transformer-rectifiers or multiple channels, each transformer-rectifier and channel shall be fully identified and shall conform to this subclause.
 - .17 Tests shall be conducted at the manufacturer's facility to demonstrate full functional conformity and fitness for purpose of the transformer-rectifier. The tests shall be arranged to represent realistic on-site working conditions and the results shall be fully documented and shall constitute part of the permanent records for the works.
 - .18 All electrical tests shall be carried out in a manner prescribed by the relevant national or international standards.
 - .19 Preapproved product: IRT BMASAS 12 (8) – 8 (8) BlzL40MaQaSVr. Alternates to be approved by *Contract Administrator*.

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3.0 EXECUTION

3.1 General

- .1 Coordinate all work with other trades. Special attention shall be paid to scheduling of demolition of existing topping, installation of new topping and abrasive blast cleaning activities on the underside of the deck.
- .2 The *Contractor* shall facilitate the condition assessment of the concrete deck and the underside of the structure at the Floorbeams by the *Contract Administrator*. Access shall be provided by the *Contractor* to the deck after removal of the existing topping and to the underside of the structure. The assessment work on the structural slab after removal of the topping will include a delamination survey, concrete covermeter survey, steel/concrete potential survey, tensile surface testing of the concrete and verification of electrical continuity as outlined in this section. The *Contractor* shall allow for 15 working days in their construction schedule to allow for assessment of the deck condition and analysis of the data to confirm the design assumptions. The results of the assessment can be provided to the *Contractor*.
- .3 The cathodic protection system shall be installed after removal of the existing topping prior to the installation of the new topping.
- .4 Attention shall be given to the location, removal or insulation of steel in the surface of concrete. Contact between the impressed current anode and such steel will either result in short-circuits between anode and reinforcement causing a failure of that cathodic protection zone or in corrosion of isolated steel.
- .5 The installation of the cathodic protection system shall be completed in such a way as to restrict access from the public to deter vandalism. A fenced in area as shown on drawing 22160-103 has been provided below the south approach to restrict access to electrical components of the system such as the dataloggers and rectifiers.
- .6 Installation of the anode system including connections to the reinforcing steel shall be in accordance with the requirements of this specification and those of the manufacturer. In cases of discrepancy the more stringent requirement shall govern.
- .7 The installation of the anode system shall be supervised by a Cathodic Protection Site Foreman. The Site Foreman for the Cathodic Protection (CP) installation shall have attained and be in good standing of NACE Cathodic Protection Program level 2 certification or above. The Site Foreman shall be on site at key installation and commissioning activities.

3.2 Visual and Delamination Survey by the Contractor

- .1 Visual survey shall be completed to ascertain the type, causes and extent of defects, and any features of the structure or its surrounding environment, which could influence the application and effectiveness of cathodic protection. Areas which have been previously repaired, and the repair methods and materials, shall be identified. This information shall be recorded on a drawing with the structural drawings as the base plan.
- .2 All areas of the structure which are required to be cathodically protected shall be checked for delamination of the concrete cover in accordance with ASTM D4580.

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- .3 Defects, such as cracks, honeycombing or poor construction joints, which could permit significant water penetration, and which could in turn impair the effectiveness or durability of the cathodic protection system, shall be recorded.
- .4 The *Contractor* shall delineate areas of delaminated concrete to be confirmed and quantified in the field with the *Contract Administrator*. The delaminated concrete areas shall be repaired prior to installation of the cathodic protection system.

3.3 Concrete Cover and Reinforcement Location by the Contractor

- .1 Concrete cover distribution and embedded steel and reinforcement size and position measurements shall be carried out in order to assess whether the anode/cathode spacing will be adequate for the particular anode system envisaged, and to identify dense regions of steel or reinforcement which may require high current density. Shielding of the steel to be protected, caused by embedded metal meshes, metal fibres or plates, plastic sheets or non-conductive repair materials, which could impair the efficiency of cathodic protection, shall be assessed. Possible short-circuits between reinforcing steel and impressed current anodes shall be assessed.
- .2 Reinforcement bar location may be determined using ground penetrating radar (GPR). Concrete cover shall be determined using an electromagnetic covermeter.
- .3 Areas of concrete cover that are less than 15 mm shall be identified on site and on the record drawings.
- .4 Spot checks of concrete cover shall be completed by the *Contract Administrator*. Access for performing concrete cover measurements to be provided by the *Contractor*.

3.4 Steel/Concrete Potential by the Contractor

- .1 The top surface of the deck shall be surveyed in accordance with ASTM C876 at a maximum spacing of 500 mm in order to identify the most anodic locations within the cathodic protection zones for future installation of reference electrodes. The concrete surface shall be presoaked for a period of 12 hours prior to performing the half-cell potential survey. No standing water shall be present during the half-cell potential survey.
- .2 The *Contract Administrator* shall identify areas on the underside of the bridge adjacent to the I-Beams to be protected with the ICCP system. Within these zones the structure shall also be surveyed adjacent to the I-Beams in accordance with ASTM C876 at a maximum spacing of 250 mm in order to identify the most anodic locations within the cathodic protection zones along the edges of the beams for future installation of reference electrodes.
- .3 Equipotential lines in mV shall be reported in 100 mV increments with different colours for each range. The most anodic locations within each zone shall be identified on site and on the record drawings.
- .4 The test report shall include the ambient temperature, relative humidity and general weather conditions at the time of the survey.
- .5 The report shall include type of connection to steel, type of electrolyte, reference electrode, calibration of reference electrode, input impedance of multimeter.

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3.5 Tensile Testing by the Contractor

- .1 The *Contractor* shall perform tensile testing of the prepared surface of the structural deck concrete in accordance with CSA A23.2-6B. One test shall be completed for every 200 m² of surface area. One test consists of three test samples.
- .2 Locations of tensile testing shall be recorded on the record drawings. Records provided to *Contract Administrator*.

3.6 Chloride Sampling and Analysis by the Contractor

- .1 Chloride sampling shall be completed by the *Contractor* during the condition assessment of the deck near the most anodic zones within each zone (minimum 12 sets of samples). At representative areas of moderate to low corrosion potential additional chloride samples shall be obtained (minimum 8 sets of samples). Samples shall be obtained either by core removal and crushing sections of the core at select depths (minimum 3 depths) or hammer drilling to obtain powder samples. If hammer drilling is to be performed, then a minimum diameter 20 mm bit shall be used. The analysis shall include chloride concentrations at three distinct zones starting at 5 mm depth and shall extend a minimum of 10 mm past the depth of the top reinforcing steel.
- .2 Samples shall be analyzed in accordance with ASTM C1152. Values shall be reported in percent of mass of sample.
- .3 The *Contractor* is to make good all test locations.
- .4 Locations of chloride sampling shall be recorded on the record drawings.
- .5 Results of the testing shall be provided to the *Contract Administrator*.
- .6 The *Owner* may also obtain their own samples for chloride content analysis at their own discretion.
- .7 Chloride content analysis shall be based on the acid soluble method. If water-soluble testing is to be carried out, then a sample directly adjacent to the water-soluble sample shall also be tested for acid soluble chloride content.

3.7 Areas of High Likelihood of Active Corrosion

- .1 After review of the potential measurement and chloride content data the *Contract Administrator* may require removal of concrete within select portions of the bridge deck topping or on the underside of the structure for further review.
- .2 The *Contractor* shall prepare the openings as directed by the *Contract Administrator* and facilitate review of the areas by the *Contract Administrator*. Openings shall be repaired by the *Contractor* at no additional cost to the *Owner*.

3.8 Electrical Continuity Testing by the Contractor

- .1 Continuity between reinforcing bars or elements of steel in concrete shall be tested by a direct current reverse polarity resistance measurement technique, by measuring the resistance using a direct current resistance instrument and then reversing the polarity of the test leads, or by a direct current potential difference measurement technique. The

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acceptance criteria for such testing shall be stable values and a resistance less than 1,0 Ω . All steel exposed during concrete repairs or other works shall be continuity tested, and any bar or component tested failing the test shall be continuity bonded to ensure long-term resistance of 1,0 Ω or less.

Alternatively, a potential measurement technique may be used with a fixed-location reference electrode used to measure steel/concrete/electrode potential connected to one reinforcement bar or element of steel and then, without moving the reference electrode, connecting to another steel bar or element. The acceptance criteria shall be stable potential measurements with a difference of less than 1 mV when connections are made to the two steel bars or elements.

- .2 At representative locations in each unit or discrete part of the structure, sufficient reinforcement and any other embedded steel shall be exposed and tested at selected locations to determine the general level of electrical continuity of the reinforcement/steel. The testing shall include at least an assessment of the following on a representative basis:
 - a) electrical continuity between elements of the structure within each zone of the cathodic protection system;
 - b) electrical continuity of reinforcement within elements of the structure;
 - c) electrical continuity of metallic items, other than reinforcement, to the reinforcement itself.
- .3 A minimum of two locations shall be checked per 100 m² of surface area. Contact points to be cleaned to bright steel.
- .4 Continuity testing and bonding, as necessary, shall be applied to all steel exposed during concrete repairs.
- .5 The continuity testing results, all available construction drawings, the nature of the structure and its construction shall be assessed in order to determine whether additional reinforcement/steel should be exposed for testing and possible bonding.
- .6 All ancillary steel fixed to or part of the concrete structure (e.g. embedded steel beams, bearings, drainage pipes) either shall be continuity tested as above and bonded if required.
- .7 Electrical contact shall be prevented between reinforcement or ancillary steel and the anode system of any impressed current cathodic protection system any tying wire, nails or other metal components visible on the concrete, that might contact the anode system or might be too close to the anode for optimum anode/cathode spacing, shall be cut back and the concrete shall be repaired.

3.9 Holiday Testing

- .1 After completion of the patch repairs and prior to installation of the anode on the bridge deck a holiday survey shall be completed to identify areas of low cover on the exposed concrete surface using a high voltage holiday detector with a minimum voltage setting of 1 KV.

3.10 Cathodic Protection System Design

- .1 The *Contractor* shall review the proposed cathodic protection zones as shown on the

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- contract drawings. The proposed CP zone layout shall be confirmed based on the results of the condition assessment work. Alternate zoning arrangement shall be submitted to the *Contract Administrator* for review. The zones shall be selected to be representative of each area based on exposure condition, chloride concentration and expected current demand.
- .2 Each zone of the impressed cathodic protection system shall be provided with the means necessary to monitor its power supply output voltage and output current and its steel/concrete potential using reference electrodes permanently embedded at representative locations.
 - .3 Each zone of the impressed current system shall be adequately monitored with permanent reference electrodes. There shall be a minimum of two reference electrodes per zone or one per 100 m², whichever is greater. Their locations shall be selected to be representative of the entire zone but also to monitor locations where steel density, chloride contamination, environmental exposure or other factors may represent an area of greater risk of corrosion or greater difficulty of protection.
 - .4 The extent and locations of deployment of the permanently installed performance evaluation system shall be in accordance with the design. The areas addressed shall include the following:
 - a) high probability to corrosion or under-protection;
 - b) high probability to excessive protection;
 - c) high corrosion risk or activity.
 - .5 Reference electrodes and other sensors shall not be placed in, or close to, concrete repairs unless there are no alternative locations. In the vicinity of the sensor, concrete surrounding the steel shall remain undisturbed. Typically reference electrodes should, if possible, be placed a minimum of 500 mm from concrete repairs which incorporate steel. The distance of the sensor to the reinforcing steel (with parent concrete attached) shall be less than or equal to 10 mm. The reference electrode shall not be placed within the ionic flow path between the anode and reinforcing steel. The electrode shall be placed horizontally adjacent to the reinforcing steel. Reference electrodes shall be embedded in prebagged concrete repair material.
 - .6 Permanently installed reference electrodes, and other sensors that can be calibrated prior to installation, shall be calibrated. Function tests shall be completed on sensors prior to installation.
 - .7 Negative connections to the steel shall be two per zone minimum or one per 200 m², whichever is the greater.
 - .8 Test connections to the steel shall be like the steel negative connections or dedicated one per reference electrode and connected to steel close to the electrode (but not in concrete repairs within 0,5 m of the electrode).
 - .9 The open-circuit potential of all permanent reference electrodes shall be measured against a closely placed calibrated, stable, portable reference electrode.
 - .10 The design shall take into account the recommendations of NACE SP0290 "Standard Practice – Impressed Current Cathodic Protection of Reinforcing Steel in Atmospherically Exposed Concrete Structures".

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3.11 Connections to Steel in Concrete

- .1 Each zone of the cathodic protection system shall be provided with multiple (a minimum of two) negative connections of cables to reinforcement/steel for the cathodic protection current and a minimum of one test connection to the reinforcement/steel for measurement of steel/concrete potentials with respect to permanent electrodes.
- .2 The electrical continuity between all negative connections and test connections of each individual zone shall be tested and shall be 1.0 Ω or less. If this requirement is not initially achieved, additional reinforcement/steel exposure for testing and bonding shall be undertaken.
- .3 The cable connections to the reinforcement and steel shall be made by methods providing a long-term cable/reinforcement or steel resistance of less than 0.01 Ω .
- .4 Any concrete repairs associated with the installation of performance monitoring system electrodes, other sensors and the connections to steel in concrete shall be undertaken in accordance with the sensor manufacturers requirements.
- .5 Connections to steel shall be isolated with an epoxy coating to prevent contact with moisture to prevent corrosion of the connection. The connections must be strong enough to resist mechanical loads so that it is not damaged during subsequent concrete application. Additionally, an epoxy-based mortar shall be applied over the connection.

3.12 Installation of Anodes

- .1 The surface of the concrete shall be clean and free of contaminants prior to installation of the anodes. The surface profile shall have achieved an 6 mm depth from the top of the aggregate in the deck.
- .2 All cracks greater than 0.5 mm in the deck shall be repaired prior to installation of the anodes with a cementitious grout.
- .3 A minimum anode/reinforcement or other steel distance of 15 mm shall be maintained.
- .4 The anodes shall be distributed in accordance with the cathodic protection system design, on the concrete surface. Titanium connectors shall be spot welded to the mesh or grid to distribute current to all component parts of the anode and to facilitate electrical connections to the anode. Where anode/cable connections are to be incorporated into the cementitious overlay, they shall be of a type and installed in a manner that can be demonstrated by trials or past projects to enable the design anode and anode/cable connection performance to be achieved.
- .5 Non-metallic fixings (isolating materials) shall be utilized to facilitate the fixing of the anode material to the surface of the concrete prior to application of repair mortar, shotcrete, or concrete.
- .6 The *Contractor* shall ensure that there are no short-circuits between anode and reinforcement/steel. Verification of no short circuits to the anode shall be provided to the *Contract Administrator* prior to installation of the topping.
- .7 The size and distribution of the anodes shall conform to the cathodic protection system design.

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- .8 The anodes shall be protected from damage prior to the application of repair mortar, shotcrete, or concrete.

3.13 Connections to the Anode System

- .1 Each zone of the impressed current cathodic protection system shall be provided with multiple positive cable/anode connections such that the failure of any one anode/cable connection shall not significantly impair the performance of the cathodic protection system in that zone. An uncoated titanium wire shall be welded to the anodes. A minimum of two weld points is required per anode. A maximum spacing of 15 m of weld points shall be maintained.
- .2 The failure of any one anode/cable connection in a zone should not reduce the local zone anode current density by more than 10 % of the nominal anode current density at any location within the zone; anode/cable connections should be designed and located and also cable and anode voltage drops should be designed to ensure such uniformity.
- .3 Connections to anode shall be isolated with an epoxy coating to prevent contact with moisture to prevent corrosion of the connection. The connections must be strong enough to resist mechanical loads so that it is not damaged during subsequent concrete application. Additionally, an epoxy-based mortar shall be applied over the connection.
- .4 The anode/cable connection system shall be of a type and installed to such standards, as can be demonstrated by trials or past projects to enable the requisite anode and anode/cable connection performance to be achieved.
- .5 In each individual zone, the electrical resistance of all anode/cable connections shall be tested and compared with calculated values for the particular anode type and distribution. Data shall be assessed to determine whether additional testing or additional anode/cable connections are required.
- .6 A 100 % visual inspection shall be undertaken of the anode system, including all related cables and cable connections, prior to application of any coating or overlay.

3.14 Coordination with Topping Installation

- .1 A site meeting shall occur with the concrete topping installation *Contractor* to highlight the sensitive nature of the cathodic protection system installation. This meeting shall be documented.
- .2 The site foreman for the cathodic protection installation shall be on site for the installation of the cementitious overlay.
- .3 The potential between the anode and reinforcement/steel (cathode) shall be monitored to detect short-circuits during the installation of the overlay.
- .4 Testing in accordance with the quality plan shall include the following for the cathodic protection system:
- a) polarity checks for all circuits (the results shall be unambiguous)
 - b) continuity checks for all circuits, (the results of which shall demonstrate individual circuit resistance values within ± 10 % of those calculated from cable and component values);
 - c) insulation checks for all circuits of impressed current systems, which may have to be

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undertaken prior to connections to either anode or reinforcement/steel, and which shall demonstrate the electrical isolation of DC positive cables from DC negative cables.

- .5 The mains voltage electrical power supply system and the transformer-rectifier(s) providing low voltage DC to the cathodic protection system shall be tested and documented for electrical safety in accordance with international and national electrical safety standards.
- .6 *Contractor* to ensure that the concrete overlay extends over the whole area covered by cathodic protection anodes.
- .7 The overlay material shall be applied as soon as possible after fixing and testing of anodes, conductor bars, and reference electrodes.

3.15 Electrical Installation

- .1 All electrical installation works shall be undertaken in accordance with national (or other applicable international) electrical safety standards.
- .2 The electrical installation shall be coordinated with Division 26 Electrical.
- .3 The direct current and monitoring cables of a cathodic protection system are all classified as “extra low voltage” (ELV) in accordance with IEC 61140.
- .4 Cables shall be installed within PVC conduit. Anchorage points of the conduit shall be at a minimum one per metre.
- .5 In addition to the particular requirements of the cathodic protection system, the following electrical safety measures shall be applied to all installations:
 - a) mains voltage cables shall be electrically isolated and separated from low voltage direct current cables in accordance with local regulations;
 - b) cables shall be uniquely identified at the direct current power supply, at any junction box and at their point of connection;
 - c) cables shall be adequately supported and protected from environmental, human and animal damage;
 - d) In locations where there is high risk of damage, cables may be embedded into concrete or may be protected by steel wire armouring.
 - e) except for the cable connections covered in item f), cable connections shall only be made at locations in enclosures or junction boxes;
 - f) connections inside boxes, whose construction and/or installation renders their environmental protection rating below the worst case external environmental exposure, including boxes with non-sealed conduit entries, shall be made by methods suitable for long-term water immersion;
 - g) Connections inside water resistant or sealed boxes constructed and installed with an environmental protection rating above the worst-case external environmental exposure may utilize copper or brass threaded or proprietary connection assemblies.
 - h) it is permissible for anode/cable connections for anodes (e.g. activated titanium mesh), which are to be permanently embedded in an overlay material to be installed without junction boxes if the anode/cable connection and its method of electrical/mechanical/moisture sealing can be demonstrated by trials or past

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- projects to enable the requisite performance to be achieved;
- i) anode systems for which there is no overlay or electrical barrier to prevent direct human or animal contact, e.g. conductive coating, shall be limited to a supply voltage of 24 V DC with a maximum ripple content of 100 mV RMS;
 - j) equipment shall be marked with all relevant electrical safety/testing/maintenance markings in accordance with national and International Standards.
- .6 Prior to energizing, the AC service to the cathodic protection system shall be inspected for compliance with the Canadian Electrical Code and such local codes and ordinances that may be applicable or in force. It shall be verified that the AC service voltage, phase and wiring size are compatible with the cathodic protection rectifier. The *Contract Administrator* shall be in attendance for the energizing of the AC service. Provide 5 days notice prior to energizing the system.
- .7 Prior to energizing, the rectifier shall be inspected. The integrity of all AC input and DC output connections shall be verified. All mechanical fasteners shall be inspected and tightened or replaced if appropriate.

3.16 Commissioning

- .1 Commissioning of the cathodic protection system shall be completed in accordance with ISO 12696 clause 8 and the requirements of this section.
- .2 The “natural” or “as found” potential of all embedded reference electrodes shall be monitored after installation for a minimum period of 21 days prior to energizing of the cathodic protection system.
- .3 Measurement of “ON” steel/concrete potentials (including IR drop) shall be performed.
- .4 Each rectifier shall be turned on and operated manually at not more than 20% of the full rated maximum design current output. During this initial energizing period, all circuits shall be tested.
- a) Proper circuit polarity shall be verified.
 - b) The rectifier shall be tested for proper operation. The accuracy of all rectifier meters shall be verified with a calibrated portable meter.
 - c) Proper cathodic protection current distribution through all anode feed circuits shall be determined. If panel boards for such testing were not included in the system design, clamp-on DC ammeters or other techniques shall be used.
 - d) The anodes shall be inspected for proper operation. Areas of relatively high initial current discharge shall be investigated.
 - e) Reference electrodes and other monitoring devices shall be tested.
 - f) Additional equipment required by the cathodic protection system design shall be inspected for proper operation.
 - g) After completion of the initial energizing inspection, the impressed current cathodic protection system shall be adjusted for current requirements.
 - h) Tests shall be conducted that the electrically isolated metal is not adversely affected by stray current from the operation of the impressed current cathodic protection system.
- .5 A final sign off is required by the *Contract Administrator* for the commissioning process at which time the operation and maintenance portion of the work shall initiate.

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- .6 The *Contract Administrator* shall be given a minimum of 20 working days notice of the date of commissioning.

3.17 System Records and Documentation

- .1 System records and documentation shall be completed in accordance with ISO 12696 clause 9.
- .2 Copies of the design data calculations shall be provided.

3.18 Operation and Maintenance

- .1 The *Contractor* shall operate and maintain the cathodic protection system for a period of 5 years after *Substantial Completion*.
- .2 The operation and maintenance shall be completed in accordance with ISO 12696 clause 10.
- .3 Intervals for inspection shall be as follows:
- a) Visual on-site review of system – Year 1-5: once per year (subject to satisfactory performance otherwise twice per year).
 - b) Function check – Year 1: once per month.
 - c) Function check – Year 2-5: once per 6 months (subject to satisfactory performance otherwise once per 3 month).
 - d) Performance assessments (excluding visual assessment) – Year 1: once per 3 months.
 - e) Performance assessments (excluding visual assessment) – Year 2-5: once per 6 months (subject to satisfactory performance otherwise once per month).
- .4 The system review report shall be submitted to the *Owner* at the end of each year. The system review report shall include a summary of the cathodic protection data (depolarization trials, current consumption, half-cell potential readings, instant on and off readings), a summary of the maintenance and alteration work completed on the system and identification of periods of over and under protection of CP zones.
- .5 The *Contractor* shall be responsible for maintenance and repair to system not covered under the warrantee which is required due to all factors besides vandalism and acts of god at no cost to the *Owner*. Vandalism of the cathodic protection system and its components shall be at the risk of the *Owner*.
- .6 Access to the data management system shall be provided to the *Contractor* from the *Owner*.
- .7 It is the intent that the *Contractor* and the *Owner* shall enter into a maintenance agreement outside of this contract, based on the terms of this section, for the term of 5 years.

3.19 Operational Training for Owner Staff

- .1 Prior to *Total Completion* the *Contractor* will provide a technical representative to provide training to *Owner* staff during a minimum full day on site training session.
- .2 The technical representative shall be a qualified corrosion technician experienced in the installation and operation of impressed current cathodic protection systems for reinforced

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concrete structures.

- .3 The training session shall be based on the NACE Cathodic Protection Tester Program and provide an overview of corrosion theory as well as functional training on the operation of the installed impressed current system. The contents of the operations and maintenance manual shall be presented. The aim of the training session will be to provide sufficient instructions for attendees to become familiar with the operation of the installed rectifiers and data loggers. Additionally, the *Owner* staff shall be able to download the data from the dataloggers both manually and remotely (if applicable). The seminar shall contain a health and safety component outlining the potential hazards of the system and precautions to be taken working near electricity.

3.20 Quality Control

- .1 The *Contractor* is responsible for quality control and for ensuring that all aspects of the Work comply with the manufacturer's recommendation and this specification.
- .2 Submit, for the *Contract Administrator's* review, details of the *Contractor's* quality control plan to ensure that it meets the requirements of this specification.
- .3 Defects and deficiencies shall be reported to the *Contract Administrator* prior to undertaking any corrective action.
- .4 Proposed remedial measures for deficiencies shall be submitted to the *Contract Administrator* for review prior to implementation.
- .5 The following quality control testing shall be carried out as a minimum:
 - a) Steel continuity verification,
 - b) Grout cubes or cylinders as applicable for compressive strength.
 - c) Environmental conditions during placing and curing or repair materials (RH, Temp).
 - d) Resistivity testing of proposed concrete repair and anode installation material. Report shall include a description of the test procedure used.
 - e) Survey to confirm electrical isolation between anodes and rebar/embedded metals.
- .6 A minimum of one set of concrete grout cubes (9 cubes) or cylinders (4 cylinders) shall be taken for compressive tests for each type of pre-packaged concrete patch materials.
- .7 Compression tests on concrete shall be carried out in accordance with CSA A23.2. Frequency of testing is one test per day for each concrete type and a minimum of one test per 20 m³. Concrete cylinders shall be tested as follows: 2 at 7 days and 2 at 28 days and 1 spare.
- .8 Compression tests on grout or repair mortar shall be completed on grout cubes. Frequency of testing is one set of cubes for each batch of grout. Grout cubes shall be tested as follows: 3 cubes at 7 days, 3 cubes at 28 days.
- .9 Testing of concrete to be performed by a CCIL certified laboratory.
- .10 Curing of prepackaged material for compressive strength testing shall be as per manufacturer recommendations.
- .11 Electrical resistivity of individual batches of prebagged material for both concrete repair and anode installation shall be tested prior to use on site. One test per batch of prebagged concrete repair material and anode installation material shall be completed in accordance

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with FM 5-578.

3.21 Quality Assurance

- .1 The *Contract Administrator* will designate a representative to review the work of the *Contractor* on site and associated submissions.
- .2 The *Contractor* shall facilitate review of the work by the *Contract Administrator*.
- .3 The *Contractor* shall establish the following hold points for the work to allow for review and access for inspection and testing. The *Contractor* shall provide five (5) days notice in advance of hold points or witness points to allow for adequate notice. following hold points shall require review by the *Contract Administrator* prior to proceeding with additional subsequent work:
 1. Document Review of required preconstruction documentation.
 2. First Partial Review
 - i. Review of surface condition after removal of concrete overlay prior to concrete repairs and anode installation,
 - ii. Review of *Contractor* condition assessment (Sections 3.2 to 3.9),
 3. Second Partial Review
 - i. Review of delineated concrete repair areas,
 - ii. Review of surface preparation of partial depth repairs.
 - iii. Review of cathodic protection system installation:
 - i. Position of electrodes,
 - ii. Types of electrodes,
 - iii. Function check of electrodes,
 - iv. Cable installation, identification, connections, cable impedance,
 - v. Function check of data monitoring system.
 - vi. Review of anode installation, including survey of electrical isolation.
 4. Commissioning
 - i. Review of commissioning documentation (Section 3.18). Data set must include a minimum of 72 hours of data.
 5. Final Review for *Total Completion*
 - i. To be completed at earliest 2 months after topping and anode installation.
 - i. Review of updated commissioning documentation (Section 3.18).
Review of changes to system settings since commissioning.
 - ii. Confirmation of automatic data download with comparison to minimum of two manual measurements.
 - iii. Confirmation of system having achieved performance criteria.
 - iv. Review of depolarization trials. Minimum of two 24-hour trials completed within a minimum 4 weeks.
 - v. Review of maintenance manual provided by *Contractor*.
- .4 The hold points indicated in 1.21.3 are verification points identified by the *Owner* beyond which work may not advance until review and verification by the *Contract Administrator* in

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writing. Any verification will not form an acceptance of the works by the *Owner*.

- .5 The *Owner* may add additional hold points at any time by written notification to the *Contractor*.

3.22 Ownership

- .1 The *Owner* will accept ownership of the cathodic protection system once the system commissioning verifications and quality assurance reviews have been completed and deemed accepted by the *Contract Administrator* and the *Owner* has been provided the required training.

3.23 Warranty

- .1 The *Contractor* shall warrant the work as being free of defects in materials and workmanship for a period of five (5) years from the date of Substantial Performance of the Work.
- .2 Defects and deficiencies covered by the warranty shall be, but not limited to, the following:
- a) debonding of concrete patch repairs,
 - b) failure of anodes to pass current,
 - c) failure of half-cell to provide stable readings,
 - d) failure of datalogger to function as intended; and
 - e) other distress or deterioration due to surface preparation or application.
- .3 The warranty shall include cost of labour and materials to remove and replace defective work.
- .4 The *Contractor* shall repair and make good all defects identified during the warranty period at no cost to the *Owner*.

3.24 Remedial Work Under Warranty

- .1 The *Contractor* shall perform any required warranty repairs during the warranty period at no cost to the *Owner*.
- .2 Upon receipt of notice from the *Owner* of a defect in the Work the *Contractor* shall take necessary steps to protect against further damage to the structure and adjacent elements. The *Contractor* shall schedule the repair work with the *Owner* and shall make every attempt to make good the defects within six weeks of notice.
- .3 Any damages incurred to obtain access to defective areas shall be remedied at no cost to the *Owner*.
- .4 The warranty period for repaired defects shall be extended by the amount of time lapsed between issuance of notice of the defect and completion of the remedial work. The warranty period will then re-commence upon completion of the remedial work.

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END OF SECTION

HEATERS AND VENTILATION

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Revision History

Rev. No.	Date	Description of Revisions	Prep. By	Rev. By
-	November 12, 2020	Issued for Tender	MS	IN

HEATERS AND VENTILATION

Part 1 General

1.0 DOCUMENTS

- .1 This Technical Specification forms a part of the Contract Documents and is to be read, coordinated and implemented in conjunction with all other parts.

1.1 TECHNICAL SPECIFICATION INCLUDES

- .1 Materials and installation for heating and ventilation systems.

1.2 RELATED TECHNICAL SPECIFICATIONS

- .1 Technical Specification 26 05 00 - Common Work Results – Electrical
- .2 Technical Specification 26 05 10 – Testing and Commissioning
- .3 Technical Specification 26 05 31 – Splitters, Junction, Pull Boxes and Cabinets
- .4 Technical Specification 26 27 16 – Electrical Kiosk
- .5 Technical Specification 26 31 13 014 – Power Generation – Diesel

1.3 REFERENCES

- .1 Not Used

1.4 SUBMITTALS

- .1 Submit in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Technical Specification 26 05 00 Common Work Results – Electrical.

1.6 MEASUREMENT AND PAYMENT

- .1 Measurement and Payment for this section shall be considered incidental to the other payment elements for the project and shall include supply and installation of all items necessary to undertake the work.

Part 2 Products

2.0 HEATERS

HEATERS AND VENTILATION

- .1 Element: durable tubular heating element with fins.
- .2 Finish: epoxy-polyester powdercoat
- .3 Installation: wall mounted with surface mounting box (included)
- .4 Wattage & Voltage: per drawings
- .5 Control: Built-in thermostat with control knob.
- .6 Standard of Acceptance: Ouellet OVS Series or approved equal.

2.1 VENTILATION

- .1 Kiosk ventilation fan in accordance with Technical Specification 26 27 16 – Electrical Cabinets and Enclosures.
- .2 Control: External thermostat mounted inside control compartment.

2.2 CONTROLS

- .1 Refer to electrical Contract Drawings for details on heating and ventilation control.
- .2 Provide control equipment as shown on electrical Contract Drawings. Devices to be industrial quality, line voltage (120/240 volts), single-pole, white.
- .3 Provide clear plastic thermostat guard for all heating/cooling wiring devices: thermostats, astronomical time switch.

Part 3 Execution

3.0 INSTALLATION

- .1 Mount heaters on kiosk wall as indicated on Contract Drawings.
- .2 Electrically connect ventilation as shown in manufacturer's installation instructions.
- .3 Install control equipment in locations indicated on Contract Drawings.
- .4 Install heat trace equipment in water compartment of electrical kiosk.
- .5 Make power and control connections.

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Technical Specification 26 05 10 – Testing and Commissioning.
- .2 Ensure that heaters, ventilation and controls operate correctly.

END SECTION