



**Request for Quotations**  
**For**  
**Wastewater Treatment Plant Secondary Clarifiers & Aeration Tanks Rehabilitation**

Request for Quotations No.: **2025-55**

Issued: **July 10, 2025**

Submission Deadline: **August 7, 2025 at 3:00 PM local time**

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## PART 1 – INVITATION AND SUBMISSION INSTRUCTIONS

### 1.1 Invitation to Respondents

This Request for Quotations (the “RFQ”) is an invitation by the City of Brantford (the “City”) to prospective respondents to submit non-binding quotations for secondary clarifiers and aeration tank rehabilitation at the Wastewater Treatment Plant, located at 385 Mohawk St., Brantford, as further described in Section A of the RFQ Particulars (Appendix B) (the “Deliverables”).

### 1.2 City’s Procurement Policy

The City’s procurement processes are governed by the City’s Purchasing Policy Bylaw 34-2020 (the “City’s Policy”). It is the respondent’s responsibility to become familiar with and comply with the City’s Policy, which is available on line at:

<https://www.brantford.ca/en/business-and-development/bids-and-tenders.aspx>

### 1.3 RFQ Contact

For the purposes of this procurement process, the “RFQ Contact” will be:

**Eva Cislo, Coordinator of Purchasing - Capital**

Email: [evacislo@brantford.ca](mailto:evacislo@brantford.ca)

Respondents and their representatives are not permitted to contact any employees, officers, agents, elected or appointed officials or other representatives of the City, other than the RFQ Contact, concerning matters regarding this RFQ. Failure to adhere to this rule may result in the disqualification of the respondent and the rejection of the respondent’s quotation.

### 1.4 Type of Contract for Deliverables

The selected respondent will be requested to enter into a contract for the provision of the Deliverables on the terms and conditions set out in the Form of Agreement (Appendix A) (the “Agreement”). It is the City’s intention to enter into a contract with only one legal entity.

### 1.5 RFQ Timetable

Issue Date of RFQ	<b>July 10, 2025</b>
Site Visit	<b>July 17, 2025 at 11:30 AM local time</b>
Deadline for Questions	<b>July 29, 2025 at 3:00 PM local time</b>
Deadline for Issuing Addenda	<b>August 1, 2025</b>
Submission Deadline	<b>August 7, 2025 at 3:00 PM local time</b>
Rectification Period	2 business days
Anticipated Execution of Agreement	<b>Month X, 2025</b>

The RFQ timetable is tentative only, and may be changed by the City at any time. For greater clarity, business days means all days that the City is open for business.

## **Site Meeting Details**

**Location:** 385 Mohawk St., Brantford

**Site Requirements:** Respondents are required to wear CSA approved personal protective clothing (reflective vest, hardhat and safety shoes) in order to participate in the site meeting. Safety equipment will not be provided by the City.

## **1.6 Submission of Quotations**

### **1.6.1 Electronic Quotation Submission**

The City shall only accept and receive electronic quotation submissions through the City's electronic bidding system at: bids.brantford.ca (the "Bidding System").

All respondents must establish a Bidding System vendor account and be registered as a Plan Taker for the procurement opportunity, which will enable the respondent to download the RFQ documents, to receive addenda email notifications, download addenda and to submit their quotation electronically through the Bidding System.

HARD COPY QUOTATION SUBMISSIONS WILL **NOT** BE ACCEPTED.

### **1.6.2 Multiple or Alternate Bids**

Unless otherwise provided for in this RFQ, the City will not accept multiple quotations or alternate quotations from a respondent. The submission of multiple quotations by a respondent may result in the rejection of all of the quotations submitted by that respondent.

### **1.6.3 Addendum**

Any addenda issued by the RFQ Contact shall form part of the bid documents. Respondents must acknowledge receipt of any addenda when submitting their quotation through the Bidding System. Respondents must check a box for each addendum and any applicable attachments that have been issued before a respondent can submit their quotation submission online.

Questions or additional information requested from the RFQ Contact must be submitted in accordance with section 3.2.1. Addendum will typically be issued through the Bidding System, forty-eight (48) hours prior to the Submission Deadline.

To ensure all addenda have been acknowledged, the City encourages respondents not to submit their quotation prior to forty-eight (48) hours before the Submission Deadline. If a respondent submits their quotation and an addendum is issued by the City, the Bidding System shall **WITHDRAW** their quotation submission and change their quotation submission to an **INCOMPLETE STATUS** (not accepted by the City). The withdrawn bid can be viewed by the respondent in the "**MY BIDS**" section of the Bidding System. The respondent is solely responsible to:

- i) review the status of their bid;
- ii) make any required adjustments to their quotation;
- iii) acknowledge the addendum; and
- iv) ensure the re-submitted quotation is RECEIVED by the Bidding System by no later than the Submission Deadline.

#### **1.6.4 Withdrawal or Amendment of Quotations**

Quotations are non-binding and may be withdrawn at any time prior to entering into a contract for the provision of the Deliverables. Respondents may withdraw their submission prior to the Submission Deadline through the Bidding System. To withdraw a submission after the Submission Deadline, a notice of withdrawal must be sent to the RFQ Contact and must be signed by an authorized representative of the respondent. The City will not accept amendments to submitted quotations. If a respondent wishes to amend an already submitted quotation prior to the Submission Deadline, the respondent may withdraw the existing quotation and submit a revised quotation prior to the Submission Deadline through the Bidding System. The respondent is solely responsible to ensure the re-submitted quotation is **RECEIVED** by the Bidding System by no later than the Submission Deadline.

#### **1.6.5 Submission Deadline**

The closing time shall be determined by the Bidding System web clock.

Respondents are cautioned that the timing of a quotation submission is based on when the quotation is **RECEIVED** by the Bidding System, **not** when a bid is submitted by a respondent, as bid transmission can be delayed in an internet bottleneck due to file transfer size, transmission speed, etc.

[End of Part 1]

## **PART 2 – EVALUATION AND AWARD**

### **2.1 Stages of Evaluation**

The City will conduct the evaluation of quotations in the following stages:

### **2.2 Stage I – Mandatory Submission Requirements**

Stage I will consist of a review to determine which quotations comply with all of the mandatory submission requirements. If a quotation fails to satisfy all of the mandatory submission requirements, the City will issue the respondent a rectification notice identifying the deficiencies and providing the respondent an opportunity to rectify the deficiencies. If the respondent fails to satisfy the mandatory submission requirements within the Rectification Period, its quotation will be excluded from further consideration. The Rectification Period will begin to run from the date and time that the City issues a rectification notice to the respondent. The mandatory submission requirements are listed in Section C of the RFQ Particulars (Appendix B).

### **2.3 Stage II – Mandatory Technical Requirements**

The City will review the quotations to determine whether the mandatory technical requirements as set out in Section D of the RFQ Particulars (Appendix B) have been met. Questions or queries on the part of the City as to whether a quotation has met the mandatory technical requirements will be subject to the verification and clarification process set out in Part 3.

### **2.4 Stage III – Pricing**

Stage III will consist of an evaluation of the submitted pricing in each qualified quotation in accordance with the price evaluation method set out in the Pricing Form. The evaluation of price will be undertaken after the evaluation of mandatory requirements has been completed.

### **2.5 Selection of Top-Ranked Respondent**

After the completion of Stage III, compliant respondents will be ranked based on the price evaluation. Subject to the process rules contained in the Terms and Conditions of the RFQ Process (Part 3), the top-ranked respondent will be invited to enter into the Agreement in accordance with Part 3. In the event of a tie, the tie will be broken in accordance with the City's Policy. The selected respondent will be notified in writing and will be expected to satisfy any applicable conditions of this RFQ, including the pre-conditions of award listed in Section E of the RFQ Particulars (Appendix B) within 10 days, and enter into the Agreement within 30 days, of the date of the notice of selection. Failure to do so may result in the disqualification of the respondent and the selection of another respondent or the cancellation of the RFQ.

[End of Part 2]

## **PART 3 – TERMS AND CONDITIONS OF THE RFQ PROCESS**

### **3.1 General Information and Instructions**

#### **3.1.1 Respondents to Follow Instructions**

Respondents should structure their quotations in accordance with the instructions in this RFQ. Where information is requested in this RFQ, any response made in a quotation should reference the applicable section numbers of this RFQ.

#### **3.1.2 Quotations in English**

All quotations are to be in English only.

#### **3.1.3 No Incorporation by Reference**

The entire content of the respondent's quotation should be submitted in a fixed form, and the content of websites or other external documents referred to in the respondent's quotation but not attached will not be considered to form part of its quotation.

#### **3.1.4 References and Past Performance**

In the evaluation process, the City may include information provided by the respondent's references and may also consider the respondent's past performance or conduct on previous contracts with the City or other institutions. The City may disqualify a respondent on the basis of information regarding the respondent's past performance or conduct that the City finds unsatisfactory or unacceptable regardless of the respondent's fee.

#### **3.1.5 Information in RFQ Only an Estimate**

The City and its advisers make no representation, warranty or guarantee as to the accuracy of the information contained in this RFQ or issued by way of addenda. Any quantities shown or data contained in this RFQ or provided by way of addenda are estimates only, and are for the sole purpose of indicating to respondents the general scale and scope of the Deliverables. It is the respondent's responsibility to obtain all the information necessary to prepare a quotation in response to this RFQ.

#### **3.1.6 Respondents to Bear Their Own Costs**

The respondent will bear all costs associated with or incurred in the preparation and presentation of its quotation, including, if applicable, costs incurred for interviews or demonstrations.

#### **3.1.7 Quotation to be Retained by the City**

The City will not return the quotation or any accompanying documentation submitted by a respondent.

### **3.1.8 No Guarantee of Volume of Work or Exclusivity of Contract**

The City makes no guarantee of the value or volume of work to be assigned to the successful respondent. The contract with the selected respondent will not be an exclusive contract for the provision of the described Deliverables. The City may contract with others for goods and services the same as or similar to the Deliverables or may obtain such goods and services internally.

## **3.2 Communication after Issuance of RFQ**

### **3.2.1 Respondents to Review RFQ**

Respondents should promptly examine all of the documents comprising this RFQ, and may direct questions or seek additional information in writing through the Bidding System by using the **SUBMIT A QUESTION** button, on or before the Deadline for Questions.

All questions or comments submitted by respondents will be deemed to be received once the email has entered into the Bidding System's email inbox. No such communications are to be directed to anyone other than the RFQ Contact. The City is under no obligation to provide additional information, and the City is not responsible for any information provided by or obtained from any source other than the RFQ Contact. It is the responsibility of the respondent to seek clarification from the RFQ Contact on any matter it considers to be unclear. The City is not responsible for any misunderstanding on the part of the respondent concerning this RFQ or its process.

Where a named manufacturer, product, 'or approved equivalent' appears in the specification, and an equivalent product is anticipated to meet or exceed the requested product, it is the responsibility of the respondent to submit a question in writing to the RFQ Contact through the Bidding System prior to the Deadline for Questions requesting the approved equivalent be considered. The respondent should be prepared to provide supporting documentation to state the details of the equivalent offered and demonstrate equivalence to the satisfaction of the City. Should the requested approved equivalent be deemed acceptable, in the sole discretion of the City, an addendum will be issued to inform all plan takers of the approved equivalent.

### **3.2.2 All New Information to Respondents by Way of Addenda**

This RFQ may be amended only by addendum in accordance with this section. If the City, for any reason, determines that it is necessary to provide additional information relating to this RFQ, such information will be communicated to all respondents by addendum. Each addendum forms an integral part of this RFQ and may contain important information, including significant changes to this RFQ. Respondents are responsible for obtaining all addenda issued by the City.

### **3.2.3 Post-Deadline Addenda and Extension of Submission Deadline**

If the City determines that it is necessary to issue an addendum after the Deadline for Issuing Addenda, the City may extend the Submission Deadline for a reasonable period of time.

### **3.2.4 Verify, Clarify and Supplement**

When evaluating quotations, the City may request further information from the respondent or third parties in order to verify, clarify or supplement the information provided in the respondent's



quotation, including but not limited to clarification with respect to whether a quotation meets the mandatory technical requirements set out in Section D of the RFQ Particulars (Appendix B). The City may revisit and re-evaluate the respondent's response on the basis of any such information.

### **3.3 Notification and Debriefing**

#### **3.3.1 Notification to Other Respondents**

Once an agreement is executed by the City and a respondent, the other respondents will be notified by public posting of the outcome of the RFQ process on the City's website.

#### **3.3.2 Debriefing**

Respondents may request a debriefing after receipt of a notification of the outcome of the procurement process. All requests must be in writing to the RFQ Contact and must be made within sixty (60) days of such notification.

#### **3.3.3 Procurement Protest Procedure**

If a respondent wishes to challenge the RFQ process, it should provide written notice to the RFQ Contact in accordance with the dispute resolution process set out in the City's Policy and any applicable trade agreement or other applicable bid protest procedures. The notice must provide a detailed explanation of the respondent's concerns with the procurement process or its outcome.

### **3.4 Conflict of Interest and Prohibited Conduct**

#### **3.4.1 Conflict of Interest**

For the purposes of this RFQ, the term "Conflict of Interest" includes, but is not limited to, any situation or circumstance where:

- (a) in relation to the RFQ process, the respondent has an unfair advantage or engages in conduct, directly or indirectly, that may give it an unfair advantage, including but not limited to (i) having, or having access to, confidential information of the City in the preparation of its quotation that is not available to other respondents, (ii) communicating with any person with a view to influencing preferred treatment in the RFQ process (including but not limited to the lobbying of decision makers involved in the RFQ process), or (iii) engaging in conduct that compromises, or could be seen to compromise, the integrity of the open and competitive RFQ process or render that process non-competitive or unfair; or
- (b) in relation to the performance of its contractual obligations under a contract for the Deliverables, the respondent's other commitments, relationships or financial interests (i) could, or could be seen to, exercise an improper influence over the objective, unbiased and impartial exercise of its independent judgement, or (ii) could, or could be seen to, compromise, impair or be incompatible with the effective performance of its contractual obligations.

### **3.4.2 Disqualification for Conflict of Interest**

The City may disqualify a respondent for any conduct, situation or circumstances, determined by the City, in its sole and absolute discretion, to constitute a Conflict of Interest as defined above.

### **3.4.3 Disqualification for Prohibited Conduct**

The City may disqualify a respondent, rescind notice of selection or terminate a contract subsequently entered into if the City determines that the respondent has engaged in any conduct prohibited by this RFQ.

### **3.4.4 Prohibited Respondent Communications**

Respondents must not engage in any communications that could constitute a Conflict of Interest and should take note of the Conflict of Interest declaration set out in the Submission Form.

### **3.4.5 Respondent Not to Communicate with Media**

Respondents must not at any time directly or indirectly communicate with the media in relation to this RFQ or any agreement entered into pursuant to this RFQ without first obtaining the written permission of the RFQ Contact.

### **3.4.6 No Lobbying**

Respondents must not, in relation to this RFQ or the evaluation and selection process, engage directly or indirectly in any form of political or other lobbying whatsoever to influence the selection of the successful respondent(s).

### **3.4.7 Illegal or Unethical Conduct**

Respondents must not engage in any illegal business practices, including activities such as bid-rigging, price-fixing, bribery, fraud, coercion or collusion. Respondents must not engage in any unethical conduct, including lobbying, as described above, or other inappropriate communications; offering gifts to any employees, officers, agents, elected or appointed officials or other representatives of the City; deceitfulness; submitting quotations containing misrepresentations or other misleading or inaccurate information; or any other conduct that compromises or may be seen to compromise the competitive process provided for in this RFQ.

### **3.4.8 Past Performance or Past Conduct**

The City may prohibit a supplier from participating in a procurement process based on past performance or based on inappropriate conduct in a prior procurement process, including but not limited to the following:

- (a) illegal or unethical conduct as described above;
- (b) the refusal of the supplier to honour its submitted pricing or other commitments; or
- (c) any conduct, situation or circumstance determined by the City, in its sole and absolute discretion, to have constituted an undisclosed Conflict of Interest.

### **3.5 Confidential Information**

#### **3.5.1 Confidential Information of the City**

All information provided by or obtained from the City in any form in connection with this RFQ either before or after the issuance of this RFQ

- (a) is the sole property of the City and must be treated as confidential;
- (b) is not to be used for any purpose other than replying to this RFQ and the performance of any subsequent contract for the Deliverables;
- (c) must not be disclosed without prior written authorization from the City; and
- (d) must be returned by the respondent to the City immediately upon the request of the City.

#### **3.5.2 Confidential Information of Respondent**

A respondent should identify any confidential information in its quotation or any accompanying documentation. The City will make reasonable efforts to safeguard confidential information of respondents, subject to its disclosure requirements under the Municipal Freedom of Information and Protection of Privacy Act or any other disclosure requirements imposed by law or by order of a court tribunal. Respondents are advised that their quotations will, as necessary, be disclosed, on a confidential basis, to advisers retained by the City to advise or assist with the RFQ process, including the evaluation of quotations. In addition, respondents are advised that certain contractual information, including pricing information, may be disclosed to City Council and, accordingly, may become part of the public record. If a respondent has any questions about the collection and use of information pursuant to this RFQ, questions are to be submitted to the RFQ Contact.

### **3.6 Procurement Process Non-binding**

#### **3.6.1 No Contract A and No Claims**

This procurement process is not intended to create and will not create a formal, legally binding bidding process and will instead be governed by the law applicable to direct commercial negotiations. For greater certainty and without limitation:

- (a) this RFQ will not give rise to any Contract A–based tendering law duties or any other legal obligations arising out of any process contract or collateral contract; and
- (b) neither the respondent nor the City will have the right to make any claims (in contract, tort, or otherwise) against the other with respect to the award of a contract, failure to award a contract or failure to honour a quotation submitted in response to this RFQ.

#### **3.6.2 No Contract until Execution of Written Agreement**

This RFQ process is intended to solicit non-binding quotations for consideration by the City and may result in an invitation by the City to a respondent to enter into the Agreement. No legal relationship or obligation regarding the procurement of any good or service will be created

between the respondent and the City by this RFQ process until the execution of a written agreement for the acquisition of such goods and/or services.

### **3.6.3 Non-binding Price Estimates**

While the pricing information provided in quotations will be non-binding prior to the execution of a written agreement, such information will be assessed during the evaluation of the quotations and the ranking of the respondents. Any inaccurate, misleading or incomplete information, including withdrawn or altered pricing, could adversely impact any such evaluation or ranking or the decision of the City to enter into an agreement for the Deliverables.

### **3.6.4 Cancellation**

The City may cancel or amend the RFQ process without liability at any time.

## **3.7 Governing Law and Interpretation**

These Terms and Conditions of the RFQ Process (Part 3):

- (a) are intended to be interpreted broadly and independently (with no particular provision intended to limit the scope of any other provision);
- (b) are non-exhaustive and must not be construed as intending to limit the pre-existing rights of the parties to engage in pre-contractual discussions in accordance with the common law governing direct commercial negotiations;
- (c) are to be governed by and construed in accordance with the laws of the province of Ontario and the federal laws of Canada applicable therein; and
- (d) if a respondent is required by applicable law to hold or obtain a licence, permit, consent or authorization to carry on an activity contemplated in its quotation, neither acceptance of the quotation nor execution of the contract shall be considered to be approval by the City of carrying on such activity without their requisite licence, permit, consent or authorization.

[End of Part 3]

## **APPENDIX A – FORM OF AGREEMENT**

The contract form for the project shall be the Canadian Construction Documents Committee **CCDC-2, 2020** Stipulated Price Contract (not attached hereto but shall form part of the contract) as amended by the City of Brantford's Supplemental General Conditions.



# SUPPLEMENTARY CONDITIONS

## AMENDMENTS TO CCDC 2-2020 STIPULATED PRICE CONTRACT

These Supplementary Conditions modify, delete and/or add to the Agreement between Owner and Contractor, the Definitions, and the General Conditions of the Stipulated Price Contract, Standard Construction Document CCDC 2 – 2020.

### SC 1. AGREEMENT BETWEEN OWNER AND CONTRACTOR

#### SC 1.1 ARTICLE A-5 PAYMENT

1.1.1 Delete paragraph 5.2 and replace it with the following:

“5.2 Should either party fail to make payments as they become due under this *Contract* or in an award by arbitration, adjudication or court, interest will begin to accrue on the amount that is not paid from the date when it is due until the date it is paid at the prejudgment interest rate prescribed by the Courts of Justice Act (Ontario).”

#### SC 1.2 ARTICLE A-6 RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING

1.2.1 Amend paragraph 6.2 by deleting the words “other form of electronic communication” and replacing them with “e-mail”.

1.2.2 Amend paragraph 6.4 by deleting the words “any form of electronic communication” and replacing them with “e-mail”.

#### SC 1.3 ARTICLE A-10 EXECUTION OF THE CONTRACT

1.3.1 Add a new Article A-10 as follows:

##### “ARTICLE A-10 EXECUTION OF THE CONTRACT

10.1 This *Contract* may be executed in counterparts and each of which so executed shall be deemed to be an original and such counterparts together shall constitute one and the same instrument and, notwithstanding their date of execution, shall be deemed to bear date as of the date first written above. The parties agree that this *Contract* may be transmitted by electronic transmission (scanned and transmitted by email) or other form of electronic document execution and delivery method (such as DocuSign), and that the reproduction of signatures by way of electronic means will be treated as though such reproductions were executed originals and shall be binding upon each party.”

### SC 2. DEFINITIONS

2.1.1 Amend the following Definitions:

(a) Amend the Definition of “**Consultant**” by adding the following to the end:

“For purposes of this *Contract*, the terms “*Consultant*”, “*Architect*” and “*Engineer*”, wherever used in the *Contract Documents*, shall be considered synonymous.”

(b) Amend the Definition of “**Payment Legislation**” so that, as amended, it reads as follows:

“*Payment Legislation* means the Construction Act (Ontario) as amended, and all regulations made thereunder.”

2.1.2 Add the following new Definitions:

(a) **As-Built Drawings**

“*As-Built Drawings* are the drawings prepared by the *Contractor* indicating as-built conditions and changes from the *Drawings* which occur during the course of the *Work* including, but not limited to, the exact location of major building components and structures that were shown generally on the *Drawings*. For certainty, *As-Built Drawings* shall be in computer-aided design (CAD) format approved by the *Owner*, as well as in paper and PDF formats.”

(b) **Deficiency Rectification Security**

"*Deficiency Rectification Security* means the amount to be delivered by the *Contractor* pursuant to paragraph 5.4A.2 of GC 5.4A – DEFICIENCY RECTIFICATION SECURITY."

(c) **Key Personnel**

"*Key Personnel* has the meaning assigned to such term in paragraph 3.5.3 of GC 3.5 – SUPERVISION."

(d) **OHSA**

"*OHSA* means the Occupational Health and Safety Act (Ontario), as amended, and all rules and regulations passed under it."

(e) **Proper Invoice**

"*Proper Invoice* means an application for payment given by the *Contractor* to the *Owner* that fully complies with the requirements of GC 5.1A – PROPER INVOICE."

(f) **Unrecoverable Costs**

"*Unrecoverable Costs* means all costs of head office personnel and overhead costs, standby time or impact costs, any consequential, punitive, exemplary, indirect or special damages, and any loss of profit or loss of opportunity costs and damages, whether incurred or suffered by the *Contractor* or any *Subcontractor* or *Supplier*."

(g) **WSIB**

"*WSIB* means the Ontario Workplace Safety & Insurance Board."

### SC 3. GENERAL CONDITIONS

#### SC 3.1 GC 1.1 CONTRACT DOCUMENTS

3.1.1 Delete paragraph 1.1.1 and replace it with the following:

"1.1.1 The intent of the *Contract Documents* is to include all labour, *Products*, materials, *Construction Equipment* and services necessary or normally considered necessary for the performance of the *Work*. Any item of *Work* mentioned in the *Contract Documents* or reasonably inferable from the *Contract Documents* but not otherwise shown or described, shall be provided by the *Contractor* as if shown or otherwise described or inferable. Any items omitted from the *Contract Documents* which are reasonably necessary or inferable for the completion of the *Work* or related work shall be considered a portion of the *Work* and included in the scope of *Work* to be performed under this *Contract*."

3.1.2 Amend paragraph 1.1.5.1 by changing the order of the first four bullet points so that, as reordered, the bullet points read as follows:

- "- Supplementary Conditions,
- the Agreement between *Owner* and *Contractor*,
- the Definitions,
- the General Conditions"

3.1.3 Add a new paragraph 1.1.5A as follows:

"1.1.5A Notwithstanding paragraph 1.1.5, if there is a conflict or discrepancy between the requirements of two or more *Contract Documents* in relation to the amount or quality of labour or materials required to complete a particular item of *Work*, the *Contractor* shall supply and shall include in the *Work* the labour and materials which would provide the greatest benefit to the *Owner*, as determined by the *Owner*."

3.1.4 Amend paragraph 1.1.9 by adding new paragraphs 1.1.9.1 and 1.1.9.2 as follows:

"1.1.9.1 The *Contract Documents* shall be read as a whole and are the minimum construction requirements. If the *Contractor* finds discrepancies in, or omissions from, the *Drawings*,

*Specifications* or other *Contract Documents* or has any doubt as to the meaning or intent of any part thereof, he shall at once notify the *Consultant*, who will send written instructions or explanations.

- 1.1.9.2 The *Drawings* are intended to convey the scope of the *Work* and indicate general and approximate locations, arrangement and sizes of fixtures, equipment, outlets, utilities and underground services. The *Contractor* shall obtain more accurate information and shall satisfy itself as to the locations, arrangement and sizes of fixtures, equipment, outlets, utilities and underground services from study and coordination of the *Drawings*, including *Shop Drawings*, and shall become familiar with conditions and spaces affecting these matters before proceeding with the *Work*. Where site conditions require reasonable minor changes to indicated locations and arrangements, the *Contractor* shall make such changes at no additional cost to the *Owner*. Similarly, where known conditions or existing conditions interfere with new installation and require relocation, the *Contractor* shall include such relocation in the *Work* at no additional cost to the *Owner*. The *Contractor* shall arrange and install fixtures and equipment in such a way as to conserve as much headroom and space as possible."

3.1.5 Add new paragraphs 1.1.12 to 1.1.14 as follows:

- "1.1.12 The *Contractor* shall review the *Contract Documents* and shall report promptly to the *Consultant* any error, inconsistency or omission the *Contractor* may discover. Provided it has exercised the degree of care and skill described in GC 3.11 – CONTRACTOR'S STANDARD OF CARE, the *Contractor* shall not be liable for damages or costs resulting from such errors, inconsistencies or omissions in the *Contract Documents* which the *Contractor* did not discover.
- 1.1.13 If the *Contractor* finds any error, inconsistency or omission in the *Contract Documents* or has any doubt as to the meaning or intent of any part thereof, the *Contractor* shall immediately notify the *Consultant*, who will provide written instructions or explanations. Neither the *Owner* nor the *Consultant* will be responsible for oral instructions.
- 1.1.14 Notwithstanding paragraphs 1.1.12 and 1.1.13, errors, inconsistencies and/or omissions shall not include lack of reference on the *Drawings* or in the *Specifications* to labour and/or *Products* that are normally required or normally recognized within respective trade practices as being necessary for the complete execution of the *Work*."

### SC 3.2 GC 1.3 RIGHTS AND REMEDIES

3.2.1 Add a new paragraph 1.3.3 as follows:

- "1.3.3 To be effective, the *Owner's* waiver of a right or remedy under this *Contract* must be expressly written by an authorized representative of the *Owner*. For greater certainty, actions of the *Owner* which shall not constitute a waiver include, but are not limited to, the following:
- .1 making partial payments to the *Contractor*;
  - .2 any partial or entire use or occupancy of the *Project*;
  - .3 final acceptance of the *Work*;
  - .4 failure to object to known defects;
  - .5 specifying a list of defects will not be held a waiver of defects not listed."

### SC 3.3 GC 1.4 ASSIGNMENT

3.3.1 Delete paragraph 1.4.1 and replace it with the following:

- "1.4.1 The *Owner* may assign the *Contract* or a portion thereof without the consent of the *Contractor* where such assignment is to an entity undertaking the *Project* for the use of the *Owner*. The *Contractor* shall not assign the *Contract* or any portion thereof or its interest therein without the written consent of the *Owner*, which consent may be unreasonably and arbitrarily withheld. In the event of an assignment of the *Contract* by the *Contractor*, such assignment shall not relieve the *Contractor* from its obligations and liabilities under this *Contract*. "

### SC 3.4 GC 1.5 CONFIDENTIALITY

3.4.1 Add a new GC 1.5 as follows:



### “GC 1.5 CONFIDENTIALITY

1.5.1 The *Contractor* shall keep confidential all matters respecting technical and commercial issues relating to or arising from the performance of the *Contract* and shall not, without the prior written consent of the *Owner*, disclose any such matters, except in strict confidence, to:

- .1 its employees, *Subcontractors* and *Suppliers* who have a need to know the same in order to use the same in connection with the *Work* and the *Project*; and
- .2 its professional advisors but only to the extent as may be required by government authorities or applicable law.

The confidentiality restrictions shall not apply to any information that is required to be disclosed by applicable law, regulations or judicial process. Provided, however, that the *Contractor* shall give *Owner* at least ten (10) *Working Days*’ prior written notice of any intended disclosure together with the relevant provision of law, regulation or judicial process under which the disclosure is intended to be made, and the *Contractor* shall cooperate with the *Owner* and its legal counsel in connection with any protective order or other appropriate remedies the *Owner* may seek to prevent or limit such disclosure.”

### SC 3.5 GC 2.2 ROLE OF THE CONSULTANT

3.5.1 Amend paragraph 2.2.12 by adding the following to the end:

“If the *Contractor* believes a *Supplemental Instruction* will result in either a change to the *Contract Price* or the *Contract Time*, the *Contractor* shall, within five (5) *Working Days* of receipt of such *Supplemental Instruction*, provide the *Consultant* with a *Notice in Writing* to that effect and shall await further instructions. The *Contractor*’s failure to provide such *Notice in Writing* within the time stipulated in this paragraph shall be deemed an acceptance of the *Supplemental Instruction* by the *Contractor* without adjustment to the *Contract Price* or *Contract Time*.”

3.5.2 Amend paragraph 2.2.18 by deleting the words “against whom the *Contractor* makes no reasonable objection and”.

### SC 3.6 GC 2.4 DEFECTIVE WORK

3.6.1 Amend paragraph 2.4.1 as follows:

- (a) insert the words “, at the *Contractor*’s sole cost and expense,” after the words “The *Contractor* shall” in the first line; and
- (b) add the following to the end:

“The *Contractor* shall promptly pay to the *Owner* all costs, damages and loss incurred by the *Owner* for *Work* destroyed or damaged or for any alterations necessitated by the *Contractor*’s removal, replacement or re-execution of defective portions of the *Work*. The *Owner* shall be entitled to set-off and deduct all such costs, damages and loss against amounts owing to the *Contractor* under this *Contract*.”

3.6.2 Add a new paragraph 2.4.4 as follows:

“2.4.4 The *Contractor* shall prioritize the correction of any defective work or deficiencies identified as priorities by the *Owner* or the *Consultant*.”

### SC 3.7 GC 3.1 CONTROL OF THE WORK

3.7.1 Amend paragraph 3.1.2 by adding the word “schedules,” after the word “techniques,”.

3.7.2 Add new paragraphs 3.1.3 to 3.1.6 as follows:

“3.1.3 The *Contractor* is solely responsible for the quality of the *Work* and shall undertake any quality control activities specified in the *Contract Documents* or, if none are specified, as may be reasonably required to ensure such quality. The *Contractor* shall perform the *Work* in accordance with modern practice and in accordance with applicable laws, ordinances, rules, regulations or codes relating to the performance of the *Work*. Without limiting the generality of

the foregoing, the *Contractor* is responsible for coordinating the *Work* so that no part shall be left in an unfinished or incomplete condition.

- 3.1.4 The *Contractor* shall abide by and shall enforce directives and policies regarding signs, advertisements, fires, smoking and vaping at the *Place of the Work* as directed by the *Owner*.
- 3.1.5 The *Contractor*, without in any way limiting its responsibilities under this *Contract*:
- .1 shall perform the *Work* so as to avoid disturbing the occupants of any facilities, premises, or the public in general;
  - .2 shall respect and comply with local regulations and all *Owner's* requirements regarding permitted work hours, noise levels and work conditions;
  - .3 shall abide by and enforce *Owner* directives and policies regarding signs, advertisements, fires and smoking at the *Place of the Work* as directed by the *Owner*;
  - .4 shall take all reasonable steps to avoid interference with fire exits, building or site access and egress, continuity of electric power and all other utilities, to suppress dust and noise, to avoid conditions likely to propagate mould or fungus of any kind, and shall take all other steps reasonably necessary to promote and maintain the safety and comfort of the users and occupants of any facilities, premises and the public in general, and to maintain access to and the operation of any existing facilities at the *Place of the Work*;
  - .5 shall take precautions not to allow any unauthorized visitors entry to the *Place of the Work*;
  - .6 shall not permit any worker or *Subcontractors* to use any existing facilities including, without limitation, elevators, lavatories, toilets, entrances, and parking areas other than those designated by the *Owner*.
- 3.1.6 Prior to commencing the *Work* the *Contractor* shall verify all relevant measurements and levels necessary for proper and complete fabrication, assembly and installation of the *Work* and shall further carefully compare such field measurements and conditions with the requirements of the *Contract Documents*. Where dimensions are not included or exact locations are not apparent in the *Contract Documents*, the *Contractor* shall immediately notify the *Consultant* in writing and shall obtain written instructions before proceeding with any part of the affected *Work*. Failure to do so shall be at the sole risk and cost of the *Contractor*."

### SC 3.8 GC 3.2 CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS

3.8.1 Delete paragraph 3.2.2.

3.8.2 Amend paragraph 3.2.3.4 by adding the following to the end:

"Failure by the *Contractor* to so report shall invalidate any claims against the *Owner* by reason of the deficiencies in the work of *Other Contractors* or *Owner's* own forces except for those deficiencies not then reasonably discoverable; and"

3.8.3 Add a new paragraph 3.2.3.5 as follows:

"3.2.3.5 assume overall responsibility for the *Owner's* own forces and for *Other Contractors* for compliance with all aspects of the applicable health and construction safety legislation at the *Place of the Work*, including all of the responsibilities of the "constructor" under the *OHSA*."

3.8.4 Add a new paragraph 3.2.7 as follows:

"3.2.7 The placement, installation, application and connection of work by the *Owner's* own forces or by *Other Contractors* on and to the *Work* shall not relieve the *Contractor* of its responsibility to provide and maintain the warranties specified in this *Contract*. If the *Contractor* is of the view that the work of *Other Contractors* or the work of the *Owner's* own forces will compromise, void or nullify any of the warranties to be provided pursuant to this *Contract*, the *Contractor* shall immediately give *Notice in Writing* to the *Owner* and shall include in such notice the reasons why, in the *Contractor's* view, a warranty or warranties will be compromised, voided or nullified, together with the *Contractor's* recommendations for avoiding such result."

### SC 3.9 GC 3.4 CONSTRUCTION SCHEDULE

3.9.1 Delete paragraph 3.4.1 and replace it with the following:

“3.4.1 The *Contractor* shall:

- .1 within ten (10) *Working Days* of signing this *Contract* submit to the *Owner* and the *Consultant*, for the *Owner's* approval, a construction schedule that indicates the timing of major activities and critical milestone dates for the *Work*, demonstrating that the *Work* will be performed in conformity with the *Contract Time*. Such schedule:
  - (a) shall be prepared using a scheduling software approved in writing by the *Owner*, and
  - (b) shall be provided in both a native editable electronic format that includes and shows all logic links between activities, and in paper format, and
  - (c) shall be prepared in collaboration with, and supported by, the *Subcontractors* and *Suppliers* whose activities affect the critical path of the *Work*, and
  - (d) shall include and make provision for statutory holidays, weather conditions that are normally experienced at the *Place of the Work*, and the rectification of defects and deficiencies, and
  - (e) shall provide sufficient detail of the critical events and their inter-relationship and shall include a baseline schedule indicating the critical path for the *Project*; and
- .2 provide the expertise and resources, including labour and *Construction Equipment*, as are necessary to maintain progress under the construction schedule; and
- .3 monitor the adequacy of *Subcontractor* and *Supplier* personnel and equipment and the availability of *Products* to meet the construction schedule and take appropriate action when requirements of a contract with a *Subcontractor* or *Supplier* are not being met; and
- .4 monitor the progress of the *Work* on a weekly basis relative to the construction schedule, update the schedule on a monthly basis, and immediately advise the *Owner* and the *Consultant* in writing of any variation from the baseline or slippage in the schedule; and
- .5 at each site meeting provide to the *Owner* and the *Consultant* a look-ahead schedule indicating the major activities to be undertaken in the next month.

3.4.2 If at any time the *Contractor* forms the opinion or anticipates that the progress of the *Work* is behind schedule or is likely to fall behind schedule the *Contractor* shall take appropriate steps, at the *Contractor's* own expense, to cause the actual progress of the *Work* to conform to the schedule and shall produce and present to the *Owner* and the *Consultant*, for review and approval, a recovery plan demonstrating how the *Contractor* will achieve recovery of the schedule.

3.4.3 The *Contractor* shall not change the scheduled *Ready-for-Takeover* date.”

### SC 3.10 GC 3.4A CONTRACTOR'S MONTHLY REPORTS

3.10.1 Add a new GC 3.4A as follows:

“GC 3.4A CONTRACTOR'S MONTHLY REPORTS

3.4A.1 The *Contractor* shall prepare and deliver a monthly written report to the *Owner* and the *Consultant* on the status of the *Project*. Such monthly report shall include:

- .1 an overview of the state and progress of the *Work*;
- .2 confirmation that the *Work* is on schedule or, if the schedule has suffered slippage, a recovery plan demonstrating how the *Contractor* will achieve recovery of the schedule;
- .3 a list of critical issues of which the *Contractor* is aware and which require resolution, including dates by which decisions are required and by whom;
- .4 proposed or anticipated changes of which the *Contractor* is aware, and their expected impacts on the *Project*;
- .5 claims or anticipated claims of which the *Contractor* is aware, including claims against the *Contractor*, the *Owner*, or the *Project*;
- .6 the *Contractor's* proposed plan and schedule for repairing, correcting or reworking of any defective work;

- .7 an updated construction schedule which conforms to the requirements of paragraph 3.4.1.1 of GC 3.4 – CONSTRUCTION SCHEDULE.

3.4A.2 The *Contractor's* monthly report shall be included with its monthly application for progress payment.”

#### **SC 3.11 GC 3.5 SUPERVISION**

3.11.1 Amend paragraph 3.5.1 by adding the following to the end:

“, and upon the *Contractor* obtaining the *Owner's* prior written consent, which consent will not be unreasonably withheld.”

3.11.2 Add a new paragraph 3.5.3 as follows:

“3.5.3 The *Contractor's* key team members and personnel for the *Project* (“**Key Personnel**”) are listed in the Schedule attached to the Supplementary Conditions. The *Contractor* shall ensure the *Key Personnel* remain on the *Project* for the duration of the *Project* and shall not permit any *Key Personnel* to be changed, substituted, replaced or reassigned without the prior written approval of the *Owner*. If the *Owner* approves a change in *Key Personnel*, the *Contractor* shall promptly arrange for an appointment of a replacement person of comparable or greater experience, subject to the *Owner's* written approval. The *Contractor* shall provide to the *Owner* all relevant information on each proposed replacement person, including a current resume and synopsis of the individual's roles on previous projects. All costs associated with the transition of replacement personnel onto the *Project* shall be at the sole cost and expense of the *Contractor*.”

#### **SC 3.12 GC 3.6 SUBCONTRACTORS AND SUPPLIERS**

3.12.1 Amend paragraph 3.6.2 as follows:

- (a) by deleting the words “before signing the *Contract*” in the third line; and
- (b) by adding the following to the end:

“If the *Contractor* wishes to change any *Subcontractors* or *Suppliers*, the *Contractor* shall advise the *Owner* in writing and give the reasons for the proposed change. The *Contractor* shall not change *Subcontractors* or *Suppliers* without the *Owner's* prior written approval, which approval will not be unreasonably withheld.”

3.12.2 Amend paragraph 3.6.3 by deleting the words “before the *Owner* has signed the *Contract*,” in the first line.

3.12.3 Add a new paragraph 3.6.7 as follows:

“3.6.7 Notwithstanding paragraph 3.6.5, the *Owner* may assign to the *Contractor*, and the *Contractor* shall accept the assignment of, any contract for *Work* or *Products* required on the *Project* that has been procured or negotiated by or on behalf of the *Owner*. In such event the *Contract Price* shall be increased by the balance of the contract price remaining under such assigned contract.”

#### **SC 3.13 GC 3.7 LABOUR AND PRODUCTS**

3.13.1 Amend paragraph 3.7.1 as follows:

- (a) insert the words “agents, *Subcontractors* and *Suppliers*” after the word “employees” in the first line; and
- (b) add the following to the end:

“Without in any way limiting the generality of the foregoing, the *Contractor* shall prepare and implement the job site rules more particularly described in the *Contract Documents*. If no job site rules are described in the *Contract Documents*, the *Contractor* shall draft job site rules for the review and approval of the *Consultant* and the *Owner*. Such job site rules prepared by the *Contractor* shall be consistent with the *Contractor's* duties and obligations under *OHSA*, shall include and incorporate all *Owner's* policies and protocols relating to construction and working in *Owner* facilities, and shall

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include provisions making smoking, vaping and the consumption of alcohol or non-prescription drugs on the *Project* site the subject of discipline proceedings and/or termination of employment.”

#### 3.13.2 Add new paragraphs 3.7.4 to 3.7.8 as follows:

- “3.7.4 The *Contractor* shall ensure that all materials and *Products* are delivered to the *Project* site in original containers and packages with labels and seals intact and that they are protected from the elements and visible for inspection by the *Owner* and/or the *Consultant*.
- 3.7.5 The *Contractor* is responsible for the safe on-site storage of *Products* and their protection (including *Products* supplied by the *Owner* and *Other Contractors*) so as to avoid dangerous conditions, deterioration, damage or contamination to the *Products*, persons, or property and in locations at the *Place of the Work* to the satisfaction of the *Owner* and the *Consultant*.
- 3.7.6 The *Owner* or the *Consultant*, acting reasonably, shall have the right to order the *Contractor* to remove from the *Project*, without cost to the *Owner*, any representative or employee of the *Contractor* or any representative or employee of any *Subcontractor* or *Supplier* whose conduct, in the opinion of the *Owner* or the *Consultant*, jeopardizes the safety or security of the *Project*, any person, the *Owner's* operations, is a detriment to the *Project*, or whose behaviour may be considered as harassment in the workplace. Immediately upon receipt of such order the *Contractor* shall make arrangements for the appointment of a replacement representative or employee acceptable to the *Owner*. All costs associated with the transition of replacement staff onto the *Project* shall be at the sole cost and expense of the *Contractor*.
- 3.7.7 The *Contractor* shall not, and shall ensure that its *Subcontractors* and *Suppliers* do not, employ any person on the *Project* whose labour affiliation or lack thereof is incompatible with other labour employed in connection with the *Work*. All costs arising from labour disputes arising from the *Contractor's* failure to comply with this paragraph shall be the sole expense of the *Contractor*.
- 3.7.8 The *Contractor* shall cooperate with the *Owner*, the *Consultant* and their representatives and shall take all reasonable and necessary actions to maintain stable and harmonious labour relations at the *Place of the Work*, including cooperation to attempt to avoid *Work* stoppages, trade union jurisdictional disputes, and other labour disputes.”

#### SC 3.14 GC 3.8 SHOP DRAWINGS

##### 3.14.1 Amend paragraph 3.8.1 by adding the following to the end:

“Prior to the first application for payment, the *Contractor* shall prepare a schedule for the dates of submission, review and return of *Shop Drawings* and shall deliver it to the *Consultant* and *Owner* for review and approval. The draft *Shop Drawings* schedule shall clearly indicate the phasing of *Shop Drawings* and submissions.”

##### 3.14.2 Add new paragraphs 3.8.8 to 3.8.11 as follows:

- “3.8.8 Reviewed *Shop Drawings* shall not authorize a change in the *Contract Price* or the *Contract Time*.
- 3.8.9 The *Contractor* shall not use the term “by others” on *Shop Drawings* and shall identify the responsible *Subcontractor* or *Supplier* where such work is within the scope of the *Work*.
- 3.8.10 Where *Specifications* require the *Shop Drawings* to bear the seal and signature of a professional, such professional shall be registered in the jurisdiction of the *Place of the Work* and shall have expertise in the area of practice reflected in the *Shop Drawings*.
- 3.8.11 The *Consultant's* review of the *Shop Drawings* shall not relieve the *Contractor* from responsibility for defective *Work* resulting from errors or omissions of any kind on the reviewed *Shop Drawings* and shall not constitute authorization to the *Contractor* to perform additional *Work* or changed *Work*. The *Contractor* is solely responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes, and for techniques of construction and installation.”

#### SC 3.15 GC 3.9 USE OF THE WORK

##### 3.15.1 Add a new GC 3.9 as follows:



#### **"GC 3.9 USE OF THE WORK**

- 3.9.1 The *Contractor* shall confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and operations of employees, *Subcontractors* and *Suppliers* to limits indicated by laws, ordinances, permits, or the *Contract Documents*, and shall not unreasonably encumber the *Place of the Work*.
- 3.9.2 The *Contractor* shall not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety of the *Work*."

#### **SC 3.16 GC 3.10 CLEANUP**

3.16.1 Add a new GC 3.10 as follows:

##### **"GC 3.10 CLEANUP**

- 3.10.1 The *Contractor* shall:
- .1 maintain the *Work* and the *Place of the Work* in a safe and tidy condition and free from the accumulation of waste products and debris;
  - .2 ensure the *Place of the Work* is cleaned and left in a tidy condition on a daily basis.
- If the *Contractor* fails to remove waste and debris as provided in this GC 3.10, then, the *Owner* may remove such waste and debris and deduct from payments otherwise due to the *Contractor* the costs of doing so.
- 3.10.2 Before delivering the application for *Ready-for-Takeover* the *Contractor* shall remove all surplus *Products*, tools, *Construction Equipment*, *Temporary Work*, waste products and debris and shall ensure the *Place of the Work* is clean and tidy and suitable for occupancy by the *Owner*."

#### **SC 3.17 GC 3.11 CONTRACTOR'S STANDARD OF CARE**

3.17.1 Add a new GC 3.11 as follows:

##### **"GC 3.11 CONTRACTOR'S STANDARD OF CARE**

- 3.11.1 In performing this *Contract* the *Contractor* shall exercise a standard of care, skill, judgment and diligence that would normally be exercised by an experienced, skilled and prudent contractor performing similar work for similar projects. The *Contractor* acknowledges and agrees that, throughout this *Contract*, the *Contractor's* obligations, duties and responsibilities shall be interpreted in accordance with this standard. The *Contractor* shall exercise the same standard of care, skill, judgment and diligence in respect of any *Products*, *Subcontractors*, *Suppliers*, personnel or procedures which it may employ on the *Project*.
- 3.11.2 The *Contractor* represents, covenants and warrants to the *Owner* that:
- .1 the *Contractor's* personnel assigned to the *Project* are appropriately experienced and trained;
  - .2 it has sufficient qualified and competent personnel to replace its designated supervisor, superintendent and project manager, subject to the *Owner's* approval, in the event of incapacity, removal or resignation; and
  - .3 there are no pending, threatened or anticipated claims that would have a material effect on the financial ability of the *Contractor* to perform this *Contract*."

#### **SC 3.18 GC 3.12 CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS**

3.18.1 Add a new GC 3.12 as follows:

##### **"GC 3.12 CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS**

- 3.12.1 The *Contractor* shall not make use of elements of the mechanical and electrical systems or equipment comprising a permanent part of the *Work*, including the HVAC system and elevators, without the *Owner's* prior express written consent obtained in accordance with this GC 3.12.
- 3.12.2 If the *Contractor* wishes to make use of such systems or equipment the *Contractor* shall, before using such systems or equipment:

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- .1 obtain the manufacturer's instructions regarding the preventative maintenance services to be performed on such systems and equipment; and
  - .2 submit a written request to the *Owner* for consent to use such systems or equipment, which request shall include all of the information received from the manufacturer of such systems or equipment and shall include the *Contractor's* comprehensive operation and preventative maintenance plan for such systems and equipment.
- 3.12.3 If the *Owner* issues a written consent to the *Contractor's* use of elements of the mechanical and electrical systems or equipment comprising a permanent part of the *Work*, the *Contractor* shall:
- .1 operate and maintain such systems and equipment in strict compliance with the requirements set out in the *Specifications*, any instructions received from the manufacturers of such systems and equipment, and the *Contractor's* comprehensive operation and preventative maintenance plan; and
  - .2 perform all preventative maintenance services on such systems and equipment in accordance with the *Specifications*, any instructions received from the manufacturers of such systems and equipment, and the *Contractor's* comprehensive operation and maintenance plan; and
  - .3 before applying for *Ready-for-Takeover*, clean and make good, to the satisfaction of the *Owner*, all such systems and equipment as it had been permitted to use; and
  - .4 pay any and all costs associated with such use, operation, preventative maintenance services, cleaning and making good at no cost or charge to the *Owner*."

#### SC 3.19 GC 4.1 CASH ALLOWANCES

3.19.1 Add a new paragraph 4.1.8 as follows:

- "4.1.8 The *Owner* reserves the right to call, or to have the *Contractor* call, for competitive bids for portions of the *Work* to be paid for from cash allowances."

#### SC 3.20 GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER

3.20.1 Delete GC 5.1.

#### SC 3.21 GC 5.1A PROPER INVOICE

3.21.1 Add a new GC 5.1A as follows:

##### "GC 5.1A PROPER INVOICE

- 5.1A.1 In this *Contract* a *Proper Invoice* shall mean an application for payment made by the *Contractor* that:
- .1 is given to the *Owner* monthly by e-mail sent to "●.com" and is sent concurrently to the *Consultant* by e-mail, or as the *Owner* may otherwise direct; and
  - .2 includes all of the following:
    - .1 the *Contractor's* name and address and HST registration number;
    - .2 the date of the application for payment and the period during which the services or materials were supplied;
    - .3 information identifying the authority, whether in the *Contract* or otherwise, under which the services or materials were supplied, including the applicable RFT or purchase order number;
    - .4 a description, including quantities where appropriate, of the services and materials that were supplied;
    - .5 the amount payable for the services or materials that were supplied, and the payment terms. Ensure the amounts align with the *Contractor's* pricing form;
    - .6 the name, title, telephone number and mailing address of the person to whom payment is to be sent;
    - .7 copies of all *Change Orders* and *Change Directives* for which the *Contractor* is claiming payment together with all backup documentation;

- .8 a statement based on the schedule of values for the *Work*,
- .9 for all applications for payment except the final payment, the monthly report required by GC 3.4A – CONTRACTOR'S MONTHLY REPORTS, including an updated construction schedule which complies with the requirements of paragraph 3.4.1.1 of GC 3.4 – CONSTRUCTION SCHEDULE;
- .10 a current valid clearance certificate issued by the *WSIB*;
- .11 for the second and all subsequent applications for payment, a CCDC 9A Statutory Declaration stating that all accounts for services and materials and other indebtedness incurred by the *Contractor* for which the *Owner* may in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified matter in dispute."

#### SC 3.22 GC 5.2 APPLICATIONS FOR PAYMENT

3.22.1 Delete paragraphs 5.2.1 and 5.2.2 and replace them with the following:

- "5.2.1 *Proper Invoices* for progress payment shall be given monthly to the *Owner* and the *Consultant* as the *Work* progresses on a day of the month agreed to by the parties.
- 5.2.2 Five (5) *Working Days* before submitting a *Proper Invoice* the *Contractor* shall convene a meeting with the *Owner*, the *Consultant*, and those *Subcontractors* whose *Work* is to be included in the *Proper Invoice*, for the purpose of reviewing the progress of the *Work* and to review a draft *Proper Invoice*. For certainty, the purpose of such meeting is not to pre-certify or pre-approve the *Proper Invoice*."

3.22.2 Amend paragraph 5.2.3 by adding the following to the end:

"No amount claimed shall include *Products* delivered to the *Place of the Work* unless the *Products* are free and clear of all security interests, liens, and other claims of third parties."

3.22.3 Delete paragraph 5.2.4 and replace it with the following:

- "5.2.4 The *Contractor* shall, within 15 *Working Days* after signing this *Contract*, submit to the *Consultant*, for the *Consultant's* approval, a schedule of values for the parts of the *Work* aggregating the total amount of the *Contract Price*, so as to facilitate evaluation of applications for payment. Such schedule of values:
  - .1 shall include a detailed breakdown of the *Work*; and
  - .2 shall include line items which assign an appropriate portion of the *Contract Price* for the preparation and delivery of *As-Built Drawings*, quality control, and closeout of the *Work*.Once approved, this schedule of values shall be the basis of payment unless shown to be in error."

3.22.4 Amend paragraph 5.2.6 by adding the following to the end:

" , as modified by paragraph 5.1A.1.2 of GC 5.1A – PROPER INVOICE."

3.22.5 Amend paragraph 5.2.8 by adding the following to the end:

"Any *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall remain at the risk of the *Contractor* notwithstanding that title has passed to the *Owner* pursuant to GC 14.2 – OWNERSHIP OF MATERIALS."

#### SC 3.23 GC 5.3 PAYMENT

3.23.1 Delete paragraph 5.3.1 and replace it with the following:

- "5.3.1 After receipt by the *Consultant* and the *Owner* of an application for progress payment given by the *Contractor* in accordance with GC 5.2 – APPLICATIONS FOR PAYMENT, the *Consultant* will issue to the *Owner* and copy to the *Contractor*, no later than 10 calendar days after the date of receipt of a *Proper Invoice*, a certificate for payment in the amount applied for, or in such other amount as the *Consultant* determines to be properly due.



- 5.3.2 Subject to the *Owner's* right to give notice of non-payment in accordance with the *Payment Legislation*, and subject to the applicable statutory holdback provisions, the *Owner* will pay the amount payable under a *Proper Invoice* for progress payment no later than 28 days after the date the *Owner* receives the *Proper Invoice*. Provided that the *Owner's* obligation to make payment shall not arise unless and until the *Contractor's* application for payment constitutes a complete *Proper Invoice* as provided in GC 5.1A – PROPER INVOICE. For certainty, and without limitation, the *Owner* may refuse to pay all or any portion of an application for payment where:
- .1 the application does not comply with all of the requirements of a *Proper Invoice* in GC 5.1A – PROPER INVOICE; and/or
  - .2 the *Owner* is entitled to deduct and retain amounts in accordance with the *Contract Documents*; and/or
  - .3 the amount applied for exceeds the amount certified for payment by the *Consultant* in the certificate for payment issued pursuant to paragraph 5.3.1."

#### SC 3.24 GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

- 3.24.1 Delete paragraphs 5.4.2 to 5.4.4 and replace them with the following:

- "5.4.2 Immediately after the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor*:
- .1 shall, in consultation with the *Owner* and the *Consultant*, establish reasonable dates for *Ready-for-Takeover* and for finishing the *Work* and correcting deficient *Work*; and
  - .2 shall cause the certificate to be published in the manner prescribed by the *Payment Legislation* and shall immediately deliver a copy of the published certificate to the *Owner*.
- 5.4.3 The *Contractor* shall submit an application for payment of the lien holdback amount which shall include all of the following.
- .1 a written request for the release of the holdback amount;
  - .2 a declaration that no written notices of lien have been received by the *Contractor*;
  - .3 a copy of the published certificate of *Substantial Performance of the Work*;
  - .4 a current *WSIB* clearance certificate; and
  - .5 a CCDC 9A Statutory Declaration stating that all accounts for services and materials and other indebtedness incurred by the *Contractor* for which the *Owner* may in any way be held responsible have been paid in full, except for amounts properly retained as a holdback or as an identified matter in dispute.
- 5.4.4 Subject to the *Owner's* right to give notice of non-payment of holdback in accordance with the *Payment Legislation*, the *Owner* will pay the amount authorized by the certificate for payment of the holdback in accordance with the *Payment Legislation*."

- 3.24.2 Delete paragraph 5.4.5 and replace it with the following:

- "5.4.5 The *Contractor* may request the *Owner* to direct the *Consultant* to make a determination whether a *Subcontractor* contract has been completed prior to *Substantial Performance of the Work*. If the *Owner* agrees to so direct the *Consultant*, the *Contractor* shall submit documentation clearly identifying the *Work* and the *Subcontractor* involved and such other documents as are stipulated by the *Payment Legislation* or requested by the *Owner* or the *Consultant*. For greater certainty, the *Owner's* decision whether or not to direct the *Consultant* to determine if a *Subcontractor* contract has been completed is at the *Owner's* sole discretion.
- 5.4.5A If, after being directed to do so by the *Owner* pursuant to paragraph 5.4.5, the *Consultant* determines that a *Subcontractor* contract has been completed prior to *Substantial Performance of the Work*, the *Consultant* shall complete and issue a certificate of completion of subcontract in the form prescribed by the *Payment Legislation* and the *Owner* shall pay the *Contractor* the holdback amount retained for such subcontract work after the expiry of the applicable holdback period stipulated in the *Payment Legislation*."



## SUPPLEMENTARY CONDITIONS

### AMENDMENTS TO CCDC 2-2020 STIPULATED PRICE CONTRACT

#### SC 3.25 GC 5.4A DEFICIENCY RECTIFICATION SECURITY

3.25.1 Add a new GC 5.4A as follows:

##### **"GC 5.4A DEFICIENCY RECTIFICATION SECURITY**

- 5.4A.1 The *Contractor* shall, within 25 days after the date of *Substantial Performance of the Work*, deliver to the *Owner* the *Deficiency Rectification Security* in the amount determined in accordance with paragraph 5.4A.2 in the form of:
- .1 an irrevocable standby letter of credit in a form satisfactory to the *Owner*; or
  - .2 a certified cheque or bank draft payable to the *Owner*.
- 5.4A.2 The amount to be paid by the *Contractor* (the "***Deficiency Rectification Security***") shall be:
- .1 if the *Contract Price* is less than \$100,000, the amount of \$5,000 plus *Value Added Taxes*, or such other amount as the *Owner* may require;
  - .2 if the *Contract Price* is \$100,000 or more but is less than \$1,500,000, the amount equivalent to 5% of the *Contract Price*, plus *Value Added Taxes*;
  - .3 if the *Contract Price* is \$1,500,000 or more but is less than \$2,500,000, the amount equivalent to 3% of the *Contract Price*, plus *Value Added Taxes*;
  - .4 if the *Contract Price* is \$2,500,000 or more, the amount equivalent to 1.5% of the *Contract Price*, plus *Value Added Taxes*.
- 5.4A.3 If the *Contractor* fails to deliver the *Deficiency Rectification Security* in accordance with paragraphs 5.4A.1 and 5.4A.2, the *Owner* may deduct and retain the *Deficiency Rectification Security* from any amount owing to the *Contractor*, and such retained amount shall take the place of and shall become the *Deficiency Rectification Security*.
- 5.4A.4 The *Owner* will use the *Deficiency Rectification Security* to cover the costs of correcting defects, deficiencies or non-compliant items of *Work* which appear prior to and during the warranty period, as described in paragraph 12.3.5A of GC 12.3 – WARRANTY."

#### SC 3.26 GC 5.5 FINAL PAYMENT

3.26.1 Delete paragraph 5.5.1 and replace it with the following:

- "5.5.1 When the *Contractor* considers that the *Work* is completed, the *Contractor* shall deliver a *Proper Invoice* for final payment."

3.26.2 Amend paragraph 5.5.2 by adding the following to the end:

"Without limiting the generality of the foregoing, the application for final payment will not be considered valid until *Products* installed are tested and conform to the requirements specified in the *Contract Documents* and all documents required by the *Contract Documents* have been received and accepted by the *Consultant*."

3.26.3 Delete paragraphs 5.5.3 and 5.5.4 and replace them with the following:

- "5.5.3 Subject to the *Owner's* right to give notice of non-payment in accordance with the *Payment Legislation*, the *Owner* will pay the amount payable under a *Proper Invoice* for final payment no later than 28 days after the date the *Owner* receives the *Proper Invoice*. Provided that the *Owner's* obligation to make payment shall not arise unless and until the *Contractor's* application for payment constitutes a complete *Proper Invoice* as provided in GC 5.1A – PROPER INVOICE."

#### SC 3.27 GC 5.8 WITHHOLDING OF PAYMENT

3.27.1 Add a new GC 5.8 as follows:

##### **"GC 5.8 WITHHOLDING OF PAYMENT**

- 5.8.1 Notwithstanding any provision in the *Contract Documents* to the contrary, the *Owner* may withhold payment of any amount claimed in an application for payment, in a *Proper Invoice*, or in any certificate for payment to the extent required to offset any claims the *Owner* may have

against the *Contractor*, or to offset previous overpayment made to the *Contractor*, or for damages or costs incurred by the *Owner*, or to the extent as may be necessary to protect and/or indemnify the *Owner* from loss, claims and/or damage, including from loss, claims and/or damage arising as a result of:

- .1 the *Contractor's* failure to perform any of its material obligations or where the *Contractor* is otherwise in default under the *Contract Documents*, whether or not the *Contractor* has been noted in default;
- .2 defective *Work* not remedied;
- .3 damage done to work performed by *Other Contractors* or by the *Owner's* own forces;
- .4 the *Contractor's* failure to make prompt payments to its *Subcontractors* and *Suppliers* respecting *Work* for which the *Owner* has made payment to the *Contractor*;
- .5 claims or reasonable evidence indicating possible commencement of claims for which the *Contractor* may be responsible to indemnify the *Owner*;
- .6 the *Contractor's* failure to remove liens arising from the *Work* or to otherwise satisfy its obligations under GC 14.2 – LIENS AND ACTIONS;
- .7 reasonable evidence the *Contractor* will not attain *Ready-for-Takeover* in accordance with the construction schedule or within the *Contract Time*;
- .8 any claim for which the *Owner* is entitled to indemnification from the *Contractor* pursuant to the *Contract Documents*.

- 5.8.2 Where the *Owner* has withheld payment to the *Contractor* pursuant to the provisions of this *Contract*, the *Owner* shall be entitled to apply the funds withheld toward the costs of any required remedial work, completion costs or toward damages or losses suffered and for which the *Owner* is entitled to compensation under this *Contract*, including legal costs and expenses."

### SC 3.28 GC 6.1 OWNER'S RIGHT TO MAKE CHANGES

- 3.28.1 Amend paragraph 6.1.2 by adding the following to the end:

"All such changes require approval by a representative of the *Owner* with proper signing authority. The requirement that the *Contractor* obtain a *Change Order* or a *Change Directive* is of the essence and it is the express intention of the parties that any claims by the *Contractor* for a change in the *Contract Price* and/or *Contract Time* shall be barred unless there is strict compliance with PART 6 – CHANGES IN THE WORK. No course of conduct or dealings between the parties, no express or implied acceptance of alterations or additions to the *Contract* or the *Work*, and no claims that the *Owner* has been unjustly enriched by any alteration or addition to the *Work*, whether or not there is any such unjust enrichment, shall be the basis of a claim for damages or additional payment or for a change in the *Contract Price* or *Contract Time*. Without limiting the generality of the foregoing, under circumstances of expediency the *Contractor* shall proceed with a change in the *Work* without first obtaining a *Change Order* or a *Change Directive* where it has received from the *Owner* or the *Owner's* authorized representative some form of written or e-mail direction agreeing to the change, in which case such change, and the value of such change, if any, will be determined pursuant to GC 6.2 or GC 6.3, at the option of the *Owner*."

### SC 3.29 GC 6.2 CHANGE ORDER

- 3.29.1 Add new paragraphs 6.2.3 to 6.2.6 as follows:

- "6.2.3 The value of a change shall be determined in one or more of the following methods as directed by the *Owner*:
- .1 by estimate and acceptance of a lump sum. The lump sum shall include overhead, profit and other reasonable charges and mark-ups and shall be the total cost to the *Owner*; or
  - .2 by unit prices established in the *Contract Documents* or subsequently agreed upon. Unit prices shall include all costs related to *Products*, labour, equipment, delivery and handling, statutory charges, overhead and profit, other related charges, and shall include all applicable duties (excluding HST), and shall be the total cost to the *Owner*. Adjustment to the *Contract Price* shall be based on a net quantity difference from the original quantity; or
  - .3 by actual credits and cost to the *Owner*. The cost to the *Owner* shall be the actual cost plus the following percentage fee for overhead and profit after all credits included in the change have been deducted. For certainty, no mark-up or other charges shall be permitted for

overhead and profit where the change results in a net decrease (credit) to the *Contract Price*:

- (a) on *Work* performed by the *Contractor's* own forces, the *Contractor* may charge a maximum mark-up of 5% as a combined percentage fee for overhead and profit;
- (b) on *Work* performed by *Subcontractors*, the *Subcontractors* may charge a maximum mark-up of 5% as a combined percentage fee for overhead and profit, and the *Contractor* may charge a maximum mark-up of 5% as a combined percentage fee for overhead and profit on the aggregate of the *Work* performed by *Subcontractors* (excluding the *Subcontractors'* fee mark-up).

- 6.2.4 The mark-ups referred to in paragraph 6.2.3.3 shall constitute the only compensation the *Contractor* shall be entitled to for any and all overhead, profit, general expenses, incidental and administrative costs whatsoever related to the change including, but not limited to, costs relating to superintendence and supervision, general cleanup, *Shop Drawing* production, estimating, site office and head office expenses and personnel, administration costs, workers' tools, temporary facilities and controls, record drawings, *As-Built Drawings*, use of scheduling and modelling software, warranty, insurance, bonding, job safety costs, and coordination of any and all *Work*-related activities.
- 6.2.5 No claim whatsoever for a change in the *Contract Time*, delay, prolongation charges, remobilization or otherwise shall be permitted with respect to a change, unless first authorized by the *Consultant* and approved by the *Owner* and set out in a *Change Order*. For certainty, an adjustment to the *Contract Time* will be considered only when the *Contractor* demonstrates to the *Owner* that a change in the *Work* affects the critical path of the *Work*. Any costs associated with an adjustment to the *Contract Time* shall be identified by the *Contractor* and shall be limited to the reasonable direct costs directly attributable to the adjustment to the *Contract Time*.
- 6.2.6 The *Contractor* shall not be entitled to any additional compensation or an adjustment to the *Contract Time* arising out of changes to the *Work* aside from the amounts stated in a *Change Order*. In no event shall the *Owner* be liable to the *Contractor* for any costs, including indirect, impact or consequential costs, arising out of changes to the *Work* beyond the agreed upon amount of the *Change Order*."

### SC 3.30 GC 6.3 CHANGE DIRECTIVE

3.30.1 Amend paragraph 6.3.7 by inserting the words "Subject to paragraph 6.3.14," at the beginning.

3.30.2 Amend paragraph 6.3.12 by inserting the following to the beginning:

"An adjustment to the *Contract Time* will be considered only where the change affects the critical path of the *Work*."

3.30.3 Add a new paragraph 6.3.14 as follows:

- "6.3.14 Without limitation, the following shall not form part of the cost of performing the work attributable to a *Change Directive*, and shall not be recoverable by the *Contractor*:
- .1 head office salaries and benefits and all other overhead or general expenses, except only for the amounts described in paragraph 6.3.7.1;
  - .2 capital expenses and interest on capital;
  - .3 general clean-up, except where the performance of the work attributed to the *Change Directive* causes specific additional clean-up requirements;
  - .4 wages paid for field supervision of *Subcontractors* and *Suppliers* and for project managers, assistants, watch persons and administrative personnel;
  - .5 wages, salaries, rentals or other expenses that exceed the rates that are standard in the locality of the *Place of the Work* or that are otherwise deemed unreasonable by the *Consultant*;
  - .6 costs or expenses attributable to the negligence, improper work, deficiencies, or breaches of contract by the *Contractor* or any *Subcontractor* or *Supplier*;

- .7 costs of quality assurance, such as inspection and testing services, charges levied by authorities having jurisdiction, and any legal fees unless any such costs or fees are pre-approved in writing by the *Owner*; and
- .8 the costs of the items listed in paragraph 6.2.4 of GC 6.2 – CHANGE ORDER.”

#### SC 3.31 GC 6.4 CONCEALED OR UNKNOWN CONDITIONS

3.31.1 Add a new paragraph 6.4.0 as follows:

“6.4.0 The *Contractor* confirms that, before signing this *Contract*, it carefully investigated and examined the *Place of the Work*, the *Contract Documents* and any other documents made available by the *Owner*, and has satisfied itself as to the conditions, circumstances, limitations and requirements necessary for the *Contractor* to perform the *Work* in accordance with the *Contract Documents*. No allowances will be made for additional costs and no claims by the *Contractor* will be considered for an adjustment in the *Contract Price* or *Contract Time* in connection with conditions which were reasonably apparent or which could reasonably have been discovered before the signing of this *Contract*.”

3.31.2 Amend paragraphs 6.4.1.1 and 6.4.1.2 by adding the following to the end of each paragraph:

“and which were concealed from discovery notwithstanding the conduct of the investigations and examinations described in paragraph 6.4.0.”

#### SC 3.32 GC 6.5 DELAYS

3.32.1 Amend paragraph 6.5.1 by deleting the last sentence and replacing it with the following:

“The *Contractor* shall be reimbursed by the *Owner* for reasonable direct costs directly flowing from the delay, but excluding all *Unrecoverable Costs*.”

3.32.2 Amend paragraph 6.5.2 by deleting the last sentence and replacing it with the following:

“The *Contractor* shall be reimbursed by the *Owner* for reasonable direct costs directly flowing from the delay, but excluding all *Unrecoverable Costs*. Provided that this paragraph 6.5.2 shall not apply where the stop work order is issued as a result of a declaration of a state of emergency or the occurrence of an epidemic or pandemic, in which case any resulting delay shall be governed by paragraph 6.5.3.”

3.32.3 Amend paragraph 6.5.3 as follows:

(a) add a new subparagraph 6.5.3.0 as follows:

“6.5.3.0 acts, orders, legislation, regulations or directives of any court, government or other public authority, including stop work orders or *Project* closures or suspensions, made or issued as a result of a declaration of a state of emergency or the occurrence of an epidemic or pandemic,”

(b) add a new subparagraph 6.5.3.5 as follows:

“6.5.3.5 demonstrations and protests including, but not limited to, native protests, sit-ins, blockages, riots, insurrections and uprisings,”

3.32.4 Amend paragraph 6.5.4 by adding the following to the end:

“For certainty:

- .1 the fact there may be a discussion of or relating to delay during a meeting or the fact delay may be mentioned in minutes of meetings does not constitute *Notice in Writing* of the cause of delay nor an effective notice of delay; and
- .2 it is the intention of the parties that an extension for delay will be considered only when the *Contractor* demonstrates that the delay affects the critical path of the *Work* and that reasonable mitigation efforts have been attempted to reduce the delay and the costs associated therewith, and any adjustment to the *Contract Time* shall only be to the extent that the critical path of the *Work* is affected.”

3.32.5 Add new paragraphs 6.5.6 to 6.5.8 as follows:



- “6.5.6 The *Contractor* acknowledges and agrees that the *Owner* shall not be liable for any delay or part thereof that occurs concurrently with an independent cause of delay for which the *Owner* is not responsible. In addition, in the event the *Owner* is responsible for two or more separate causes of delay that run in whole or in part parallel to each other, those two or more events shall be considered as one for the purpose of determining the duration of the extension of the *Contract Time* and/or any amount payable to the *Contractor*.
- 6.5.7 The *Contractor* shall be responsible for the care, maintenance and protection of the *Project* in the event of any suspension of the *Work* as a result of the delay described in paragraphs 6.5.1, 6.5.2 and 6.5.3 and shall be reimbursed by the *Owner* for the reasonable direct costs incurred by the *Contractor* for such care, maintenance and protection, but excluding the *Contractor's* head office personnel and overhead costs.
- 6.5.8 If the *Contractor* is delayed in the performance of the *Work* by an act or omission of the *Contractor* or anyone directly or indirectly employed or engaged by the *Contractor*, or by any cause within the *Contractor's* control, then:
- .1 the *Contractor* shall, at the *Contractor's* own expense, make best efforts to minimize the delay, including working extended shifts or weekends; and
  - .2 the *Contract Time* shall be extended for such reasonable time as the *Consultant* may decide in consultation with the *Owner*.
- In addition, the *Contractor* shall reimburse the *Owner* for all reasonable costs and expenses incurred by the *Owner* as a result of the delay including, but not limited to, the costs of additional services required by the *Owner* from the *Consultant* or any other consultants, project managers, contractors, or others employed or engaged by the *Owner*.”

#### **SC 3.33 GC 7.1 OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK OR TERMINATE THE CONTRACT**

3.33.1 Delete paragraph 7.1.2 and replace it with the following:

- “7.1.2 If the *Contractor* neglects to prosecute the *Work* properly, or fails or neglects to maintain the construction schedule, or otherwise fails to comply with the requirements of the *Contract* to a material extent, the *Owner* may, without prejudice to any other right or remedy the *Owner* may have, notify the *Contractor* in writing that the *Contractor* is in default of the *Contractor's* contractual obligations and instruct the *Contractor* to correct the default in the 5 *Working Days* immediately following the receipt of such notice, but without affecting in any respect the liability of the *Contractor* in respect of earlier defaults.”

3.33.2 Add a new paragraph 7.1.5A as follows:

- “7.1.5A If the *Owner* terminates the *Contractor's* right to continue with the *Work* in whole or in part or terminates the *Contract* as provided in this GC 7.1, the *Contractor* shall deliver to the *Owner*, within 5 days of the effective date of the termination, all of the materials listed in paragraph 12.1.1 of GC 12.1 – READY-FOR-TAKEOVER in the possession of or available to the *Contractor*.”

3.33.3 Add a new paragraph 7.1.7 as follows:

- “7.1.7 The *Owner* may terminate this *Contract* for convenience at any time for any or no reason by giving written notice to the *Contractor*. In such event, the *Owner* shall pay for the *Work* performed up to the effective date of termination, including demobilization costs, and for such additional reasonable direct costs, if any, directly flowing from and which are a reasonable consequence of the termination, but excluding all *Unrecoverable Costs*. The *Owner* shall not be liable to the *Contractor* for any other claims, costs or damages whatsoever arising from such termination of this *Contract*.”

#### **SC 3.34 GC 7.2 CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT**

3.34.1 Amend paragraph 7.2.2 by deleting “20 *Working Days*” in the first line and replacing it with “40 *Working Days*.”

3.34.2 Amend paragraph 7.2.3 as follows:

- (a) delete paragraphs 7.2.3.1 and 7.2.3.2;
- (b) delete paragraphs 7.2.3.3 and 7.2.3.4 and replace them with the following:

“7.2.3.3 the *Owner* fails to pay the *Contractor* when due the amount certified by the *Consultant* or awarded by arbitration or a court; provided that this paragraph shall not apply to the *Owner's* withholding of payments in accordance with the *Contract Documents*, or

7.2.3.4 the *Owner* violates the requirements of this *Contract* to a substantial degree, and the *Consultant* gives a written statement to the *Owner* and the *Contractor* that provides details of such violation and confirms to the *Contractor* and the *Owner* that sufficient cause exists to justify the *Contractor's* action.”

3.34.3 Amend paragraph 7.2.4 by deleting “5” in the second line and replacing it with “10”.

3.34.4 Delete paragraph 7.2.5 and replace it with the following:

“7.2.5 If the default cannot be corrected within the 10 *Working Days* specified in paragraph 7.2.4, the *Owner* shall be deemed to have cured the default if it:

- .1 commences the correction of the default within the specified time; and
- .2 provides the *Contractor* with a reasonable schedule for such correction; and
- .3 completes the correction in accordance with such schedule.

7.2.6 If the *Contractor* terminates the *Contract* under the conditions described in this GC 7.2, the *Contractor* shall ensure the *Work* and the *Place of the Work* are left in a safe and secure condition as required by authorities having jurisdiction and the *Contract Documents*, and shall be entitled to be paid for all *Work* performed to the date of termination together with the costs directly flowing from and which are a reasonable consequence of the termination, but excluding all *Unrecoverable Costs*. The *Owner* shall not be liable to the *Contractor* for any other claims, costs or damages whatsoever arising from such termination of the *Contract*.”

### SC 3.35 GC 9.1 PROTECTION OF WORK AND PROPERTY

3.35.1 Amend paragraph 9.1.1.1 by adding the following to the end:

“which the *Contractor* could not reasonably have discovered applying the degree of care and skill described in this *Contract*,”

3.35.2 Amend paragraph 9.1.2 by deleting the words “reasonably apparent in” from the second line and replacing them with “reasonably discoverable from”.

3.35.3 Add a new paragraph 9.1.5 as follows:

“9.1.5 Without in any way limiting the *Contractor's* obligations under this GC 9.1, should the *Contractor* or any *Subcontractor* or *Supplier* cause loss or damage to property, including roads, buildings, structures, paving, grass, sod, trees or other plantings, whether owned by the *Owner* or others, and whether at the *Place of the Work* or adjoining it, the *Contractor* shall be liable for the cost of making good such damage and for the repair and any replacement cost of the grass, sod, trees or other plantings damaged, including the cost of any arborist or other consultant, and such costs may be deducted by the *Owner* from amounts otherwise owing to the *Contractor*. If there is no amount owing by the *Owner* to the *Contractor* at that time, then the *Contractor* shall reimburse the *Owner* for all of the said costs.”

### SC 3.36 GC 9.2 TOXIC AND HAZARDOUS SUBSTANCES

3.36.1 Amend paragraph 9.2.3 by deleting the words “The *Owner*” in the first line and replacing them with “The *Contractor*”.

3.36.2 Amend paragraph 9.2.4 by deleting the words “Unless the *Contract* expressly provides otherwise, the *Owner*” in the first line and replacing them with “The *Contractor*”.

3.36.3 Add new paragraphs 9.2.5.5 and 9.2.5.6 as follows:

- "9.2.5.5 take all reasonable steps necessary to mitigate or stabilize any conditions resulting from encountering toxic or hazardous substances, and
- 9.2.5.6 take all necessary steps to mitigate the impact on *Contract Time* and *Contract Price*."

3.36.4 Amend paragraph 9.2.7.3 by adding the words " , but excluding all *Unrecoverable Costs*" after the words "as a result of the delay" at the end of the second line.

3.36.5 Amend paragraph 9.2.8 by adding the following after the word "responsible," in the second line:

"or that any toxic or hazardous substances already at the *Place of the Work* (and which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements) were dealt with by the *Contractor* or anyone for whom the *Contractor* is responsible in a manner which does not comply with legal and regulatory requirements, or which threatens human health and safety or the environment, or material damage to the property of the *Owner* or others,"

3.36.6 Add new paragraphs 9.2.10 and 9.2.11 as follows:

- "9.2.10 The *Contractor* shall, immediately upon becoming aware of any environmentally toxic and hazardous substance or materials (within the meaning of applicable environmental legislation), notify the *Owner* in writing setting out particulars concerning the type of the environmentally toxic and hazardous substance or materials, where it was discovered, and all other information that the *Contractor* has at the time of the notice.
- 9.2.11 The *Contractor* shall indemnify the *Owner* and its manager, officers, directors, employees, agents and elected officials in respect of any loss, costs, expense or fine which might be imposed in respect of any failure by the *Contractor* to satisfy its obligations under this GC 9.2 and, without limiting the general nature of this indemnity, the *Contractor* shall indemnify the *Owner* and its manager, officers, directors, employees, agents and elected officials in respect of any loss, costs, expense or fine if the *Project* is made subject to an order from a court or government agency requiring remediation of any contamination caused as a result of the *Work* performed by the *Contractor* or its *Subcontractors* or *Suppliers*."

### SC 3.37 GC 9.4 CONSTRUCTION SAFETY

3.37.1 Delete paragraph 9.4.5.

3.37.2 Add new paragraphs 9.4.6 to 9.4.9 as follows:

- "9.4.6 The *Contractor* represents and warrants that it is an experienced contractor and has extensive experience and expertise with respect to compliance with the requirements and obligations of the *OHSA* in performing the *Work*, and acknowledges that the *Owner* relied on such representation and warranty in selecting the *Contractor* to perform the *Work* and in entering into this *Contract*.
- 9.4.7 Without limiting the generality of paragraph 9.4.1, the *Contractor* shall be and shall assume all of the responsibilities of the "constructor" under *OHSA* for the *Project* and shall file the "Notice of Project" with the appropriate government agency naming the *Contractor* as the "constructor" for the *Project*.
- 9.4.8 The *Contractor* shall be solely and exclusively responsible for controlling the workplace and the *Place of the Work* and shall take all steps to effectively direct and supervise the *Work* in order to ensure conformity and compliance with *OHSA* and all other applicable construction health and safety requirements, regulations, industry standards and guidelines, including COVID-19 protocols for construction sites and any applicable *Owner* handbooks, guides, protocols or requirements. The *Contractor* represents and warrants to the *Owner* that appropriate health and construction safety instruction and training have been provided and will be provided to the *Contractor's* employees, *Subcontractors*, *Suppliers* and all others attending at the *Place of the Work*, including the *Owner's* representatives, the *Owner's* own forces, and *Other Contractors*. No comments, suggestions or instructions from the *Owner*, the *Consultant* or any other representative of the *Owner* are to be relied upon or assumed to reduce or replace the



*Contractor's* designation as the "constructor" or its responsibility for construction safety on the *Project*.

- 9.4.9 The *Contractor* shall indemnify and save harmless the *Owner* and its manager, officers, directors, employees, agents and elected officials, as well as the *Owner's* consultants, successors and assigns, from and against any and all liability, costs, expenses, charges, fines, damages and all other consequences arising from any and all safety infractions on the *Project*, including the payment of legal fees and disbursements on a full indemnity basis."

#### SC 3.38 GC 9.5 MOULD

- 3.38.1 Amend paragraph 9.5.2.3 by adding the words "and for any delay" immediately before the comma near the end.
- 3.38.2 Amend paragraph 9.5.3.3 by adding the words ", but excluding all *Unrecoverable Costs*" after the words "as a result of the delay".

#### SC 3.39 GC 10.1 TAXES AND DUTIES

- 3.39.1 Amend paragraph 10.1.2 by adding the following to the end:

"For greater certainty, the *Contractor* shall not be entitled to any mark-up for overhead or profit on any increase in such taxes and duties."

- 3.39.2 Add new paragraphs 10.1.3 to 10.1.6 as follows:

- "10.1.3 If the *Owner* is entitled to an exemption or a recovery of sales taxes, customs duties, excise taxes or *Value Added Taxes* applicable to the *Contract*, the *Contractor* shall, at the request of the *Owner*, assist with the application for any exemption, recovery or refund of all such taxes and duties and all amounts recovered or exemptions obtained shall be for the sole benefit of the *Owner*. The *Contractor* agrees to endorse over to the *Owner* any cheques received from the federal or provincial governments, or any other taxing authority, as may be required to give effect to this paragraph.
- 10.1.4 The *Contractor* shall maintain accurate records of equipment, material and component costs reflecting the sales taxes, customs duties, excise taxes and *Value Added Taxes* paid.
- 10.1.5 Any refund of taxes including, without limitation, any government sales tax, customs duty, excise tax or *Value Added Tax*, whether or not paid, which is found to be inapplicable or for which exemption may be obtained, is the sole and exclusive property of the *Owner*. The *Contractor* agrees to cooperate with the *Owner* and to cause all *Subcontractors* and *Suppliers* to cooperate with the *Owner* in the application for any refund of any taxes, which cooperation shall include, but not be limited to, making or concurring in the making of an application for any such refund or exemption and providing to the *Owner* copies, or where required, originals of records, invoices, purchase orders and other documentation necessary to support such applications or exemptions or refunds. All such refunds shall either be paid to the *Owner* or shall be a credit to the *Owner* against the *Contract Price*, in the *Owner's* discretion.
- 10.1.6 Customs duties and penalties or any other penalty, fine or assessment levied against the *Contractor* shall not be treated as a tax or customs duty for purposes of this GC 10.1."

#### SC 3.40 GC 10.2 LAWS, NOTICES, PERMITS, AND FEES

- 3.40.1 Amend paragraph 10.2.4 by adding the following to the end:

"and shall be present at each site inspection by an inspector or registered code agency."

- 3.40.2 Amend paragraph 10.2.5 by deleting "The" at the beginning and replacing it with the words "Subject to paragraph 1.1.12 of GC 1.1 – CONTRACT DOCUMENTS, the".

- 3.40.3 Amend paragraph 10.2.6 as follows:

- (a) delete the words "performs work knowing it to be" and replace them with "performs work when it knew or ought to have known that such work is"; and

- (b) delete the words “bear the” in the third line and replace them with “indemnify and save the *Owner* harmless against all”.

3.40.4 Amend paragraph 10.2.7 by adding the following to the end:

“, provided that any claims arising from any delays due to such changes will be dealt with in accordance with GC 6.5 – DELAYS.”

#### SC 3.41 GC 11.1 INSURANCE

3.41.1 Delete GC 11.1 in its entirety and replace it with the following:

##### “GC 11.1 INSURANCE

11.1.1 The *Contractor* shall obtain, maintain, pay for and provide to the *Owner* evidence of the insurance coverage required under this *Contract*. Any deductible and/or self-insured retention are the responsibility of the *Contractor* and shall not constitute a *Project* expense chargeable back to the *Owner* in any way.

##### .1 Commercial General Liability Insurance

General liability insurance shall be maintained from the date of commencement of the *Work* until one year from the date of *Ready-for-Takeover*. Liability coverage shall be provided for completed operations hazards from the date of *Ready-for-Takeover*, as set out in the certificate of *Ready-for-Takeover*, on an ongoing basis for a period of 6 years following *Ready-for-Takeover*

Commercial General Liability, underwritten by an insurer licensed to conduct business in the Province of Ontario, for a limit of not less than \$5,000,000 per occurrence, an aggregate limit of not less than \$10,000,000, within any policy year with respect to completed operations and a deductible of not more than \$50,000. The insurance coverage shall not be less than the insurance provided by IBC Form 2100 and IBC Form 2320. The policy shall include an extension for a standard provincial and territorial form of non-owned automobile liability policy. This policy shall include but not be limited to:

- .1 Name the *Owner* as an additional insured;
- .2 Cross-liability and severability of interest;
- .3 Blanket Contractual;
- .4 Products and Completed Operations;
- .5 Premises and Operations Liability;
- .6 Personal Injury Liability;
- .7 Contingent Employers Liability;  
Work performed on Behalf of the Named Insured by Sub-Contractors;
- .8 Firefighting Expenses;
- .9 Elevator and Hoist Liability;
- .10 Attached Machinery – while loading and unloading

The following also applies:

- a) If applicable to the *Project*, coverage shall include shoring, blasting, excavation, underpinning, demolition, pile driving, caisson work and work below ground surface including tunneling and grading.
- b) If the *Work* involves asbestos removal, the policy shall provide coverage for this exposure.
- c) If the *Work* involves the use or operation of an owned or non-owned manned aircraft or watercraft, the policy shall provide coverage for this exposure.
- d) To achieve the desired limits, umbrella or excess liability insurance may be used.
- e) The *Owner* reserves the right to request in addition to Commercial General Liability Insurance coverage Wrap-up Liability. The Wrap-up shall be in the names of the *Owner*, *Contractor*, all *Subcontractors*, the *Consultant* and all other architects,

## SUPPLEMENTARY CONDITIONS

### AMENDMENTS TO CCDC 2-2020 STIPULATED PRICE CONTRACT

engineers, consultants, planners and project managers. Limits and coverages shall comply with the requirements outlined above.

.2 Automobile Insurance

Standard Form Automobile Liability Insurance that complies with all requirements of the current legislation of the Province of Ontario, having an inclusive limit of not less than \$5,000,000 per occurrence for third party liability, in respect of the use or operation of vehicles owned, operated or leased by the *Contractor*.

.3 Contractor's Equipment Floater

The *Contractor* shall provide and maintain coverage for all equipment used on the *Project* during the term of this *Contract*. Coverage will be provided, on a broad form basis, for construction machinery, equipment, tools and stock that will be used by the *Contractor* in the performance of the *Work*. The coverage will also include rental expense. Coverage is to be carried from the date of commencement of the *Work* until one year after the date of *Ready-for-Takeover*.

.4 Contractor's Pollution Liability

The *Contractor* shall carry a Contractor's Pollution Liability Policy, underwritten by an insurer licensed to conduct business in the Province of Ontario for a limit of not less than \$2,000,000. Coverage shall include bodily injury, property damage, clean-up and remediation costs. The Contractor shall purchase at minimum a 3 Year Extended Reporting Endorsement.

.5 Crane Operators/Hook Liability

If booms or cranes are involved in moving any materials or installing equipment, the Contractor will require Hook or Crane Operators Liability. The limit for this coverage should equal the cost of the most expensive piece to be moved or installed.

.6 All Risk Property Installation Floater

All Risk Property Installation Floater in the joint names of the City, Contractor and subcontractors. The policy shall have limits of not less than 1.1 times the value of the Work. Should the City provide any property to be incorporated into the Work, the policy must be endorsed to include the City's property. Coverage shall be maintained during the term of this Agreement and until ten (10) days after the date of the completion of the Work.

The Property Installation Floater shall:

- a) Include the loading, unloading, transportation, storage, installation, testing, inspecting and commissioning and subsequent use of any materials, supplies, equipment and machinery including boilers, pressure vessels or vessels under vacuum;
- b) Be subject to a waiver of coinsurance;
- c) Not be subject to a deductible clause; and
- d) Provide that in the case of a loss or damage, payment shall be made to the City, Contractor and subcontractors as their respective interests may appear. The Contractor shall act on behalf of the City for the purposes of adjusting the amount of such loss or damage. When the extent of the loss or damage is determined, the Contractor shall proceed to restore the Work. Loss or damage shall not affect the rights and obligations of either party under this Agreement, except that the Contractor shall be entitled to a reasonable extension to complete the Work.

.7 Proof of Insurance

- .1 The *Contractor* shall provide the *Owner* with an executed certificate of insurance and a renewal replacement as may be necessary, stating any pertinent exclusions as applicable contained in the policies which may affect coverage as outlined in this *Contract*. The certificate will be delivered prior to the commencement by the *Contractor* of the *Work* or upon renewal of the policy. The *Contractor's* insurance carriers and the insurance policy provisions must be acceptable to the *Owner*. All lines of coverage required by this *Contract* must be shown on the certificate of insurance. The *Contractor* will make available complete certified copies of all applicable insurance policies for examination if required by the *Owner*.

- .2 The *Contractor* shall ensure that each *Subcontractor* requires adequate insurance in accordance with the work being performed under the terms of their engagement. It is the *Contractor's* responsibility to ensure this exposure is insured adequately and at no time will costs associated with this exposure be transferred to the *Owner*.
- .3 Delivery to and examination or approval by the *Owner* of any certificates of insurance or policies of insurance or other evidence of insurance shall not relieve the *Contractor* of any of its indemnification or insurance obligations under this *Contract*. The *Owner* shall be under no duty to either ascertain the existence of or to examine such certificate of insurance or policies of insurance or to advise the *Contractor* in the event that such insurance coverage is not in compliance with the requirements set out in this *Contract*. The *Contractor* is responsible for ensuring such compliance.
- .4 All policies of insurance shall:
  - .1 Be recorded as being a primary policy and shall be in a form and issued by an insurance company satisfactory to the *Owner* and that is licensed to carry on business in Ontario;
  - .2 Be maintained continuously during the course of the *Work* or for such period of time as may be required after completion of the *Work* as may be deemed necessary by the *Owner*;
  - .3 The *Contractor* shall ensure that any self-insured and deductible limits are prudent and responsible for the type of work being undertaken under the *Contract*. Any and all claim costs are borne by the *Contractor* including, but not limited to, deductibles, adjusting fees, legal costs, disbursements, and settlements;
  - .4 Ensure that, except in the case of automobile liability insurance, non-owned automobile liability insurance, the *Owner* is to be added to the policy as an additional insured and/or loss payee;
  - .5 Contain a cross-liability and severability of interest provisions, as may be applicable;
  - .6 Provide that at least thirty (30) days prior written notice, fifteen (15) days in the case of automobile liability insurance, and ten (10) days in the event of non-payment of premiums, shall be given to the *Owner* by the insurer before the insurer or the *Contractor* takes any steps to cancel, terminate, fail to renew, amend or otherwise change or modify the insurance or any part thereof.
  - .7 Necessary notification to insurers is required to ensure continuous coverage is in place at all times. This will include, but is not limited to, transfer of coverage from one policy to another (i.e. completion of a building constructed under a Builder's Risk Policy being transferred to a Property policy once *Ready-for-Takeover* has been attained)."

#### SC 3.42 GC 12.1 READY-FOR-TAKEOVER

3.42.1 Delete paragraphs 12.1.1.4 and 12.1.1.5 and replace them with the following:

"12.1.1.4 The delivery to the *Owner* of guarantees, warranties, certificates, testing and balancing reports and spare parts, distribution system diagrams, *Shop Drawings*, maintenance and operating manuals, instructions, samples, existing reports and correspondence from authorities having jurisdiction, and all other close-out materials or documents specified in the *Contract Documents*.

12.1.1.5 The delivery to the *Owner* of the *As-Built Drawings* acceptable to the *Consultant* showing the *Work* completed to date."

3.42.2 Delete paragraph 12.1.2 and replace it with the following:

"12.1.2 If any of the prerequisites set forth in paragraphs 12.1.1.3 to 12.1.1.6 are deferred by agreement between the *Owner* and the *Contractor*, *Ready-for-Takeover* shall not be delayed. To be effective, such agreement shall be in writing and shall be signed by both parties."

3.42.3 Amend paragraph 12.1.5 by adding the following to the end:

" , which shall be no later than thirty (30) days after *Ready-for-Takeover*."

3.42.4 Delete paragraph 12.1.6.

#### SC 3.43 GC 12.2 EARLY OCCUPANCY BY THE OWNER

3.43.1 Delete paragraphs 12.2.1 through 12.2.4 and replace them with the following:

- “12.2.1 The *Owner*, its agents, and *Other Contractors* shall have the right to enter, occupy, take possession of and/or use for any intended purpose any portion or all of the undelivered portion of the *Project*, even though *Ready-for-Takeover* may not have been attained, provided that such entry, occupation, taking of possession or use will not interfere, in any material way, with the progress of the *Work*. The entry, occupation, taking of possession or use of any such portion of the *Project* or *Work* shall not be deemed to be the *Owner's* acknowledgement or acceptance of the *Work* or the *Project*, nor shall it be deemed to be an acknowledgment or acceptance by the *Owner* that such *Work*, or portions of the *Work*, have met the *Ready-for-Takeover* requirements, nor shall it entitle the *Contractor* to an adjustment to the *Contract Time* or *Contract Price*.
- 12.2.2 The *Contractor* shall, as directed by the *Consultant*, give priority to certain parts of the *Work* and bring such parts to a “ready for use” status. Such instructions may require installation of temporary stairs and exits and temporary services, all of which shall be provided and subsequently removed.
- 12.2.3 The *Contractor* shall maintain full access to the *Work* for the *Owner's* use, as required. The *Contractor* shall maintain or restore heat and power to areas when necessary or as scheduled and keep existing utilities and services functional.
- 12.2.4 The entry, occupation, taking of possession or use of any portion of the *Project* by the *Owner*, its agents or *Other Contractors* pursuant to this GC 12.2 – EARLY OCCUPANCY BY THE OWNER shall not relieve the *Contractor* of any of its obligations under the *Contract*, including the *Contractor's* designation and obligations as “constructor” under *OHSA* and the *Contractor's* obligations respecting construction health and safety, and all of the *Contractor's* other obligations, rules, regulations and practices shall continue to apply notwithstanding such entry, occupation, taking of possession or use.”

#### SC 3.44 GC 12.3 WARRANTY

3.44.1 Amend paragraph 12.3.1 by adding the following to the end:

“Notwithstanding the foregoing, if an item of *Work* is not completed at *Ready-for-Takeover*, except for extended warranties as described in paragraph 12.3.6, the warranty period for such item of *Work* shall be one year from the date that such item of *Work* has been completed and accepted in writing by the *Owner*.”

3.44.2 Amend paragraph 12.3.2 by adding the following to the end:

“If the *Contractor* has been permitted to make use of permanent equipment or systems, as provided in GC 3.12 – CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS, such permanent equipment or systems shall be subject to the same warranty as described in this GC 12.3 and shall be judged, for purposes of assessing compliance with the warranty, as though the equipment or systems were new, clean and unused by the *Contractor*, except for normal commissioning and start-up activities.”

3.44.3 Amend paragraph 12.3.4 by adding the following to the end:

“The *Contractor* shall perform all remedial and warranty work at its own cost and expense and at a time convenient to the *Owner*, which may be outside of normal working hours. Before performing the remedial and warranty work the *Contractor* shall provide, for the *Owner's* review and approval, a proposed schedule for the performance of such work. Except for any extended warranties provided for in the *Contract Documents*, the warranty period for any corrective work performed by the *Contractor* pursuant to GC 12.3 – WARRANTY shall commence on the date that such corrective *Work* was completed.”

3.44.4 Add new paragraphs 12.3.5A and 12.3.5B immediately after paragraph 12.3.5 as follows:

- “12.3.5A If the *Contractor* fails to perform the remedial and warranty work and/or fails to correct the defects, deficiencies or items of non-compliant *Work* or is not diligently working towards completion of the same to the satisfaction of the *Consultant*, or if the *Contractor* fails to correct or pay for damage resulting from corrections made, as required in paragraph 12.3.5, the *Owner*



may engage others to perform the work necessary to complete the remedial and warranty work and to correct the outstanding defects, deficiencies or items of non-compliant *Work* and to correct damage resulting from corrections made, all at the risk and cost of the *Contractor*, and the *Owner* may deduct all costs and may pay for all damages incurred from the *Deficiency Rectification Security*. If the costs and damages incurred by the *Owner* exceed the amount of the *Deficiency Rectification Security*, the *Contractor* shall reimburse the *Owner* for all excess costs and damages. The *Owner's* rights under this paragraph are in addition to any other rights the *Owner* may have pursuant to the *Contract* and/or at law.

- 12.3.5B Provided that the *Contractor* has completed all outstanding remedial and warranty work and has corrected all defects and deficiencies and has completed all items of non-compliant *Work* and has corrected or paid for all damage resulting from corrections made, all to the satisfaction of the *Consultant*, the *Owner* shall return to the *Contractor* the remaining balance of the *Deficiency Rectification Security*, if any, without interest, thirty (30) days after the date that is the later of (a) the date of total completion of the *Contract*, and (b) the date on which the warranty period ends."

### SC 3.45 GC 13.1 INDEMNIFICATION

3.45.1 Delete GC 13.1 and replace it with the following:

- "13.1.1 The *Contractor* shall indemnify and shall defend and save harmless the *Owner*, its manager, officers, directors, agents, representatives, elected officials, successors, and employees harmless from and against any claims, causes of action, demands, losses, charges, fees, duties, accounts, fines, penalties, expenses and costs (including legal costs on a solicitor and client basis), or other proceedings of every kind or nature whatsoever at law or in equity brought against, suffered by, or imposed on the reason of,
- .1 the *Contractor* carrying out or failing to carry out any obligation to which it is subject including the performance of the *Work*, or exercising any right to which it is entitled, under the *Contract* except to the extent that the same are caused by the negligence or deliberate wrong-doing of the *Owner* or other person entitled to indemnification under this section, or
  - .2 any patent, trademark, copyright infringement or other breach of any intellectual property right of any person, for which the *Contractor* or any *Subcontractor* to the *Contractor* is responsible.
- 13.1.2 The *Contractor* shall indemnify and hold harmless the *Owner's* agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings by third parties that arise out of, or are attributable to, the *Contractor's* performance of the *Contract*, provided such claims are attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property, and caused by negligent acts or omissions of the *Contractor* or anyone for whose acts the *Contractor* may be liable, and made in writing within a period of 6 years from the date of *Ready-for-Takeover* as set out in the certificate of *Ready-for-Takeover*, or within such shorter period as may be prescribed by any limitation statute or the province or territory of the *Place of the Work*."

### SC 3.46 PART 14 – OTHER PROVISIONS

3.46.1 Add a new "PART 14 – OTHER PROVISIONS" as follows:

#### "PART 14 OTHER PROVISIONS

##### GC 14.1 LIENS AND ACTIONS

- 14.1.1 The *Contractor* shall save and keep the *Owner* and the *Place of the Work* free from all construction liens and all other liens whatsoever arising out of the *Work*. If any lien is claimed, filed or registered or any written notice of a lien is received by reason of any *Work* supplied or claimed to have been supplied by or through a *Subcontractor* or *Supplier*, the *Contractor* shall, at its own expense, within ten (10) *Working Days* of being notified of the lien or written notice of a lien, secure the discharge, release, vacating or withdrawal of such lien or written notice of a lien by payment or by giving security or in such other manner as is or may be required or permitted by law, failing which the *Owner* may, but shall not be required, take such steps as it, in its absolute discretion, may deem necessary to release, vacate or discharge the lien or written notice of a lien.

- 14.1.2 If a lien action is commenced arising out of a lien described in paragraph 14.1.1, the *Contractor* shall take all reasonable steps to remove the *Owner* from such action and shall indemnify the *Owner* and hold it harmless in such action.
- 14.1.3 All amounts, including legal costs on a full indemnity basis, disbursements, interest, borrowing, premium or other bonding costs and/or charges incurred by the *Owner* in releasing, vacating, discharging and/or otherwise dealing with a *Subcontractor* or *Supplier* lien, written notice of a lien and/or defending or otherwise dealing with a lien action, shall be charged to the *Contractor* and shall be set off and deducted from any amount owing to the *Contractor*. If there is no amount owing by the *Owner* to the *Contractor* at that time, then the *Contractor* shall reimburse the *Owner* for all amounts incurred by the *Owner*.

#### **GC 14.2 OWNERSHIP OF MATERIALS**

- 14.2.1 Unless otherwise specified, all materials existing at the *Place of the Work* at the time of execution of this *Contract* shall remain the property of the *Owner*. All *Products* delivered to the *Place of the Work* by the *Contractor* shall be the property of the *Owner* and shall be free of encumbrances. The *Contractor* shall remove all surplus or rejected materials from the *Place of the Work*.

#### **GC 14.3 DAILY REPORTS/DAILY LOGS**

- 14.3.1 The *Contractor* shall cause its supervisor, or such competent person as it may delegate, to prepare and maintain a daily site log or diary recording, at least, the following: (a) daily weather conditions and temperatures at the *Place of the Work*, (b) the number of workers of the *Contractor*, *Subcontractors*, *Suppliers* and any other forces at the *Place of the Work*, (c) the *Construction Equipment* at the *Place of the Work*, (d) the descriptions and quantities of *Products* delivered and utilized, and (e) the general nature of *Project* activities. Such log or diary shall also record any extraordinary or emergency events which may occur and also the identities of any persons who visit the *Place of the Work* who are not part of the day-to-day workforce. The *Contractor* shall also take or arrange for the taking of *Project* photographs to record the progress of the *Work*.
- 14.3.2 The *Contractor* shall maintain, either at its head office or at the *Project* site, records recording labour and material resourcing on the *Project*, including the records identified in paragraph 14.3.1 and other records which document the activities of the *Contractor*.
- 14.3.3 Upon request of the *Owner* or the *Consultant*, the *Contractor* shall make available for inspection and copying all of the records generated pursuant to this GC 14.3, along with any other routine *Project* records ordinarily maintained by the *Contractor*.

#### **GC 14.4 ADVERTISING AND PUBLIC STATEMENTS**

- 14.4.1 The *Contractor* shall not publish, issue or make any statements or news release, electronic or otherwise, concerning the *Contract*, the *Work*, or the *Project*, and shall not use the *Owner's* name or logo, without the prior express written consent of the *Owner*. For greater certainty, the *Contractor* shall obtain the prior written approval of the *Owner* for any public advertising, written public sales promotions, press release or other general publicity matter, in which the name or logo of the *Owner* is mentioned or used, or in which words are used from which any connection with the *Owner* may be inferred. The *Contractor* will not erect or permit the erection of any sign or advertising at the *Place of the Work* without the prior written approval of the *Owner*.

#### **GC 14.5 AODA REQUIREMENTS**

- 14.5.1 Pursuant to sections 7 and 80.49 of the Integrated Accessibility Standards Regulation, O. Reg. 191/11 (the "**Regulation**") under the *Accessibility for Ontarians with Disabilities Act, 2005* ("**AODA**"), the *Contractor* shall ensure that all of its employees, agents, volunteers, or others for whom it is at law responsible receive training about the provision of the goods and services contemplated herein to persons with disabilities. Such training shall be provided in accordance with sections 7 and 80.49 of the *Regulation* and shall include, without limitation, a review of the purposes of AODA and the requirements of the *Regulation*, as well as instruction regarding all matters set out in sections 7 and 80.49 of the *Regulation*. When requested by the *Owner*, the *Contractor* shall provide written proof that all employees have been trained as required under AODA as well as any documentation regarding training policies, practices and procedures.

#### **GC 14.6 AMENDMENTS TO THE CONTRACT**

- 14.6.1 Except for the written or e-mail direction referred to in paragraph 6.1.2 of GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES, no alteration or amendment to this *Contract*, no course of conduct

## **SUPPLEMENTARY CONDITIONS**

### **AMENDMENTS TO CCDC 2-2020 STIPULATED PRICE CONTRACT**

or dealing between the parties, and no express or implied acceptance of alterations or amendments to the *Contract* shall be binding unless it is in writing and signed by each party.

- 14.6.2 No waiver by or on behalf of a party of any breach of a provision of this *Contract* shall be binding upon the party unless it is expressed in writing and duly executed by the party or signed by its fully authorized representative, and such a waiver shall not operate as a waiver of any future breach, whether of a like or different character. No waiver shall be inferred from or implied by the conduct of any party.

#### **GC 14.7 CONTRACT SECURITY**

- 14.7.1 The *Contractor* shall deliver to the *Owner* a performance bond and a labour and material payment bond in the forms specified in the *Payment Legislation*, each in the amount of fifty percent (50%) of the *Contract Price* plus *Value Added Taxes*.
- 14.7.2 Such bonds shall be issued by a duly licensed surety company authorized to transact the business of suretyship in Ontario and shall be maintained in good standing until the fulfillment of the *Contract*. All premiums and other costs of the bonds are included in the *Contract Price*.

#### **GC 14.8 TIME IS OF THE ESSENCE**

- 14.8.1 The *Contractor* represents and warrants that it will attain *Ready-for-Takeover* by the date stipulated in paragraph 1.3 of Article A-1 of the Agreement – THE WORK, as such date may be adjusted in accordance with this *Contract*, and agrees that time shall be of the essence in the performance of the *Contractor's* obligations under this *Contract*."

*[Schedule of Key Personnel follows]*





## SUPPLEMENTARY CONDITIONS

### AMENDMENTS TO CCDC 2-2020 STIPULATED PRICE CONTRACT

## SCHEDULE – KEY PERSONNEL

The following are the *Key Personnel* assigned to the *Project*:

Name and Position	Employed By

The *Contractor* represents that the *Key Personnel* will be assigned to and will be dedicated to the *Project* on a full-time basis unless noted otherwise.

## **APPENDIX B – RFQ PARTICULARS**

### **A. THE DELIVERABLES**

The City is seeking qualified contractors to rehabilitate the secondary clarifiers and aeration tanks at the Wastewater Treatment Plant, located at 385 Mohawk St., Brantford, as further described herein.

### **B. MATERIAL DISCLOSURES**

- Equipment list and Asset Database as prepared by the City of Brantford
- Clarifier Submittal Tanks 5 & 6 – Spec Section 11451 as prepared by CIMA +, dated January 29, 2024
- Clarifier Submittal GA Drawing Tanks 8 – Spec Section 11451 as prepared by CIMA +, dated January 29, 2024

### **C. MANDATORY SUBMISSION REQUIREMENTS**

#### **1. Submission Form & Schedule of Prices**

Each quotation must be submitted through the City's electronic Bidding System.

#### **2. Other Mandatory Submission Requirements**

- (a) Workplace Injury Summary Report (WISR) from within the last 90 days; and
- (b) Occupational Health and Safety Management System Certificate (ISO 45001 or COR® Certification)

### **D. MANDATORY TECHNICAL REQUIREMENTS**

N/A


### **E. PRE-CONDITIONS OF AWARD**

The selected respondent must satisfy the following conditions and provide the following information:

- A digital Labour & Material Payment e-bond provided on *Construction Act of Ontario (Form 31)* in an amount equal to 50% of the value of the contract price, inclusive of value added taxes;
- A digital Performance e-bond provided on *Construction Act of Ontario (Form 32)* in an amount equal to 50% of the value of the contract price, inclusive of value added taxes;
- Certificate of Insurance for the coverage and limits as set out in the agreement, naming The Corporation of the City of Brantford as additionally insured;
- WSIB clearance certificate confirming the Contractor is registered and has an account in good standing;

- Health and Safety Plan, which includes procedures on how the Contractor intends to address and handle any hazardous substance encountered in the project limits, if applicable; and
- Notice of Project to the Ontario Ministry of Labour.

TECHNICAL SPECIFICATION SEAL SHEET		DATE OF ISSUE: 6/19/2025	
CLIENT	The Corporation of the City of Brantford	ISSUED FOR THE FOLLOWING PURPOSE(S) ONLY:	
PROJECT:	Brantford WWTP Secondary Clarifiers Rehabilitation	MECP Approval	<input type="checkbox"/>
		Tender	<input checked="" type="checkbox"/>
CLIENT REF No	2025-55	Building Permit	<input type="checkbox"/>
LOCATION:	385 Mohawk Street, Brantford, ON N3T 5L9	Construction	<input type="checkbox"/>
<b>NOTE:</b> The Professional Seals on this page are in respect to the technical specification comprising Divisions 1 through 16 inclusive. Each seal is limited to the discipline as noted below.			



Sheet 1 of 3		
SITE CIVIL		
STRUCTURAL Div 3,5,6,&7		
ARCHITECTURAL		

**TECHNICAL SPECIFICATION SEAL SHEET**DATE OF ISSUE: **6/19/2025**

CLIENT	The Corporation of the City of Brantford	ISSUED FOR THE FOLLOWING PURPOSE(S) ONLY:	
PROJECT:	Brantford WWTP Secondary Clarifiers Rehabilitation	MECP Approval	<input type="checkbox"/>
		Tender	<input checked="" type="checkbox"/>
CLIENT REF No	2025-55	Building Permit	<input type="checkbox"/>
LOCATION:	385 Mohawk Street, Brantford, ON N3T 5L9	Construction	<input type="checkbox"/>

**NOTE:** The Professional Seals on this page are in respect to the technical specification comprising Divisions 1 through 16 inclusive. Each seal is limited to the discipline as noted below.

**Sheet 2 of 3**

PROCESS MECHANICAL		
ELECTRICAL		
CONTROL AND INSTRUMENTATION		

<b>TECHNICAL SPECIFICATION SEAL SHEET</b>		<b>DATE OF ISSUE: 6/19/2025</b>	
<b>CLIENT</b>	The Corporation of the City of Brantford	<b>ISSUED FOR THE FOLLOWING PURPOSE(S) ONLY:</b>	
<b>PROJECT:</b>	Brantford WWTP Secondary Clarifiers Rehabilitation	MECP Approval	<input type="checkbox"/>
		Tender	<input checked="" type="checkbox"/>
<b>CLIENT REF No</b>	2025-55	Building Permit	<input type="checkbox"/>
<b>LOCATION:</b>	385 Mohawk Street, Brantford, ON N3T 5L9	Construction	<input type="checkbox"/>
<b>NOTE:</b> The Professional Seals on this page are in respect to the technical specification comprising Divisions 1 through 16 inclusive. Each seal is limited to the discipline as noted below.			

<b>Sheet 3 of 3</b>		
<b>BUILDING MECHANICAL</b>		

## **DIVISION 1 – GENERAL REQUIREMENTS**

**DIVISION 1 – GENERAL REQUIREMENTS**

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<b>Section No.</b>	<b>Title</b>
01000	General Requirements
01025	Measurement and Payment
01110	Summary of Work
01120	Coordination and Sequence of Work
01140	Special Project Procedures
01200	Alternatives
01300	Admin. Requirements
01320	Construction Schedule
01330	Submittals
01330A	Submittals – Shop Drawing Transmittal
01330B	Submittals – Shop Drawing Naming
01351	Health and Safety
01355	Project Waste Management
01400	Environmental Protections
01410	Regulatory Requirements
01420	References
01450	Quality Control
01510	Temporary Utilities
01520	Construction Facilities
01610	Basic Product Requirements
01740	Cleaning
01760	Warranty Work
01770	Closeout Procedures
01780	Closeout Submittals



Section No.	Title
01810	Testing and Commissioning
01820	Demonstration and Training

## **1 GENERAL**

### **1.1 General**

- 1.1.1 This Section identifies the general intent and requirements of the overall Contract to be followed by the Contractor, sub-contractors and all trades involved in completing the work.
- 1.1.2 The Contractor shall study the Contract Documents to determine the extent of work required by each Section and upon which work of other Sections depend and to co-ordinate scope and extent of work to be performed by each trade.
- 1.1.3 The Contractor shall within 48 hours of becoming aware of circumstances which may require a clarification or change in the Work, give written notice to the Engineer outlining such circumstances and requesting written directions.
- 1.1.4 As applicable, maintain in good condition and order on site one copy of the documents approved for building permit, addenda, site instructions, proposed changes, change orders, test reports, manufacturer's installation and application instructions, progress photographs, redline drawings, approved progress schedules, minutes of site meetings, and other modifications to the Contract Documents.

### **1.2 Specification Format**

- 1.2.1 Specifications serve to indicate standards, materials and methods for completing the work.
- 1.2.2 Where Contract Documents do not provide sufficient information for completing installations, comply with manufacturer's written instructions.
- 1.2.3 The following definitions apply:
  - .1 Provide - To Supply and Install, complete and in place, including accessories, finishes, tests and services as required to render item so specified complete and ready for use.
  - .2 Commission - Start-up and initial operation of equipment as required to demonstrate satisfactory operation of components and entire system including calibration of any control instrumentation as required to maintain operations.
  - .3 Drawings, Lists or Schedules of Items are intended to show scope and arrangement of work. For locations of items described refer to such Drawings, Lists or Schedules unless locations are stipulated in the Specifications.
  - .4 Wherever words "reviewed", "selected", "directed", "designated", "permitted", "inspected", "instructed", "required", "report", "submit", "obtain", "consult", or similar words or phrases are used in the Contract Documents, it shall be understood that "by/to/from/with the Engineer" shall follow.
  - .5 Where specification sections designate authorities such as "Engineer", "Consultant", or "Contract Administrator", these designations shall be taken to mean CIMA Canada Inc. Where specification sections designate "Owner" or "Purchaser", these designations shall be taken to mean The City of Brantford.

- 1.2.4 If there a discrepancy between specifications and drawings or between specification sections, the most stringent drawings, clause or note shall take precedent as per the Engineer's interpretation.

### **1.3 Standards**

- 1.3.1 Conform to the latest editions as amended and revised to date of Contract.
- 1.3.2 If requested provide copy on Site of such standard(s).
- 1.3.3 Where standards designate authorities such as "Engineer" or "Consultant", these designations shall be taken to mean CIMA Canada Inc. Where standards designate "Owner" or "Purchaser" or other such designation, these designations shall be taken to mean The City of Brantford.

### **1.4 Requirements of Authorities and Agencies**

- 1.4.1 The Contractor shall be responsible for complying fully with the requirements of all Authorities and Agencies that govern any or all of the works under this Contract. These requirements may affect installation and construction methods and may include a written notice to an Authority or Agency prior to the commencement of construction. When a written notice to an Authority or Agency is required, a copy of the notice shall be submitted to the Engineer by the Contractor.
- 1.4.2 Comply with The Building Code Act including the Building Code, as amended; and Regulations and by-laws of other authorities having jurisdiction including latest amendments thereto: all hereafter referred to as Code. Where Code or Contract Documents do not cover a particular, conform to requirements of the National Building Code, as amended, including its related supplements. Where Drawings and/or Specifications exceed Code requirements satisfy such additional requirements.

### **1.5 Reference Information**

- 1.5.1 The drawings governing alterations to existing works if required were prepared using the following assumptions:
- .1 The existing structures were built in accordance with the original contract documents, significant details of which have been reproduced on the drawings.
  - .2 Existing building documents used in preparing the documents for this contract include the following:

<b>Contract or Project No.</b>	<b>Project Title</b>	<b>By</b>	<b>Date</b>
	City of Brantford Sewage Treatment Plant	Proctor & Redfern	October 1957
E.O.76182	City of Brantford Sewage Treatment Plant Extension	Proctor & Redfern	November 15, 1977

- .3 The workmanship and materials employed on the existing structures were of good quality and the building has not deteriorated significantly.

- .4 Bearing walls, structural steel and structural concrete is reasonably true and plumb.
- 1.5.2 Examine the site and buildings or structures on it. Establish conditions under which the work is to be done, and accept the premises as found upon taking possession of the property. Direct all inquiries to the Consultant.
- 1.5.3 Existing base horizontal and vertical control points will be provided by the Owner.
- 1.5.4 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- 1.5.5 Make no changes or relocations without prior written notice to the Engineer.
- 1.5.6 Report to the Engineer when a reference point is lost or destroyed or requires relocation because of necessary changes in grades or locations.
- 1.5.7 The Owner will replace control points in accordance with the original survey control. The cost of resetting or replacing control points disturbed by the Contractor shall be at the Contractor's expense.
- 1.5.8 Elevations indicated on the Contract Drawings or Specifications are based on elevations presented in the recent Influent Pumping and Preliminary Treatment upgrades project (Contract No.2004-621) referenced above. Where applicable, ground elevations are based on a site survey completed January 2017 which refers to Geodetic Datum derived from a City of Brantford benchmark.
- 1.5.9 All general layout required by the Contractor for the purposes of construction shall be carried out by the Contractor. The Contractor shall provide such masts, scaffolds, batter boards, slope stakes, straight edges, templates and other devices as may be necessary to facilitate layout and inspection and construction of the Works within the contract price.
- 1.5.10 Survey Requirements by Contractor:
  - .1 Record locations, with horizontal and vertical data in Project Record Documents.
  - .2 Establish lines and levels, locate and lay out the works using appropriate instrumentation.
  - .3 Stake for grading, fill and topsoil placement and landscaping features.
  - .4 Stake slopes and berms.
  - .5 Establish pipe invert elevations.
  - .6 Stake batter boards for foundations.
  - .7 Establish foundation column locations and floor elevations.
  - .8 Establish lines and levels for mechanical and electrical work.

**1.6 Subsurface Conditions**

- 1.6.1 Promptly notify the Engineer in writing if subsurface conditions, or any reasonable assumption of probable conditions, differs materially from those indicated in the Contract Documents.
- 1.6.2 The Engineer or other agents of the Owner will promptly investigate the conditions and the Engineer will advise the Contractor in writing of any necessary changes to the Works.

**1.7 Protection and Safety**

- 1.7.1 The Contractor shall undertake the role of the "Constructor" as defined in the Occupational Health and Safety Act.
- 1.7.2 Ensure that those who handle, and/or are exposed to, or are likely to handle or be exposed to, hazardous materials are fully instructed and trained in accordance with WHMIS requirements.
- 1.7.3 Protect excavations, trenches and building from damage by rainwater, ground water, backing up of drains or sewers and other water, frost and other weather conditions. Provide sheeting, piling, shoring, pumps, equipment, temporary drainage, protective covering and enclosures. Provide necessary pumps including spare pump for keeping excavations free of water throughout construction period.
- 1.7.4 Protect active services. Cap inactive services and remove unwanted portions with approval of Engineer.
- 1.7.5 Protect finished work. Damaged work shall be restored or redone at the Contractor's expense at the discretion of the Engineer.
- 1.7.6 Protect public and those employed on Work from injury. Mobile equipment when not in use shall have keys removed and locked up in secure location.
- 1.7.7 Ensure that working conditions for the Owner are not adversely affected by work under this contract.

**1.8 Manufacturer's Instructions**

- 1.8.1 Install or erect products in accordance with manufacturer's direct written instructions.
- 1.8.2 Handle and store materials in accordance with manufacturers' and suppliers' recommendations and to prevent damage to materials during storage and handling.
- 1.8.3 Notify the Engineer in writing, of conflicts between the specification and manufacturer's instructions, so that the Engineer may establish the course of action.

**1.9 Equipment Pricing by Manufacturers, Distributors or Dealers**

- 1.9.1 The Owner supports open, fair, and competitive pricing practices and expects that all equipment Resellers (Manufacturers, Distributors, and Dealers) adhere to such practices. Resellers must offer equipment individually priced as requested by the Contractor. In addition to individual pricing, equipment offered in a bundle quote to provide further quantity based discounts to Subcontractors is an acceptable practice; however, if the Owner determines that

bundled pricing for a group of items is being offered to unfairly restrict competition for the individual equipment involved, the Owner reserves the right to delete that manufacturer from the list of pre-approved manufacturers listed in the tender specifications. Furthermore, the Owner reserves the right to request that the Successful Bidder provide more detailed price breakdowns than noted in Schedule of Prices for the establishment and recording of asset and depreciation values.

**1.10 Progress Draw Cost Breakdowns**

- 1.10.1 Use Table of Contents of the Specification as basis for identifying line items in the breakdown and any provisional items identified in the Schedule of Prices.

**1.11 Concealment of Services**

- 1.11.1 Pipes, conduits, service lines and ducts shall be concealed in chases, behind furring or above ceilings, and such items shall not be exposed to view except where they are noted as being exposed to view or reviewed and approved by the Engineer.
- 1.11.2 Where no ceiling is provided, such items occurring in ceiling spaces may be exposed. In this case, workmanship must be of the highest quality, all lines etc. shall be run straight and true.

**1.12 Mobilization and Demobilization**

- 1.12.1 The Contractor must provide for the mobilization/demobilization of the site in accordance with these contract documents.
- 1.12.2 Comply with the Engineer's and Owner's instructions in regards to the allocation of the mobilization areas of the site; construction fencing, temporary signage, field offices and storage areas, access and parking.
- 1.12.3 Successful mobilization will generally consist of the following:
- .1 Supply and erect all temporary signs, barricades/fences, flashers, delineators, flag persons, and such other protection as may be required to protect the public during construction.
  - .2 Provide security protection for Site office, plant and stored materials.
  - .3 Move onto site and set up offices, storage facilities, plant, sanitary facilities, temporary fencing, temporary work areas, temporary hydro and telephone if specified or required by the Contractor to complete the Works.
  - .4 Provide all necessary access to the project including temporary access as required.
- 1.12.4 Successful demobilization will generally consist of the following:
- .1 Removal of temporary signs, barricades/fences, flashers, delineators, flag persons, and such other protection that was installed at the beginning of the Contract.
  - .2 Removal of temporary access or work areas, and restoration of damaged surfaces to original condition or better.

- .3 Move off site and remove offices, storage facilities, and all temporary or construction plant or facilities and leave the site clean and tidy.

### **1.13 Damage to Existing Utilities and Structures**

- 1.13.1 Obtain the necessary drawings and perform any necessary sub-surface investigations in order to determine the exact location of all existing utility services, structures, underground pipes, cables, and other similar items. Notify Engineer immediately of any potential conflicts with proposal buried piping and utilities.
- 1.13.2 The location for existing structures and underground pipes, cables, utilities, and other similar items as shown on the Contract Drawings do not relieve the Contractor of this responsibility.
- 1.13.3 Take the necessary steps to ensure that no damage is caused to existing structures, buildings, foundations, roads, sidewalks, property, utility services, and other similar items during the progress of the Work.
- 1.13.4 If any damage is caused, inform the engineer of the damage and proposed repair methodology, repair and make good such damage at no additional cost within a reasonable time and to the complete satisfaction of the Engineer.

### **1.14 Occupying the Site**

- 1.14.1 Use only those areas designated by the Owner for the access, except in so far as is necessary for the execution of the Works, and in so doing, do not unnecessarily obstruct the normal traffic of, to, from or about the Site; and do not unreasonably allow any vehicles or materials to stand in front of, or near to, any buildings on the Site or any access thereto.
- 1.14.2 Areas shown as Contractor's Limits are areas to be used by the Contractor for construction, parking lot, storage and temporary facilities.
- 1.14.3 All inquiries and deliveries related to the Contractor's activities will be directed to the Contractor's site trailer.
- 1.14.4 Confine operations within areas designated for construction, storage and access as shown on the Contract Drawings and/or as directed by the Engineer.
- 1.14.5 Limit access to and from the site as instructed by the Engineer.
- 1.14.6 Maintain safe access to any existing facilities for the operations staff at all times.
- 1.14.7 Limit possession of any areas of the Site occupied by operational plant (Restricted Areas) to such times as are necessary for the execution of the works in those areas.
- 1.14.8 Clearly identify in the schedule when occupation of Restricted Areas or the main work area is required and notify the Engineer in writing when such possession is required at least 10 working days in advance.
- 1.14.9 Do not occupy or use any of the Restricted Areas for a longer period than is necessary for the execution of any part of the works to be undertaken in those areas. Occupy an area not greater than the minimum required for that part of the works.



**1.15 Contractor Use of Premise**

- 1.15.1 Arrange with the Owner and Engineer for storage areas and access to the Works.
- 1.15.2 Make arrangements with property owners if additional areas are required. Obtain written agreements and submit copies to the Engineer.
- 1.15.3 Confine operations within working limits for construction, storage and access.
- 1.15.4 Install and maintain temporary chain link fencing along working and storage areas and access routes.
- 1.15.5 Carry out the construction of the Works in such a manner that a minimum of inconvenience is caused to the Owner and occupants of properties adjacent to the Works.
- 1.15.6 Store materials separately on the Site at locations agreed upon with the Engineer, suitably protected to prevent their deterioration or the intrusion of foreign matter. In the opinion of the Engineer, remove any material which has deteriorated or been damaged immediately from the Site at no additional cost to the Owner.
- 1.15.7 During construction of the facilities, liaise with the Engineer and plant operating staff to schedule work to minimize impacts on plant operations.
- 1.15.8 Obtain written approval from the Engineer for tie-in work to the existing facilities. Plant operating staff will operate any valve, switch, or other controls on existing facilities.
- 1.15.9 The contractor shall provide portable washroom facilities to be used by the Contractor's personnel. They are to be maintained by the Contractor in neat and clean condition for the duration of the contract. Washroom facilities shall be located outside the plant's buildings. Contractor forces are under no circumstances to use the Owner's washrooms.

**1.16 Owner Occupancy**

- 1.16.1 The Owner and plant operating staff will occupy premises during entire construction period for execution of normal operations.
- 1.16.2 Cooperate with the Owner and operating staff in scheduling operations to minimize conflict and to facilitate usage by the Owner and plant operating staff.
- 1.16.3 The Contractor shall ensure that heavy construction equipment, amenities, offices or any potential obstruction in the Work area minimizes disruption and impact to operations and ongoing activities at the plant.
- 1.16.4 Maintain free access and parking for the Owner, Engineer and plant operating staff.

**1.17 Partial Owner Occupancy**

- 1.17.1 Schedule and substantially perform designated portions of Work for Owner's occupancy prior to Substantial Performance for the entire Works.
- 1.17.2 Provide additional warranty for all equipment, materials and workmanship placed into service and used by the Owner to maintain operations in accordance with the sequence of construction until issuance of Substantial Performance for the entire Works.

- 1.17.3 The Owner and operating staff will occupy designated areas for the purpose of operation to ensure plant compliance,

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Intent**

- 1.1.1 This Section stipulates the Contract requirements and submittals required to develop payment certificates.

### **1.2 Scope**

- 1.2.1 The Contract Price shall cover all Work required by the Contract Documents. All costs in connection with the proper and successful completion of the Work, including furnishing all materials, equipment, supplies, and appurtenances; providing all construction plant, equipment, and tools; and performing all necessary labour and supervision to fully complete the Work, shall be included in the unit and lump sum prices bid. All Work not specifically set forth as a pay item in the Schedule of Prices shall be considered subsidiary obligation of the Contractor and all costs in connection therewith shall be included in the prices bid.

### **1.3 Measurement for Payment**

- 1.3.1 Contract Administrator will review the Contractor's application for payment based on the percentage of work completed for the billing period and prices entered in the Schedule of Prices and related breakdown.
- 1.3.2 The Contractor's application will not be considered proper until all quantities and supporting documentation have been accepted by the Contract Administrator.

### **1.4 Payment Requisitions**

#### **1.4.1 Contractor's Responsibilities:**

- .1 Submit for review a draft payment requisition breakdown to the Contract Administrator within three (3) weeks of the order to commence.
- .2 Submit subsequent payment requisitions to Contract Administrator on the date established at the Pre-Construction Meeting. The Contract Administrator will review and respond or make changes as required based on the progress of work completed for the billing period. Proper invoice shall include:
  - .1 Contractor name
  - .2 Date and period of supply
  - .3 Date of proper invoice
  - .4 Description of services
  - .5 Amount payable
  - .6 Payment terms
  - .7 Invoice number

- .8 PO number
- .9 Payment remit to name and address
- .10 Timing for invoice submittal
- .11 City Lead, Consultant name, and Contractor Lead
- .12 Estimate of percentage of work completed against each item of Lump Sum Price Breakdown.
- .13 Include all labour and materials incorporated in work and all materials stored at site.
- .14 Include labour and materials incorporated in work for all agreed extras and deductions,
- .3 Supply documentation to support claim for materials on site in the form of itemized lists or unpriced purchase orders showing quantities.
- .4 Supply other evidence required by Contract Administrator in support of payment requisition.

**1.4.2 Contract Administrator's Responsibilities:**

- .1 Review Contractor's payment requisition, prepare Progress Payment Certificate and issue to Owner within five (5) Working Days following receipt of the Contractor's proper payment requisition.
- .2 The Contract Administrator's estimate of percentage of work completed for the payment requisition period shall govern for all Progress Payment Certificates.
- .3 Inform the Contractor of amendments to payment requisition by copy of Progress Payment Certificate.

**1.5 Changes Orders or Change Directives**

- 1.5.1 Complete and promptly return all Request for Quotations (RFQs) issued by Contract Administrator, quoting unit and/or lump sum prices as requested. Include appropriate supporting documentation to verify prices.
- 1.5.2 Do not proceed with work affected by RFQs until authorized to do so by Change Order, or authorization to proceed in writing by the Contract Administrator.
- 1.5.3 A Change Order is only valid when signed by Contract Administrator, Owner and Contractor.
- 1.5.4 The method used to determine the amount of adjustment to the Contract Price, if any, for the proposed change in the Work shall be one of the following:
  - .1 Negotiated lump sum,
  - .2 Unit price, as set out in the Contract Documents or subsequently agreed upon, or,

- .3 Cost - Plus (Time and Materials), in accordance with the General Conditions of the Contract.
- 1.5.5 The "Contractor's fee" as provided in paragraph 6.3.6 of GC 6.3 – CHANGE DIRECTIVE shall only apply where the method of adjustment to be used is the Negotiated lump sum or Cost - Plus (Time and Materials) method.
- 1.5.6 The "Contractor's percentage fee" as provided in paragraph 6.3.6 of GC 6.3 – CHANGE DIRECTIVE shall be based on the following:
  - .1 10% for work performed directly by the Contractor's forces.
  - .2 10% for work performed by a Subcontractor, plus 10% for the Contractor, not compounded.
  - .3 No further mark-up shall be applied regardless of the extent to which the work is assigned or sublet to others. If work is assigned or sublet to an associate, as defined by the Securities Act, no Subcontractor mark-up whatsoever shall be applied.
  - .4 A reasonable rental rate not exceeding OPS rates to be agreed upon, if rental charge is not stipulated in the Contract, before the work is begun for machinery and heavy equipment, such as tractors, bulldozers, ditching machines, air compressors, concrete mixers and graders, for the actual time required in operation for the performance of the extra work, to which no percentage shall be added.
- 1.5.7 The Contractor's percentage fee shall include allowances for overhead and profit. Allowances for overhead and profit shall cover all the Contractor's administrative and incidental costs relating to a change, including, without limitation, costs relating to superintendence and supervision, shop drawing production, Site Office and Home Office expenses, workers tools, temporary facilities and controls. No further claim for change in the contract time, delay, prolongation charges, impact costs, loss of anticipated profit or other such claims will be accepted as having resulted from a Change Order, after it has been accepted by the Owner.
- 1.5.8 The Contractor's proposal for adjustment of the Contract Price, if any, shall include a breakdown of the labour, Construction Equipment, Products and Subcontractor work which is anticipated to be required by the change in the Work. Allowable mark-ups on labour, Construction Equipment, Products and Subcontractor work shall be applied in accordance with the General Conditions of the Contract.
- 1.6 Submittals**
  - 1.6.1 The format and detail of the submitted payment details shall be provided in accordance with the Owner's requirements.
  - 1.6.2 Submittals shall be made electronically in accordance with the requirements of Section 01330.
  - 1.6.3 Submittals shall clearly distinguish between the following:
    - .1 Base scope as defined in the contract documents broken down by Division.

- .2 Provisional items as delineated in the Schedule of Prices. Note that payment will only be processed for items approved for in writing by the Owner.
- .3 New scope of work items as may arise over the course of the work, payable via the Owner's contingency allowance. Note that payment will only be processed for items approved for in writing by the Owner.

## **1.7 Schedule of Prices**

### **1.7.1 Lump Sum Work:**

- .1 Reflect the schedule of Sections and Prices and specified cash allowances in the Schedule of Prices, as applicable.
- .2 Break down by Divisions 1 through 16 including a breakdown by each Specification Section.

1.7.2 Any schedule which is deemed by the Contract Administrator to be unbalanced or front-end loaded will not be acceptable. The Contract Administrator reserves the right to modify any unbalanced payment breakdowns.

1.7.3 Summation of the complete Lump Sum Price Breakdown representing all of the Work shall equal the Contract Price.

1.7.4 Submit the Lump Sum Price Breakdown in a spreadsheet format compatible with the latest version of Microsoft Excel prior to the pre-construction meeting.

### **1.7.5 Section 01120 – Coordination and Sequence of Work**

- .1 There shall be a line item in the monthly payment certificate entitled "mobilization and demobilization". The price provided for this item shall be consistent with the actual costs involved, but should not in any event, exceed 10% of the Lump Sum Total Price (not including HST). In the event the amount provided for this item exceeds 10% of the Lump Sum Total Price, the Owner reserves the right, at its sole discretion, to apportion any or all of the cost of this item to the Demobilization component, which shall be paid upon completion of demobilization.
- .2 Payment for line items that are required for the duration of Construction shall be pro-rated on a monthly basis based on the duration of Construction.

### **1.7.6 Section 01320 – Construction Schedule**

- .1 The price provided for this Section shall be consistent with the actual costs involved, but should not in any event, be less than 0.5% of the Sub-Total of Lump Sum Prices for Divisions 2 to 16 inclusive (not including HST). In the event the amount provided for this Section is less than 0.5% of the Sub-Total of Lump Sum Prices for Divisions 2 to 16 inclusive, the Owner reserves the right, at its sole discretion, to apportion any or all of the cost for this Section from another Section as it sees fit.

- 1.7.7 Section 01810 – Testing and Commissioning and Section 01820 – Demonstration and Training
- .1 The combined price provided for these Sections shall be consistent with the actual costs involved but should not in any event be less than 5% of the Sub-Total of Lump Sum Prices for Divisions 11, 13, and 16 inclusive (not including HST). In the event the amount provided for these Sections is less than 5% of the Sub-Total of the Lump Sum Prices for Divisions 11, 13, and 16 inclusive, the Owner reserves the right, at its sole discretion, to apportion any or all of the cost for these Sections from another Section as it sees fit.
- 1.7.8 Section 01780 – Closeout Submittals (Redline Drawings and O&M Manuals)
- .1 To certify that the “Redline Drawings”, as specified in Section 01330 and Section 01780, are being kept up to date by the Contractor, there shall be a line item in the monthly payment certificate entitled “Redline Drawings” under Section 01780 with a total value of \$25,000 (not including HST). 75% of the total amount shall be assigned and paid to the Contractor on monthly progress. The balance shall not be paid until Final “Redline Drawings” are submitted and accepted by the Contract Administrator.
- .2 There shall be a line item in the monthly payment certificate entitled “O&M Manual” under Section 01780 with a total value of \$25,000 (not including HST). Up to 75% of the total amount shall be assigned and paid to the Contractor with documented progress towards a draft O&M Manual. The balance shall not be paid to the Contractor until after the Contract Administrator’s acceptance of the final submission.
- .3 Final 2% of the Sub-Total of Lump Sum Prices for Divisions 11, 13, and 16 shall not be paid until all spare parts have been provided and accepted by the Contract Administrator.
- 1.7.9 Section 01770 - Close-out Procedures
- .1 The price provided for this Section shall be consistent with the actual costs involved, but shall not in any event, be less than \$50,000 (not including HST). In the event the amount provided for this Section is less than \$50,000, the Owner reserves the right, at its sole discretion, to apportion any or all of the cost for these Sections from another Section as it sees fit.
- 1.8 Contingency Items**
- 1.8.1 Contingency payments shall only be made with prior written authorization of the Owner.
- 1.8.2 Prior to authorization, the Contractor shall – in coordination with the Contract Administrator and Owner – submit a quotation / proposal for the work to be done, including all supporting information including a workplan, labour rates and hours, vendor quotations and expected impact to the project schedule. Contractor may be required to provide a quotation from several vendors.
- 1.8.3 Approval of contingency works shall be at the sole discretion of the Owner. The Contractor shall have no claim to any unused portion of the contingency.



**1.9 Estimated Quantities**

- 1.9.1 All estimated quantities stipulated in the Schedule of Prices or other Contract Documents are approximate and are to be used only:
- .1 As a basis for estimating the cost of the Work and
  - .2 For the purpose of comparing the Bids submitted for the Work.
- 1.9.2 The actual amounts of work done, and materials furnished under unit price items may differ from the estimated quantities. The basis of payment for work and materials will be the actual amount of work done and materials furnished. Contractor agrees that it will make no claim for damages, anticipated profits, or otherwise on account of any difference between the amounts of work performed and materials actually furnished and the estimated amounts therefore.
- 1.9.3 The Contractor shall track and submit verification on an ongoing basis to the Contract Administrator. In the event that the quantities are exceeded or over-estimated, the unit rate provided in the Schedule of Prices will be used as the basis to calculate additional fees to be paid from the provisional allowance or contingency, or to estimate a credit to the Owner.
- 1.9.4 No extra work shall take place without the Owner's approval in advance of the work being undertaken.

**1.10 Measurement**

- 1.10.1 For items in Divisions 11, 13, 15, and 16, payment will be measured as follows:
- .1 Payment for shop drawings shall not exceed 2.5% of line item upon submission and 2.5% of line item following approval of shop drawing.
  - .2 Payment for equipment delivered to site but not yet installed and incorporated shall not exceed 60% of line item.
    - .1 For equipment pre-selected under RFQ 2022-92, payment shall follow terms of that contract. Payment for equipment will be released at the Release for Fabrication and Notification of Ready to Ship milestones identified by the vendor. However, payment for Line Items 7-11 as detailed in the RFQ 2022-92 price form will not be released until successful completion of those tasks onsite.
  - .3 Payment for installation of equipment not to exceed 20% of line item.
  - .4 Under all cases, no more than 90% of each pay item will be released until successful completion of equipment start-up, commissioning and performance testing.
  - .5 Payment up to 90% of the value of equipment may be considered with proof of value for equipment that is delivered but not yet installed.
- 1.10.2 Only items that have been shipped and unloaded to site will be eligible for payment. Payment will not be made for surplus materials on hand after the completion of the work.

- 1.10.3 Payment will not be made for any equipment or materials that have been rejected as defective, failed, or otherwise unacceptable to the Owner. Costs associated with loading, hauling and disposal of rejected materials will be borne by the Contractor.

**1.11 Applications for Payment**

- 1.11.1 The Contractor shall use a detailed Application for Payment form in a format acceptable to the Owner and Contract Administrator.

- 1.11.2 Applications for payment shall be made on a monthly basis and shall include the following elements as a minimum:

- .1 Signed and Dated transmittal form / cover sheet
- .2 Payment requisition including Proper Invoice, as described by Clause 1.4.1.2
- .3 Statutory declaration (form to be provided by the Owner)
- .4 Copy of current WSIB certificate
- .5 Updated Detailed Progress Schedule and associated documents per requirements in Section 01320 – Construction Schedule in the form acceptable to the Contract Administrator.
- .6 Updated summary of the divisional price breakdown including all approved allowance and contingency items, holdback and taxes.

- 1.11.3 The Owner shall not release monies for Payment Certificates until the Contractor has provided all supporting documentation in a satisfactory manner, and as approved by the Contract Administrator. Deviations from these requirements shall require resubmission of the application for payment. No claims will be accepted due to delays in processing payment as a result of rejected applications for payment.

- 1.11.4 Payment for Mobilization/Demobilization shall be made as follows:

- .1 Up to sixty percent (60%) from commencement of construction for full mobilization. The payment of mobilization shall be included in the first payment certificate issued for the Contract subject to the Contract Administrator being satisfied that full mobilization has been carried out. If the Contract Administrator is not so satisfied, the Contract Administrator shall allow a payment amount which, in the opinion of the Contract Administrator, reflects the degree of mobilization effected to date.
- .2 Progressively from 60% at the commencement of construction to 80% at Substantial Performance of the Work.
- .3 The remaining 20% to be paid immediately prior to completion of the Work for Demobilization.
- .4 As referred to in subsection 1.7.5.1 above, in the event that the price of this item exceeds 1% of the Lump Sum Total Price, the Owner reserves the right, at its sole discretion, to apportion the payment of this item, including apportioning any or all of the cost of this item to the Demobilization component, which shall be paid upon the completion of Demobilization.

**1.12 Payment**

**1.12.1 General:**

- .1 Progress payments will be made monthly.
- .2 The date for the Contractor's submission of the monthly Application for Payment shall be established at the preconstruction Meeting.

1.12.2 Payment for all of the Work shown or specified in the Contract Documents is included in the Contract Price.

1.12.3 Payment for unit price items covers all of the Work necessary to furnish and install the items identified in the schedule of Additional Unit Prices in the Schedule of Prices.

**1.13 Nonpayment for Rejected or Unused Products**

**1.13.1 Payment will not be made for the following:**

- .1 Loading, hauling, and disposing of rejected material.
- .2 Quantities of material wasted or disposed of in a manner not called for under the Contract Documents.
- .3 Rejected loads of material, including material rejected after it has been placed by reason of failure of the Contractor to conform to requirements of the Contract Documents.
- .4 Material not unloaded from a transporting vehicle.
- .5 Defective Work not accepted by the Owner.
- .6 Material remaining on hand after completion of the Work.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Intent**

- 1.1.1 The intent of these specifications is to provide for the works herein enumerated to be fully completed in every detail for the purposes designated. It is hereby understood that the Contractor, in accepting the Contract, agrees to furnish any apparatus, appliances, material or labour not herein specifically mentioned or included, but which is found necessary to complete, perfect, and test every requirement written and implied in these specifications, without extra cost to the owner.

### **1.2 Schedule of Work**

- 1.2.1 The schedule of work for this contract is as follows:

- .1 Tendering Closing - Summer 2025
- .2 Anticipate Award Date – Fall 2025
- .3 Substantial Completion – 18 months after award

### **1.3 Work Covered by Contract Documents**

- 1.3.1 The work to be done under this Contract, as specified and/or as shown on the Drawings includes the complete supply of all materials, labour and equipment for the construction of utilities and services required for: Brantford WWTP Secondary Clarifiers Rehabilitation

- 1.3.2 Work of this Contract comprises general construction associated with:

- .1 Provision of all temporary measures and works (including equipment, supports, electrical, etc.) to complete work under this Contract including but not limited to:
  - .1 Supply of temporary power for construction services. The Contractor shall obtain ESA approval for the connection of temporary power.
  - .2 Supply and installation of temporary isolation and pumping equipment.
- .2 Structural rehabilitation of Secondary Clarifiers #1-8.
- .3 Refurbish Secondary Clarifier #1 mechanism.
- .4 Installation of new equipment within Secondary Clarifiers #1-8, including new power feed and control wiring conduits and equipment integration. Scope of new equipment includes:
  - .1 Installation of density current baffles (SC #1-4)
  - .2 Installation of clarifier mechanisms (SC#2-6, #8)
  - .3 Installation of new mechanism motor and gear drive (SC#7)
  - .4 Installation of new clarifiers weirs (SC#3-6, #8)

- .5 Structural rehabilitation and installation of new manual gates and v-notch weirs within all field chambers and channels within the project area identified on the project drawings.
- .6 Yard piping cleaning and solids debris cutting, as identified on the project drawings.
- .7 PROVISIONAL ITEM: Structural refurbishment of exposed portions of concrete walls and replacement of handrails around Plant 1 Aeration Tank 1 exterior.
- .8 PROVISIONAL ITEM: Structural refurbishment of exposed portions of concrete walls and replacement of handrails around Plant 1 Aeration Tank 2 exterior.
- .9 The Contractor shall be aware of the long period of time it will take to drain the aeration tank in order to conduct the handrail replacement work, and as such shall take the drainage time into consideration.
- .10 The Contractor shall be responsible for protecting the exposed aeration diffusers when the aeration tanks are drained, and to ensure debris from the structural refurbishment and handrail replacement work does not damage the aeration diffusers.

1.3.3 This clause is not intended to define the scope of the contract. Use it only as a general guide to the extent of the work.

#### **1.4 Location of Work**

1.4.1 Brantford Wastewater Treatment Plant

385 Mohawk Street

City of Brantford

N3T 5L9

#### **1.5 Hours of Work**

1.5.1 Normal working hours of Plant Operations and City staff are Monday to Friday between 8 am and 4 pm. Requests for the Contractor to work longer hours will be considered, as long as they comply with all applicable noise bylaws.

1.5.2 The Contractor is advised that night, weekend or holiday work may be required in the Contract. The Owner or Engineer may, where they deem it necessary to speed up the work or deem it necessary or expedient in order to preserve and maintain traffic over or on any street or road, or to restore utility service, order any work to be carried out in whole or in part at night or on two or three shift basis, or on Sundays or holidays, and the Contractor shall have no claim for extra compensation in respect thereof.

1.5.3 The Contractor shall, as far as possible, refrain from work on days which are legal holidays for the Owner. If it is desired to work on any such holiday, the Contractor shall notify the Owner in writing at least four (4) days in advance of such holiday of their intention to work, stating the areas where the work will be conducted.

1.5.4 If the Contractor fails to give such notice in advance of any holiday, such failure shall be considered as an indication that no work requiring the presence of an authorized representative of the Owner is to be done by the Contractor on such a holiday.

**1.6 Coordination within this Contract**

- 1.6.1 Designate a fully qualified individual, as a General Superintendent, to be responsible for directing the progress of this Contract continuously, including the coordination and work of sub-contractors.

**1.7 Work by Others**

- 1.7.1 Other contractors may be expected to be on site during this Contract. Project shall be separated in time or space from other contract work.
- 1.7.2 Portions of the Brantford WWTP will remain online during the construction process. Planned construction work will not interfere with Plant Operations Staff or plant performance.
- 1.7.3 The Contractor will coordinate all utility Contractors and all testing and commissioning work with the Owners, Staff and Agents.

**1.8 Existing Roads**

- 1.8.1 Repair any damage and reinstate plant roads to original condition.
- 1.8.2 The Contractor shall choose and operate all equipment to avoid any damage to existing roads. Any existing asphalt, concrete curbs and sidewalks, shoulder or grass areas, which are damaged by the Contractor due to his operation, shall be replaced by the Contractor to the satisfaction of the Owner at the Contractor's cost. Concrete sidewalks and curbs which are damaged by the Contractor shall be removed from joint to joint and reconstructed to match existing.

**1.9 Existing Dimensions/Elevations**

- 1.9.1 Dimensions shown are based on existing drawings and are approximate. Verify field dimensions, elevations, and details before commencing work. Report discrepancies to the Engineer. No extra cost to the Owner for the verifications.

**1.10 Cooperation with Other Contractors**

- 1.10.1 Other contracts may be awarded or be underway at same or other locations on the plant site. The Owner will provide a list of Contracts at the pre-construction meeting.
- 1.10.2 Ensure strict compliance with the Ministry of Labour requirements governing the completion of multiple contracts on the site. Coordinate work to ensure separation in time and space from other contractors.
- 1.10.3 At the interface with other contracts, jointly plan and coordinate with other contractors the work so that the project:
- .1 Will not be delayed.
  - .2 Will not be endangered in any way.
  - .3 Will be correctly connected.

- .4 Will not cause the Owner to be designated as the constructor (through Contractor's non-compliance with Ministry of Labour requirements for separation in space and/or time between different Contracts, including any site access restrictions).

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**



## **1 GENERAL**

### **1.1 General Coordination**

- 1.1.1 The Contractor shall develop and finalize the construction sequence so as to minimize impact on operations, subject to approval of the Engineer and the Owner.
- 1.1.2 Construct Work in stages to accommodate the Owner's use of the premises during construction, as necessary. Work shall be carried out expeditiously to minimize disruptions to existing operations.
- 1.1.3 The Contractor shall arrange the timing of, and the method by which the works are carried out so as not to affect the operation of the existing facilities. The work will be carried out in stages to accommodate the Owner's continued access for operation and maintenance of all facilities during installation. The Contractor's detailed construction schedule shall be coordinated with the Owner and the Engineer and shall show the sequence including the data and duration of equipment or system shutdowns required for construction purposes. No deviation from this schedule shall be permitted without the Contractor having first obtained the Owner's written approval.
- 1.1.4 The Contractor must note the necessity of keeping the existing Brantford WWTP in continuous operation for the duration of construction activities.
- 1.1.5 Any shutdowns shall be in strict accordance with the sequence in the Contractor's schedule and shall be carefully coordinated with the Owner, Engineer and Operating personnel to avoid unplanned impacts to the wastewater treatment system.
- 1.1.6 Prior to shutdown of any facilities the Contractor must request in writing at least twenty (20) working days in advance of the required shutdown. Depending on demand the Owner may require the shutdown to be done at other than normal working hours or postponed to a time more suitable to plant operation. The Contractor shall reschedule their work to suit plant operation at no additional cost to the Owner.

### **1.2 Shutdown Coordination**

- 1.2.1 Coordinate all construction activities with the Owner through the Engineer and verify that these activities do not interfere with operations of the Facility. Obtain written permission from The Owner through the Engineer for each shutdown or temporary works at least four (4) weeks in advance. Submit a plan for each shut-down that clearly defines the system to be taken out of service and the length of time of the shut-down. Identify a contingency plan or temporary works necessary to maintain operations of the Facility where necessary. The Owner shall at all times have unhindered access to all portions of the Facility that are in operation.
- 1.2.2 Provide backup to critical operations in case of failure, including temporary pumping or other measures as required. Indicate backup to be provided including alternate power supplies and controls in shutdown plan.
- 1.2.3 Shutdown Coordination shall be as follows:
  - .1 Contractor shall secure approval for their proposed shutdown or interference with operations at least four (4) weeks prior to the actual shutdown or interference.

- .2 Contractor shall submit the Shutdown Notification form at least four (4) weeks prior to the actual shutdown or interference. Shutdown Notification form is appended at the end of this Section.
- .3 The date which the Contractor shall submit the Shutdown Notification form shall be known as the Submission Date.
- .4 The date which the required shutdown or inference with facility operations falls on shall be known as the Shutdown Date.
- .5 Shutdown Notification forms that are submitted less than (4) weeks ahead of the Shutdown Date will be rejected.
- .6 The Contractor shall arrange a Facility Walkthrough with the Engineer and the Owner. The Plant Walkthrough will be conducted within a week after submitting the Shutdown Notification Form.
- .7 The Owner and Engineer shall identify any concerns, operational preparation requirement, maintenance preparation requirement, and any other shutdown requirements that shall be the Contractor's responsibility to fulfill and comply to.
- .8 The Contractor shall arrange for a Second Plant Walkthrough with the Engineer and The Owner to be conducted 24 hours before the Shutdown Date.
- .9 During the Second Plant Walkthrough, The Owner and Engineer shall identify any concerns that could prevent the shutdown.
- .10 If the Owner and Engineer deem the Shutdown acceptable, the Engineer shall approve and sign the Shutdown Notification Form.
- .11 The Contractor shall follow the above steps for each shutdown.
- .12 The Contractor shall provide two (2) Master Shutdown Calendars.
  - .1 Calendars will have the scheduled shutdown date, affected processes, area, and duration of shutdown.
  - .2 One calendar will be given to the Owner and provide an overview of planned shutdowns to the Owner.
  - .3 The second calendar will be displayed in the Engineers Site office.
  - .4 The Contractor shall provide updates to both calendars on a weekly basis incorporating any new approved Shutdown Notification Forms.
  - .5 The lasted Individual Shutdown Notification Forms shall be kept in a binder, in the Engineers site office.

- 1.2.4 Issues requiring action by the Owner shall be included in the Contractor's shut-down plans. Describe the reason, anticipated length of time, and areas affected by the outage in the shut-down plan. Identify temporary means for continuing power, gas, fuel oil, air, and/or water supply as appropriate to critical existing facility components if requested by the Owner and Engineer.

- 1.2.5 Access to certain parts of the Facility is restricted and the space available for the Contractor's staging activities is limited. Stage the Work such that access to the Facility is maintained at all times.
- 1.2.6 Plan and schedule construction activities recognizing that shutdowns of the existing facilities and systems are to be minimized and can only proceed after reaching agreement with The Owner.
- 1.2.7 Coordinate the requirements of this Section with all other Specification Sections in Division 1, and with all other applicable specification sections contained herein.
- 1.2.8 The Contractor shall coordinate and facilitate confined space entry operations where multiple parties are involved in accordance with O. Reg. 628/05.
- 1.2.9 When shutdown and/or switch-over of any plant process or electrical systems are required, the Contractor shall coordinate all trades involved. Coordination with Owner shall be through the Engineer, using the Shutdown Notification form attached to the end of this Section. Detailed written sequences are required to be submitted to the Engineer to permit such coordination. Refer to Clause 3.2 for scheduling constraints and limitations of construction.
- 1.2.10 There is no guarantee that permission will be granted to take any system off line.

### **1.3 Submittals for Review**

- 1.3.1 Submit detailed sequence of work that meets the requirements of Section 01330 – Submittals.

## **2 PRODUCTS (NOT APPLICABLE)**

## **3 EXECUTION**

### **3.1 General**

- 3.1.1 The Contractor shall take responsibility for carefully coordinating all aspects of the work including all permanent and temporary connections whether identified on the Contract Drawings or not, to successfully complete the Works. Designate a fully qualified individual, as a General Superintendent, to be responsible for directing the progress of this Contract continuously, including the coordination and work of sub-contractors.
- 3.1.2 Coordinate Progress Schedule and coordinate with the Owner occupancy during construction.
- 3.1.3 Some equipment or supplies may require lengthy delivery times and as such must be ordered as soon as a notice to proceed is given by the Engineer. The Owner will not entertain extra claims or waive damages as a result of late delivery of such items.
- 3.1.4 Existing systems or individual equipment items will be isolated by the Owner. The Contractor is responsible for unwatering, disposal, de-commissioning, de-energizing, de-pressurizing, cleaning, pressure-washing and disinfecting, as required. Perform all such work in accordance with the shutdown plan submitted by the Contractor and approved by the Engineer. The Owner will operate all valves and gates as required. The Contractor shall not rely on existing equipment to unwater existing systems or equipment.

- 3.1.5 Contractor shall assume all waste from draining of process systems to be full of grit, screenings and other substances considered non-hazardous. Disposal of waste shall be in accordance with Section 02061.
- 3.1.6 The Owner will remove from service process units, tanks, and pipelines only once, unless otherwise specified. The owner will isolate each forcemain, as required. If the Contractor requires that a process unit, tank, or pipeline be removed from service more than once, then the Contractor shall bear all costs for such removal from service, emptying, cleaning, and placement back into service.
- 3.1.7 The Contractor shall provide protection against tank/structure flotation for all emptying operations throughout construction phases done by the Contractor.
- 3.1.8 The Contractor shall be responsible for maintaining any equipment that is taken out of service as a result of construction activities.
- 3.1.9 Provide all necessary temporary pumps, plugs, temporary screening/grinding, blinds, valves, piping, electrical wiring, controls, and labour incidental to complete the Work. Any pumps and water level must be continuously monitored by the Contractor during any tie-ins to make all provisions necessary to prevent flooding and bypassing during all diversion pumping operations or tie-ins. Monitoring of water levels may extend beyond the site limits for sewer collection systems.
- 3.1.10 The Contractor shall retain an Engineer to design all temporary systems. All temporary system designs shall be stamped by a Professional Engineer licensed in Ontario.
- 3.1.11 Some shutdowns may have to take place outside normal working hours, i.e. nighttime and/or weekends in order to comply with shutdown limitations as described in this Section.
- 3.1.12 Coordinate tie-ins to allow staged construction by area. Supply and install additional temporary isolation valves to ensure only one shutdown is required for each connection.
- 3.1.13 Coordinate scheduling, submittals, and work of the various Sections of the Project Specifications and other requirements of the Contract Documents to ensure efficient and orderly sequence of installation of interdependent construction elements.
- 3.1.14 Coordinate work of various Sections having interdependent responsibilities for installing, connecting to, and placing in service, such elements.
- 3.1.15 Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on the Drawings. Follow routing shown for pipes, ducts, and conduit as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance and for repairs.

## **3.2 Monitoring and Emergency Response**

- 3.2.1 Contractor shall have and include in his bid the resources, materials, personnel, and equipment necessary to provide continuous 24-hours per day, 7-days per week, monitoring and emergency repair of sheeting, shoring, stop log installations, bypass pumping operations, and controlling sewage flows where, in the opinion of the Owner or Engineer, the failure of such temporary systems could adversely impact plant operations.

3.2.2 Contractor shall provide and operate temporary systems to contain and/or remove leakage through the gates, valves, and stop logs that are used to accommodate scheduled construction activities.

3.2.3 Contractor shall supply appropriate rescue and emergency response resources and plans as required by O. Reg. 628/05.

### **3.3 Permitted Outages**

3.3.1 All outages to be coordinated with the Owner and the Owner's Operator. The Owner will decide the maximum length of equipment shutdown following the review of the Contractor's work plan submittal. Shutdown of any plant treatment processes will not be permitted.

3.3.2 Table below outlines maximum allowed outages of various plant-wide systems

<b>Service/Process</b>	<b>Maximum Continuous Outage Period</b>	<b>Comments</b>
Plant 1 Aeration Tanks	4-8 hrs	To facilitate installation of temporary systems (e.g. plugs, temporary pumping, etc.)
Plant 2 Aeration Tanks	4-8 hrs	To facilitate installation of temporary systems (e.g. plugs, temporary pumping, etc.)
Electrical Feed Installation (MCC-4, MCC-10)	4 hrs	To complete modifications at the MCCs.
Effluent Flow	0 hrs	Flow through the plant to be maintained at all times.

### **3.4 Operation/Construction Constraints**

3.4.1 The following operation/construction constraints to be considered in scheduling the work.

3.4.2 Operational Constraints:

- .1 Plant is to maintain adequate treatment capacity for the duration of the project. Bypass of any treatment processes will not be permitted.

3.4.3 Construction Constraints:

- .1 Contractor shall maintain sufficient separation in time and/or space from other contract work being completed onsite.
- .2 Ensure there is no impact on the overall treatment process when scheduling work.
- .3 Maintain at least one lane of traffic at all times to allow access to the treatment plant.

### **3.5 Suggested Sequence of Construction**

3.5.1 This Section is not intended to describe the full extent of the work to be done under this Contract. It is intended to outline the general construction sequence only. The Contractor will be responsible for scheduling the detailed construction of the works within the general sequence and permitted outages.

3.5.2 The Contractor shall schedule his work and conform with the intent of the following requirements, and ample allowance shall be made in the schedule to comply therewith. The following is not intended to imply the Contractor must carry out the work in the exact manner indicated but is intended to indicate the restrictions that shall be imposed on construction work sequence and to set out the time duration of shutdowns.

3.5.3 Upon award of the Contract, the Contractor shall begin work as described in the following sequence of construction. The following suggests the general chronological order in which construction activities are proposed to take place. This list is not intended to be comprehensive in all activities required to complete the works, but is intended to identify the main constraints on the scheduling of construction activities. The construction of the works is proposed to proceed as follows:

.1 Confirm laydown area and delivery routes.

.2 Construct all temporary fencing areas, as required.

#### **.3 Plant 1 Aeration Tank Handrail Upgrades**

.1 Coordinate all construction materials required for work to minimize the construction time required during the aeration tank shutdown period.

.2 Aeration Tanks to be drained to 300mm depth as noted on drawings prior to upgrade work. Tank 2 must remain in service while work is completed on Tank 1 and vice-versa.

.3 Complete Plant 1 Aeration Tank handrail upgrades during Phase 1 or Phase 3 of upgrades as noted below. Aeration Tank handrail upgrades cannot be performed during Phase 2.

#### **.4 Phase 1 – Upgrades to Secondary Clarifiers #1-4**

.1 Install temporary plugs at the Plant 1 Aeration Tank outlet chamber, Process Module 1 Sludge Chamber, and the Secondary Clarifier #1-4 Effluent Manhole 2 to completely isolate the area of work.

.2 Perform complete removal of all electrical equipment at Secondary Clarifiers #1-4, including receptacles, duct banks, local control stations, disconnect switches, wiring and raceways as directed in the contract drawings.

.3 Complete all equipment removals, structural refurbishment, and installation of new clarifier mechanisms and gates within:

Secondary Clarifiers #1-4

Secondary Clarifier #1-4 Distribution Chamber

Secondary Clarifier #1-4 Effluent Manhole 1

Secondary Clarifier #1-4 Effluent Manhole 2  
Secondary Clarifier #3-4 Sludge Chamber  
Process Module 1 Sludge Chamber

- .4 Complete modifications to MCC-4 located in the Blower Building, including the removal of existing starter compartments, and installation of new motor starter compartments for Secondary Clarifiers #2-4. Shutdown(s) of MCC-4 may require staging to accommodate
- .5 Install new electrical equipment at Secondary Clarifiers #1-4, including new junction box, duct banks, wiring and raceways.
- .6 Complete cleanout of all yard piping isolated under Phase 1 operating conditions, including clarifier feed piping, return sludge piping, and effluent yard piping.
- .7 Remove temporary plugs. Test and commission Secondary Clarifiers #1-4.
- .5 **Phase 2 – Upgrades to Secondary Clarifiers #7-8**
  - .1 Isolate Secondary Clarifiers #7-8 using existing gates. Plant 2 will be taken offline by the City offline for duration of Phase 2 work.
  - .2 Perform complete removal of all electrical equipment at Secondary Clarifiers #7-8, including receptacles, duct banks, local control stations, disconnect switches, wiring and raceways as directed in the contract drawings. Any abandoned electrical equipment located at Secondary Clarifier #8, including raceways, to be removed.
  - .3 Complete all structural refurbishment and process equipment upgrades within:
    - Secondary Clarifier #7 (new motor and gear drive)
    - Secondary Clarifier #8 (new mechanism, weir)
    - Secondary Clarifier #7-8 Feed Chamber
    - Secondary Clarifier #7-8 Distribution & Waste Sludge Chamber
    - Secondary Clarifier #7-8 Return Sludge Chamber
  - .4 Complete cleanout of all yard piping isolated surrounding Secondary Clarifiers #7-8 under the Phase 2, including clarifier feed piping and return sludge piping.
  - .5 Complete modifications to MCC-10 located in the Screw Pump Building, including removal of existing starter buckets, and installation of new motor starter compartments for Secondary Clarifiers #7-8.
  - .6 Install new electrical equipment at Secondary Clarifiers #7-8, including new junction box, duct banks, wiring and raceways.
  - .7 Test and commission Secondary Clarifiers #7-8.
  - .8 Phase 2A
    - .1 This work will occur concurrently with the work as described in Phase 2.

- .2 Install and commission coffer dams and temporary pumping system to isolate yard piping as described in Phase 2A drawing of Section 01120 – Coordination and Sequence of Work Sketch.
  - .3 Complete cleanout of all yard piping isolated under the Phase 2A operating condition, including effluent yard piping. Process Module 1 Effluent Manhole, and the isolated section of the Secondary Clarifier Effluent Channel. Inspect and repair the isolated yard piping and structures, as needed.
  - .4 Decommission coffer dams and temporary pumping system after the repairs are completed
- .9 Phase 2B
- .1 This work will occur concurrently with the work as described in Phase 2, and after the work as described in Phase 2A has been completed.
  - .2 Install and commission coffer dams and temporary pumping system to isolate yard piping as described in Phase 2B drawing of Section 01120 – Coordination and Sequence of Work Sketch.
  - .3 Complete inspection and repair of Secondary Clarifier Effluent Channel isolated under Phase 2B operating conditions.
  - .4 Decommission coffer dams and temporary pumping system after the repairs are completed

**.6 Phase 3 – Upgrades to Secondary Clarifiers #5-6**

- .1 Install temporary plugs at the Plant 1 Aeration Tank outlet chamber and Process Module 1 Sludge Chamber to completely isolate the area of work.
- .2 Perform complete removal of all electrical equipment at Secondary Clarifiers #5-6, including receptacles, duct banks, local control stations, disconnect switches, wiring and raceways as directed in the contract drawings.
- .3 Complete all structural refurbishment and installation of new clarifier mechanisms and gates within:  
  
Secondary Clarifiers #5-6  
Secondary Clarifier #5-6 Distribution & Sludge Chamber
- .4 Complete cleanout of all yard piping isolated under Phase 1 operating conditions, including clarifier feed piping, return sludge piping, and effluent yard piping.
- .5 Complete modifications to MCC-10 located in the Screw Pump Building, including removal of existing starter buckets, and installation of new motor starter compartments for Secondary Clarifiers #5-6.
- .6 Install new electrical equipment at Secondary Clarifiers #5-6, including new junction box, duct banks, wiring and raceways.
- .7 Test and commission Secondary Clarifiers #5-6



.7 Complete site remediation and demobilization.

3.5.4 The exact construction sequence must be developed by the Contractor based on his own work plan and projections of the required time required to complete the work. The Contractor may have to stage equipment shutdowns, to accomplish a task, in order to meet the constraints identified herein. The Contractor's detailed schedule submitted after award of the Contract shall provide the number of shutdowns and the duration of each shutdown. The Owner and the Engineer reserve the right to adjust the suggested construction sequence based on operational requirements of the system at no extra cost to the Owner. The Contractor shall provide ample float in the construction schedule to allow the Engineer to make adjustments to activities affecting shutdowns of components in the Facility.

3.5.5 The Contractor is encouraged to combine activities during shutdowns to minimize impact on the Facility. Following review of the construction schedule, the Engineer may reduce the number of total shutdowns, if, in the opinion of the Engineer, there are excessive number of shutdowns. In this case, the Contractor will be required to adjust the construction schedule to accommodate the reduced number of shutdowns, at no extra cost to the Owner.

### **3.6 Contractor Use of Premises and Restricted Areas**

3.6.1 The Contractor shall arrange with the Owner for easements for construction, storage and access to all of the Works within the Owner's property line.

3.6.2 Make arrangements with property owners if additional areas are required. Obtain written agreements and submit copies to the Engineer.

3.6.3 Confine operations within easements for construction, storage and access.

3.6.4 Install and maintain adequate security or construction fencing and gates around storage areas or the construction site and maintain during the construction period.

3.6.5 Do not enter upon or occupy with workers, tools or materials any lands other than public streets, roadways, right-of-ways or easements shown on the Contract Drawings except after written consent has been received from the property owner.

3.6.6 The construction of the Works shall be carried out in such a manner that a minimum of inconvenience is caused to the Owner and occupants of properties adjacent to the Works.

3.6.7 Materials shall be stored separately on the Site at locations agreed upon with the Engineer and shall be suitably protected to prevent their deterioration or the intrusion of foreign matter. In the opinion of the Engineer, any material which has deteriorated or been damaged shall be removed immediately from the Site at the Contractor's expense.

3.6.8 The flow in existing drains and ditches shall be maintained by the Contractor at all times at no extra cost to the Owner. During construction of the facilities, the Contractor shall liaise with the Engineer to schedule work to ensure continual flow. The Contractor, where necessary, shall provide temporary drainage systems during construction at no extra cost to the Owner. Following construction activities, the Contractor shall inspect and clean all existing catch basins, storm and sanitary drains within the Work area including those affected by the Work that may be outside of the Work area, at no extra cost to the Owner.

3.6.9 The Owner's Operating staff will operate any valve, switch, or other control on existing facilities.

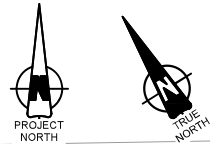
### **3.7 Owner Occupancy**

- 3.7.1 The use or occupancy of the Work or any part thereof by the Owner shall not be taken in any manner as an acceptance by the Owner of any work or material not in accordance with the Contract or to relieve the Contractor or their surety from liability, whether heretofore or here after incurred or arising, in respect of the observance or performance of any covenant or condition in the Contract not then performed, whether such covenant or condition be by way of indemnity to the Owner or otherwise, save to the extent that loss or damage is caused during such use or occupancy by the Owner or by employees of the Owner for whom the Owner is responsible.
- 3.7.2 Entry by the Owner's own forces and by other Contractors does not mean acceptance of the Work and does not relieve the Contractor of their responsibility to complete the Contract. In particular, without limiting the generality of the foregoing, the use or occupancy of the Work or any part thereof by the Owner shall not release the Contractor from liability to pay to the Owner, or waive or impair the right of the Owner to deduct and retain, liquidated damages and engineers' and inspectors' fees, in accordance with the Contract.
- 3.7.3 The Owner shall have the right to enter upon and take possession of the Work, in whole or in part, for the purpose of placing fittings and equipment or other use before completion, if in the opinion of the Engineer such action does not prevent or interfere with the Contractor in the performance of total completion of the Contract within the time specified. Such entry and possession shall not be considered as acceptance of the Work nor in any way relieve the Contractor of responsibility to complete the Contract.
- 3.7.4 The Contractor shall ensure that Operators have unlimited, unobstructed, 24/7 access to the existing facilities. Access shall be made available by the Contractor without exception.

### **3.8 Partial Owner Occupancy**

- 3.8.1 Schedule and substantially perform designated portions of Work for the Owner's occupancy prior to Substantial Performance of entire Works
- 3.8.2 Provide additional warranty for all equipment, materials and workmanship placed into service and used by the Owner to maintain operations in accordance with the sequence of construction until issuance of Substantial Performance for the entire Works.
- 3.8.3 The Owner may occupy designated areas of the Facility to ensure continuous operation, prior to Substantial Performance.
- 3.8.4 In the event of any conflicts between this section and the General Conditions, more stringent requirements shall apply

**END OF SECTION**



CHAIN LINK FENCE

1500mm CPP  
EFFLUENT PIPE

Install temporary plug  
(Phase 1)

Phase 1  
Upgrades

1060mm RC  
EFFLUENT PIPE

SECONDARY  
CLARIFIER 3-4  
SLUDGE CHAMBER

1060mm CPP EFFLUENT PIPE

SECONDARY  
CLARIFIER 1-4  
EFFLUENT MANHOLE 2

SECONDARY  
CLARIFIER 1-4  
EFFLUENT MANHOLE 1

SECONDARY  
CLARIFIER No. 6

SECONDARY  
CLARIFIER No. 8

900mm CPP  
INFLUENT PIPE

SECONDARY  
CLARIFIER 7-8  
DISTRIBUTION &  
WASTE SLUDGE  
CHAMBER

200mm DI WASTE  
SLUDGE PIPE

SECONDARY  
CLARIFIER 7-8  
FEED CHAMBER

SECONDARY  
CLARIFIER 7-8  
RETURN SLUDGE  
CHAMBER

900mm CPP  
INFLUENT PIPE

200mm DI WASTE  
SLUDGE PIPE

SECONDARY  
CLARIFIER No. 7

BOL  
BOL

SCREW  
PUMP  
BUILDING

1650mm CPP  
INFLUENT PIPE

Install temporary plug  
(Phase 1)

Install temporary plug  
(Phase 1)

1060mm CPP  
EFFLUENT PIPE

PROCESS MODULE 1  
SLUDGE CHAMBER

PLANT 2 AERATION  
EFFLUENT CHAMBER

ASPHALT

BOL

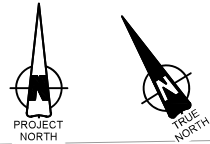


5935 Airport Road, Suite 500  
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## Construction Sequencing Phase 1

Brantford WWTP Secondary Clarifier Rehabilitation

DATE:	2024-04
DRAWN BY:	
APPROVED BY:	
SCALE:	NTS
REVISION:	02
STD No.:	SK-001



CHAIN LINK FENCE

Install temporary pumping with  
discharge downstream of coffer dam

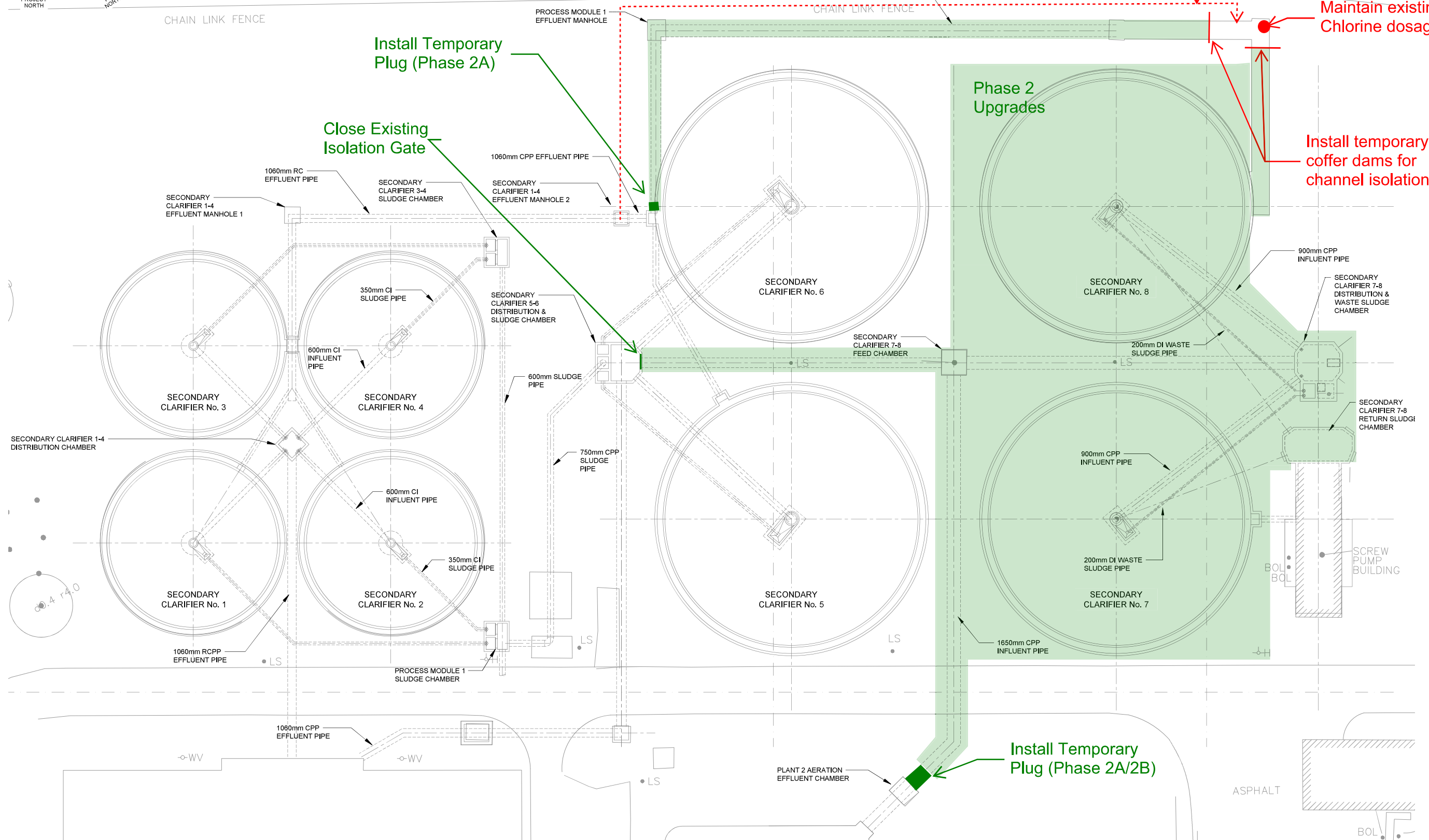
Maintain existing  
Chlorine dosage point

Install Temporary  
Plug (Phase 2A)

Close Existing  
Isolation Gate

Install temporary  
coffer dams for  
channel isolation

Phase 2  
Upgrades



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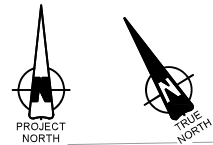
## Construction Sequencing Phase 2A

Brantford WWTP Secondary Clarifier Rehabilitation

DATE:	2024-04
DRAWN BY:	
APPROVED BY:	
SCALE:	NTS
REVISION:	02
STD No.:	SK-002







CHAIN LINK FENCE

PROCESS MODULE 1  
EFFLUENT MANHOLE

CHAIN LINK FENCE

1500mm CPP  
EFFLUENT PIPE

Phase 3  
Upgrades

1060mm RC  
EFFLUENT PIPE

SECONDARY  
CLARIFIER 1-4  
EFFLUENT MANHOLE 1

SECONDARY  
CLARIFIER 3-4  
SLUDGE CHAMBER

1060mm CPP EFFLUENT PIPE

SECONDARY  
CLARIFIER 1-4  
EFFLUENT MANHOLE 2

350mm CI  
SLUDGE PIPE

SECONDARY  
CLARIFIER 5-6  
DISTRIBUTION &  
SLUDGE CHAMBER

SECONDARY  
CLARIFIER No. 6

Install Temporary  
Plug (Phase 3)  
(To be installed at  
the end of Phase  
2B while channel  
is isolated)

SECONDARY  
CLARIFIER No. 8

SECONDARY  
CLARIFIER 7-8  
DISTRIBUTION &  
WASTE SLUDGE  
CHAMBER

900mm CPP  
INFLUENT PIPE

200mm DI WASTE  
SLUDGE PIPE

SECONDARY  
CLARIFIER 7-8  
RETURN SLUDGE  
CHAMBER

SCREW  
PUMP  
BUILDING

900mm CPP  
INFLUENT PIPE

200mm DI WASTE  
SLUDGE PIPE

SECONDARY  
CLARIFIER No. 7

1650mm CPP  
INFLUENT PIPE

ASPHALT

BOL

SECONDARY CLARIFIER 1-4  
DISTRIBUTION CHAMBER

SECONDARY  
CLARIFIER No. 3

SECONDARY  
CLARIFIER No. 4

600mm CI  
INFLUENT PIPE

600mm CI  
INFLUENT PIPE

350mm CI  
SLUDGE PIPE

SECONDARY  
CLARIFIER No. 1

SECONDARY  
CLARIFIER No. 2

1060mm RCPP  
EFFLUENT PIPE

PROCESS MODULE 1  
SLUDGE CHAMBER

1060mm CPP  
EFFLUENT PIPE

Install Temporary  
Plug (Phase 3)

PLANT 2 AERATION  
EFFLUENT CHAMBER

LS

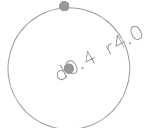
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## Construction Sequencing Phase 3

Brantford WWTP Secondary Clarifier Rehabilitation

DATE:	2024-04
DRAWN BY:	
APPROVED BY:	
SCALE:	NTS
REVISION:	02
STD No.:	SK-004

## **1 GENERAL**

### **1.1 Intent of Section**

- 1.1.1 This Section includes temporary controls not incorporated into the final or permanent Works.
- 1.1.2 Read this Section in conjunction with all other Division 1, and Divisions 2 through 16 Specification Divisions.

### **1.2 Regulations**

- 1.2.1 Occupational Health & Safety Act R.S.O. 1990 (as amended).
- 1.2.2 Ontario Ministry of Labour - O. Reg. 278/05 - Designated Substance - Asbestos on Construction Projects and in Buildings and Repair Operations, under the Occupational Health & Safety Act.
- 1.2.3 Ontario Ministry of Labour - R.R.O. 1990, Reg. 837 - Designated Substances - Asbestos, as amended by O. Reg 279/05.
- 1.2.4 Ontario Ministry of Environment - R.R.O. 1990, Reg. 347 - General - Waste Management, under the Environmental Protection Act, as amended to O. Reg. 395/07.
- 1.2.5 Ontario Ministry of Transportation - R.R.O. 1990, Regulation 261 - General, under the Dangerous Goods Transportation Act, as amended to O. Reg. 252/02.
- 1.2.6 CSA Standard Z94.4-02: Selection, Use, and Care of Respirators.

## **2 PRODUCTS (NOT APPLICABLE)**

## **3 EXECUTION**

### **3.1 General**

- 3.1.1 The Contractor shall take responsibility for the proper functionality of all devices in the scope, including existing modified devices, at the conclusion of their work. Prior to beginning work and upon the Contractor's request, with five working days' notice, the Owner will demonstrate the functionality of any piece of existing equipment.
- 3.1.2 Where existing active mechanical, electrical or other services, concealed or exposed, extend through or are within the area to be renovated, include for concealing existing services behind new finishes wherever they would be exposed in new finished areas.
- 3.1.3 Carefully remove existing fixtures, equipment, construction and finishes shown on the Contract Documents to be removed employing experienced tradesmen. Salvage, identify and store the Products that are to be reused or delivered to the Owner.
- 3.1.4 Where mechanical or electrical fixtures and equipment are removed, cut back obsolete piping, ductwork and conduit behind finishes, unless otherwise specified, and cap. Cap piping watertight. Remove obsolete wiring back to its source. Provide blank cover plates on obsolete outlet boxes.

- 3.1.5 Remove and dispose of the site products not designated for reuse or delivery to the Owner.
- 3.1.6 Be responsible for and enforce fire protection methods and procedures and adherence to local fire regulations, including requirement of the Occupational Health and Safety Act.
- 3.1.7 Maintain fire access/control at all times.
- 3.1.8 Whenever soldering, welding or any open-flame work is performed, ensure the area is suitable for such work, ensure the proper incombustible shields are provided to protect combustible products and materials and have an observer present at all times to ensure adjacent products and materials are not ignited and welding, soldering or open flame work does not produce a hazardous condition.
- 3.1.9 Ensure the existing fire protection and alarm systems are not obstructed, shutoff or made inactive at any time. Do not use any fire hydrant, standpipe, or hose system for other than fire protection purposes.
- 3.1.10 Open fires and burning of rubbish are not permitted on the site.
- 3.1.11 Smoking is not permitted in hazardous areas or any other buildings on the site.
- 3.1.12 Comply with Chapter 321 of OHSA Regulations for Construction Projects.

### **3.2 Welding and Cutting**

- 3.2.1 All welding and cutting within the existing works is to follow National Fire Protection Association (NFPA) Standard 51B "Fire Prevention During Welding, Cutting, and Other Hot Work".

### **3.3 Work in Confined Spaces**

- 3.3.1 Confined locations include manholes, underground chambers, tunnels, or other locations where the atmosphere may be contaminated by combustible gas or lack of oxygen.
- 3.3.2 Make all Contractor staff including subcontractors aware of confined spaces and the requirements for entering such spaces.
- 3.3.3 Where work is to be done in confined space conditions, follow the requirements listed in Clause 3.5, below.

### **3.4 Work Procedures for Confined Spaces**

- 3.4.1 Hazardous Locations are to be classified and managed as Confined Spaces (as defined by O. Reg. 628/05, OHSA). All work and entry into the identified Confined Spaces is to be done in accordance with the Regulation (O. Reg. 628/05).
- 3.4.2 Where workers are required to enter a confined space, as defined by the OHSA, O. Reg. 632/05 Section 221.2, ensure that workers of the Contractor and all Subcontractors follow the requirements of the above legislation, including but not limited to:
  - .1 Having a method for recognizing each confined space to which the program applies.
  - .2 Having a method for assessing the hazards to which workers may be exposed.



- .3 Having a method for the development of confined space entry plans (which include on-site rescue procedures).
  - .4 Having a method for training workers.
  - .5 Having an entry-permit system.
- 3.4.3 The Contractor is responsible for all confined space entry permitting, assessment, entry, control and rescue planning in accordance with the Regulation.
- 3.4.4 The Contractor shall maintain all appropriate documentation required under the Regulation and provide daily copies to the Engineer.
- 3.4.5 The Contractor shall supply all required safety, control and personal protective equipment required for confined space entry operation, including, but not limited to entry and rescue equipment, atmosphere monitors and breathing apparatus/respiratory protection.
- 3.4.6 The Contractor shall ensure that all workers entering or interacting with the identified confined spaces are appropriately trained and that proof of training is supplied to the Owner.
- 3.4.7 The Contractor shall make provisions for the Engineer to enter the identified confined spaces, if needed and as required, under the Contractor's confined space entry permits and plans with one (1) days notice (or less under emergency conditions).

### **3.5 Work in Hazardous Locations**

- 3.5.1 In hazardous areas provide and use safe mechanical and electrical devices and equipment.
- 3.5.2 All construction activities that occur in hazardous locations require continuous combustible gas monitoring by the Contractor's forces as specified herein.
- 3.5.3 Test for explosive or toxic gases, or oxygen deficiency before commencing the day's work and continuously while working in areas which may contain an explosive, toxic or oxygen deficient atmosphere. If a hazardous condition is found, make the work area safe before commencing or continuing work.
- 3.5.4 Use non-sparking tools in Class 1, Division 1 areas or where an explosive atmosphere may exist, and hazard cannot be eliminated by Contractor.
- 3.5.5 The areas considered electrically classified by virtue of the possible presence of explosive gases are specified elsewhere. However, caution must be exercised everywhere in the Plant.
- 3.5.6 Conform to Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance. Construction activities, except wire pulling and cleaning, that occur in hazardous locations require continuous combustible gas monitoring, by the Contractor. Provide documentation of tests for gas and oxygen deficiency prior to starting work in hazardous locations.
- 3.5.7 Metering for Toxic Gas, Combustible Gas and Oxygen Deficiency: Monitor toxic gas, combustible gas, and oxygen deficiency at all levels in hazardous locations as per requirements of Ontario Occupational Health and Safety Act.

- 3.5.8 Gas Metering: Maintain a minimum of two portable gas detection meters. These meters continuously monitor for combustible gas, oxygen deficiency, carbon monoxide, metal oxide, and hydrogen sulphide in the surrounding atmosphere and alarms at a pre-set warning level. Recharge as necessary in accordance with manufacturer's specifications. Recalibration will be completed every three weeks or more frequently if required. Update and provide records of calibration and re-calibration and provide this information upon request from the Engineer.
- 3.5.9 Meter Operator: Provide a trained person to operate and read the portable meter continuously while construction activities occur in the designated hazardous locations. This meter operator is not permitted to assist in the construction activity in any way since this person's function is to watch the combustible gas and oxygen deficiency dials at all times. The meter operator must be located in the immediate vicinity of the construction activity. If work in two or more different hazardous locations is required at the same time, provide the additional meter operator(s) and meter(s) at no additional cost to the Owner.
- 3.5.10 Training: Provide for the manufacturer's representative to supply site training to all designated meter operators. Provide as many training sessions as required so that every meter operator attended a session.
- 3.5.11 Hazardous Event Procedure: If a dial on the meter deflects to indicate 10% of the Lower Explosive Limit (LEL), 19.5% oxygen, 10 ppm hydrogen sulphide or 35 ppm carbon monoxide, then discontinue the construction activity, evacuate the area, and notify the Owner's site representative.
- 3.5.12 Log Book: maintain a log book that will contain the following information:
- .1 Date
  - .2 Name of meter operator
  - .3 Explosive gas, oxygen deficiency, hydrogen sulphide and carbon monoxide readings every ½ hour
  - .4 Construction activity type
  - .5 Location of construction activity
- 3.5.13 Submit the logbook to the Engineer when construction is complete and make available for inspection by Owner when requested.
- 3.5.14 Firefighting Equipment: Provide and maintain suitable firefighting equipment when working in the designated hazardous locations. Train Contractor's personnel working in these areas in the use of firefighting equipment.
- 3.6 Explosion-Proof Construction**
- 3.6.1 Certain areas may be designated on the Drawings as "explosion proof", "hazardous", or may be classified under Section 18 of CSA C22.1. In areas having such designations, the Contractor shall provide explosion proof electrical equipment, wiring devices and installation which meets the requirements of CSA C22.1, Section 18.
- 3.6.2 In hazardous areas as defined above, the Contractor shall provide intrinsically safe mechanical devices and equipment such as non-sparking aluminum wheels for fans,

pneumatic operators for dampers and aluminum clappers for check valves on pipelines conveying gaseous fuels.

- 3.6.3 The Contractor shall provide, mount and maintain signs warning of all hazards and the proper procedure required for working in the hazardous areas.
- 3.6.4 The Contractor shall ensure compliance with CGA-B105-M93 and the applicable safety codes when working on or in the area of natural or digester gas pipes and systems. The Contractor shall purge all gas lines and tanks with nitrogen prior to proceeding with Work. Note the existing gas lines passing through the Work area may need to be maintained in service during the construction. The Contractor shall take suitable safety precautions to protect personnel and to protect these services from damage during the Work.

### **3.7 Holes in Existing Concrete**

- 3.7.1 When it is required to make new holes in existing concrete for piping, conduit, cables, or equipment, using either method described below:
- .1 Chip with an electric hammer with chisel point. If any impediment is encountered, advise the Engineer before proceeding further. Adjust the location of holes as necessary to avoid electrical conduits. Cut reinforcing steel after permission is received.
  - .2 For any openings which are to be saw cut into an existing structure pre-drill the corners using a 100 mm dia. core drill. Do not over core corners.
  - .3 Core-drill holes after radiograph procedures are followed.
- 3.7.2 Radiograph the existing concrete for 3 diameters around the centreline of the proposed penetration. If no structural steel, piping or electrical conduits are found, core the hole. If structural steel, piping or electrical conduits are found, select an alternative location and radiograph it. If structural steel, piping or electrical conduits are found, do not core unless written permission from the Engineer is received.
- 3.7.3 Prior to commencing work, submit to the Engineer a photocopy of the license issued under the Atomic Energy Control Board Regulations for radiography. Perform work in accordance with current Atomic Energy Control Board Regulations for radiography. Be responsible for boundary controls and signs that protect the personnel and others from hazards in the radiograph work area. Inform the Engineer in writing 48 hours prior to commencing any radiography.
- 3.7.4 Radiograph shall be done after 4 p.m.

### **3.8 Protection of, and Modification to Existing Work**

- 3.8.1 All existing structures, mechanical and electrical systems to remain shall be protected in a manner satisfactory to the Engineer. The Contractor shall document existing conditions prior to completing any new works.
- 3.8.2 Should any parts of the existing structures or systems become heaved, cracked or otherwise damaged after commencement of the work by the Contractor, all such damaged portions of the work shall be completely repaired and made good by the Contractor at its own expense and to the satisfaction of the Engineer, notify the Engineer of any conditions that would not permit the required repairs to be affected. If, in the final inspection of the work any defects,

faults or omission are found, the Contractor shall cause the same to be repaired or removed and replaced by proper material and workmanship without extra compensation for the labour and materials required. Further, the Contractor shall be fully responsible for the satisfactory maintenance and repair of the construction and other work undertaken herein for at least the guarantee period described in the General Conditions of the Contract.

3.8.3 The Contractor shall be held fully responsible by the Owner for any damage to utilities, properties, buildings, homes or structures adjacent to, or in the general area of, the Work, through settlement of ground, vibration or shock resulting from any cause relating to the execution of the Work carried out under this Contract. The Contractor shall make good and repair such damage at the Contractor's expense.

3.8.4 Control of Vibrations

- .1 The Contractor shall control vibration levels to prevent damage to concrete Work, existing structures, equipment, and utilities during construction.
- .2 The Contractor shall control the use of vibration producing construction techniques or equipment so that the ground adjacent to concrete has a resultant peak particle velocity (P.P.V.) not exceeding the following limits:

Age of Concrete (Hours)	Maximum Permissible Resultant P.P.V. (mm/s)
Less than 4	5
4 to 60	10
Over 60	50

- .3 The Contractor shall schedule and execute placing of concrete so that, for concrete 4 to 24 hours old, a minimum distance of 40 m between the source of vibration and the concrete is maintained.
- .4 The Contractor shall retain the services of an independent inspection agency to monitor vibration effects.
- .5 The Engineer reserves the right to require additional restrictive limits for vibration control if recommended by the inspection agency.

3.8.5 The Contractor shall sustain in their place and protect from direct or indirect injury, water and gas mains, public and private sewers and drains, conduits, cables, service pipes, poles, sidewalks, curbs, embankments, structures, equipment and other property in the vicinity of the Work.

3.8.6 The Contractor shall sustain and support structures that are uncovered, weakened, endangered or threatened.

3.8.7 The Contractor shall provide a plastic covering or tarp over equipment and/or employ other measures to prevent dust and dirt from entering buildings or areas where equipment is stored or is operating.

3.8.8 The Contractor shall provide a plastic covering or tarp over equipment and/or employ other measures to prevent dust, water or other deleterious substances from entering areas with existing electrical, heating, ventilating, pumping and other equipment.

- 3.8.9 Where existing wall sections are removed or where pipes are installed through existing walls or where any dust generating operation is necessary, the Contractor shall provide a suitable temporary wall or enclosure suitably reinforced and sealed to prevent dust from entering the existing area. When execution of the Work is completed remove temporary dust control devices and thoroughly clean all areas affected by the Work.

- 3.8.10 The Contractor shall comply with the requirements of Section 01400 - Environmental Protection.

### **3.9 Salvage of Existing Equipment**

- 3.9.1 All equipment removed or demolished as part of this project shall be disposed of accordingly by the Contractor.

### **3.10 Protection, Soundness, and Repair of New Construction**

- 3.10.1 The Contractor shall protect newly constructed Work from damage. The Contractor shall prevent heavy loading of newly constructed Work and repair any damage. The Contractor shall construct the Works watertight and correct any rejected work.

- 3.10.2 If, in the final inspection, deficiencies are found, the Contractor shall repair or replace defective work as directed by the Engineer. The Contractor shall be responsible for satisfactory maintenance and repair of Work undertaken for the specified warranty period. The Contractor shall protect and store all equipment supplied under this Contract.

### **3.11 Storage and Protection of Materials and Equipment**

- 3.11.1 The Contractor shall be governed by the direction of the Owner or the Engineer in all matters connected with, or concerning, storage of machinery, materials and supplies along the line of Work and shall, at its own cost, shift or remove such machinery, materials and supplies immediately upon receipt of notice from the Owner or the Engineer and to a location or locations acceptable to the Owner or the Engineer.

- 3.11.2 The Contractor shall arrange for delivery to the Site, and protection of materials and equipment:

- .1 The Contractor shall schedule delivery of equipment to protect units from weather and construction dust and debris.
- .2 The Contractor shall provide equipment and labour to unload, move and place units in their final position.
- .3 The Contractor shall protect materials and equipment from damage.

- 3.11.3 The Contractor shall protect existing materials that are being modified as part of the Work and shall ensure that all existing materials being modified remain in the same condition as they were prior to modifications.

- 3.11.4 The Contractor shall protect materials and equipment after unloading from weather, dust, dirt and moisture both before and after erection and placing. The Contractor shall observe the manufacturer's written instructions for temporary storage.

- 3.11.5 The Contractor shall provide dry, heated 15°C temporary housing for pumps, motors, valves and other equipment or materials which may be injured by weather, dust, dirt or moisture.
- 3.11.6 The Contractor shall maintain shafts and bearings in good condition by rotating them weekly.
- 3.11.7 The Contractor shall provide the manufacturer's written instructions for the storing of equipment during the construction period well in advance of equipment delivery.
- 3.11.8 The Contractor shall store specialty items to ensure protection from damage to materials or finish.
- 3.11.9 The Contractor shall store materials which may be susceptible to water absorption off the ground. Protect materials from other damage due to environmental conditions under waterproof covers.
- 3.11.10 The Contractor shall promptly, as the Work proceeds, and upon completion, clean up and remove from the Site all surplus materials resulting from the foregoing Work.

### **3.12 Protection Against Freezing**

- 3.12.1 Furnish necessary equipment and fuel for heating buildings and structures during construction. Maintain a minimum temperature of 130C in interior areas for mechanical, electrical, masonry, painting and other work susceptible to frost damage. The Contractor shall not rely on the Facility's existing heating system.
- 3.12.2 Drain pipelines in trenches which may be left exposed in winter. Drain pipelines below concrete slabs or in areas too large to heat practicably.
- 3.12.3 Refer to Divisions 3, 4, 9, 11, 15 and 16 as applicable for detailed cold-weather procedures for cast-in-place concrete, masonry, finishes, mechanical work and electrical work respectively.

### **3.13 Protection Against Flotation**

- 3.13.1 The Contractor shall control groundwater levels to prevent damage to any pipe or structure due to water pressure during and after construction and until the Work is completed.

### **3.14 Protection Against Flooding**

- 3.14.1 The existing Facility has below grade structures that are placed at risk of flooding if the existing below grade walls are breeched. Flooding of the below grade areas of the Facility will result in damage to the existing Facility, equipment and the operation of the existing Facility.
- 3.14.2 The Contractor shall be held fully responsible by the Owner for any damage to utilities, equipment, properties, buildings, homes or structures adjacent to, or in the general area of, the Work, through flooding resulting from any cause relating to the Work carried out under this Contract. The Contractor shall make good and repair such damage at their own expense.

### **3.15 Drainage**

- 3.15.1 The Contractor shall keep all portions of their work properly and efficiently drained during construction and until completion, and they will be held responsible for all damage which may

be caused or result from water backing up or flowing over, through, from or along any part of the Work, or which any of their operations may cause to flow elsewhere.

- 3.15.2 The Contractor shall dewater all work sites and excavations as necessary or as directed to enable the Work to be constructed in a satisfactory manner.
- 3.15.3 The Contractor shall not be entitled to any additional payment for compliance with the requirements hereof beyond the prices tendered for the construction of the Work.

### **3.16 Dewatering of Existing Structures**

- 3.16.1 Contractor shall be responsible for dewatering channels, tanks, pipes, sewers and all existing water retaining structures, as required, to facilitate construction. Provide temporary sump and pump if required.
- 3.16.2 Cleaning shall be in accordance with Specification Section 01740.
- 3.16.3 Provide temporary pumps to dewater and control water levels in existing channels. Discharge pump flows to channels in service.
- 3.16.4 Empty pipelines by draining to a temporary sump and pump to an area identified by the Engineer. Flush pipelines clean prior to making connections.
- 3.16.5 Contractor shall not rely on existing equipment to drain the existing infrastructure. Provide temporary pumps and piping as required to facilitate dewatering activities.
- 3.16.6 Contractor shall assume that tanks, wet wells, manholes and other water retaining structures have not been previously cleaned and will have accumulated grit, sedimentation and other waste typically found in wastewater. This waste is not suitable to be discharged to other areas of the Facility. The Contractor shall remove all grit, sedimentation and other waste typically found in wastewater and dispose of it accordingly as hazardous waste. The Contractor shall also assume that grit, sedimentation and other waste typically found in wastewater may have solidified at the bottom of the tanks, wet wells, manholes and other water retaining structures and will require pressure washing or sand blasting for removal.
- 3.16.7 Each raw wastewater forcemain is to be dewatered for completion of forcemain upgrades. Forcemains will be isolated and dewatered individually, and at least one forcemain will be online at all times. Owner will isolate the forcemain. Contractor shall be responsible for dewatering.

**END OF SECTION**

## **1 GENERAL**

### **1.1 General**

- 1.1.1 After Contract Award, the Contractor may submit an alternate material or piece of equipment to the Engineer and Owner for review. An Alternate will only be evaluated and considered acceptable if it meets the intent of the original design and specifications, and where there is a credit offered, an advancement to the schedule, or provision of an enhanced design.

### **1.2 Requests for Substitution**

- 1.2.1 Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier or manufacturer, the naming of the item is regarded as the basis of design to establish the type, function and quality required.
- 1.2.2 Material or equipment of equal or better performance and quality may be offered in substitution for those specified. Requests for review of substitute items of material and equipment will not be accepted by the Contract Administrator from anyone other than the Contractor.
- 1.2.3 All requests for substitution must be accompanied by a detailed listing of the expected cost savings to the Owner.
- 1.2.4 Substitutions will not be considered when they are indicated or implied on Shop Drawings or product data submittals without a separate written request.
- 1.2.5 Requests for substitution include any request for changes from the Contractor that require significant design changes, redesign or significant design reviews.
- 1.2.6 A request for substitution constitutes a representation that the Contractor:
- .1 Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.
  - .2 Will provide the same warranty for the substitution as for the specified product.
  - .3 Will coordinate the installation and make changes to other Work which may be required for the Work to be complete at the Contractor's expense and at no additional cost to the Owner.
  - .4 Waives claims for additional costs or time extension which may subsequently become apparent.
  - .5 Will reimburse the Owner for review or redesign services.
- 1.2.7 Request for substitution to be made by written application to the Engineer and is to include sufficient data to enable the Engineer to assess the acceptability of requirements, including the following:
- .1 All submittal information required for the specified equipment, including all deviations from the specified requirements and/or necessitated by the requested substitution.



- .2 Materials of construction, including material specifications and references.
- .3 Dimensional drawings, showing required access and clearances, including any changes to the work required to accommodate the proposed substitution.
- .4 Drawings and details showing changes if the offered substitution necessitates changes to or coordination with other portions of the Work. Perform these changes as part of the substitution of material or equipment at no additional cost.
- .5 Certification that the proposed substitute will adequately perform the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified with the same or better warranty.
- .6 Information and performance characteristics for all system components and ancillary devices to be furnished as part of the proposed substitution.
- .7 Certification that acceptance of the proposed substitute will not prejudice achievement of Substantial Completion.
- .8 Itemization of all costs including any licenses fee or royalty that will result directly or indirectly from the acceptance of the proposed substitution. Include redesign and cost of claims of any other contract affected by the resulting change.
- .9 Guaranteed credit or cost reduction offered if the proposed substitution is accepted and a waiver of claims for additional expenses which may subsequently become apparent.
- .10 Recommended maintenance requirements and availability of spare parts and service.
- .11 Written confirmation from subcontractors and suppliers on cost, schedule, and technical requirements if requested by the Engineer.

### **1.3 Engineer's Review**

- 1.3.1 Engineer will evaluate each proposed substitution. Engineer will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without the Engineer's prior written acceptance by either a Change Order or a reviewed shop drawing. The burden of proof is on the Contractor.
- 1.3.2 Pay the Engineer's cost for evaluating the requested substitution even though the request may be denied, or for additional redesign work required as a result of any substitution. Costs will be charged on a time and expense basis and will be deducted from progress payments due the Contractor.

## **2 PRODUCTS (NOT APPLICABLE)**

## **3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section describes the minimum administrative requirements expected by the Contractor to coordinate the work, under the administration of the Engineer.
- 1.1.2 Involves coordination of project schedules, submittals, meetings, use of site, temporary utilities, construction facilities, construction progress of the work, required shut-downs and commissioning.

### **1.2 Responsibilities of Engineer**

- 1.2.1 Schedule and administer pre-construction and construction progress (site) meetings, as well as responses to requests for information, and clarification of the scope of work.
- 1.2.2 Prepare the agenda with copies for all participants and preside at the meeting.
- 1.2.3 Record minutes and distribute copies of minutes within five working days after each meeting and transmit to meeting participants, affected parties not in attendance, the Contractor and the Owner. The Engineer will include and identify significant proceedings, decisions or actions with 'Action By' in the minutes.

### **1.3 Responsibilities of Contractor**

- 1.3.1 Provide physical space for meetings.
- 1.3.2 Comply with Engineer's allocation of mobilization areas of site; for field offices and sheds, for access, traffic, and parking facilities in accordance with Section 01510 - Temporary Utilities and 01520 - Construction Facilities.
- 1.3.3 Provide information required to the Engineer and be prepared to discuss all items on the agenda, such as schedule updates, two-week look-ahead schedules, responses to previous or outstanding action items.
- 1.3.4 Representatives of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of the party each represents.
- 1.3.5 Identify any errors in minutes to the Engineer in writing within three days of receipt. Any conflicts shall be coordinated with the Engineer. Otherwise, it will be interpreted that the Contractor resolves the interference issues at his own responsibility.
- 1.3.6 During construction coordinate use of site and facilities through Engineer's procedures for intra project communications, submittals, reports and records, schedules, coordination of drawings, recommendations, and resolution of ambiguities and conflicts.

### **1.4 Pre-construction Kick-off Meeting**

- 1.4.1 Within 15 days from award of the Contract, the Engineer will convene a pre-construction meeting to discuss and resolve administrative procedures and responsibilities from the start of the project.

- 1.4.2 Representatives of the Owner, the Engineer and the Contractor and major Sub-Contractors shall be in attendance.
- 1.4.3 The Engineer will establish a time and location for the meeting and notify concerned parties a minimum of five working days before the meeting.
- 1.4.4 The meeting agenda will include such items for discussions as:
- .1 Appointment of official representative of participants in Work.
  - .2 Schedule of Work, progress scheduling and delivery schedule of major equipment in accordance with Section 01320 -Construction Schedule.
  - .3 Schedule of submission of shop drawings, samples and colour chips in accordance with Section 01330 - Submittals.
  - .4 Requirements and location for temporary facilities, site sign, offices, storage sheds, utilities, and fences in accordance with Section 01510 - Temporary Utilities.
  - .5 Site security in accordance with Section 01520 - Construction Facilities.
  - .6 Contemplated changes and change orders procedures, approvals required, mark-up percentages permitted, time extensions and administrative requirements.
  - .7 Owner supplied products.
  - .8 Redline drawings in accordance with Section 01780 - Closeout Submittals.
  - .9 Maintenance materials and manuals in accordance with Section 01780 - Closeout Submittals.
  - .10 Take-over procedures, acceptance and warranties in accordance with Section 01760 - Warranty Work and 01780 Closeout Submittals.
  - .11 Monthly progress claims, administrative procedures, progress photographs and holdbacks.
  - .12 Appointment of independent inspection and testing agencies or firms (i.e., concrete, geotechnical, compaction, asphalt, etc.).
  - .13 Insurance.
  - .14 Safety issues.
  - .15 Environmental issues, including spills reporting.
  - .16 Other items of discussion
- 1.4.5 The Engineer will document the responsibilities and necessary activities of the participants during construction as discussed.

**1.5 On Site Documents**

1.5.1 Maintain at job site, one copy each of the following:

- .1 Contract drawings.
- .2 Specifications.
- .3 Addenda.
- .4 Reviewed shop drawings.
- .5 Contract Change Directives.
- .6 Other modifications to Contract.
- .7 Field test reports.
- .8 Copy of approved Work schedule.
- .9 Manufacturers' installation and application instructions.
- .10 Notice of Project
- .11 Building Permit
- .12 Health and Safety Plan and related documents

1.5.2 The Owner will supply electronic copies of drawings and specifications in digital format to the Contractor. The Contractor shall reproduce additional copies for his use, if required.

**1.6 Schedule Management**

1.6.1 Submit to the Engineer within five working days of award of the Contract, the preliminary construction progress schedule, based on the tender, and all required schedules, in accordance with Section 01320 - Construction Schedule.

1.6.2 After review by the Engineer, revise and resubmit all schedules to comply with revised project schedule.

1.6.3 Identify and track all critical items on all schedules and advise the Engineer of any changes to the schedules.

1.6.4 Actively manage and coordinate the work to avoid delays against reviewed schedules.

1.6.5 Revise schedules, reorganize and replace construction to minimize the impact of any identified delays.

**1.7 Coordination of Construction**

1.7.1 This is a lump sum contract to be completed in its entirety by the Contractor using the Contractor's own forces or the forces of individual subcontractors and sub-trades.

- 1.7.2 All of the specifications and drawings shall be interpreted as one contract and the Contractor shall be wholly responsible for coordination of all work by the Contractor's own forces, sub-trades or subcontractors to complete the work.
- 1.7.3 No Section or Division of these specifications shall be construed or interpreted as being the responsibility of any sub-trade, subcontractor or supplier.
- 1.7.4 The Contract Drawings provide general routing of piping and general location of equipment unless specific dimensions are indicated. Locate piping and equipment to avoid interference with walkways, other equipment and required headroom.
- 1.7.5 The Engineer may furnish supplementary drawings to assist in proper execution of the Works. Such drawings will be issued for clarification only and will have the same meaning and intent as if part of the plans referred to in the Contract Documents.
- 1.7.6 The Contractor shall examine the work of all trades and ensure that conditions are satisfactory for the completion of any subsequent work.
- 1.7.7 The Contractor shall notify the Engineer immediately of any adverse conditions which may affect subsequent work and shall not proceed with any subsequent work until such conditions are rectified.

## **1.8 Submittals**

- 1.8.1 Make all necessary submittals to the Engineer for review and approval.
- 1.8.2 Submit preliminary shop drawings, product data and samples in accordance with Section 01330 - Submittals for review for compliance with Contract Documents; for field dimensions and clearances, for relation to available space, and for relation to the work of other contracts. After review, revise and resubmit by transmittal to the Engineer.
- 1.8.3 Submit all requests for payment to the Engineer.
- 1.8.4 Submit requests for interpretation of Contract Documents, requests for information or clarification of the scope of work to the Engineer.
- 1.8.5 Submit requests for use of Alternatives to the Engineer.
- 1.8.6 Submit requests for Contemplated Contract Changes to the Engineer.
- 1.8.7 Deliver all closeout submittals to the Engineer.

## **1.9 Construction Progress or Site Meetings**

- 1.9.1 Site meeting frequency shall be monthly, or more frequently as required, at no additional cost to the Contract, if performance and schedule are not to the satisfaction of the Engineer and the Owner, or for additional coordination as required.
- 1.9.2 The Owner, Engineer and Contractor will be in attendance. The purpose of these meetings is to discuss the progress of the Work and related matters including:
  - .1 Review approval of minutes of previous meeting.

- .2 Review of Work progress since previous meeting.
- .3 Field observations, problems and conflicts.
- .4 Problems which may impede construction schedule.
- .5 Review of off-site fabrication delivery schedules.
- .6 Corrective measures and procedures to regain projected schedule.
- .7 Revisions to construction schedule.
- .8 Progress, schedule, during succeeding work period.
- .9 Review submittal schedules (shop drawing, RFI, etc.): expedite as required.
- .10 Maintenance of quality standards.
- .11 Pending changes and substitutions.
- .12 Review proposed changes for effect on construction schedule and on completion date.
- .13 Safety issues.
- .14 Environmental issues.
- .15 Other business.

**1.10 Shut-Down Coordination Meetings**

- 1.10.1 Shutdown coordination shall be per Section 01120, Clause 1.2.
- 1.10.2 The Contractor shall request a meeting for any shut-down that may impact the flow of water through the facility and/or has a duration of greater than six hours.
- 1.10.3 Require attendance of all parties directly affecting, or affected by, work of the specific equipment or facility that must be shut-down.
- 1.10.4 Notify the Engineer, in writing, ten working days in advance of the meeting date so that the Engineer may coordinate with the Owner.
- 1.10.5 At least 20 working days in advance of the requested meeting the Contractor shall:
  - .1 Prepare and distribute a draft agenda.
  - .2 Submit the proposed shut-down sequence and procedure.
  - .3 Submit the proposed start date and time and duration of shut-down.
  - .4 Provide the isolation and assistance requirements needed by operating staff.
  - .5 Provide a contingency response approach in the event of problem or extended shut-down duration.

1.10.6 The Engineer will record minutes and distribute copies to participants and those affected by decisions made.

1.10.7 Identify errors in the minutes, if any, to the Engineer in writing within three days of receipt.

**1.11 Pre-Commissioning Meeting(s)**

1.11.1 A pre-commissioning meeting shall be held ten working days prior to any commissioning activities to review the pre-commissioning and final commissioning plan and schedule. Where work requires staggered commissioning of unit processes, hold a dedicated pre-commissioning meeting for each unit process.

1.11.2 Attendance at the pre-commissioning meeting shall include the Owner, Engineer, Operator, Contractor-appointed commissioning supervisor, and key Contractor personnel involved with the commissioning of the Work.

**1.12 Contractor's Representative at Meetings**

1.12.1 The Contractor shall attend all Construction Progress Meetings or other such coordination meetings as directed by the Engineer.

1.12.2 The Contractor's representative at these meetings shall be the Site Supervisor or Project Manager/Contract Administrator and/or a competent and reliable person who is familiar with the Work. The Contractor's representative shall have full authority to make decisions on the Contractor's behalf.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section specifies requirements and procedures for preparing and updating construction schedules and reports for planning, coordinating, executing and monitoring the progress of the work. The construction work shall be scheduled using the Critical Path Method (CPM) of network analysis.

### **1.2 Scheduling**

- 1.2.1 The CPM type construction schedule will be used to monitor job progress. The Contractor will be responsible for providing all information concerning sequencing, logic and duration of all activities as well as providing the initial CPM logic network diagram and tabular report data. Once the initial logic network diagram is accepted, the contractor will be responsible for providing regular schedule updates including information on logic, percent complete, actual start and finish dates and duration changes.
- 1.2.2 The Contractor shall dedicate the necessary resources for updating the Detailed Progress Schedule monthly such that the schedule is always current and accurately reflects the activities occurring on site. Furthermore, the Contractor shall store a live version of the schedule on a File Transfer Protocol (FTP) and provide viewing access to the Engineer - such that the Engineer, at any time, may view a current and accurate version of the Detailed Progress Schedule.
- 1.2.3 The Contractor shall retain a third-party scheduler if the Contractor does not have the technical resources to provide a schedule that meets the requirements of this Section. The Contractor shall retain a third-party scheduler if the first submission of the Detailed Preliminary Baseline Schedule does not demonstrate that the Contractor has the technical resources to provide a schedule that meets the requirements of this Section.
- 1.2.4 There shall be sufficient cause for Default by the Contractor, should the Contractor fail to comply with the requirements of this Section.
- 1.2.5 Failure of the Contractor to comply with the requirements of this provision shall subject the Contractor to, at the Owner's Sole discretion, a withholding, in partial or in total of payments otherwise due to the Contractor for work performed under this Contract. The Contractor agrees that any withholding of money is not a penalty for noncompliance, but is an assurance for the Owner that funds will be available to implement these requirements should the Contractor fail to do so, since failure of the Contractor to comply with these requirements shall mean that the Contractor failed to execute the work with such diligence as to ensure its completion within the time for completion.

### **1.3 Schedule Preparation and Submittal Requirements**

#### **1.3.1 Baseline Schedules:**

- .1 Summary Level Preliminary baseline Schedule:

- .1 Shall be submitted to the Engineer and the Owner by the Contractor a minimum of two (2) Working Days prior to the preconstruction meeting.



.2 Detailed Preliminary Baseline Schedule:

- .1 Shall be submitted to the Engineer and the Owner by the Contractor within ten (10) Working Days after the date of the Order to Commence or prior to the first progress payment, whichever occurs first.
- .2 To ensure that the schedule is being developed according to the requirements of the Contract Documents, the Contractor shall be required to attend an initial schedule planning meeting and may be required to attend weekly meetings at which it will present to the Engineer the then-current version of the schedule. The Contractor will provide both hard copy and electronic copies of the schedule as it is developed, and as required by the Engineer. If requested by the Engineer, the Contractor will require Subcontractors to attend these meetings.
- .3 Shall be a resource-loaded, CPM schedule using the latest commercially available version of MS Project.
- .4 Shall be submitted with accompanying narrative report.
- .5 Shall be submitted as a shop drawing in accordance with Section 01330 – Submittals.
- .6 The Contractor shall provide the electronic copy of the schedule as both a MS Project file and PDF file.

.3 Detailed Final Baseline Schedule

- .1 Shall be submitted to the Engineer and the Agency by the Contractor within twenty (20) Working Days after the date of the Order to Commence or prior to the first progress payment, whichever occurs first.
- .2 Same requirements and format as specified above for Detailed Preliminary Baseline Schedule.

1.3.2 Progress Schedules:

.1 Detailed Progress Schedules:

- .1 Shall be submitted to the Engineer and the Agency by the Contractor on a monthly basis or more frequently as required.
- .2 Shall be accompanied by a narrative itemising and describing any changes made to the schedule.
- .3 Shall be subject to the same requirements and format as specified above for the Detailed Final Baseline Schedule.
- .4 Shall be submitted with accompanying construction photographs.

**1.4 Schedule Preparation**

- 1.4.1 With the exception of the Summary Level Preliminary Baseline Schedule, the Contractor shall prepare schedules using the latest commercially available version of MS Project.

- 1.4.2 The scheduling software shall be used to produce a resource-loaded CPM schedule in the form of time-scaled diagrams with the critical path activities highlighted.
- 1.4.3 Schedules shall be submitted to the Engineer in both MS Project file and PDF file. The schedule shall be formatted as follows:
- .1 Formatted to print on 279mm x 432mm sheet size
  - .2 Title Block: Show the name of the project, project number, Contract number, Owner, Date, date submitted, revision or update number, and the name of the scheduler.
  - .3 The Detailed Baseline Schedule will be numbered '0.0'. Revisions, if required, will be numbered '0.1', '0.2', etc. Numbering for the Progress Schedule updates shall reflect the number of months elapsed since the Contract commenced: that is, the first update will be numbered '1.0'; second month '2.0', etc.
  - .4 The Contractor shall identify horizontally, across the top of the schedule, the time frame by year, month and day.
  - .5 The Contractor shall identify each activity with a unique number and activity code and a brief description of the Work associated with that activity.
  - .6 The Contractor shall reflect sequences of the Work, restraints, delivery windows, review times, shutdowns, Contract Times and Project Milestones.
  - .7 The Contractor shall identify the duration of each activity and show early start, early finish, late start, late finish, and completion, and float for each activity and sub-activity.
  - .8 The Contractor shall identify the Work of separate stages and other logically grouped activities, and clearly identify critical path activities.
  - .9 Legend to describe standard and special symbols and bars.
- 1.4.4 Scheduling Software:
- .1 File Transfer and Back-up: The Contractor, if required, shall provide a copy of all baselines and update files electronically.
  - .2 Settings: The Contractor shall provide the Engineer with all of the software settings it has used in the baseline schedules and updates. Examples of the information required include but are not limited to: Calendar Settings, User Preferences, Schedule Settings, etc.
  - .3 Exported to Excel: If requested, the Contractor will provide the Engineer with an Excel spreadsheet containing report data exported from the schedule.
  - .4 The Contractor will produce schedule layouts and reports according to the Engineer's requirements and instructions. Reports such as the following will be required in the indicated file formats:
    - .1 Detailed Schedule Layout [.pdf and .mpp]
    - .2 Critical Path Layout [.pdf and .mpp]

.3 Early and Late Resource Curves [.pdf and .xls]

### **1.5 Summary Level Preliminary Baseline Schedule**

- 1.5.1 The purpose of this schedule submission is to convey to the Owner at an early stage the Contractor's original plan to achieve overall and milestone(s) completion in accordance with the Contract Documents. Since this schedule is only expected to be developed to a summary level, it may be a bar chart, as opposed to a Critical Path Method schedule, and may be created using an MS Excel spreadsheet or other software application. The schedule should contain as much detail as is necessary to fully articulate the Contractor's plan up to and including Total Performance of the Work. The Contractor is also required to provide an accompanying narrative, describing in general terms how it intends to resource the project as well as assumed rates of production for major items of Work. The Contractor will provide any information requested by the Owner that the Owner considers necessary in order to understand the Contractor's original plan.
- 1.5.2 The Contractor must submit the Summary Level Preliminary Baseline Schedule a minimum of two (2) Working Days prior to the Pre-Construction meeting and be prepared to discuss the schedule at the same meeting.

### **1.6 Detailed Preliminary Baseline Schedule**

- 1.6.1 The Detailed Preliminary Baseline Schedule must be submitted within ten (10) Working Days after the date of Order to Commence or prior to the first progress payment whichever occurs first.
- 1.6.2 The Detailed Preliminary Baseline Schedule shall cover all phases of the Work and shall represent the Contractor's practical original plan to complete the Work, considering restrictions of access and availability of Work areas, and availability and use of manpower, material and equipment. It is to be a fully resource-loaded schedule, with labour, material and equipment resources provided at an activity level or as required by the Engineer.
- 1.6.3 The Detailed Preliminary Baseline Schedule shall show the sequence and interdependencies of construction and commissioning activities, as well as project related activities reasonably required to complete the Work, and shall address the following, at a minimum:
- .1 The issuance and the Contractor's receipt of the Order to Commence Work.
  - .2 Obtaining any applicable permits, design drawings, specifications and shop drawings for early product procurement, and long lead time items. Refer to Section 01330.
  - .3 Mobilization and other preliminary activities.
  - .4 Setup of Engineer's trailer
  - .5 Site Access
  - .6 Any initial Site Work as applicable
  - .7 Specified Work sequences, constraints, and Milestones, including Substantial and Total Performance of the Work date(s).
  - .8 Type of Work to be performed by the Subcontractor(s) involved.

- .9 Major equipment design, fabrication, factory testing, and delivery dates.
  - .10 Delivery dates for Owner-furnished pre-purchased equipment, if applicable.
  - .11 Submittals such as shop drawings that are critical or near critical to schedule completion.
  - .12 Major components of the Work and other relevant details, including at a minimum:
    - .1 Site Work
    - .2 Concrete Work
    - .3 Architectural Work
    - .4 Equipment Work
    - .5 Mechanical Work
    - .6 Electrical Work
    - .7 Leakage testing of tanks, pipes and structures
    - .8 Shutdowns and Tie-ins
      - .1 Work by Owner
      - .2 Work by Contractor
    - .9 Instrumentation, SCADA design and control Work
    - .10 Any applicable interfaces with Owner pre-purchased equipment, if applicable
    - .11 Other important Work for each major facility
    - .12 Equipment and system start-up, training, and test activities. Refer to Section 01810 Testing and Commissioning.
    - .13 Project close-out and cleanup
    - .14 Demobilization
- 1.6.4 The Contractor shall break the work into activities with a duration of minimum 5/maximum 20 (5-20) working days each, except for non-construction activities (such as procurement of materials and delivery of equipment) and other activities which may require a longer duration and shutdowns, tie-ins and connections, which may require a shorter duration. To the extent feasible, activities related to a specific physical area of the project shall be grouped on the network for ease of understanding and simplification. The selection and number of activities shall be subject to review by the Engineer and Owner.
- 1.6.5 The activities defined in the Detailed Preliminary Baseline Schedule shall represent the planned durations in anticipation of normal manpower and equipment utilization in durations of whole Working Days. The Engineer may require that the duration of major activities be calculated by the scheduling software on the basis of the planned rate of daily production.

The Contractor will resource load the schedule using labour, and not crew, hours unless otherwise instructed by the Engineer.

1.6.6 In calculating activity durations, normally adverse weather conditions shall be considered. The Contractor shall include sufficient float in the schedule to account for normally adverse weather conditions.

1.6.7 The Contractor shall schedule the Work to minimize the effect of adverse weather, and to allow for protection of the Work from such effects.

1.6.8 Activity Descriptions

.1 Activity names shall: describe action; identify building elements; and specify location.

1.6.9 Activity Numbering

.1 Activity numbering shall be alphanumeric and conform to the Engineer's instructions.

1.6.10 Activity Coding

.1 The Contractor shall make extensive use of the activity coding capabilities of the scheduling software in order to satisfy the grouping, sorting, filtering and report generating requirements of the Agency.

1.6.11 Examples of the activity codes that will be required are: phase; area; location; responsibility; work type, etc.

1.6.12 The Detailed Final Baseline schedule shall be accompanied by a narrative that provides a detailed description of the labour, materials, plant, means and methods that the Contractor intends to use to carry out the Work and achieve the planned rate of production required to support the activity durations shown in the schedule. The narrative shall also provide explanations supporting the use of lead-lag relationships and constrained dates.

1.6.13 The Contractor shall submit all revisions and/or additional information requested by the Engineer pursuant to its review should the Engineer consider that these additions are necessary for the Detailed Preliminary Baseline Schedule in order to comply with the requirements of this Section.

1.6.14 Submission of the schedules (including Baseline and Progress Schedules) referred to in this Specification Section, and any subsequent updates to such schedules, shall constitute the Contractor's representation that:

.1 The Contractor and its Subcontractor(s) intend to execute the Work in the sequence indicated in such schedule.

.2 The Contractor has distributed the proposed schedule to Subcontractor(s) and Equipment Vendors for their review and comment and has obtained their concurrence.

.3 All elements of the Work required for the performance of the Contract are included. Failure to include any such element shall not excuse the Contractor from completing the Work within the milestone dates and Contract Time and other constraints specified in the Contract Documents.

- .4 Seasonal weather conditions have been considered and included in the planning and scheduling of the Work influenced by high and low ambient temperatures and/or precipitation.
- .5 The Contractor has thoroughly inspected the Site, considered the work of other Contractors and where necessary to complete the Work under this Contract, coordinated its plan with other Contractors retained by the Owner.
- .6 The Contractor has incorporated any other special conditions in planning the Work such as specified or required Work restriction periods, etc.
- .7 The express or implied acceptance by the Owner and/or the Engineer of the final baseline schedule and any progress schedules shall not constitute an approval or acceptance of the Contractor's construction means, methods, or sequencing or its ability to complete the Work in a timely manner, and shall not place any obligation or responsibility on the Owner or Engineer toward the Contractor nor shall it, in any way, limit or restrict the Contractor's obligations and responsibilities under the Contract.

#### **1.7 Detailed Final Baseline Schedule**

- 1.7.1 The required revisions must be made and the Detailed Preliminary Baseline Schedule finalized to the satisfaction of the Owner and Engineer, whereupon it will become the Detailed Final Baseline Schedule, against which progress will be measured.
- 1.7.2 The Detailed Final Baseline Schedule must be submitted within twenty (20) Working Days after the date of Order to Commence or prior to the first progress payment, whichever occurs first. The Owner shall withhold all or part of the monthly progress payment until the Detailed Final Baseline Schedule is acceptable by the Owner and Engineer.
- 1.7.3 The Contractor acknowledges and understands that time is of the essence of this Contract and therefore that Baseline Early dates for activities, and not the late dates, reflect the target dates for project planning and execution. The Contractor will plan for, and enlist, resources with the goal of achieving the early dates.

#### **1.8 Detailed Progress Schedules**

- 1.8.1 The Contractor shall submit a Detailed Progress Schedule to the Engineer at the end of each month, with each application for payment starting with the second monthly progress payment. The schedule, together with the related data and reports specified in this Section, shall be submitted along with the monthly progress payment application. The progress payment will not be reviewed until the schedule along with all the related data and reports specified in this Section are submitted. The Owner may withhold all or part of the monthly progress payment until the updated Detailed Progress Schedule is updated in a manner acceptable to the Engineer.
- 1.8.2 Each Detailed Progress Schedule shall record and report data and report actual completion and/or start dates for each completed or in-progress activity, activity percent complete for in-progress activities and forecast completion dates for all activities that are not yet complete. As-built logic will be adjusted as required to reflect the actual sequence of the Work. The Detailed Progress Schedule shall show the projected Completion Date of the Work based on the progress information inserted into it, without changes to the schedule logic or the original duration of any activity. The Contractor shall use the retained logic option when executing schedule calculation. The Detailed Progress Schedule will be shown as a target schedule to

indicate whether the current progress schedule remains on target, has slipped or is ahead of schedule.

- 1.8.3 The Contractor may then, in a second and subsequent update to the progress schedule, incorporate any logic and duration changes that represent its revised planning, provided all such changes are identified and documented in the schedule narrative and are agreed to by the Engineer.
- 1.8.4 If it appears that the progress schedule submitted by the Contractor no longer represents the actual sequencing and progress of the Work, the Engineer may instruct the Contractor to revise the Detailed Progress Schedule. The Owner may withhold all or part of the monthly progress payment until the Detailed Progress Schedule is updated in a manner acceptable to the Engineer.
- 1.8.5 A complete schedule update submission (to be submitted with each monthly progress payment application) must include the following schedule and progress reports:
- .1 An updated Detailed Progress Schedule, comparing actual and target progress.
  - .2 A resource-loaded graph, comparing targeted to actual labour and material.
  - .3 A schedule narrative, including:
    - .1 Detailed description of progress, including comparison of planned to actual rates of production, key deliveries to the Site, construction, erection, testing and commissioning.
    - .2 A discussion of the basis for any Work sequencing, logic, interdependencies or original activity duration revisions incorporated into an updated schedule.
    - .3 Comparisons of actual and planned progress, with a brief commentary on any actual or forecast delays or problems that might have an impact on the completion date of the Work, and a discussion of the measures being (or to be) adopted to overcome these.
    - .4 Records of all Contractor and Subcontractor(s) personnel and construction equipment on Site.
    - .5 Progress photographs
    - .6 Any other information specifically required by the Engineer
  - .4 The Contractor shall provide the Engineer with a complete weekly list of personnel, plant and construction equipment as well as production rates actually achieved on all major activities, and labour hours for all major trades such as, for example, the formwork, mechanical, and electrical trades.
  - .5 The Contractor shall incorporate and logically connect approved Contract changes into the CPM schedule. Each change will be identified by number and description.
  - .6 In the case of a potentially critical delay occurring between the regular schedule updates, and if requested by the Engineer, the Contractor shall update the schedule at the beginning of the delay event and at the resolution of the delay issue. Activities will

be added to the schedule as required to analyze the delay using the Time Impact Analysis method.

- .7 In order to further define (beyond the level of detail shown in the Detailed Final Baseline Schedule) critical portions of the Work such as facility shutdowns, the Contractor shall, if requested, develop detailed schedule fragments.
- .8 The Contractor shall also maintain, in an MS Excel worksheet provided by the Engineer, a daily as-built bar chart schedule that will record Work actually performed against each schedule activity.

### **1.9 Completion, Milestones and Constraints**

- 1.9.1 The Owner has set out a Substantial Performance date for the Work based on the Time for Completion clauses in the Contract Documents. These dates shall be strictly adhered to; in this regard, the Contract provides for liquidated damages.
- 1.9.2 Float is defined as the amount of time between the earliest start date and the latest start date of an activity or chain of activities on the CPM schedule. Float shall not be for the exclusive use of either the Contractor or Owner.
- 1.9.3 Use of float suppression techniques such as software constraints, preferential sequencing, special lead/lag logic restraints, extended activity times, or imposed dates, other than as required by the Contract, shall be cause for the rejection of any schedule submitted by the Contractor.
- 1.9.4 In the event that the Contractor's progress schedule indicates completion prior to the stipulated overall completion (or other milestones) date, such float will not be for exclusive use of either the Contractor or Owner.

### **1.10 Compliance with Schedule**

- 1.10.1 The Contractor shall comply with the latest schedule approved by the Owner and Engineer.
- 1.10.2 If the Contractor fails to complete a major activity, critical event or milestone by the date indicated in the latest update to the construction schedule and such failure is anticipated to extend the Contract Time or milestones, the Contractor shall, within seven (7) calendar days of such failure, submit an updated construction schedule with a narrative clearly indicating how the Contractor intends to correct the non-performance and return to the accepted construction schedule. Actions by the Contractor to complete the Work within the Contract Time (and milestones) shall not be justification for an adjustment to the Contract Time or Contract Price unless such failure is due to a delay in accordance with the provisions of Clause 2.1 below.
- 1.10.3 The Owner may, at no additional cost to the Owner, order the Contractor to increase Construction Equipment, labour force or working hours if the Contractor fails to:
  - .1 Complete a milestone activity by its scheduled completion date, or
  - .2 Satisfactorily perform the Work as necessary to prevent delay to the overall completion of the Work, but only to the extent required to return to the agreed upon construction schedule.



- .3 In the event of a conflict between the Contractor's performance of the Work and the Owner's requirements to operate an operational facility, the operation of the facility shall always take precedence.

#### **1.11 Progress Photographs**

- 1.11.1 The Contractor must photographically document all phases of the Contract including pre-construction, construction progress, and post-construction.
- 1.11.2 The Contractor must ensure that a digital camera is available at the Site for its own use and for the use of the Engineer. The Contractor shall take photographs of the various parts of the construction on a regular basis and when problems or matters of particular interest or importance arise.
- 1.11.3 Copies of such photographs shall be retained on Site until completion of the Work and should be identified with the following information:
  - .1 Date when photograph was taken and by whom;
  - .2 Contract number;
  - .3 Contractor's name;
  - .4 Location (e.g. – grid lines);
  - .5 Direction of view;
  - .6 Description; and Contractor's photo file number (so that each photo and negative may be readily identified).
- 1.11.4 The Engineer shall have the right to select the subject matter and vantage point from which photographs are taken. Matters of importance or interest which are to be photographed include:
  - .1 After the effective date of the agreement and before the Work at the Site is started, and again upon issuance of Substantial Performance, take photographs of the construction Site as well as the property adjacent to the perimeter of the construction Site;
  - .2 Structures, both inside and outside the Site. The pre-construction records will be compared to the post-construction records to assess damage or displacement of existing structures.
  - .3 Faulty work;
  - .4 Type of excavation; width of trench, etc.;
  - .5 Sheeting and shoring used;
  - .6 Dewatering methods, condition of bottom of excavation;
  - .7 Work on elements.

- 1.11.5 A complete set of photographs shall be prepared by the Contractor in accordance with the above requirements and submitted to the Engineer on USB when the Monthly Progress Report is submitted. The photos shall demonstrate how the Work is actually progressing and the planned and detailed sequencing of the Work at the time of the report. The Engineer may direct the contractor to obtain additional photographic records of structures and features within the site limit. The cut-off date for the Monthly Progress Report shall be as instructed by the Engineer.

- 1.11.6 Allow for quarterly aerial photos for the entire project site for the duration of the Work.

## **1.12 Look-Ahead Schedule**

- 1.12.1 Provide by 4:00 pm EST on the last workday of each week a Three-Weekly Progress and Planning Report including the following:

- .1 An overview of the previous working week's progress including quantification where applicable.
- .2 An updated schedule showing progress to date, critical path, and planned activities for the upcoming three weeks (on a rolling basis). All major upcoming items are to be highlighted, especially where coordination is required (e.g., shutdowns, inspections).
- .3 General summary of staff utilization including downtimes for training, maintenance of equipment, waiting on others (such as Engineer, Owner or others), etc.
- .4 Summary log of all Issues/Concerns, RFIs, RFCs, and their current status.
- .5 Health and Safety summary including the names of all those who have received the Contractor's and the site-specific training and any incident reports.
- .6 Summary of all external visitors to site including but not limited to the Owner, the Engineer, regulatory authorities, the testing companies, the subcontractors and the suppliers.

## **2 PRODUCTS (NOT APPLICABLE)**

## **3 EXECUTION**

### **3.1 Contract Completion Time**

#### **3.1.1 Causes for Extension of Time**

- .1 The contract completion time will be adjusted only for causes specified in the Contract Documents. In the event the Contractor requests an extension of any contract completion date, the Contractor shall furnish justification and supporting evidence. The Engineer will, after receipt of such justification and supporting evidence, make findings of fact and will advise the Contractor in writing thereof. If the Engineer finds that the Contractor is entitled to an extension of the Contract completion date under the provisions of the Contract, the Engineer's determination as to the total number of days' extension shall be based upon the current accepted and updated CPM schedule and on all data relevant to the extension. Such data shall be included in the next monthly updating of the schedule. The Contractor acknowledges and agrees that actual delays in activities which, according to the CPM schedule, do not affect any contract completion

date shown by the critical path in the network do not have any effect on the contract completion date or dates and therefore will not be the basis for a change in Contract Time.

- .2 The Contractor shall submit to the Engineer a detailed account of the claim and the grounds upon which the claim is based. Such claim shall be submitted within a reasonable time, and in any event no later than Thirty (30) Calendar Days after completion of the specific Work affected by the situation. Oral arrangements will not be considered. The Contractor must produce written evidence in support of the claim and shall advance no claim in the absence of such written evidence. Claims submitted later than Thirty (30) Calendar Days after completion of the specific Work affected by the situation will not be considered.
- .3 The Contractor is to account for fifteen (15) days per calendar year of abnormally adverse weather in their base contract. Only abnormally adverse weather exceeding fifteen (15) days per calendar year will be evaluated for an extension to the contract completion time.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Summary**

1.1.1 This section defines necessary submittals to be made to the Engineer, before, during and after construction. These include, but are not limited to:

- .1 Proposed location and details of temporary buildings
- .2 Shop drawings for permanent and temporary Works
- .3 Shutdown Notifications
- .4 Shutdown Master-list
- .5 Samples
- .6 Site progress reports
- .7 Tests and reports
- .8 Certificates and transcripts
- .9 Maintenance data and operating instructions
- .10 Interference drawings
- .11 Redline drawings
- .12 Other specific submittals as requested in individual specification sections.

### **1.2 Administrative**

1.2.1 The Contractor's responsibility for errors and omissions in submittals is not relieved by the Engineer's review of submittals. The review of shop drawings by the Engineer is for the sole purpose of ascertaining conformance with the general design concept on the Contract Drawings and documents. This review shall not mean that the Engineer approves detail design inherent in the manufacture of specific pieces of equipment, or those details required for construction, the responsibility for which shall remain with the Contractor submitting same, and such review shall not relieve the Contractor of responsibility for errors or omissions in shop drawings or of responsibility for meeting all requirements of construction and the Contract Documents. Without restricting the generality of the foregoing, 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 co-ordination of the work of all sub trades.

1.2.2 The Contractor's responsibility for deviations in submittals from requirements of Contract Documents is not relieved by the Engineer's review.

1.2.3 Submit all submittals to the Engineer for review as specified.

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- 1.2.4 Submit with reasonable promptness and in orderly sequence so as to not cause delay in the Works. Failure to submit in ample time is not considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- 1.2.5 The Contractor shall be responsible for:
- .1 The accuracy and completeness of the information contained in each submittal and ensure that the material, equipment or method of work is as described in the submittal.
  - .2 Verifying that features of products conform to the specified requirements.
  - .3 Editing submittal documents to indicate only those items, models, or series of equipment that are being submitted for review. Cross out or otherwise obliterate extraneous materials.
  - .4 Coordinating submittals among the subcontractors and suppliers and ensure there is no conflict with other submittals.
  - .5 Notifying the Engineer in each case where a submittal may affect the work of trades or the Owner.
- 1.2.6 Verify that the materials and equipment to be furnished and method of work comply with the provisions and the intent of the Contract as a whole. The Contract Documents are complementary, and what is required by any one shall be as binding as if required by all.
- 1.2.7 Verify and guarantee that features and characteristics of materials, equipment and other items to be incorporated into the work, and for which no submittals are required, conform to the Contract requirements.
- 1.2.8 Work affected by submittals shall not proceed until the review process is complete.
- 1.2.9 Present shop drawings, product data, samples and mock ups in SI Metric units.
- 1.2.10 The Contractor shall review submittals prior to submission to the Engineer. This review confirms that each submittal has been checked and coordinated with requirements of the Works and Contract Documents. Submittals not stamped, signed, and dated by the General Contractor will be returned without being examined and shall be considered rejected. The Contractor shall specifically identify whether or not they have any comments on the shop drawings submitted by their sub-contractors and suppliers. If it is evident that the Contractor has not performed their own review of the submittal then the Engineers review of the submittal will cease and the submittal returned to the Contractor immediately.
- 1.2.11 Notify the Engineer in writing identifying deviations from the Contract Documents stating reasons for deviations. Also refer to Section 01200 – Alternatives.
- 1.2.12 Verify that field measurements have been taken and affected adjacent work has been coordinated.
- 1.2.13 The Engineer has allowed for up to two shop drawing submittals and reviews as part of the normal review process. Any more than two shop drawing submittals will be considered a deviation for which the Engineer may seek compensation from the Contractor for the additional time and effort of shop drawing review. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.

- 1.2.14 Keep one reviewed copy of each submission on site.
- 1.2.15 Compliance Statement: Include in every shop drawing submission, a copy of the relevant specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included. Check-mark each paragraph to indicate compliance with the specification or mark otherwise to indicate requested deviations from specified requirements. Check marks (✓) denote full compliance with a paragraph in its entirety. If deviations from the specifications are indicated, underline each point of deviation and denote by a number in the margin to the right of the identified paragraph. The remaining portions of the paragraph not underlined will signify compliance with the specified requirements. Provide in the submittal a detailed, written justification for each deviation.
- 1.2.16 Certificate of Proper Equipment Application: With the initial shop drawing submittal or substitution request, provide a signed letter from the Equipment Manufacturer stating that the manufacturer has reviewed the Contract Documents and the equipment being supplied is suitable for the intended application. Submittal review will not be conducted without this completed certificate.
- 1.3 Shop Drawings and Product Data**
- 1.3.1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Works.
- 1.3.2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Works. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of where they are specified or on which drawings the work appears. Indicate cross-references to Contract Drawings and Specifications.
- 1.3.3 Provide a list of all shop drawings that the Contractor will be submitting to the Engineer fourteen (14) working days after the Order to Commence has been issued.
- 1.3.4 Allow 10-15 working days for the City's and Engineer's review of each submission. The Contractor must stage the submittals such that the Engineer can review in the allotted time.
- 1.3.5 Adjustments made on shop drawings by the Engineer do not address the issue of Contract Price. If adjustments affect the value of the Works, state this in writing to the Engineer prior to proceeding with the work. Any changes affecting Contract Price or Contract Time require a Change Order to be issued.
- 1.3.6 Make all changes to shop drawings as required by the Engineer and consistent with Contract Documents. When resubmitting, notify the Engineer in writing of any revisions other than those requested.
- 1.3.7 Submittals:
- .1 Submittals must be uploaded to the CIMA FTP (file transfer protocol) site and transmitted to the Engineer with a Submittal Transmittal Form in a form acceptable to Engineer for official submission, emailed with a Transmittal Form or submitted in hardcopy.

- .2 The marked-up copies will be returned to the Contractor via the CIMA FTP site, email or hardcopy by mail/courier.
- .3 The final submittals will be retained by the Engineer and stored at the site office.
- .4 The Contractor is responsible for producing hardcopies and sharing softcopies with Equipment Manufacturers and with subcontractors.
- .5 Submittal Cover Page
  - .1 For each discrete submittal, type or print the appropriate information on a cover page to fully describe the submittals being sent for review. Include the cover page for each discrete submittal. The title page shall include the following:
    - .1 Project Title
    - .2 Project / Contract Number
    - .3 Submittal / Shop Drawing Title
    - .4 Contractor Reference Number (if applicable)
    - .5 Specification number
    - .6 Revision Number
    - .7 Filename

1.3.8 Submissions shall include:

- .1 Contractor's name, contact phone no. and address.
- .2 Date and revision dates.
- .3 Project title and number.
- .4 Name and address of:
  - .1 Subcontractor.
  - .2 Supplier.
  - .3 Manufacturer.
  - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
- .5 Section of Contract where specified and location to be installed.
- .6 Apply shop drawing stamp, signed by Contractor's authorized representative certifying their review and approval of submissions, verification of field measurements and compliance with Contract Documents.

- .7 Compliance statement, refer to Clause 1.2.15
- .8 Certificate of Proper Equipment Application, refer to Clause 1.2.16
- .9 Details of appropriate portions of Work as applicable:
  - .1 Fabrication.
  - .2 Layout, showing dimensions, including identified field dimensions and clearances.
  - .3 Setting or erection details.
  - .4 Capacities.
  - .5 Performance characteristics.
  - .6 Standards.
  - .7 Operating Weight.
  - .8 Details of anchorage including bolt diameter, location and projection.
  - .9 Complete piping drawings, including size and location of all sleeves and/or openings to be formed into structural works.
  - .10 Submit all equipment and instrument shop drawings in advance of MCC and control panel shop drawings to allow coordination and any vendor specific power, I/O or control wiring requirements.
  - .11 Wiring diagrams.
  - .12 Single line and schematic diagrams.
  - .13 Relationship to adjacent work.
  - .14 Enclosure ratings (NEMA or IEC) for electrical equipment
  - .15 Electrical supply requirements including:
    - .1 Acceptable voltage range for mains and control power
    - .2 Current draw at full load
    - .3 Maximum and/or minimum setting of upstream protection
    - .4 Withstand and interrupt ratings
- 1.3.9 Submit one copy of product data sheets or brochures for requirements requested in the specifications and as requested by the Engineer where shop drawings will not be prepared due to standardized manufacture of product.
- 1.3.10 Submit shop drawings for each requirement requested in specification Sections and as Engineer may reasonably request.



1.3.11 Softcopy submittals

- .1 All softcopy submittals shall be named using the following nomenclature: [5]-[3]-R[2]-[4]-[1].pdf, where the fields in the filename are defined as follows:
  - .1 [1] = Contractor specific unique reference number (if applicable)
  - .2 [2] = Revision number
  - .3 [3] = Specification number
  - .4 Submittal number – some specs have more than one submittal, need a way to track those.
  - .5 [4] = Submittal/Shop Drawing title
  - .6 [5] = Project/Contract number
- .2 Each discrete shop drawing submittal shall be a single complete PDF document complete with cover page as the first page.
- .3 At the request of the engineer, the Contractor shall submit native files of certain submittals (MS Word, MS Excel, MS Project, Primavera, etc.) to help expedite the review process.
- .4 The Engineer reserves the right to request hardcopy submissions of any shop drawing submittal where it is deemed by the Engineer to be of benefit to have a complete hard copy version of the shop drawing for review.

1.3.12 Submittals will be returned with one or of the following notations. Take action as noted:

- .1 "NO COMMENT" - Make and distribute additional copies promptly as required for execution of Work. Instruct parties to report promptly any inability to comply with provisions.
- .2 "REVISE & RESUBMIT" - Make the necessary revisions and resubmit revised drawings for review. This procedure will not relieve the responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of Contract. Show the drawing number of the first such revised drawing and show the latest revision number applicable to the drawing by increasing the revision index – "R0", "R1", "R2", etc. Refer to 01330 – Submittals – Supplement B: Shop Drawing File Naming Convention Instructions for instructions on how to apply revision numbers.
- .3 "AS NOTED" – Make the necessary revisions prior to commencing with the execution of work. A resubmission for Engineer review is not required. Resubmit with all necessary revisions for record and coordination purposes.
- .4 "REJECTED" – This notation indicates that the Engineer has received the submission and has deemed it incomplete or improper for review.
- .5 "NOT REVIEWED" - This notation indicates when Engineer has acknowledged receipt of the shop drawing and that a review is not required.

- 1.3.13 Use only those shop drawings on the work that bear the "NO COMMENT" or "AS NOTED" notation.
- 1.3.14 Do not revise shop drawings marked "NO COMMENT" unless resubmitted to the Engineer for further review.
- 1.3.15 Ship one set of reviewed shop drawings, installation instructions, lubrication schedules, parts lists and other information along with each piece of equipment to the Site and clearly mark "DO NOT REMOVE FROM SITE".
- 1.3.16 Neither the Engineer nor the Owner will accept responsibility for the cost of changes necessary if any equipment is fabricated without prior review of shop drawings. Completion of the Engineer's review will be designated by the presence of the Engineer's initialed reviewed stamp on the returned drawings.
- 1.3.17 Where more than one type of shop drawing has been specified for one item, e.g., wiring diagrams, layout details, and dimensional drawings, the shop drawings will be submitted together, to enable Engineer to review the drawings as a package.
- 1.3.18 Catalogue pages or drawings applicable to an entire family or range of equipment will not be accepted as shop drawings unless they are clearly marked to show the pertinent data for the particular materials.
- 1.3.19 Manufacturers' catalogues, manuals, or price lists will not be accepted as shop drawings. Such materials may be used as supplemental information to the shop drawings.
- 1.3.20 Indicate the tag number of all instruments and valves and clearly show the features and details applicable to the equipment being supplied.
- 1.3.21 Determine which shop drawings have, in addition to those drawings specifically mentioned in the Contract, design elements requiring the seal of a Professional Engineer registered in the Province of Ontario, in accordance with the applicable provincial or federal engineering acts or other governing legislation. Seal such drawings before submitting them for review. Submit for review engineering calculations signed by the registered Professional Engineer responsible for the shop drawing design elements.
- 1.3.22 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, a copy will be returned denoted "AS NOTED", and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned denoted "REVISE AND RESUBMIT", and resubmission of corrected shop drawings, through the same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- 1.3.23 Owner may deduct, from payments due, costs of additional engineering work incurred if correct shop drawings are not submitted after one review.
- 1.3.24 Review by Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review does not mean that Engineer approves the detail design inherent in the shop drawings, responsibility for which remains with the Contractor, and such review does not relieve the responsibility for errors or omissions in the shop drawings or of the responsibility for meeting all requirements of the Contract Documents. It also does not relieve the responsibility 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.

- 1.3.25 As per Clause 1.6, prepare and submit proposed sleeve location drawings showing the location and size of sleeves, openings and miscellaneous items to be formed in the work with the reinforcing steel drawings to allow full coordination. Any reinforcing steel modifications required as a result of failure of the contractor to provide these drawings, will be at no cost to the Owner.
- 1.3.26 Delete information not applicable to project from all submittals.
- 1.3.27 Supplement standard information to provide details applicable to project as required.
- 1.3.28 When corrected copies are resubmitted, the Contractor shall direct specific attention to all revisions in writing and shall list separately any revisions made other than those called for by the Engineer on previous submittals. Requirements specified for initial submittals shall also apply to resubmittals.
- 1.3.29 If more than one resubmittal is required because of failure of the Contractor to provide all previously requested corrected data or additional information, the Contractor shall reimburse the Owner for the charges of the Engineer for review of the additional resubmittals. This does not include initial submittal data such as shop tests and field tests that are submitted after initial submittal.
- 1.3.30 When resubmittals are needed, resubmittals shall be made within 15 business days. The Contractor may submit an acceptable request for an extension of time, listing the reasons why the resubmittal cannot be completed within the stipulated time.
- 1.3.31 The need for more than one resubmittal, or any other delay in obtaining the Engineer review of submittals, will not entitle the Contractor to extension of the Contract Times unless delay of the Work is the direct result of a change in the Work authorized by a Change Order.
- 1.3.32 The maximum size of shop drawings shall be 600 mm x 900 mm to permit red line photocopy reproduction.
- 1.3.33 Shop drawings which require the approval of a legally constituted authority having jurisdiction shall be submitted by Contractor to such authority for approval. Such shop drawings shall receive final approval of authority having jurisdiction before Consultant's final review.
- 1.3.34 Drawings stamped "AS NOTED" must be revised for inclusion in the Operation and Maintenance Manuals.
- 1.3.35 Submit hardcopy and softcopy sets of final shop drawings as part of the O&M submission.

#### **1.4 Shop Drawings for Temporary Works**

- 1.4.1 Submit for review shop drawings of temporary works which:
  - .1 Control the dimensions and locations of any part of the structures to be constructed under the contract.
  - .2 Impose loads on parts of the works which are still under construction or on existing structures.

- 1.4.2 Payment will not be made for work started or completed without the required drawing review. Submit shop drawings well in advance of the time when they are required for construction. Coordinate shop drawings prepared by different trades so that information is available to prevent conflict or errors where the work of one trade affects the work of another.
- 1.4.3 Two copies of submitted shop drawings will be returned to the Contractor after review.
- 1.4.4 Shop drawings will be reviewed for conformity with the required arrangement and dimensions of the permanent structures and for general conformity with the specifications.
- 1.4.5 If resubmittal is requested, discuss the comments made and resolve all issues raised by them, then resubmit the shop drawings amended accordingly.
- 1.4.6 Do not begin construction of temporary works before review of the shop drawings is completed.
- 1.4.7 Review of the Contractor's drawings does not relieve the Contractor of the responsibility for the results arising from errors or omissions of design or from the use or abuse of the temporary works.
- 1.4.8 Keep one copy of each stamped, reviewed drawing at the site of the work for reference during the duration of the construction work.
- 1.4.9 Make no changes to drawings after they have been reviewed.
- 1.4.10 Submit shop drawings in SI metric units.
- 1.4.11 Use either ANSI size A (8.5" x 11") for text and drawings or size B (11" x 17") for drawings. Do not reduce originals to a degree that compromises legibility.
- 1.4.12 Have no lettering, symbols, and characters less than Font 11 in size.
- 1.4.13 The Contractor shall retain the services of a Professional Engineer to design and stamp all temporary works.
- 1.5 Samples**
  - 1.5.1 Submit samples in duplicate for review as requested in respective specification Sections. Submit samples with identifying labels bearing material or component description, manufacturer's name and brand name, Contractor's name, project name, location in which material or component is to be used, and date.
  - 1.5.2 Deliver samples prepaid to the Engineer's business address, or as otherwise directed by the Engineer.
  - 1.5.3 Notify the Engineer in writing, at time of submission of deviations in samples from requirements of the Contract Documents.
  - 1.5.4 Where colour, pattern or texture is a selection criterion, submit the full range of samples.
  - 1.5.5 Adjustments made on samples by the Engineer do not address the issue of Contract Price. If adjustments affect the value of the Works, state such in writing to the Engineer prior to proceeding with the work.

1.5.6 Make all changes to samples as required by the Engineer and consistent with Contract Documents.

1.5.7 Reviewed and accepted samples will become the standard of workmanship and material against which installed work will be verified.

## **1.6 Insert and Sleeve Location Drawings**

1.6.1 Submit insert and sleeve location drawings showing the location and size of sleeves, anchor bolts, openings and miscellaneous items to be formed in the work. Submit these drawings with the reinforcing steel drawings to allow full coordination.

## **1.7 Interference Drawings**

1.7.1 Prepare composite working/layout/construction/interference drawings, fully dimensioned of cables, conduits, cable trays, cable bus ducts, sleeves, structures, clearances, pipes, ducts etc. and equipment in all areas to avoid conflict of trades. Base drawings on manufacturers' working drawings. Drawings shall be developed from consultation with and the agreement of all trades. All drawings shall be reviewed, checked for compliance with contract documents and stamped as "Reviewed" by the Contractor and Subcontractor prior the submission to the Engineer for review. Drawings that are not stamped as "Reviewed" by the Contractor and Subcontractor will be returned to the Contractor and shall have to be re submitted to the Engineer after review by the General Contractor and Subcontractor.

1.7.2 Before installation of structural, mechanical and electrical systems, prepare an integrated set of interference drawings in cooperation with all trades.

1.7.3 After discussion with Engineer, at no additional cost, make necessary relocations due to interference of trades, as a result of incomplete drawings.

## **1.8 Professional Engineering Design**

1.8.1 Where specifications require Professional Engineer design, such Engineer is required to be licensed in the related discipline in the Province of Ontario.

## **1.9 Test and Reports**

1.9.1 Insofar as practical, test materials and equipment on site. Where shop test is necessary, give Engineer two (2) weeks notice in writing of proposed shop test date.

1.9.2 Complete an equipment report prior to site testing each item of rotating mechanical equipment. During testing complete the remainder of the equipment report. Submit the reports for inclusion in the Installation, Operation and Maintenance manual.

1.9.3 Before operating equipment, engage the services of a qualified manufacturer's service representative to inspect, operate, test and adjust the equipment after installation.

1.9.4 Submit the manufacturer's representative's signed report describing in detail the inspection, tests and adjustments made, quantitative results and suggestions for precautions to be taken for correct maintenance. Verify that the equipment and its installation conform to the requirements of the Contract for the service intended and is ready for permanent operation. Bind copies of report into the installation, operation and maintenance manuals.

- 1.9.5 Inspection includes:
- .1 Soundness (without cracked or otherwise damaged parts).
  - .2 Completeness of installation as specified and as recommended by manufacturer.
  - .3 Correctness of setting, alignment and relative arrangement of various parts of system.
- 1.9.6 Operate, test and adjust equipment to prove it is correctly installed to operate under the intended conditions.
- 1.9.7 Equipment will only be accepted after receipt of the manufacturer's representative's report.
- 1.9.8 Submit notice in writing at least 48 hours before manufacturer's representative is scheduled to perform these services.
- 1.9.9 Modify or replace equipment or materials failing required tests.
- 1.9.10 Perform additional testing required due to changes of materials requested by Contractor or due to failure of materials or construction to meet specifications.
- 1.10 Redline Drawings**
- 1.10.1 The Owner will supply a set of contract drawings. Mark thereon all revisions in red ink as the job progresses to produce a set of redline drawings.
- 1.10.2 Dimension locations (vertically and horizontally) of buried or concealed work, especially piping and conduit, with reference to exposed structures. Dimension the installed locations of concealed service lines on the site or within the structure by reference from the centre line of the service to the structure column lines or other main finished faces or other structural point easily identified and located in the finished work.
- 1.10.3 Update these drawings and make available for monthly review. Payment against the Progress Payment line item for updated drawings will be withheld if drawings have not been maintained up-to-date.
- 1.10.4 Submit redline drawings in SI metric units.
- 1.10.5 Record on the white prints on a daily basis, work constructed differently than shown on the Contract Documents. Record all changes in the work caused by site conditions, or originated by the Owner, the Engineer, the Contractor, or a sub-contractor and by addenda, supplemental drawings, site instructions, supplementary instructions, change orders, correspondence, and directions of regulatory authorities. Accurately record the location of concealed mechanical services and electrical main feeders, junction boxes and pull boxes. Do not conceal critical work until its location has been recorded.
- 1.10.6 Do not use these drawings for daily working purposes and make the set available for periodic inspection by the Engineer.
- 1.10.7 Make records in a neat and legibly printed manner with non-smudging medium.

- 1.10.8 The Contractor shall scan the complete set of redline drawings in PDF (full resolution) and upload progress redline drawings onto the CIMA FTP site and transmit to the Engineer on a quarterly basis (every 3 months).
- 1.10.9 To certify that the redline drawings are being kept up to date by the Contractor, there shall be a line item in the monthly payment certificate entitled "Redline Drawings". Refer to Section 01025 for further details.
- 1.10.10 Submit all redline drawings to the Engineer prior to Substantial Performance. Substantial Performance will not be issued until redline drawings are completed by the Contractor, submitted to the Engineer and reviewed with no further comments.

#### **1.11 Site Progress Records**

- 1.11.1 All site progress reports shall be provided as required to the Engineer and a copy shall also be kept for the Contractor's records.
- 1.11.2 Provide by 10:00 am EST a Daily Progress Report including the following:
  - .1 The weather conditions with maximum and minimum temperatures
  - .2 The conditions encountered during excavation
  - .3 The commencement and the completion dates of the work of each trade in each area of the Contract.
  - .4 The erection and removal dates of formwork in each area of the Contract
  - .5 The dates, the quantities, and the particulars of each concrete pour
  - .6 The dates, the quantities, and the particulars of roofing installation
  - .7 The dates on which major items are installed.
  - .8 The numbers and classifications of the Contractor's and the Sub-contractor's trades people working at the site and the numbers and classifications of construction machinery and equipment and the number of hours each is operated.
  - .9 The visits to the site by the Owner, Engineer, the Regulatory Authorities, testing companies, the Sub-contractors and the suppliers.

#### **1.12 Weekly Newsletters**

- 1.12.1 The Contractor shall prepare weekly newsletters and email a PDF copy to the Engineer and Owner every Monday morning by 10 a.m.
- 1.12.2 Newsletter shall summarize the Work completed the previous week and shall include pictures of the Work per Clause 1.14. A detailed description of the Work completed by all subcontractors/trades daily are to be included in the newsletter and not just a caption of the picture.
- 1.12.3 Throughout the project, the Owner and Engineer may request the raw (non-PDF) electronic copies of any newsletters, including pictures.

- 1.12.4 Prior to Substantial Performance, a USB containing all the raw (non-PDF) and PDF copies shall be provided.
- 1.12.5 Any Work completed between Substantial Performance and the end of Warranty shall also be included in newsletters and the USB updated at the end of the Warranty period to cover the entire Contract.

### **1.13 Pre-Construction Photographs**

- 1.13.1 Provide pre-construction photographs in digital format, prior to commencement of work on the site. Deliver to the Engineer before starting any construction, two electronic copies by digital devices. The Engineer may direct the Contractor to obtain additional photographic records of structures and features within the site limits. The pre-construction records will be compared to the post-construction records to assess damage or displacement of existing structures.
- 1.13.2 Pre-construction survey will be performed by an inspection company experienced in this work and approved by the Engineer. The Contractor will be required to indemnify the Owner against any claim by abutting property owners for damages sustained due to any construction activities.
- 1.13.3 The Contractor shall ensure that advanced notice is given to the residents, advising them of a pre-construction survey. A copy of the pre-construction survey shall be filed with the Engineer and Owner prior to commencement of construction.
- 1.13.4 Obtain pre-construction photos of the existing:
  - .1 Roads, sidewalks and curbs.
  - .2 Shoulder and grass areas.
  - .3 Building exterior.
  - .4 Trees
  - .5 Interior views of rooms, tunnels, etc., where modifications are planned.

### **1.14 Progress Photographs**

- 1.14.1 On commencement of work and at monthly intervals thereafter, provide eight (8) different view photographs to illustrate the progress of the work. Photographs are to be taken by a professional photographer from locations selected by the Engineer. The Owner reserves the right to request hard copies of digital pictures as necessary, printed on photo quality media.
- 1.14.2 Refer to Section 01320 for further details on progress photographs.

### **1.15 Operation and Maintenance Data**

- 1.15.1 Provide two (2) hard copies and electronic copy of draft manual or sets of manuals, of instruction, in accordance with Section 01780 for review by the Engineer. One copy will be returned with comments and one copy will be retained to assist the Engineer and will be returned after delivery of the final copies. The Contractor shall submit the draft O&M manual at least twenty (20) working days prior to the start of training specified in Section 01820.



- 1.15.2 Supply 2 (2) hard copy and two (2) USB drives containing electronic copies of the final and complete manuals or sets of manual, of instruction, warranty information, in accordance with Section 01780 for further details on Operation and Maintenance data and manual. Final submission of Operation and Maintenance data is required prior to Substantial Performance.

**1.16 Equipment Inventory**

- 1.16.1 Asset tagging facilitates the efficient operation of water and wastewater activities by providing the means to locate, monitor, and keep records and information against specific assets. The Contractor will be required to complete Asset Tagging based on the Asset Inventory created in accordance with the Owner's Asset Inventory and Tagging Guidelines.
- 1.16.2 Submit a separate binder for the Computerized Maintenance Management System (CMMS) Equipment Inventory and Tagging list. An Excel template would be provided for the CMMS information. One (1) hard copy binder and one (1) USB drive containing the CMMS information will be provided.
- 1.16.3 The Engineer will provide a complete Tagging List for each piece of equipment/material installed.
- 1.16.4 Provide complete and properly formatted inventory information to the Owner. Inventory information shall include specific tag ID, asset name, building location, room location, type, sub-type, vendor, manufacturer, model number, serial number, installation date, purchase cost, estimated service life, warranty expiration date, criticality, dimensions, sizing, capacity, motor rating, material, current, RPM, frequency, voltage, phase, power, output pressure, rated air flow, rated gas flow, rated liquid flow, total dynamic head, rated weight, power safety factor, electrical information, etc.
- 1.16.5 Contractor shall work on-site to securely affix the Asset Tags to the Assets as per the Owner's standards.
- 1.16.6 Contractor shall work on-site to complete the Asset Tagging Forms for each Asset using the Owner's hardware or on a Microsoft Excel form to be supplied to the Contractor by the Engineer.
- 1.16.7 Contractor shall verify that Asset Tagging has been completed prior to Substantial Performance.
- 1.16.8 Prior to commissioning, the Owner's CMMS shall be updated by the Contractor to include pertinent maintenance data and documentation for new assets and/or modifications made to existing assets. Similarly, data for assets that are planned to be decommissioned shall be documented for removal from the CMMS.
- 1.16.9 The Contractor shall document Preventative Maintenance and related Job Plans for each Asset. Preventative maintenance information includes the recommended frequency of inspection and the list of assets the preventative maintenance is applicable for. Job plans include the key steps to perform, and the list of required materials or equipment needed to perform the work.

**1.17 Spare Parts**

- 1.17.1 Provide spare parts, in quantities specified in individual specification sections and Section 01780.

- 1.17.2 Contractor shall include a consolidated list of all spare parts that have been provided as part of the Works. The Spare Parts List shall also indicate the box number in which the equipment is located.

**1.18 Maintenance Materials**

- 1.18.1 Provide maintenance material, in quantities specified in individual specification sections and Section 01780.
- 1.18.2 Contractor shall include a consolidated list of all maintenance materials that have been provided as part of the Works. The Maintenance Material List shall also indicate the box number in which the material is located.

**1.19 Special Tools**

- 1.19.1 Provide special tools, in quantities specified in individual specification sections and Section 01780.
- 1.19.2 Contractor shall include a consolidated list of all special tools that have been provided as part of the Works. The Special Tools List shall also indicate the box number in which the tools are located.

**1.20 Warranties and Bonds**

- 1.20.1 Provide warranties and bonds as specified in individual specification sections and Section 01780.
- 1.20.2 The placing, installation and connection of work by the Owner's own forces or by any other Contractors on and to the Contractor's Work does not relieve the Contractor of their responsibility to provide the specified warranties.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**



# Shop Drawing Transmittal

SD Submittal Sheet R1.docx

Date:

Pages (incl. cover):

<b>To:</b>		<b>Phone:</b>	
<b>Company:</b>		<b>Fax:</b>	
<b>E-mail Address:</b>		<b>Other:</b>	
<b>From:</b>		<b>Phone:</b>	
<b>Company:</b>		<b>Fax:</b>	
<b>Email Address:</b>		<b>Other:</b>	

<b>Project Title:</b>			
<b>Client Project No.:</b>			
<b>Submittal Title:</b>		<b>Submittal No.:</b>	
<b>Specification:</b>		<b>Revision No.:</b>	
<b>Filename:</b>	SD Submittal Sheet R1.docx		

**Issued For:**

- |  |  |
|--|--|
| <input type="checkbox"/> Information   | <input type="checkbox"/> Tender Purposes       |
| <input type="checkbox"/> Your Comments | <input type="checkbox"/> Construction Purposes |
| <input type="checkbox"/> As Requested  | <input type="checkbox"/> Other                 |

**Mode of Delivery:**

- |  |                                      |
|--|--------------------------------------|
| <input type="checkbox"/> Postal Service  | <input type="checkbox"/> For Pick-Up |
| <input type="checkbox"/> Courier Service | <input type="checkbox"/> FTP Site    |
| <input type="checkbox"/> Hand Delivered  | <input type="checkbox"/> Other       |

CONTRACTOR CERTIFICATION SHOP DRAWING STAMP

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# Shop Drawing File Naming Convention

Four (or five) fields are used to create a file name:

- **[1]** = Contract No. (was previously no. 5)
- **[2]** = Specification Section & Clause (was previously no 3)
- **[3]** = Revision No. (was previously no. 2)
- **[4]** = Shop Drawing Title (no change)
- **[5]** = Contractor Reference # (optional) (was previously no. 1)

Filename format = **[1] - [2] - R[3] - [4] - [5]**

- Field 1 is optional and does not have to be included

<b>[1]</b> Contractor Reference #	<b>[2]</b> Revision No.	<b>[3]</b> Division	<b>[3]</b> Spec. Section – Clause(s) – [2 digit id#]	<b>[4]</b> Manufacturer	<b>[4]</b> Shop Drawing Title
001	0	1	01320-3.2-01	General Contractor	Construction Schedule
002	0	1	01400-3.2-01	General Contractor	Contractors Environmental Protection Plan
002	1	1	01400-3.2-01	General Contractor	Contractors Environmental Protection Plan
003	0	1	01400-3.2-02	General Contractor	Contractors Environmental Certificate

Please use the table below as an example of file naming conventions for fictional project **P2015-01 [5]**.

File naming examples:

P2015-01-01320-3.2-01-R0-Construction Schedule-001.pdf

- Basic file name example including fields **[1]** through **[4]**

P2015-01-01400-3.2-01-R0-Contractors Environmental Protection Plan-002.pdf

- Note the change of field **[1]**, **[3]**, and **[4]** for the new shop drawing

P2015-01-01400-3.2-01-R1-Contractors Environmental Protection Plan-002.pdf

- Note the change of field **[2]** to reflect a new **Revision No.** for an existing shop drawing

P2015-01-01400-3.2-02-R0-Contractors Environmental Certificate-003.pdf

- Note field **[3]** as 01400-3.2-02, different from the previous 01400-3.2-01
- Note the change of field **[1]**, **[2]**, and **[4]** for the new shop drawing
- For different shop drawings with the same clause reference, use **-##** to differentiate

## **1 GENERAL**

### **1.1 Construction Safety Measures**

- 1.1.1 Contractor shall submit a site specific Health and Safety Plan within 5 working days after the date of Notice to Proceed or prior to mobilization on site, whichever occurs first. The site-specific Health and Safety Plan must address the requirements of the Acts. As Constructor, the Contractor will be required to prepare a Site-Specific Health and Safety plan to be submitted for review by the Owner and Engineer. The Contractor is to submit the draft plan at the Pre-Construction Meeting which shall be revised, if needed, before construction begins.
- 1.1.2 The contractor shall meet the requirements of the following:
- .1 Occupational Health and Safety Act, Regulations for construction projects, O.Reg. 213/91 (as amended. by O.Reg. 631/94), Part II General Construction.
  - .2 Occupational Health and Safety Act, Industrial Establishments Regulation, R.R.O. 1990, Reg. 851 (as amended by O.Reg. 516/92; 630/94; 230/95; and 450/97), Part I Safety Requirements.
  - .3 Revised Statutes of Ontario 1980, Chapter 321, Revised Regulation of Ontario 1980, Regulation 691 as amended by O.Reg. 156/84 and O.Reg. 645/86, and Ontario Regulation 714/82.
  - .4 Workers Safety & Insurance Board (WSIB) and municipal statutes and authorities.
- 1.1.3 In event of conflict between any provisions of above authorities, the most stringent provision governs.
- 1.1.4 The Contractor is designated "Constructor" as defined by law.

### **1.2 Special Protection and Precautions**

- 1.2.1 Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage and disposal of hazardous materials and regarding labelling and the provision of safety data sheets (SDS) acceptable to Labour Canada.
- 1.2.2 Conform to the Ministry of Labour requirements for work in hazardous locations. Establish and implement written procedures to assure compliance.
- 1.2.3 Comply with the Owner's and Plant Operations Health and Safety Procedures.
- 1.2.4 Provide site specific health and safety training to all Contractor and Sub-Contractor staff on-site. To ensure all staff on site have attended site orientation and are accounted for in case of emergency, the Contractor is required to provide to the Owner a daily attendance sheet, listing individual's names.
- 1.2.5 Submit all required training certificates related to performing the Work to the Owner prior to undertaking the Work, e.g. confined space training, fall arrest training, asbestos awareness training.

1.2.6 Contractor to obtain CAD rating and WSIB clearance certificates from each sub-contractor and to provide to Owner upon request.

1.2.7 Smoking is not permitted at any location onsite. Smoking is prohibited on all Owner property.

### **1.3 Safety and First Aid Facilities**

1.3.1 Provide and maintain on Site, in a clean orderly condition, completely equipped First-Aid kit or facilities readily accessible at all times to Contractor's employees and, the Engineer and the Owner.

1.3.2 Facilities and staffing to be in accordance with the Industrial First Aid Regulations of the Workplace Safety and Insurance Board (WSIB) and OSHA regulations.

1.3.3 Provide fire extinguishers, smoke and CO monitors for trailers.

1.3.4 Supply three (3) additional hardhats and safety vests for visitors to site.

1.3.5 Provide and maintain on the site a completely equipped first aid kit, which shall be readily accessible at all times to all employees and the Owner.

1.3.6 Designate certain employees who are properly instructed to be in charge of first aid. At least one such employee is to be always available on the site while work is being carried out.

1.3.7 A telephone call list for summoning aid, such as doctors, ambulances, pulmotors and rescue squads from outside sources is to be conspicuously posted.

### **1.4 Safety Equipment and Hazardous Areas and Materials**

1.4.1 Safety equipment such as gas detection equipment for explosive or toxic gases or oxygen deficiency, safety belts, ropes, etc., are to be made available to the Engineer as necessary for inspection.

1.4.2 Construction personnel requiring use of respiratory equipment are to be clean shaven.

1.4.3 Post warning signs at hazardous areas or where hazardous materials are stored, and install protective barriers. Instruct personnel in proper safety procedures. Inform the Owner of the location of these materials. The Contractor shall ensure that these materials are not kept stored or used on site without the Owner's prior consent or approval.

1.4.4 Identify all areas considered to be hazardous locations and comply with all requirements of the Ministry of Labour.

1.4.5 Ensure compliance with CSA B149.6 - 15 and applicable safety codes when working on or in the area of natural and digester gas lines. Purge all gas lines with nitrogen prior to proceeding with work. Note that certain gas lines passing through the work area will continue in service during this construction. Take suitable safety precautions at all times.

### **1.5 Site Conditions**

1.5.1 Work at site may involve contact with:

.1 Raw Sewage

- .2 Effluent water
- .3 Chemicals used as part of the treatment or cleaning process
- .4 Diesel Fuel

- 1.5.2 As Constructor, the Contractor will be required to prepare a site-specific Health and Safety plan to be submitted for review by the City.
- 1.5.3 The City requires the Contractor obtain CAD rating of each sub-contractor and shall be provided upon request.
- 1.5.4 For the purposes of ensuring all staff on-site have attended site orientation and are accounted for in case of emergency, the Contractor will be required to provide the City a daily attendance sheet with individual names listed, within one hour of the start of work each day. The Contractor is responsible to similarly provide names of workers and that arrive to site including sign-in times after the daily attendance sheet has been sent.
- 1.5.5 Note that all wastewater plants have nuisance wildlife living in, and around, many facilities. Take care when entering, opening up, or working in an area.

## **2 PRODUCTS (NOT APPLICABLE)**

## **3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Waste Management Objectives**

- 1.1.1 The Owner has established that the Contract shall generate the least amount of waste possible and that processes shall be employed that ensure the generation of as little waste as possible including prevention of damage due to mishandling, improper storage, contamination, inadequate protection or other factors as well as minimizing over packaging and poor quantity estimating.
- 1.1.2 Of the inevitable waste that is generated, the waste materials designated in this specification shall be salvaged for recycling. Waste disposal in landfills or incinerators shall be minimized. This means careful recycling of job site waste.
- 1.1.3 The Contractor shall:
- .1 Institute construction waste reduction practices.
  - .2 Effect optimum control of construction waste.
  - .3 Implement a site recycling program that includes source separation of solid waste materials.
  - .4 Prepare and implement a solid waste management and environmental protection plan for the Project.
  - .5 Submit monthly a summary of solid waste generated by construction operations.
  - .6 Be responsible for final implementation of site recycling program by disposal of recyclable solid waste at appropriate recycling centres.
  - .7 Transport and dispose of waste materials that are not identified to be recycled at permitted landfill facilities.

### **1.2 Waste Management Plan**

- 1.2.1 The Contractor shall submit to the Engineer a Waste Management Plan. The Plan shall contain the following:
- .1 Analysis of the proposed job site waste to be generated, including the types of recyclable and waste materials generated (by volume or weight).
  - .2 Alternatives to Landfilling: The Contractor shall designate responsibility for preparing a list of each material proposed to be recycled during the course of the Project.
  - .3 List of compulsory materials to be recycled, shall include, at minimum, the following designated materials:
    - .1 Old corrugated cardboard, paper and packaging.
    - .2 Clean dimensional wood, palette wood.



- .3 Concrete/Concrete Block/Asphalt.
  - .4 Scrap metals.
  - .5 Unpainted gypsum wallboard.
  - .6 Glass and plastics.
  - .7 Beverage containers.
  - .8 Land clearing debris.
  - .9 Paint (to be returned to Paint Depot).
- 1.2.2 Materials Handling Procedures: The Contractor shall prevent contamination of materials to be recycled source and handle materials consistent with requirements for acceptance by designated facilities.
- 1.2.3 Waste Bins: The Contractor shall provide individual waste bins for each recyclable solid waste material and shall clearly designate recycling bins by colour coding and/or large identification signs. (Example: orange bin for wood only, green bin for trash).
- 1.2.4 Source Separation: The Contractor shall educate and monitor Sub Contractors about the acceptable methods of source separation.
- 1.2.5 Location: The Contractor shall place the recycling bins in convenient locations that are out of the way of construction traffic and shall designate this recycling area on site to prevent misuse or contamination of bins.
- 1.2.6 Contamination: When the recycling program is first started, and during construction operations the Contractor shall remind workers to keep trash out of the recyclable material bins. Coffee cups, caulking tubes, etc. must not be deposited into recycling bins.
- 1.2.7 Handling: Recyclable materials shall be free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to recycling process. The Contractor shall monitor source separation and ensure workers clean materials that are contaminated prior to placing in collection containers.
- 1.2.8 Collection: The Contractor shall arrange and pay for collection by or delivery of recyclable materials to the appropriate recycling company that accepts construction waste for purpose of recycling. The Contractor shall coordinate regular or "when-called" pick-up or delivery to eliminate overflowing bins.
- 1.2.9 Waste Management Plan Implementation:
- .1 Manager: The Contractor shall designate an on-site party (or parties) responsible for instructing workers and overseeing and recording results of the Waste Management Plan for the Project.
  - .2 Distribution: The Contractor shall distribute copies of the Waste Management Plan to the Job Site Foreman, each Sub Contractor, and the Engineer.

- .3 Instruction: The Contractor shall provide on-site instruction of appropriate separation, handling, and recycling to be used by all parties at the appropriate stages of the Project.
- .4 Separation Facilities: The Contractor shall layout and label a specific area to facilitate separation of materials for recycling. Recycling and waste bin areas are to be kept neat and clean and clearly marked in order to avoid contamination of materials.
- .5 Hazardous Wastes: Any hazardous wastes shall be separated, stored, and disposed of in accordance with the requirements of the authorities having jurisdiction including the Ontario Regulation 542/06 Municipal Hazardous or Special Waste.
- .6 The Contractor shall submit monthly to the Engineer a summary of waste materials, recycled, and disposed of using the form appended to this section or a form generated by the Contractor containing the same information. The Summary shall contain the amount (in metric tonnes) of material landfilled or incinerated from the Project, and the identity of the landfill or transfer station. For each material recycled from the Project, include the amount (in tonnes) and the destination (i.e. the material recovery facility, transfer station, landfill, incinerator or used materials yard). The Summary shall include copies of logs, manifests, weight tickets and receipts.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

Name of Company	Contact Person	Telephone No.
Project Site/Location	Project Size (in square metres)	Project Type/Construction

Explanatory Note:

- END OF SECTION**

## **1 GENERAL**

### **1.1 Intent**

- 1.1.1 This Section covers the work for the protection of the environment during construction.
- 1.1.2 The requirements of this Section are in addition to the requirements of any other Section of this specification and are not meant to limit in any way regulations, guidelines, laws or by-laws in effect at time of construction.
- 1.1.3 In all cases the most stringent requirements for environmental protection shall govern.

### **1.2 General Provisions**

- 1.2.1 Be responsible for the protection of the natural environment of the site and surrounding areas, both land and water. Protection of the environment must start with avoidance and prevention, and then control/mitigation, compensation, or enhancement (in order of descending preference).
- 1.2.2 Prime consideration must be given to protecting the environment during all phases of construction. Co-operate fully with the Engineer, Owner, operating personnel and local authorities to protect the natural environment.
- 1.2.3 Obtain the Engineer's approval of planned work and storage areas and proposed access roads. Submit a written proposal prior to starting construction.
- 1.2.4 Project construction activities must be carried out in compliance with all applicable environmental laws and regulations.
- 1.2.5 All materials (hazardous and non-hazardous) shall be handled so as to protect human health and the environment.
- 1.2.6 Activities shall be planned and implemented, and equipment shall be managed and maintained in a manner that minimizes air emissions.
- 1.2.7 Prevent the accidental discharge of containments into soils, surface water and/or groundwater. Any accidental contamination shall be reported to the Ministry of Environment, Conservation and Parks immediately and cleaned up as per provincial requirements.
- 1.2.8 Erosion control measures shall be designed, implemented and maintained to ensure that there is no increased sediment loading to surface waters leaving the Project site. The Contractor is responsible for ensuring that the erosion control measures are implemented and maintained throughout the duration of the Project.

### **1.3 Inspection**

- 1.3.1 Be advised that inspectors from the Owner, MECP, Conservation Authority and other authorities having jurisdiction may make periodic visits to the Site during construction. They have the authority to order the Contractor to stop work if in their opinion the Work is not being completed so as to ensure compliance with the environmental objectives. Acceptance of the Work by the Engineer may be withheld until the Owner and other authorities have issued their approval.

#### **1.4 Limits of the Site**

- 1.4.1 The limits of the site working area are shown on the Contract Drawings and described in the specifications. Confine operations within these limits, unless written approval is obtained from the Engineer and from the property owners concerned.
- 1.4.2 Install snow fencing stakes or other barriers suitable to the Engineer and other authorities to clearly define the working limits of the Site, parking areas, storage areas, maintenance areas and haul routes within the site and confine activities to these areas. Submit drawings of the Site showing areas outlined above for review by the Engineer.

#### **1.5 Trees**

- 1.5.1 Protect all existing trees and shrubs from damage. Protect foliage, branches, trunks and roots from damage by equipment, men or construction materials. Do not permit encroachment of machinery within the drip line in order to prevent damage to roots, trunk and foliage.
- 1.5.2 Remove trees and shrubs only as directed by the Engineer or specifically shown on the drawings.
- 1.5.3 Where damage does occur beyond recovery and cannot be replaced by similar plant material of the same type and size, pay penalties as established by the International Society of Arboriculture's booklet entitled 'A Guide to Professional Evaluation of Landscape Trees, Specimen Shrubs and Evergreens'.

#### **1.6 Erosion and Sediment Control**

- 1.6.1 Prior to the commencement of any work on this project which might cause erosion and/or sedimentation, the Contractor must receive approval from the Engineer for an erosion and sedimentation control program proposed by the Contractor. This program must be in accordance with Ontario Guidelines on Erosion and Sediment Control for Urban Construction Sites (latest revision).
- 1.6.2 Ensure adequate environmental protection and take precautions at times of inclement weather (i.e., ensure erosion and sedimentation control measures are functioning effectively and install additional measures as necessary).
- 1.6.3 All costs for developing and implementing an erosion and sediment control program shall be included in the price tendered.

#### **1.7 Site Drainage and Unwatering Discharge**

- 1.7.1 Unwatering is defined as the removal of standing water in an open excavation at less than 50,000 L/day.
- 1.7.2 Direct the discharge of unwatering operations from any site excavation to an adequate sediment basin by pumping unless approved otherwise by the Engineer. The discharge pipe shall be fitted with a "Wetland" filter bag for removal of silt. Filter bags shall be inspected periodically and replaced once full.
- 1.7.3 Prevent soil and debris carried by site drainage from entering existing sewers; swales or draining on to adjacent property in the vicinity. At areas where discharge of unwatering will, of necessity, flow onto adjacent private property make arrangements with the property

owners concerned. Take adequate precautions to prevent damage to adjacent property. Avoid point discharge of unwatering which will cause erosion.

- 1.7.4 Direct all run-off and overland flow from the site working and stockpiling area to an adequate sediment basin prior to discharge to a water course. The sediment basin shall incorporate straw bales, filter berms, sand bags, etc. as required to eliminate silt or debris from entering any watercourse.
- 1.7.5 Install check dams and silt control fencing in locations as shown on the drawings and other locations, as directed by the Engineer.
- 1.7.6 The inspection, and cleaning as required, of siltation barriers shall be carried out weekly and after each rainfall. During prolonged rainfall, check daily. Clogged filter materials such as crushed stone or straw bales, etc., shall be replaced as required and as directed by the Engineer.
- 1.7.7 If the erosion and sediment control measures are damaged or fail the Contractor is responsible for rapid and effective response to such events to minimize the introduction of sediments to aquatic systems.

## **1.8 Noise Control**

- 1.8.1 If machinery, motors, pumps and other similar equipment must be operated beyond the normal working hours, keep the noise below a level acceptable to the Engineer by housing the equipment at no additional cost to the Contract.
- 1.8.2 Establish and maintain site procedures such that noise levels from construction areas are minimized. Use vehicles and equipment equipped with efficient muffling devices. Provide and use devices that will minimize noise levels in the construction area. Adhere to all local noise bylaws.

## **1.9 Dust Control**

- 1.9.1 Prevent dust nuisance resulting from construction operations at all locations on site. Provide water for dust control as directed by the Engineer.
- 1.9.2 Use appropriate covers on trucks hauling fine or dusty material.
- 1.9.3 Use watertight vehicles to haul wet materials.
- 1.9.4 Employ only wet type equipment for saw cutting, or concrete grinding to control dust nuisance.
- 1.9.5 All trenches and areas disturbed by construction works that will produce dust shall be maintained dust free by an application of water.
- 1.9.6 Obtain Engineer's approval before chemicals are used for dust control. Under no circumstances is sodium chloride permitted for dust control.
- 1.9.7 Do not use calcium chloride on access roads.

#### **1.10 Mud Control**

- 1.10.1 Keep plant and public roadways clean and free from mud.
- 1.10.2 Provide mud mats and/or wash stations to prevent tracking of mud from any portion of the contract limits onto any paved roadway.
- 1.10.3 Obtain and pay for the services of clean outside roads into the site with a street sweeper vehicle as required; or as directed by the Engineer. The street sweeper should be capable of wet and dry cleaning. Ensure that dust is controlled during cleaning operations. Mud, dust and other debris from the construction site will not be permitted on the main roads leaving the site. The Contractor will be responsible for street cleaning as required for the duration of construction until Substantial Performance.

#### **1.11 Refuelling Areas**

- 1.11.1 Carry out all refuelling, except the fuelling of backhoes and shovels at approved refuelling areas only.
- 1.11.2 Review in detail proposed route and sequencing of construction to plan access routes and fuelling areas. Establish suitable fuelling and maintenance areas and obtain approval from Engineer.
- 1.11.3 Do not refuel, clean or maintain equipment adjacent to or in any watercourses or drains leading to watercourses. Do not fuel equipment within 30 metres of any watercourse unless non-spill facilities are used. Emptying of fuel, lubricants, pesticides or construction materials into any watercourse is strictly forbidden.

#### **1.12 Cleaning Equipment**

- 1.12.1 Clean construction equipment prior to entering roadways. Do not clean equipment in locations where debris can gain access to sewers or watercourses.

#### **1.13 Contingency and Emergency Response Plans**

- 1.13.1 To fulfil its commitment to protecting public and worker health and safety, and the environment, the Contractor is required to adopt a preventive strategy. Through this strategy, the potential issues and emergency events that can be anticipated will be identified and procedures put in place to minimize their potential occurrence.
- 1.13.2 To address unanticipated events, the Contractor is required to develop Contingency and Emergency Response Plans and implement these plans as part of its contract with the Owner for undertaking the Project.

#### **1.14 Spills**

- 1.14.1 Submit procedures for interception, rapid clean up and disposal of spillages that may occur for Engineer's review prior to commencing work. Be prepared at all times to intercept, clean up and dispose of any spillage that may occur. Keep all materials required for clean-up of spillages readily accessible on site.

- 1.14.2 Report immediately any spills causing damage to environment to:
- .1 Spills Action Centre of the Ministry of the Environment, Conservation and Parks Tel. 1 (800) 268-6060 and (416) 325-3000.
  - .2 The Municipality in which the spill occurred and the operating authority of the supply system water plant.
  - .3 Any other authority having jurisdiction or an interest in the spill including any Conservation Authority, water supply authorities, drainage authority, road authority, fire department, etc.
  - .4 The Owner of the pollutant, if known.
  - .5 The person having control over the pollutant if known.
  - .6 The Engineer.
- 1.14.3 Contact the manufacturer of the pollutant, if known, and ascertain the hazards involved, precautions required and best measures to be used in any clean up or mitigating action.
- 1.14.4 Take immediate action using any available resources to contain and mitigate the effects on the environment from any accidental spill.
- 1.15 Removal and Disposal**
- 1.15.1 Remove surplus materials and temporary facilities and controls from the Site.
- 1.15.2 Dispose of all non-contaminated waste materials, litter, debris and rubbish off-Site.
- 1.15.3 Do not burn or bury rubbish and waste materials on the Site.
- 1.15.4 Do not dispose of volatile or hazardous wastes such as mineral spirits, oil, or paint thinner in storm or sanitary drains.
- 1.15.5 Do not discharge wastes into streams or waterways.
- 1.15.6 Dispose of debris including excess construction material, non-contaminated litter and rubbish at an appropriate off-Site facility identified by Contractor and approved by Owner.
- 1.16 Environmental Awareness Training**
- 1.16.1 The Contractor is responsible for developing and implementing environmental awareness training to ensure that all on-site personnel are aware of environmental sensitivities associated with their actions; their roles and responsibilities in protecting the environment; and the mechanisms available for them to carry out their environmental protection responsibilities. The training program must include specific environmental awareness programs for the Contingency and Emergency Response Plans developed for the project.
- 1.16.2 The Contractor is responsible for submitting the training program for the Engineer's review and approval. The appropriate changes are to be made based on Engineer's review comments



**2      PRODUCTS (NOT APPLICABLE)**

**3      EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Requirements Included**

#### **1.1.1 Regulations affecting the Work imposed by the most recent editions of**

- .1 American Water Works Association
- .2 Ontario Building Code.
- .3 Occupational Health and Safety Act Regulations for Construction projects, covering safety, hazardous materials, Workplace Hazardous Material Information Ontario.
- .4 Ministry of the Environment, Conservation and Parks (MECP)
- .5 Municipal by-laws and servicing standards.
- .6 Municipal utilities.
- .7 Ontario Fire Code (OFC)
- .8 Boilers & Pressure Vessels Act Ontario (MCCR, TSSA, etc.)
- .9 Energy Act Ontario
- .10 Ontario Electrical Safety Code (OESC), latest edition and ESA bulletins
- .11 Environmental Protection Act, Ontario Regulation 309
- .12 Environment – Air, Ontario Regulation 346
- .13 Environment – Noise, Ontario Regulation NPC 205
- .14 Codes & Standards for National Fire Protection Association (NFPA)
- .15 Ontario Reduce, Reuse and Recycle Regulations O.Reg. 101/94-105/94
- .16 CSA Certificate Standards and Electrical Bulletins
- .17 OSHA Standards for equipment
- .18 CSA 2462-08 Safety in Workplace for Arc Flash Hazard
- .19 Local Conservation Authority
- .20 Municipal by-Laws and Regulations

### **1.2 Compliance with Regulations**

#### **1.2.1 Ascertain requirements and regulations of authorities listed above.**

- 1.2.2 Comply with all such requirements and regulations as applicable to the Work.
- 1.2.3 Requirements set out in this Section are for guidance and information and are not necessarily complete.

### **1.3 Codes and Standards**

- 1.3.1 The Contractor will:
- .1 Perform work in accordance with the latest named published editions of codes and standards.
  - .2 Provide material and workmanship, which meet or exceed the specifically named code or standard.
  - .3 Execute Work in accordance with the applicable Federal, Provincial, Territorial and Municipal statutes, laws, regulations to the location of the Work to be performed.
  - .4 In the event of conflict of above statutes, laws, regulations and codes execute work in accordance with the requirements of the Authority having jurisdiction.
  - .5 Enforce all safety measures in accordance with the Ontario Occupational Health and Safety Act and applicable local Construction Safety.
  - .6 Enforce all safety measures in accordance with the Workplace Hazardous Materials Information System (WHMIS).
  - .7 For the purpose of the Occupational Health and Safety Act, the Contractor for the Works will be designated "Constructor" and will assume the responsibility of the Constructor as set out in the Act and its regulations. The Engineer will monitor the quality and quantity of work, undertake progress payment inspections and inspections for compliance with specifications and plans. The Owner will NOT be a "Constructor" by reason thereof.
  - .8 Provide the Director of Construction Health and Safety Branch of the Ministry of Labour with the information required under the Occupational Health and Safety Act prior to commencing work.

### **1.4 Permits**

- 1.4.1 The Owner will apply for, obtain and pay for all permits required for the Works, including but not limited to:
- .1 All utilities approvals.
  - .2 Ministry of the Environment, Conservation and Parks
  - .3 Building permit.
  - .4 Permits to Take Water.
  - .5 Ministry of Labour.
  - .6 Local Region Conservation Authority

- 1.4.2 The Owner will secure the approval from the Ontario Ministry of Environment, Conservation and Parks.
- 1.4.3 The Contractor will apply for, obtain and pay for a demolition permit if required for the Works.
- 1.4.4 The Contractor will arrange for and inform the Engineer of inspections required by building permits, TSSA, ESA or any other Regulatory body requiring inspection.
- 1.4.5 The Contractor will arrange for and inform the Engineer of all other regular and final inspections required.
- 1.4.6 The Contractor will be responsible for all payments for the inspections as required for the permits.

**1.5 Work in Vicinity of Overhead Power Lines**

- 1.5.1 Contractor to confirm the setback requirements for operation near power lines with local utility.
- 1.5.2 Request Power Company to relocate, de-energize or guard any energized conductor where construction equipment may operate within 3 m of conductor.
- 1.5.3 Obtain Power Company approval prior to operating any equipment within 3 m of energized conductor.
- 1.5.4 Where practical, avoid storage of metallic pipe sections under high voltage overhead power lines.
- 1.5.5 If pipe sections must be stored under power lines, protect personnel from effects of induced currents by grounding pipe sections at two (2) locations with AWG #2 copper ground conductors and grounding rods.
- 1.5.6 Complete and submit applicable WSIB Forms prior to commencement of work.
- 1.5.7 Provide appropriate signs where required as per OSHA Section 44, 3(e)

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Intent of Section**

- 1.1.1 This section provides a list of references, standards and organizations that may be referred to throughout these documents by an abbreviation. The abbreviations and details on the organization and contact information are provided in this section.

### **1.2 References**

- 1.2.1 AA Aluminum Association, 900 19th Street N.W., Washington, D.C., U.S.A. 20006 <http://www.aluminum.org>.
- 1.2.2 AASHTO American Association of State Highway and Transportation Officials, 444 N Capitol Street N.W., Suite 249, Washington, D.C., U.S.A. 20001 <http://www.aashto.org>.
- 1.2.3 ACI American Concrete Institute, P.O. Box 9094, Farmington Hills, Michigan U.S.A. 48333
- 1.2.4 AHA American Hardboard Association, 887 B Wilmette Road, Palatine, Illinois, U.S.A. 60067
- 1.2.5 AITC American Institute of Timber Construction, 7012 S. Revere Parkway, Suite 140, Englewood, Colorado, U.S.A. 80112
- 1.2.6 AMCA Air Movement and Control Association Inc., 30 West University Drive, Arlington Heights, Illinois, U.S.A. 60004 1893 <http://www.amca.org>
- 1.2.7 ANSI American National Standards Institute, 11 West 42nd Street, New York, New York, U.S.A. 10036 <http://www.ansi.org>
- 1.2.8 API American Petroleum Institute, 1220 L St. Northwest, Washington, D.C., U.S.A. 20005 4070 <http://www.api.org>
- 1.2.9 ARI Air Conditioning and Refrigeration Institute, 1815 North Fort Myer Drive, Arlington, Virginia, U.S.A. 22209 <http://www.ari.org>
- 1.2.10 ASHRAE American Society of Heating, Refrigeration and Air Conditioning Engineers, 1791 Tullie Circle NE, Atlanta, Georgia, U.S.A. 30329 <http://www.ashrae.org>
- 1.2.11 ASME American Society of Mechanical Engineers, United Engineering Centre, 345 East 47th Street, New York, New York, U.S.A. 10017 2392 <http://www.asme.org>
- 1.2.12 ASTM American Society for Testing and Materials, 100 Barr Harbor Drive West, Conshohocken, Pennsylvania 19428 2959 <http://www.astm.org>
- 1.2.13 AWCI Association of the Wall and Ceiling Industries, 1711 Connecticut Avenue N.W., Washington, D.C. U.S.A. 20009 <http://www.awci.org>
- 1.2.14 AWMAC Architectural Woodwork Manufacturers Association of Canada, 516 4 Street West, High River, Alberta T1V 1B6 <http://www.awmac.com>
- 1.2.15 AWS American Welding Society, 550 N.W. LeJeune Road, Miami, Florida U.S.A. 33126 <http://www.amweld.org>

- 1.2.16 AWWA American Water Works Association, 6666 W. Quincy Avenue, Denver, Colorado, U.S.A. 80235 <http://www.awwa.org>
- 1.2.17 CFFM Canadian Forces Fire Marshal, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2
- 1.2.18 CGA Canadian Gas Association, 243 Consumers Road, Suite 1200, North York, Ontario M2J 5E3 <http://www.cga.ca>
- 1.2.19 CGSB Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 <http://w3.pwgsc.gc.ca/cgsb>
- 1.2.20 CISC Canadian Institute of Steel Construction, 201 Consumers Road, Suite 300, Willowdale, Ontario M2J 4G8
- 1.2.21 CITC Canadian Institute of Timber Construction, 200 Cooper Street, Ottawa, Ontario K2P 0G1
- 1.2.22 CMB Construction Materials Board, 101 Colonel By Drive, 8NT MGen George R. Pearkes Bldg., Ottawa, Ontario K1A 0K2
- 1.2.23 COFI Council of Forest Industries, 555 Burrard, Suite 1200, Vancouver, B.C. V7X 1S7 <http://www.cofi.org>
- 1.2.24 CRCA Canadian Roofing Contractors Association, 151 Slater Street, Suite 606, Ottawa, Ontario K1P 5H3
- 1.2.25 CSA Canadian Standards Association, 178 Rexdale Blvd., Etobicoke, Ontario M9W 1R3 <http://www.csa.ca>
- 1.2.26 CSC Construction Specifications Canada, 100 Lombard Street, Suite 200, Toronto, Ontario M5C 1M3
- 1.2.27 CSDFMA Canadian Steel Door and Frame Manufacturing Association One Yonge Street, Suite 1400, Toronto, Ontario M5E 1J9
- 1.2.28 CSPI Corrugated Steel Pipe Institute, 201 Consumers Road, Suite 306, Willowdale, Ontario M2J 4G8
- 1.2.29 CSSBI Canadian Sheet Steel Building Institute, 201 Consumers Road, Suite 305, Willowdale, Ontario M2J 4G8 <http://www.cssbi.ca>
- 1.2.30 CWC Canadian Wood Council, 1400 Blair Place, Suite 210, Ottawa, Ontario K1J 9B8 <http://www.cwc.ca>
- 1.2.31 EEMAC Electrical and Electronic Manufacturers' Association of Canada, 1 Yonge Street, Suite 1608, Toronto, Ontario M5E 1R1 <http://www.electro.ca>
- 1.2.32 FCC Fire Commissioner of Canada, Place du Portage, Phase II, 165 rue Hotel de Ville, Hull Quebec K1A 0J2
- 1.2.33 ICPI Interlocking Concrete Pavement Institute, P.O. Box 23053, Milton, Ontario L9T 2M0 <http://www.icpi.org/icpi>

- 1.2.34 IEEE Institute of Electrical and Electronics Engineers, 345 East 47th Street, New York, New York U.S.A. 10017
- 1.2.35 MTO - Ministry of Transportation Ontario.
- 1.2.36 MECP – Ministry of the Environment, Conservation and Parks.  
<https://www.ontario.ca/page/ministry-environment-conservation-parks>
- 1.2.37 MSS Manufacturers Standardization Society of the Valve and Fittings Industry, 127 Park Street, N.E., Vienna, Virginia U.S.A. 22180
- 1.2.38 NAAMM National Association of Architectural Metal Manufacturers, 8 South Michigan Avenue, Suite 1000, Chicago, Illinois U.S.A. 60603 <http://www.naamm.org>
- 1.2.39 NBC – National Building Code.
- 1.2.40 NFC – National Fire Code.
- 1.2.41 NEMA National Electrical Manufacturers Association, 1300 N. 17th Street, Suite 1847, Rosslyn, Virginia 22209 <http://www.nema.org>
- 1.2.42 NFPA National Fire Protection Association, 1 Batterymarch Park, Quincy, Massachusetts, U.S.A. 02269 9101 <http://www.nfpa.org>
- 1.2.43 NFSA National Fire Sprinkler Association, P.O. Box 1000, Patterson, New York, U.S.A. 12563 <http://www.nfsa.org>
- 1.2.44 NHLA National Hardwood Lumber Association, P.O. Box 34518, Memphis, Tennessee, U.S.A 38184 0518 <http://www.natlhardwood.org>
- 1.2.45 NLGA National Lumber Grades Authority, 260 1055 West Hastings, Vancouver, B.C. V6E 2E9
- 1.2.46 NRC National Research Council, Montreal Road, Ottawa, Ontario K1A 0S2
- 1.2.47 NSF International – P.O. Box 130140, 789 North Dixboro Road, Ann Arbor, Michigan 48105, USA <http://www.nsf.org>
- 1.2.48 OBC – Ontario Building Code.
- 1.2.49 PCI Prestressed Concrete Institute, 175 W. Jackson Blvd., Suite 1859, Chicago, Illinois, U.S.A. 60604 <http://www.pci.org>
- 1.2.50 QPL Qualification Program List, c/o Canadian General Standards Board, Place du Portage, Phase III, 6B1, 11 Laurier Street, Hull, Quebec K1A 1G6 <http://w3.pwgsc.gc.ca/cgsb>
- 1.2.51 SAE Society of Automotive Engineers, 400 Commonwealth Drive, Warrendale, Pennsylvania 15096 0001 <http://www.sae.org>
- 1.2.52 SCC Standards Council of Canada, 1200 45 O'Connor Street, Ottawa, Ontario K1P 6N7 <http://www.scc.ca>

- 1.2.53 SMACNA Sheet Metal and Air Conditioning Contractors' National Association, 4201 Lafayette Center Drive, Chantilly, Virginia 20151 1209 <http://www.smacna.org>
- 1.2.54 SSPC Steel Structures Painting Council, 40 24th Street, Pittsburgh, Pennsylvania 15222 4656 <http://www.sspc.org>
- 1.2.55 The Technical Standards and Safety Authority (TSSA), 345 Carlingview Drive, Toronto, Ontario M9W 6N9 <http://www.tssa.org>
- 1.2.56 TTMAC Terrazzo, Tile and Marble Association of Canada, 30 Capston Gate, Unit 5 Concord, Ontario L4K 3E8 <http://www.ttmac.com>
- 1.2.57 UL Underwriters' Laboratories, 333 Pfingsten Road, Northbrook, Illinois, U.S.A. 60062 <http://www.ul.com>
- 1.2.58 ULC Underwriters' Laboratories of Canada, 7 Crouse Road, Scarborough, Ontario M1R 3A9 <http://www.ulc.ca>
- 1.2.59 USACE United States Army Corps Engineers, Huntsville, Alabama <http://www.hnd.usace.army.mil>

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**



## **1 GENERAL**

### **1.1 General**

- 1.1.1 Inspection and testing, by the Owner, is not intended to relieve Contractor of responsibility but is a precaution against errors. Defective materials or workmanship, if found at any time prior to final acceptance of work, shall be rejected regardless of previous inspection.

### **1.2 Inspection**

- 1.2.1 Allow the Engineer access to the Works at all times. If part of Work is prepared at locations other than the job site, allow access to such work whenever it is in progress.
- 1.2.2 Give timely notice requesting inspection if work is designated for special tests, inspections or approvals by the Engineer instructions.
- 1.2.3 If the Contractor covers or permits to be covered, work that has been designated for special tests, inspections or approvals before such is made, uncover such work, have inspections or tests satisfactorily completed and make good such work.
- 1.2.4 The Engineer may order any part of the Works to be examined if work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such work and pay cost of examination and correction. If such work is found in accordance with Contract Documents, the Owner will pay the cost of examination.

### **1.3 Independent Inspection Agencies**

- 1.3.1 The Owner and/or Engineer may engage a Testing Laboratory or Independent Inspection/Testing Agencies for the purpose of inspecting and/or testing portions of Work. The cost of such services will be borne by the Owner.
- 1.3.2 Provide equipment required for executing inspection and testing by appointed agencies.
- 1.3.3 Employment of inspection/testing agencies does not relieve the Contractor from responsibility to perform work in accordance with the Contract Documents.
- 1.3.4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by the Engineer at no cost to the Owner. The Contractor is to pay costs for retesting and re-inspection.

### **1.4 Liquid Leakage Tests**

- 1.4.1 Before backfill has been placed against walls or any other activity that would prevent proper testing, test all liquid holding structures for leakage. Liquid retaining structures include:
- .1 Tanks
  - .2 Channels
  - .3 Chambers

- 
- 1.4.2 The Works and leakage testing shall conform to all requirements of ACI 350.1-10 published by the American Concrete Institute, Farmington Hills, Michigan, except as modified by these Contract Documents.
- 1.4.3 The test method in Clause 1.4.2 shall also apply for testing of:
- .1 Secondary containment structures
  - .2 Precast concrete structures
  - .3 Prefabricated structures made up of any material that are not governed by any other leakage test requirements.
- 1.4.4 Each cell of multi-cell containment structures shall be considered a single containment structure.
- 1.4.5 A leakage test is also required for any existing structures that the Contractor has performed Work on, unless instructed otherwise by the Engineer.
- 1.4.6 Leakage test shall be conducted prior to installation of any coating or waterproofing.
- 1.4.7 Test all liquid holding structures for leakage by filling with water. The test water level shall be at the maximum liquid level indicated on the Contract Drawings.
- 1.4.8 Provide temporary plugs and barriers where necessary to facilitate the test. All containment structure penetrations and inlet/outlets shall be securely sealed to prevent the loss of water from the containment structure during the test.
- 1.4.9 The ground water level shall be brought to a level below the top of the base slab and kept at that elevation or at a lower elevation during the test.
- 1.4.10 Repair all visible damage prior to filling the structure with water.
- 1.4.11 The Contractor shall be responsible for coordinating the supply of water for the leakage tests and for transferring water from one structure to the next for leakage test purposes. The Contractor shall also be responsible for final disposal of the water used for leakage testing.
- 1.4.12 Fill with water, and repair any visible leaks and measure leakage.
- 1.4.13 Repeat test until leakage is less than the permitted amount.
- 1.4.14 Complete leakage tests and reduce leakage to the specified limit before applying waterproofing.
- 1.4.15 After installation of the connecting pipe work the Owner will supply sufficient water from the existing system to carry out the first test. Should any subsequent tests be required, water will be supplied, but at the Contractor's expense. In wastewater treatment plants, the Owner may choose to supply effluent water to facilitate the leakage test. The Contractor shall be responsible for all transferring, filling, draining and any subsequent cleaning that may be required due to use of effluent water.

**1.5 Access to Work**

- 1.5.1 Allow inspection/testing agencies access to the Works, off-site manufacturing and fabrication plants. Cooperate to provide reasonable facilities for such access.
- 1.5.2 Provide confined space access as required for inspection of the works.

**1.6 Procedures**

- 1.6.1 Notify appropriate agency and the Engineer in advance of requirement for tests, in order that attendance arrangements can be made.
- 1.6.2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in an orderly sequence so as not to cause delay in work.
- 1.6.3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

**1.7 Rejected Work**

- 1.7.1 Remove defective work, whether a result of poor workmanship, use of defective products or damage and whether incorporated in work or not, which has been rejected by the Engineer as failing to conform to Contract Documents. Replace or re execute in accordance with Contract Documents.
- 1.7.2 Make good other contractor's work damaged by such removals or replacements promptly.
- 1.7.3 If it is the opinion of the Engineer that it is not expedient to correct defective work or work not performed in accordance with the Contract Documents, the Owner may deduct from Contract Price difference in value between work performed and that called for by Contract Documents, amount of which shall be determined by the Engineer.

**1.8 Tests and Mix Designs**

- 1.8.1 Furnish test results and mix designs as may be requested. The cost of tests and mix designs beyond those called for in Contract Documents shall be appraised by the Engineer and may be authorized as recoverable.

**1.9 Layout of Work**

- 1.9.1 Where systems, piping and/or equipment are concentrated in a small work area, prepare interference drawings, per Section 1330, of the work to define potential conflicts or challenges in work sequencing, as requested by the Engineer.
- 1.9.2 Plan the total installation by preparing a minimum 1:50 scale reproduceable interference drawing detailing the location and identifying each system to the Engineer for review. Include for work of all disciplines on drawing.
- 1.9.3 Install systems and products to provide the maximum headroom, clearances for access, specified floor to ceiling heights, and to minimize offsets in pipes, conduit, ducts and structural framing.

1.9.4 Run pipes, ducts, tubing and conduit plumb or level (except where specific slope is required for proper function) and parallel with building surfaces.

1.9.5 Notify the Engineer and request clarification if locations of fixtures, fittings, equipment and services to these items interfere with interior finishes and use of the work.

**1.10 Mill Tests**

1.10.1 Submit mill test certificates as required of Specifications Sections or as requested by the Engineer.

**1.11 Equipment and Systems**

1.11.1 Submit adjustment and balancing reports for mechanical, electrical and building equipment systems.

**1.12 Minimum Standard**

1.12.1 The Specifications and the Contract Drawings define a minimum standard of Workmanship. The Contractor shall include in the Tender, the cost of any additional work or improvements in the quality of the Works that the Contractor considers necessary to unconditionally guarantee the performance of the completed work in conformity with the Contract through the Warranty Period.

**1.13 Workmanship**

1.13.1 The quality of the workmanship and finished product shall present a neat and attractive appearance when finished.

1.13.2 If ordered by the Engineer, the Contractor shall make enough openings in the Works and/or materials as are necessary to inspect the works.

1.13.3 Should the Engineer find the work and/or materials so opened up to be faulty in any respect, the Contractor shall remove and make good all defective work and/or materials and shall bear the expense of all such opening, inspecting, and making good.

1.13.4 Should the Engineer find the work and/or materials so opened up to be in acceptable condition, the expense of such opening and closing will be borne by the Owner.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Section Includes**

- 1.1.1 Temporary utilities for the work including power, water, heating, ventilation, telephone and internet communication to be used during construction.
- 1.1.2 The Contractor shall install and pay for all temporary utilities.

### **1.2 Installation and Removal**

- 1.2.1 Provide temporary utilities and controls in order to execute work properly, safely and expeditiously.
- 1.2.2 Remove all temporary works from site after use, unless otherwise directed by the Engineer or specified in this specification. Work for the Engineer's site office will not be removed.
- 1.2.3 Make all necessary applications, obtain permits and pay for all hook-ups, fees, charges for service and use.

### **1.3 Localized Unwatering**

- 1.3.1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water. Unwatering pumps shall be electrical to keep the noise of running motors to a minimum.
- 1.3.2 Dispose of all groundwater and surface water runoff in a manner approved by the Engineer and Owner, as per Section 01400 – Environmental Protection or Section 02140 – Dewatering as required by the Contract.

### **1.4 Temporary Water Supply**

- 1.4.1 The Contractor shall make arrangements with the Owner for a continuous supply of potable water for construction use. The Contractor shall connect to water supply and meter this supply for record and billing purposes. The Contractor must employ all reasonable steps and precautions to conserve water supplied. The connection point and method of connection will be subject to the approval of the Engineer and the Owner. A backflow prevention device meeting applicable code requirements must be supplied and installed at the point of connection by the Contractor.

### **1.5 Temporary Heating and Ventilation**

- 1.5.1 Any construction heaters used inside a building must be vented to the outside or be flameless type. Solid fuel salamanders are not permitted.
- 1.5.2 Provide temporary heat and ventilation in enclosed areas as required to:
  - .1 Facilitate progress of the Works.
  - .2 Protect the Works and products against dampness and cold.
  - .3 Prevent moisture condensation on surfaces.

- .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
  - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- 1.5.3 Maintain inside temperatures above a minimum of 13°C in areas and adjacent to areas where construction is in progress or ongoing.
- 1.5.4 Ventilating:
  - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.
  - .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
  - .3 Dispose of exhaust materials in a manner that will not result in harmful exposure to persons.
  - .4 Ventilate storage spaces containing hazardous or volatile materials.
  - .5 Ventilate temporary sanitary facilities.
  - .6 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- 1.5.5 The Contractor shall provide its own temporary heating and ventilation system to facilitate construction of the Works. If permitted by the Owner, the Contractor may use the permanent heating and ventilation system of the Facility. Be responsible for damage to heating and ventilation system if use is permitted. If the permanent heating and ventilation system is used, then all maintenance requirements for the system shall be performed by the Contractor. The Contractor shall perform maintenance as recommended by the system manufacturer and required by the Owner. All maintenance activities performed by the Contractor shall be documented and submitted to the Engineer and Owner.
- 1.5.6 Substantial Performance will not be issued until the entire system is as near original condition as possible and is certified by the Engineer.
- 1.5.7 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
  - .1 Conform with applicable codes and standards.
  - .2 Enforce safe practices.
  - .3 Prevent abuse of services.
  - .4 Prevent damage to finishes.
  - .5 Vent direct-fired combustion units to outside.
- 1.5.8 Be responsible for damage to the Works due to failure in providing adequate heat and protection during construction.

## **1.6 Temporary Power**

- 1.6.1 The Contractor shall provide electric power distribution equipment, cabling and panels for both construction of the Work and feed the temporary construction trailers. The Contractor shall determine the type and amount of power required and provide both a power source and/or connections for obtaining temporary electric power service and metering equipment, and pay all costs for the electric power used during the Contract Time, except for the portions of the Work, if any, which have been designated in writing by the Engineer as being substantially performed and which have been assumed by the Owner.
- 1.6.2 The Contractor shall notify and make arrangements with the Utility Company for the supply of electric power for construction of the Works.
- 1.6.3 The Contractor shall replace any blown fuses or damaged breakers and repair any other damage caused. The Contractor shall provide extension cords as required. The Contractor shall not overload circuits beyond their rated capacities.
- 1.6.4 The Contractor shall provide ground fault protection for all electrical equipment.
- 1.6.5 The Contractor shall be responsible for payment of direct charges to the Utility Company for the provision of electric power for construction of the Works.
- 1.6.6 The Contractor may provide their own portable generators for power generation, inclusive of fuel, operation and maintenance, size appropriately for the intended work. The generator must be noise attenuated to 45 dB units from at least five metres distance under any operating condition.

## **1.7 Temporary Lighting**

- 1.7.1 The Contractor shall provide temporary lighting to meet all applicable safety requirements to allow for erection, application, or installation of materials and equipment, and observation or inspection of the Work.
- 1.7.2 The existing lighting systems may be used at no cost and to the extent possible during construction. The Contractor shall provide additional lighting as required. When the Work is complete, the Contractor shall clean all permanent fixtures and lamps that have become soiled by the performance of the Work.
- 1.7.3 The Contractor shall secure all temporary lighting and wiring from damage, falling or tripping hazards.

## **1.8 Temporary Communication Facilities**

- 1.8.1 The Contractor will provide and pay for telephone hook up equipment necessary for the Contractor's own use.
- 1.8.2 The Contractor will provide and pay for a high-speed internet service and related equipment necessary for the Contractor's and Engineer's own uses and to facilitate on-line project collaboration.

**1.9 Fire Protection**

- 1.9.1 Provide and maintain temporary fire protection equipment during performance of the Works required by governing codes, regulations and bylaws.
- 1.9.2 Burning rubbish and construction waste materials is not permitted on site.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**



## **1 GENERAL**

### **1.1 Submittals**

#### **1.1.1 Informational Submittals:**

- .1 Copies of permits and approvals for construction as required by all applicable laws, regulations and governing agencies.
- .2 Temporary Utility Submittals:
  - .1 Electric power supply.
  - .2 Water supply.
- .3 Temporary Construction Submittals:
  - .1 Parking area plans.
  - .2 Contractor's field offices locations, location of storage yard, and storage building plans, including gravel surfaced area.
  - .3 Fencing and protective barrier locations and details.
  - .4 Designated Work Areas - Fencing and protective barrier locations and details inside existing facilities to isolate New Work from ongoing Operations.
  - .5 Plan for temporary drainage course detour and details.
  - .6 Tower crane location plans (if applicable)
- .4 Temporary Control Submittals:
  - .1 Noise control plan.
  - .2 Dewatering well locations.
  - .3 Plan for disposal of waste materials and intended haul routes.
  - .4 Plan for sediment control and storm water management.

- 1.1.2 The Engineer has the right to modify the proposal for temporary works or connections at no additional cost to the Owner.

### **1.2 Mobilization**

#### **1.2.1 Mobilization of construction facilities shall include, but not be limited to, these principal items:**

- .1 Obtaining all required permits.

- .2 Moving the Contractor's field office and equipment required for the first month of operations onto the Site.
- .3 Moving Owner and Engineer's Field office and equipment onto site
- .4 Installing temporary construction power, wiring, and lighting facilities.
- .5 Providing on Site communication facilities, including telephones.
- .6 Providing on Site sanitary facilities and potable water facilities as specified in the Contract Documents and as required by all applicable laws, regulations, and governing agencies.
- .7 Providing sedimentation and erosion control measures, including silt fencing and straw bale flow checks and the maintenance and repair (if necessary) of these facilities.
- .8 Arranging for and erection of the Contractor's work and storage yard.
- .9 Posting of the Occupational Health and Safety Act required notices and establishing safety programs and procedures.
- .10 Having the Contractor's superintendent at the Site full time.

1.2.2 Use the area designated for the Contractor's temporary facilities as shown on the Drawings.

### **1.3 Temporary Utilities**

- 1.3.1 Provide temporary utilities and controls in order to execute work expeditiously.
- 1.3.2 Remove all temporary works from site after use.
- 1.3.3 Co-ordinate all required utilities with the utility company. Provide details of the proposed temporary service connection and metering provisions prior to installation.
- 1.3.4 Make all necessary applications, obtain permits and pay for all fees, charges for service and use.
- 1.3.5 Contractor shall be responsible to all water, power and consumables that are required to carry out the Work.

### **1.4 Site Documents**

- 1.4.1 Maintain documents and materials on-site, in Contractor's Site Office, in accordance with these specifications.
- 1.4.2 Maintain documents in order and make available for viewing by Engineer and Ministry of Labour Inspector at all times.

### **1.5 Storage Sheds**

- 1.5.1 Provide adequate weather tight sheds with raised floors for storage of materials, tools and equipment which are subject to damage by weather.

1.5.2 Provide heated storage structures.

1.5.3 Maintain storage sheds in neat and clean condition.

## **1.6 First Aid Facilities**

1.6.1 Provide and maintain on Site, in a clean orderly condition, completely equipped First-Aid facilities readily accessible at all times to Contractor's employees and Engineer.

1.6.2 Facilities and staffing to be in accordance with the Industrial First Aid Regulations of the Workplace Safety and Insurance Board and OHSA regulations.

## **2 PRODUCT**

### **2.1 Temporary Buildings**

2.1.1 Provide temporary buildings that meet the requirements of the Occupational Health and Safety Act.

2.1.2 Maintain temporary buildings clean and free from nuisances so as to avoid danger to Owner's personnel, property or structures, prevent complaints from the Engineer and prohibit interference with the operation of the existing Facility.

2.1.3 Prior to erection of temporary buildings to be used for construction purposes determine the extent of space required by Contractor for storage, temporary buildings, construction roads and parking, and submit a proposed layout of Contractor's compound including details of the type and proposed location of the temporary buildings.

2.1.4 Locate construction trailers and temporary buildings within the limits of the construction area or property boundaries shown on the Contract drawings and as agreed with the Engineer.

2.1.5 Provide and maintain on the site such substantially constructed, weather-tight structures as will adequately house and service personnel of the Contractor working on the project. In addition, furnish and maintain satisfactory weather-tight enclosures with raised floors as may be required to adequately protect materials and equipment stored on the site.

2.1.6 When temporary building facilities are no longer required, promptly dismantle and remove from the site, unless otherwise specified or directed. Restore areas damaged to conditions at start of Contract to the satisfaction of the Engineers.

2.1.7 Furnish and maintain all apparatus and equipment, such as ladders, scaffolds, ramps, runways, temporary stairs, derricks, hoists, elevators, chutes, etc., as required for the proper execution and progress of the Work. Such facilities shall be strong and substantial and safe for the purpose for which they are intended and shall meet all applicable requirements of governing regulations and authorities.

### **2.2 Site Facilities**

2.2.1 Contractor shall not use Owner or Engineer washroom facilities. Contractor shall maintain Engineer field office facilities in acceptable sanitary conditions, cleaned & disinfected weekly, and consumables replenished as required.

- 2.2.2 Provide and maintain on the site in a clean orderly condition, completely equipped first aid facilities which shall be readily accessible at all times to all Contractor personnel. Designate certain employees who are properly instructed to be in charge of first aid. At least one such employee shall always be available on the site while work is being carried on. Post in conspicuous locations a telephone call list for summoning aid, such as doctors, ambulances, pull motors, and rescue squads from outside sources.
- 2.2.3 The facilities shall be furnished as required by the Workers Compensation Act and the Ministry of Labour.
- 2.2.4 Contractor is to verify that the site facilities meet all the obligations and to provide temporary facilities as required.
- 2.2.5 Maintain facilities with all required toilet room supplies in a clean and sanitary condition and disinfect frequently.
- 2.2.6 Leave site in a clean sanitary condition.
- 2.3 Field Office**
- 2.3.1 Provide Contractor's and Engineer's Site Office in a shared trailer.
- 2.3.2 Floor 0.3 m above grade, complete with four (4) 50% opening windows and one (1) lockable door.
- 2.3.3 Insulate building including floor and roof and provide electric heating system to maintain +22°C inside temperature at -20°C outside temperature.
- 2.3.4 Provide air conditioner for ventilation and to maintain maximum temperature of +22°C at +30°C outside temperature.
- 2.3.5 Finish inside walls and ceiling with plywood, hardboard or wallboard and paint in selected colours. Finish floor with 19 mm thick plywood.
- 2.3.6 Install electrical lighting system to provide min 750 Lx using surface mounted, shielded commercial fixtures with 10% upward light component.
- 2.3.7 Maintain office equipment including installation, troubleshooting, and repairs.
- 2.3.8 Maintain office in clean condition.
- 2.3.9 Remove from site after use.
- 2.3.10 Provide table and seating for up to 4 people for regular site meetings.
- 2.3.11 Subcontractors may provide their own Site offices as necessary. Locate Site offices where directed by the Owner and the Engineer.
- 2.3.12 The Engineer shall be provided with a dedicated office space with a lockable door inside the Contractor's site trailer. The Engineer shall be provided with a chair, desk, power supply and shared access to a high speed wireless internet and printers.

## **2.4 Project Sign**

- 2.4.1 Provide and maintain at least one, 2400mm wide by 1200mm high signs constructed of 19 mm exterior high density overlaid plywood. Signs shall bear the name of the Contract, the Owner, the Contractor, and the Engineer. Paint shall be exterior-type enamel. Information to be included will be provided by the Engineer. Wording and colours on the sign shall be provided to the Contractor.
- 2.4.2 A suitable, stable framework to support each sign shall be provided and erected by the Contractor.
- 2.4.3 The Contractor shall erect project sign at locations acceptable to the Engineer as soon as the Work commences on Site and shall be maintained in position until Completion of the Work. The Contractor shall relocate the project signs when necessary or directed by the Engineer.
- 2.4.4 Upon completion of the Work, the Contractor is responsible for the removal of the signboards and the return of the signboards to the location of origin. No other signs or notices other than those required for the purposes of warning or indicating danger to the public in connection with their Work may be exhibited by the Contractor on the Site without the prior express approval of the Owner.

## **3 EXECUTION**

### **3.1 Security**

- 3.1.1 The Contractor shall assume overall responsibility for security of the site, during construction. Security deemed necessary for protection against loss or damage of any equipment on site in relation to the project shall be the sole responsibility of the Contractor.
- 3.1.2 Confine work and operations of employees as required by Contract Documents. Do not unreasonably encumber premises with products.
- 3.1.3 Prohibit the committing of nuisance on the site and any employee found violating such a provision shall be promptly discharged.
- 3.1.4 Positive visual identification shall be worn at all times and be monitored by the Engineer. Any person without valid identification will be removed from the site. No additional cost shall be incurred by the Owner for persons removed from site.

### **3.2 Access to the Site for Construction Deliveries**

- 3.2.1 Access to the site for deliveries and equipment is also used by other contractors.
- 3.2.2 The Engineer will not accept deliveries of any Construction materials.

### **3.3 Cleaning**

- 3.3.1 Provide professional weekly cleaning services for the Engineer's field offices as follows:
  - .1 Waste paper baskets to be emptied twice per week.
  - .2 Washrooms to be cleaned three times per week

.3 Floors to be swept clean at end of every workday.

.4 Floors to be washed once per week.

3.3.2 Be responsible for maintenance of all electrical, mechanical and general maintenance and upkeep of the Engineering Field office for the duration of the Contract.

### **3.4 Electrical and Temporary Power**

3.4.1 The Contractor shall arrange with the local power utility firm for an electrical power service to his field office and for all location that power is required to carry out construction activities. Contractor shall be responsible for installing all temporary wiring and provide all necessary means to convey the power to the location where it is required.

3.4.2 Temporary power in the form of overhead lines or portable generators shall be provided by the Contractor at no additional cost to the Owner.

3.4.3 Contractor shall pay for metered power consumption to the local hydro company at a rate set in the contract between the Contractor and the local hydro company.

3.4.4 To minimize the duration of shutdowns and to keep the plant operational, the Contractor shall maintain the existing electrical system in operation while all new electrical components required for the final electrical system are constructed.

3.4.5 Power will NOT be provided by the Owner for any temporary works and construction activity. Power by the Owner will only be provided for Functional Testing, Commissioning and Performance Testing.

### **3.5 Construction Parking**

3.5.1 Access to the site for construction personnel is also used by other Contractors, consultants, the Engineer and the Owner.

3.5.2 Contractor's personnel are to park vehicles as directed by the Engineer and noted on the drawing. If sufficient space is not available in the parking lot, arrange for parking elsewhere at no additional cost to the Owner. Do not park construction vehicles, equipment or cars on roads or grass areas within the site.

3.5.3 Snow removal to be performed and paid for by the Contractor at no additional cost to the Contract. Included in the cost of snow removal is the off-site disposal of accumulated removed snow, at a time deemed necessary by the Engineer.

3.5.4 Provide and maintain adequate access to project site.

3.5.5 Build and maintain temporary roads where indicated or directed by the Engineer and provide snow removal during period of Work.

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

**3.6 Hoisting**

- 3.6.1 Provide, operate and maintain hoists and cranes required for moving of workers, materials and equipment.
- 3.6.2 All hoists and cranes shall be operated by qualified operators.

**3.7 Temporary Barriers and Enclosures**

- 3.7.1 Provide temporary barriers to prevent unauthorized entry to construction, site office and on-site parking areas, and to protect existing facilities and adjacent properties from damage from the Contractor's operations.
- 3.7.2 Where appropriate, equipment barriers with vehicular and pedestrian gates with locks.
- 3.7.3 Provide security and facilities to protect the Work and the Site from unauthorized entry, vandalism and theft.
- 3.7.4 Maintain a log of workers and visitors and make the log available to the Engineer upon request. Include the date, name, address and company employed by, company/ person invited, time in and time out for each person, and record deliveries and security incidents.

**3.8 Removal of Temporary Facilities and Controls**

- 3.8.1 At Final Completion of the Contract, remove all temporary field offices, storage facilities, etc., and restore the areas to pre-construction conditions.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section provides the general equipment stipulations that apply to all products, materials and equipment provided for this contract. These requirements are in addition to the detailed requirements that may be covered under individual equipment specification or manufacturer specific requirements.

### **1.2 Reference Standards**

- 1.2.1 Conform to standards, in whole or in part as requested in each of the specifications.
- 1.2.2 If there is a question as to whether any product or system is in conformance with applicable standards, the Engineer reserves the right to have such products or systems tested to prove or disprove conformance.
- 1.2.3 The cost for such testing will be borne by the Owner in the event of conformance with Contract Documents or by the Contractor in the event of non-conformance.
- 1.2.4 Conform to the latest date of issue of referenced standards in effect on date of submission of Tender, except where specific date or issue is specifically noted.

### **1.3 Quality**

- 1.3.1 Products, materials, equipment and articles (referred to as products throughout specifications) incorporated in the Works shall be new, not damaged or defective, and of best quality (compatible with specifications) for purposes intended. If requested, furnish evidence as to type, source and quality of products provided.
- 1.3.2 Defective products identified prior to completion of the Work will be rejected regardless of previous inspections. Inspection by the Engineer or any agent of the Owner at no time relieves the Contractor from responsibility for the supply of acceptable quality products.
- 1.3.3 Remove and replace defective products at own expense and be responsible for delays and expenses caused by the rejection of defective products.
- 1.3.4 Should any dispute arise as to the quality or fitness of any products, the decision to accept the product(s) rests strictly with the Engineer based upon the requirements of the Contract Documents.
- 1.3.5 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Works.
- 1.3.6 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

### **1.4 Availability**

- 1.4.1 Immediately upon signing the Contract, review the product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are



foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be considered and authorized in ample time to prevent delay in performance of the work.

- 1.4.2 In the event of failure to notify the Engineer at commencement of the Works and, should it subsequently appear that the Works may be delayed for such reason, the Engineer reserves the right to substitute more readily available products of similar character, at no increase in the Contract Price or at no change to the Contract Time.

## **1.5 Storage, Handling and Protection**

- 1.5.1 Handle and store products in a manner so as to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions.
- 1.5.2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until they are to be incorporated in the Works.
- 1.5.3 Store products subject to damage from weather in weatherproof enclosures.
- 1.5.4 Store cementitious products clear of earth or concrete floors, and away from walls.
- 1.5.5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- 1.5.6 Store sheet materials, lumber and drywall on flat, solid supports and keep clear of ground. Slope to shed moisture.
- 1.5.7 Store and mix paints in heated and ventilated areas. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- 1.5.8 The Contractor shall protect existing materials that are being modified as part of the Work and shall ensure that all existing materials being modified remain in the same condition as they were prior to the modifications.
- 1.5.9 Remove and replace damaged products at own expense and to the satisfaction of the Engineer.
- 1.5.10 Touch-up damaged factory finished surfaces to the Engineer's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

## **1.6 Transportation**

- 1.6.1 Pay the costs of transportation of products required in performance of the Works.
- 1.6.2 Transportation cost of products supplied by the Owner will be paid for by the Owner.

## **1.7 Manufacturer's Instructions**

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

- 1.7.2 Notify the Engineer in writing of conflicts between Specifications and manufacturer's instructions. The Engineer will clarify or establish the most appropriate solution to the conflict.
- 1.7.3 Improper installation or erection of products, due to failure in complying with manufacturer's instructions, authorizes the Engineer to require removal and re-installation at no increase in the Contract Price or at no change to the Contract Time.
- 1.8 Quality of Work**
  - 1.8.1 Ensure Quality of the Works is of the highest standard and is executed by workers experienced and skilled in their respective duties for which they are employed. Immediately notify the Engineer if the nature of the work is such as to make it impractical to produce required results.
  - 1.8.2 Do not employ anyone unskilled in their required duties. The Engineer reserves the right to require dismissal from the Works of any workers deemed incompetent or careless.
  - 1.8.3 Decisions as to standard or fitness or the Quality of Work, in cases of dispute, rest solely with the Engineer, whose decision is final.
- 1.9 Coordination**
  - 1.9.1 Ensure the cooperation of all work in the layout of the Works. Maintain efficient and continuous supervision over the entire works.
  - 1.9.2 Be responsible for construction and placement of openings, sleeves, accessories and any materials or work necessary to fully coordinate all of the Works outlined in the Specifications.
  - 1.9.3 Before installation, inform the Engineer of all potential interferences and complete installation as directed by the Engineer.
- 1.10 Concealment**
  - 1.10.1 In finished areas, conceal pipes, ducts and wiring in floors, walls and ceilings or as indicated on drawings and specifications.
- 1.11 Remedial Work**
  - 1.11.1 Perform remedial work required to repair or replace parts or portions of the Works identified as defective or unacceptable. Coordinate adjacent affected work as required.
  - 1.11.2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of the Works.
- 1.12 Locations of Fixtures**
  - 1.12.1 Consider location of fixtures, outlets and mechanical and electrical items indicated as approximate. Fully coordinate their final placement and positioning.
  - 1.12.2 Where in doubt, or in the case of potential interferences, inform the Engineer and install as directed.

### **1.13 Material Fasteners**

- 1.13.1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless otherwise indicated.
- 1.13.2 Prevent electrolytic action between dissimilar metals and materials by providing isolation kits, gaskets or some other manner of isolation as directed by Engineer.
- 1.13.3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other materials are specifically requested in the affected Specifications.
- 1.13.4 Space anchors within the individual load limit or shear capacity and ensure that they provide positive permanent anchorage. Wood or any other organic material plugs are not acceptable.
- 1.13.5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- 1.13.6 Fastenings that cause spalling or cracking of material to which anchorage is made, are not acceptable.

### **1.14 Nuts and Bolts**

- 1.14.1 Unless specified otherwise, use U.S. standard hexagonal nuts and bolts for bolted connections. Project bolt ends beyond the nut faces at least 3 mm but not more than 1 bolt diameter. Use cadmium plated bolts and nuts on stainless steel flanges; provide stainless steel washers under bolt head and nut; use cadmium plated steel bolts and nuts on black steel and cast flanges.
  - .1 Use 316 SS nuts, washers and bolts when used in a submersible application and high humidity condition

### **1.15 Equipment Anchorage**

- 1.15.1 For all permanently or intermittently submerged services and for all exterior mounting locations, provide stainless steel anchor bolts conforming to ASTM A320.
- 1.15.2 For all other anchor bolts, provide cadmium plated or galvanized steel anchor conforming to ASTM A307, unless noted otherwise.
- 1.15.3 For rotating equipment over 35kW, provide anchor bolts with sleeves and washers to permit adjustment during installation of the equipment.
- 1.15.4 Do not use drilled expansion or adhesive anchors for anchor bolts unless submitted and reviewed by the Engineer.
- 1.15.5 Design anchor bolts for lateral forces for both pullout and shear in accordance with the requirements of Division 5.
- 1.15.6 Use 304 Stainless Steel as a minimum for all areas unless indicated otherwise on the Contract Document or affected specifications.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section describes the cleaning requirements for existing facilities and the project site.

## **2 PRODUCTS (NOT APPLICABLE)**

## **3 EXECUTION**

### **3.1 Project Cleanliness**

- 3.1.1 Maintain the Works in tidy condition, free from accumulation of waste products and debris, other than that caused by the Owner or other contractors.
- 3.1.2 Remove waste materials from site at regularly scheduled times or dispose of as directed by the Engineer. Do not burn waste materials on site.
- 3.1.3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- 3.1.4 Provide onsite drum containers for collection of waste materials and debris.
- 3.1.5 Provide and use clearly marked separate bins for recycling.
- 3.1.6 Remove waste material and debris from site and deposit in waste container at end of each working day.
- 3.1.7 Dispose of waste materials and debris off site.
- 3.1.8 Clean interior areas prior to the start of finish work and maintain areas free of dust and other contaminants during finishing operations.
- 3.1.9 Store volatile waste in covered metal containers and remove from premises at the end of each working day.
- 3.1.10 Provide adequate ventilation while using volatile or noxious substances. The use of building ventilation systems is not permitted for this purpose.
- 3.1.11 Use only cleaning materials recommended by the manufacturer of the surface to be cleaned, and as recommended by the cleaning material manufacturer.
- 3.1.12 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces and will not contaminate building systems or electrical or control panels.

### **3.2 Final Cleaning**

- 3.2.1 Prior to Substantial Performance or Completion, remove surplus products, tools, construction machinery and equipment not required for performance of remaining work.

- 3.2.2 Remove waste products and debris other than that caused by others, and leave the Works clean and suitable for occupancy.
- 3.2.3 Remove waste products and debris other than that caused by the Owner or other contractors.
- 3.2.4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- 3.2.5 Clean and polish glass, mirrors, hardware, wall tile, stainless steel, chrome, porcelain enamel, baked enamel, plastic laminate, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- 3.2.6 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls, and floors.
- 3.2.7 Clean lighting reflectors, lenses, and other lighting surfaces.
- 3.2.8 Vacuum clean and dust building interiors, behind grilles, louvres, screens and electrical control panels.
- 3.2.9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- 3.2.10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- 3.2.11 Remove dirt and other disfiguration from exterior surfaces.
- 3.2.12 Clean and sweep roofs, gutters, areaways.
- 3.2.13 Sweep and wash clean paved areas.
- 3.2.14 Clean equipment and fixtures to a sanitary condition and clean or replace filters of mechanical equipment.
- 3.2.15 Ensure downspouts, and drainage systems have not become blocked by construction activities. Clean and remove blockages if required.
- 3.2.16 Remove debris and surplus materials from crawl areas and other accessible concealed spaces

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This Section specifies requirements for work during the Warranty Period.

### **1.2 General**

- 1.2.1 Provide all warranties outlined in the Contract Documents from the time of Substantial Performance or Completion of the Works.
- 1.2.2 Perform warranty work required during progress of the work and during the Warranty Period. Reference section 01770 Closeout Procedures, 01780 Closeout Documents and the General Conditions.
- 1.2.3 Extend warranties on any component of the work that is required to be placed in operation prior to Substantial Performance for the purpose of complying with the sequence of construction.

### **1.3 Submittals**

- 1.3.1 Inform the Engineer in writing of the arrangements made for carrying out warranty work during the Warranty Period.
- 1.3.2 Provide a telephone number and address for receipt of notices relating to matters requiring action by the Contractor during the Warranty Period.

### **1.4 Inspection and Declaration of Final Completion**

- 1.4.1 Request inspection for Final Completion no later than 10 working days before the expiry of the Warranty Period.
- 1.4.2 Participate in a joint inspection of the Works for the purpose of establishing Final Completion. Arrange for, coordinate and pay for any special access required to inspect the Works, such as the draining of tanks.
- 1.4.3 Review the status of all Warranty items carried out during the Warranty Period with the Engineer.
- 1.4.4 Complete all outstanding deficiencies, repair noted defects, complete all outstanding warranty items and obtain the Engineer's written agreement that all works are complete in accordance with the Contract Documents.
- 1.4.5 Apply for Final Completion.

### **1.5 Work during Warranty Period**

- 1.5.1 Perform all warranty work required upon receipt of verbal or written notices from the Engineer.
- 1.5.2 Repair or make good settlements and defects on surfaces of backfilled trench or excavations.

1.5.3 Repair all damages to structures caused by settlement of ground adjacent to or over excavation.

1.5.4 Maintain all trees and shrubs either planted or relocated for the duration of the Warranty Period.

**1.6 Repair by Owner**

1.6.1 The Owner may, without giving notice to the Contractor, repair defects that are dangerous in nature, that constitute an emergency or that affect the operation of the Works. The Contractor will be notified prior to work being performed, when possible.

1.6.2 The Engineer will notify the Contractor of emergency work performed by the Owner.

1.6.3 The cost of labour, equipment and material to perform emergency work will be deducted from the Maintenance Security where work is not performed by the Contractor.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**



## **1 GENERAL**

### **1.1 Section Includes**

- 1.1.1 Procedures for the purpose of issuance of Substantial Performance and Completion of the Works.

### **1.2 Final Cleaning**

- 1.2.1 Execute final cleaning per Section 01740 prior to Substantial Performance of the Work.
- 1.2.2 Clean debris from drainage systems or swales.
- 1.2.3 Clean the Site; sweep paved areas and rake clean landscaped surfaces.
- 1.2.4 Maintain cleaning until acceptance by the Owner.

### **1.3 Restoration**

- 1.3.1 As a minimum, restoration shall mean replacement, repairs, or reconstruction to a condition at least as good as or better than the condition prior to commencement of the Work.
- 1.3.2 Except where specifically required otherwise by other Sections, restore areas of the Work and areas affected by the performance of the Work to conditions that existed prior to commencement of the Work and to match condition of similar adjacent, undisturbed areas.
- 1.3.3 Ensure that restored areas match existing grade and surface drainage characteristics, except as otherwise specified, and ensure a smooth transition from restored surfaces to existing surfaces.
- 1.3.4 Do not alter original conditions without prior written approval from the Engineer.
- 1.3.5 Without limiting the generality of the foregoing or other requirements of the Contract Documents, preserve and protect existing features encountered at the Site during performance of the Work including, but not limited to buildings, wells, yard hydrants, structures, fences, utilities, access roads, grassed areas, trees and other graded or improved areas.
- 1.3.6 Utilize construction methods and procedures during performance of the Work which keeps disturbance and damage of whatever nature to existing conditions to the practical minimum. Where work necessitates root or branch cutting, do not proceed without the Engineer's prior approval.
- 1.3.7 Ensure that quality, grades, elevations, and the extent of bedding, cover, and other backfill materials including subgrades, finish grades, and thickness of materials for roadways are properly documented during their removal to ensure reconstruction to at least their original and functional condition.
- 1.3.8 Restoration Material: New, except as otherwise specified, not damaged or defective, and of the best quality for the purpose intended. Furnish evidence as to type, source, and quality of materials or products furnished when requested by the Engineer or specified in other Sections.

- 1.3.9 Should any dispute arise as to the quality or fitness of materials, whether obtained on or off Site, whether previously inspected by the Engineer prior to use or not, the decision to use any material or product in the finished Works will rest solely with the Engineer.
- 1.3.10 Remove from the Site clean material not approved for reuse.
- 1.3.11 Handle and store products and materials in a manner to prevent damage, adulteration, deterioration, and soiling and in accordance with manufacturers' instructions when applicable.
- 1.3.12 Prior to commencement of restoration work, inform the Engineer of proposed material, methods, and procedures to repair, replace, or reconstruct disturbed, damaged, or suspected damage to the Work.
- 1.3.13 Perform cutting, fitting, remedial, and coordination work to make the several parts of the Work fit together.
- 1.3.14 Except as specified otherwise, dismantle and salvage materials for reuse where practicable.
- 1.3.15 Exercise due care when removing material for salvage. Repair or replace materials damaged through improper handling or through loss after removal.
- 1.3.16 Store and protect removed material approved for reuse in approved locations. Beginning of restoration work means acceptance of existing conditions.
- 1.3.17 Repair pavement, roads, sod, and all other areas affected by construction operations and restore them to original condition or to minimum condition specified.

#### **1.4 Inspection and Declaration of Substantial Performance**

- 1.4.1 Contractor's Inspection: The Contractor and all Subcontractors shall conduct an inspection of the Work, identify deficiencies and defects, and repair as required to conform to the Contract Documents.
- 1.4.2 Notify the Engineer in writing of satisfactory completion of the Contractor's Inspection and that corrections have been made and request the Engineer's Inspection no later than 10 working days before the expected Substantial Performance date.
- 1.4.3 Owner staff to attend inspection with Engineer and Contractor.
- 1.4.4 Substantial Performance: Submit a written certificate that the following has been performed:
  - .1 Work has been completed and inspected for compliance with Contract Documents.
  - .2 Defects have been corrected and deficiencies have been completed to a dollar value per the General Conditions of the Contract.
  - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
  - .4 Electrical inspections and approvals are complete and submitted.
  - .5 All required documentation has been submitted per Section 01780.

- .6 Operation of systems has been demonstrated to the Owner's personnel.
  - .7 All required training has been delivered.
  - .8 Work is complete and ready to be used for the purposes intended.
- 1.4.5 Agree to a list of outstanding work and deficiencies that do not affect Substantial Performance with the Engineer.
- 1.4.6 Apply for Substantial Performance.
- 1.5 Total Completion**
- 1.5.1 Complete all remaining outstanding work and deficiencies within the timeframe stipulated in the Schedule of Prices or within the dollar value per the General Conditions of the Contract.
- 1.5.2 Final Inspection: When all the outstanding items and deficiencies that did not affect Substantial Performance have been completed, request final inspection of the Works by the Engineer and the Owner.
- 1.5.3 Complete any outstanding work or deficiencies arising out of the final inspection that are deemed to affect issuance of the Completion Payment Certificate.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Section Includes**

- 1.1.1 Redline drawings, samples, and specifications.
- 1.1.2 Equipment and systems.
- 1.1.3 Product data, materials and finishes, and related information.
- 1.1.4 Operation and maintenance data.
- 1.1.5 Spare parts, special tools and maintenance materials.
- 1.1.6 Warranties and bonds.
- 1.1.7 Final site survey.

### **1.2 Submission**

- 1.2.1 Prepare closeout submittals as detailed with in this section and submit to the Engineer for review. Submittals shall be as detailed herein and shall also confirm to section 01330 Submittals.

### **1.3 Operation and Maintenance Data**

- 1.3.1 Prepare draft Operations and Maintenance (O&M) Manuals and submit to the Engineer for review.
- 1.3.2 One copy will be returned with comments and one copy will be retained to assist the Engineer and will be returned after delivery of the final copies.
- 1.3.3 Revise the content of documents as required prior to final submittal.

#### **1.3.1 Manual**

- .1 An organized compilation of operating and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems as specified in individual Sections of Divisions 02 to 16.
- .2 The number of draft and final hard copy submissions is identified in Section 01330 – Submittals.

#### **1.3.2 General**

- .1 Provide copies of documentation including as-constructed shop drawings to instruct the Owner's operations and maintenance staff in the operation and associated maintenance of each piece of equipment and system as supplied and installed. The following description is provided to the Contractor to describe the general requirements of the O&M Manuals. All information may not apply in all cases. Similarly, the Contractor may be required to provide additional information to adequately describe the equipment.

- .2 The Contractor will prepare a skeleton of the O&M Manuals including table of contents, section tabs and scale mock-up of printing proposed. The Contractor shall submit the draft O&M manual at least twenty (20) working days prior to the start of training specified in Section 01820.
- .3 In construction projects where work is carried out in distinct stages, the relevant portion of the manual will be required for that section of the work prior to equipment start-up.
- .4 Payment for closeout submittals shall be per Section 01025 – Measurement and Payment.

1.3.3 Submissions and review Process:

- .1 Draft Submission: Submit an electronic, PDF file format, draft manual for the Owner's and Consultant's review at least ten business days prior to equipment start-up and commissioning activity.
- .2 Owner and Consultant Review: Review shall follow typical submittal conventions established for project. If required by Owner and Consultant's review comments, revise manual contents and resubmit for Consultant's review. If required, repeat this process until Owner and Consultant accepts the draft manual in writing.
- .3 Final Submission: Following the incorporation of all revision comments and once all the draft submission has been found to be acceptable by the Owner and the Consultant, submit:
  - .1 Electronic Submission: Complete PDF file format collection on USB drive or through a file transfer service. Files to be fully functional and viewable in most recent version of Adobe Acrobat.
  - .2 Hard Copy Submission: Two (2) copies are to be provided to the Owner. Hard copy requirements:
    - .1 Print, assemble, coordinate, bind and index all material.
    - .2 Collate all data in accordance with the Table of Contents and organize in the same numerical order as the Contract Specifications (i.e., by Division and Section number).
    - .3 Label each section with tabs, protected with celluloid covers, fastened to hard paper dividing sheets.
    - .4 Binders: Submit the O&M Manual bound in 250mm x 297mm black vinyl coated, hard-covered post type binders, with hot stamped white lettering on front and spine to accommodate the documentation.
    - .5 The number of volumes in a set shall be increased and numbered as necessary to accommodate all the equipment operation and maintenance information.

- .6 The spine of the binder shall be printed with the: facility's name and the project name / description. The following is a typical example:

<p style="text-align: center;"><b>[FACILITY NAME]</b></p> <p style="text-align: center;"><b>[PROJECT NAME/DESCRIPTION]</b></p>
--

- .7 The cover of the binder shall be printed with the: facility's name, project name/description, contract number, binder volume info, and date of capital project. The following is a typical example:

<p style="text-align: center;"><b>OPERATIONS AND MAINTENANCE MANUAL</b></p> <p style="text-align: center;"><b>[FACILITY NAME]</b></p> <p style="text-align: center;"><b>[PROJECT NAME/DESCRIPTION]</b></p> <p style="text-align: center;"><b>[CONTRACT NUMBER]</b></p> <p style="text-align: center;"><b>VOLUME [X] OF [X]</b></p> <p style="text-align: center;"><b>[DATE]</b></p>
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1.3.4 Contents, organization, and electronic file collection requirements:

- .1 Cover
- .2 Table of Contents

- .3 Introduction to the Manual: A concise overview of the contents included in the manual. Provide written explanation of the layout of the manual and intended use.
- .4 Contact list: including telephone, email address, and street address for the following:
  - .1 Engineering consultant
  - .2 Contractor
  - .3 Sub-contractors
  - .4 Equipment/material suppliers, distributors and manufacturers
  - .5 Service representatives
- .5 Equipment Warranties and Bonds:
  - .1 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - .2 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers.
  - .3 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Test reports and certifications organized by specification section number and equipment identification tag/description including:
  - .1 Equipment manufacturer and supplier start-up/operations reports and certifications
  - .2 Process/system performance test reports
  - .3 Material testing reports
  - .4 Pressure tests, and disinfection certifications
  - .5 Balancing reports for HVAC
  - .6 Approval agency inspection reports as applicable including but not limited to: Building permit (i.e., plumbing and piping, heating and ventilation, electrical, building, etc.), Electrical Safety Authority, Conservation Authority, etc.
  - .7 File naming convention is to follow the specification number, product name, and installation location as referred to within this Contract Document. Example: XXXXX\_Product Name\_Location.pdf where:
    - .1 {XXXXX} is the Contract document specification section number,
    - .2 {Product Name} clearly describes the type of equipment or product described within the file, and

- .3 {Location} describes where within the facility or the project the equipment/product was installed (i.e., room name, building interior/ exterior, yard, street name, etc.).
  - .4 File name components are separated by an underscore ‘\_’ character.
  - .7 Spare parts and materials list (as supplied and delivered)
  - .8 Special Tools list (as supplied and delivered)
  - .9 Owner and Operator training material
  - .10 Control panel as-built drawings. Electrical schematics and wiring diagrams.
  - .11 Shop drawings and product data: Exact duplicates of Engineer reviewed and approved shop drawings and any supplementary equipment specific user / owner / maintenance / repair manuals as provided by the manufacturer. Organized by specification section number.
  - .1 All data for each equipment/product item is to be provided as a single comprehensive PDF file.
  - .2 File naming convention is to follow the specification number, product name, and installation location as referred to within this Contract Document. Example: *XXXXX\_Product Name\_Location.pdf* where:
    - .1 {XXXXX} is the Contract document specification section number,
    - .2 {Product Name} clearly describes the type of equipment or product described within the file, and
    - .3 {Location} describes where within the facility or the project the equipment/product was installed (i.e., room name, building interior/ exterior, yard, street name, etc.).
    - .4 File name components are separated by an underscore ‘\_’ character.
- 1.3.5 The material submitted in accordance with the contractual requirements for “As-Constructed Shop Drawings” is generally bulky and difficult to file in a binder. If requested by the Engineer, provide copies of all “As-Constructed Shop Drawing” material in a single drawer legal size cardboard file cabinet. Arrange in accordance with the Construction Specifications Institute. Identify any material located in the file cabinet as such in the appropriate location in the binders.
- 1.3.6 All schematic/control, equipment, and wiring changes made during construction shall be reflected in the final shop drawings. The Owner shall have the right to determine whether the scope of such changes requires a complete re-issue of shop drawings or may be submitted on a page page-for-page replacement basis. No extra payment will be made for any such requests.
- 1.3.7 Provide a tabulated report for all motors and other equipment on the contract outlining the description, nameplate data, measured current and voltage type, size, setting of overload heaters (thermal/electronic) installed, setting of motor circuit protectors, breaker trip settings,



fuse relays and fuse sizes in the control circuits, equipment name, horsepower. Indicate feeder conductor size and length of conduit.

- 1.3.8 At the Engineer's discretion, provide the information in plastic map pockets in appropriate sections in the binders.

.1 Binders

- .1 Binders shall be large capacity, expanding/catalogue type for 11 x 8-1/2 sheets with expanding, lockable posts, 2" to 4", or 3" to 5" capacity, having fully hinged (metal, piano type) hard covers bound in heavyweight black leather-grain cover with custom embossed gold lettering. Allow minimum 1/4" empty space inside each binder. Binders: ACCO 50505-05426, 50505-05436, or equal.
- .2 The custom embossed gold lettering on the front cover and spine must include: the name of the Owner, Contract No., Contract Title, Owner Logo, "Operation & Maintenance Manual" title, Volume x of y number, Divisions included and Set x of y number. Template for spine and cover page attached.
- .3 Binder accessories – Sections will be separated with the divider pages with labelled printed indexes (side tabs) and reinforces with a rip-proof, three hold punched strip, or similar protection. Drawings will be folded and inserted in labelled clear plastic binder type pockets/sleeves (page protectors). CDs, DVDs, and other electronic media will be placed in labelled, clear plastic, static free binder type holder sheets.

- .2 Provide one complete electronic copy on USB. The electronic copy shall be in PDF format.

- .1 Files are to be exact duplicates of the hard copy submission. Arrange by Specification number and name.
- .2 Files are to be fully functional and viewable in the most recent version of Adobe Acrobat.
- .3 The single PDF file shall include bookmarks for each section and subsection, be properly indexed, and fully searchable.

**1.4 Equipment List**

- 1.4.1 To be submitted in MS Excel file format following the conventions prescribed in the City of Brantford Equipment List and Asset Database Template. The template will be provided by the City.

- 1.4.2 Equipment List is to include detailed information related to each equipment item installed or provided under the scope of the Contract. This relates to but, is not limited to:

- .1 Process equipment including valves and pumps
- .2 Instrumentation including process instruments (e.g., flow meters, level instruments, pressure, etc.) and building mechanical monitoring (e.g., door switches, smoke detectors, thermostats)

- .3 HVAC equipment (e.g., fans, dampers and motorized actuators, heaters, air conditioners, etc.).
- .4 Plumbing equipment (e.g., backflow preventors, water heaters, expansion tanks, fixtures, etc.)
- .5 Security systems

1.4.3 Information to be included for each piece of equipment:

- .1 Contract document specification and O&M Manual section reference number
- .2 Manufacturer make, model, and serial number
- .3 Characteristic size description (i.e., performance requirement, process capacity, volume, nominal diameter, horsepower, etc.)
- .4 Power requirements if applicable including: Phase, Voltage, Amps, Watts, and Frequency.
- .5 For analog instruments, include the 4-20mA scaling range as set-up on site.

**1.5 Redline Drawings and Samples**

1.5.1 Upon completion of the Work and prior to final inspection submit As-Built drawing markups to the Engineer or Owners representative. If the job is completed without significant deviation from the contract drawings, declare this in writing and submit to the Engineer in lieu of As-Built drawings.

1.5.2 Recording "As-Built" Information

- .1 After award of Contract the Engineer will provide additional sets of drawing prints for the Contractor's use in maintaining record information.
- .2 As work progresses, neatly and accurately record deviations from Contract Drawings caused by site conditions and changes ordered by the Engineer and Owner.
- .3 Mark changes in red.
- .4 Record locations of concealed components of mechanical, electrical services and structural aspects.
- .5 Identify as "Project Record Copy". Maintain in new condition and make available for inspection on site by Engineer.

1.5.3 Dimension locations (vertically and horizontally) of buried or concealed work, especially piping and conduit, with reference to exposed structures. Dimension the installed locations of concealed service lines on the site or within the structure by reference from the centre line of the service to the structure column lines or other main finished faces or other structural point easily identified and located in the finished work.

- 1.5.4 Update these drawings and make available for monthly review. Payment against the Progress Payment line item for updated drawings will be withheld if drawings have not been maintained up-to-date.
- 1.5.5 Submit redline drawings for electrical schematic and instrument control diagrams. Submit operation and maintenance instruction manuals with updated as-built control diagrams, revised to show construction revisions.
- 1.5.6 Submit redline drawings in SI metric units.
- 1.5.7 Record on the white prints on a daily basis, work constructed differently than shown on the Contract Documents. Record all changes in the work caused by site conditions, or originated by the Owner, the Engineer, the Contractor, or a sub-contractor and by addenda, supplemental drawings, site instructions, supplementary instructions, change orders, correspondence, and directions of regulatory authorities. Accurately record the location of concealed mechanical services and electrical main feeders, junction boxes and pull boxes. Do not conceal critical work until its location has been recorded.
- 1.5.8 Do not use these drawings for daily working purposes and make the set available for periodic inspection by the Engineer.
- 1.5.9 Make records in a neat and legibly printed manner with non-smudging medium.
- 1.5.10 The Contractor shall scan the complete set of redline drawings to PDF (full resolution) and upload progress redline drawings onto the CIMA FTP site and transmit to the Engineer at the end of the project.
- 1.5.11 Submit all marked up redline drawings to the Engineer at the conclusion of the contract. Substantial Performance will not be issued until redline drawings are complete and submitted.

## **1.6 Recording Actual Site Conditions**

- 1.6.1 Record information on set of drawing prints provided by the Engineer.
- 1.6.2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.
- 1.6.3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- 1.6.4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including:
  - .1 Measured depths of elements of foundation in relation to finish first floor datum.
  - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
  - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
  - .4 Field changes of dimensions and details.

- .5 Changes made by Contract Change Directives.
  - .6 Details not on original Contract Drawings.
  - .7 References to related shop drawings and modifications.
- 1.6.5 Specifications: legibly mark each item to record actual construction, including:
- .1 Manufacturer, trade name, and catalogue number of each product actually installed particularly optional items and substitute items.
  - .2 Changes made by Addenda and Contract Change Directives.
- 1.6.6 Other Documents: maintain manufacturers' certifications, inspection certifications, field test records, required by individual specifications sections.
- 1.7 Final Survey**
- 1.7.1 The Owner will check the 'As-Recorded' survey elevations.
- 1.8 Equipment and Systems**
- 1.8.1 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.
- 1.8.2 Panel board circuit directories: provide electrical service characteristics, controls, and communications, final as-constructed diagram.
- 1.8.3 Include as-constructed installed colour coded wiring diagrams in the manual and also provide an electronic copy in AutoCAD.
- 1.8.4 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.
- 1.8.5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- 1.8.6 Provide servicing and lubrication schedule, and list of lubricants required.
- 1.8.7 Include manufacturer's printed operation and maintenance instructions.
- 1.8.8 Include sequence of operation by controls manufacturer where appropriate.
- 1.8.9 Provide original manufacturers' parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- 1.8.10 Provide installed control diagrams by controls manufacturer where appropriate. Include copies in the manuals and provide an electronic version in AutoCAD.

- 1.8.11 Provide coordination drawings, with installed colour coded piping diagrams.
- 1.8.12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- 1.8.13 Provide list of original manufacturers' spare parts, current prices, and recommended quantities to be maintained in storage.
- 1.8.14 Include test and balancing reports.
- 1.8.15 Additional requirements: As specified in individual specification sections.
- 1.8.16 Provide Engineer-reviewed Single Line Diagram in its final version. Single Line Diagram shall be of size 24-inch by 36-inch, laminated, mounted on wood board and be installed by GC in respective electrical room.

## **1.9 Spare Parts**

- 1.9.1 Provide spare parts, in quantities specified in individual specification sections.
- 1.9.2 Provide items of same manufacture and quality as items in Work.
- 1.9.3 Deliver to site location and place in storage as directed by the Owner.
- 1.9.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.
- 1.9.5 Provide a list of these spare parts and materials within the O&M Manual submission.
- 1.9.6 Where spare parts are not specified, provide the Engineer and Owner with a list of all spare parts recommended by the equipment manufacturer for all major pieces of equipment, valves, and instruments, including model or part numbers, and costs for individual items.
- 1.9.7 The Engineer or other agents of the Owner will reject defective products, regardless of any previous inspections. Defective products are to be replaced at the Contractor's expense. Pay the costs of transportation related to replacement of defective products.
- 1.9.8 Ensure spare parts and materials provided are new, undamaged and not defective, and of the same quality and manufacture as products provided in the Works. If requested, furnish evidence as to type, source and quality of products provided.

## **1.10 Special Tools**

- 1.10.1 Special tools are those tools which, because of their limited use or purpose-made design, are not normally readily available, but which are necessary for maintaining the equipment.
- 1.10.2 Provide special tools, and accessories required for repairs, adjustments, and maintenance work, in quantities specified in individual specification section.
- 1.10.3 The Engineer or other agents of the Owner will reject defective products, regardless of any previous inspections. Defective products are to be replaced at the Contractor's expense. Pay the costs of transportation related to replacement of defective products.

- 1.10.4 Provide a list of special tools within the O&M Manual submission.
- 1.10.5 Ensure special tools provided are new, undamaged and not defective, and of the same quality and manufacture as products provided in the Works. If requested, furnish evidence as to type, source and quality of products provided.
- 1.10.6 Provide items with tags identifying their associated function and equipment.
- 1.10.7 Deliver to site location and place in storage as directed by the Owner.
- 1.10.8 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.
- 1.11 Maintenance Materials**
  - 1.11.1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
  - 1.11.2 Provide items of same manufacture and quality as items in Work.
  - 1.11.3 Deliver to site location and place in storage as directed by the Owner.
  - 1.11.4 Obtain receipt for all delivered products from the Owner or Engineer and submit these receipts prior to Substantial Performance.
- 1.12 Storage Handling and Protection**
  - 1.12.1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
  - 1.12.2 Store in original and undamaged condition with manufacturers' seal and labels intact.
  - 1.12.3 Store components subject to damage from weather in weatherproof enclosures.
  - 1.12.4 Store paints and freezable materials in a heated and ventilated room.
  - 1.12.5 Remove and replace damaged products at the Contractor's own expense and to the satisfaction of the Engineer.
  - 1.12.6 Exercise all equipment in strict conformance with the equipment manufacturers written instructions during storage and following installation. Provide all equipment exercise logs to the Engineer for review.
- 1.13 Warranties and Bonds**
  - 1.13.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
  - 1.13.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
  - 1.13.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers.

- 1.13.4 No warranty will commence until issuance of Substantial Performance on respective work components. The warranty on items used during construction, with the Owner's permission, for the safe and orderly completion of the works will not commence until Substantial Performance.
- 1.13.5 Verify that documents are in proper form, contain full information, and are notarized.
- 1.13.6 Co-execute submittals when required.
- 1.13.7 Retain warranties and bonds until time specified for submittal.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **1 GENERAL**

### **1.1 Intent**

- 1.1.1 Testing is implemented to minimize commissioning time and to provide a smooth transition when bringing the system on-line.
- 1.1.2 The Contractor is responsible for coordinating the implementation and testing to ensure that the facility remains operational at all times.
- 1.1.1 The Section includes:
  - .1 Pre-commissioning checks on each component.
  - .2 Commissioning and adjustment of each component and system and all specified testing.
  - .3 Performance testing for all systems.
  - .4 In the event of any conflicts between this Section and the General Conditions, more stringent requirements shall govern.

### **1.2 General**

- 1.2.1 The Contractor shall construct, test, commission and turn over to the Owner a complete operating facility.
- 1.2.2 Cooperate with testing organization services under provisions specified in Section 01450 - Quality Control.
  - .1 Comply with applicable procedures and standards of the certification sponsoring association.
  - .2 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.
  - .3 The Contractor shall ensure that there are no visible leaks on water retaining structures and shall repair all visible leaks.
- 1.2.3 The following requirements shall be met:
  - .1 All components shall be fully protected against damage prior to start-up. All temporary protection measures are the responsibility of the Contractor.
  - .2 The Contractor shall notify the Supplier(s) and the Engineer that the Project is ready for start-up testing and operation.
  - .3 The Contractor shall supply all labour and equipment for testing and commissioning.
  - .4 Within 90 days of commencement of the Contract the Contractor shall meet with the Engineer and Owner to discuss the Testing and Commissioning program and requirements of this specification. Prior to this meeting, the Contractor shall identify information required from the Engineer and Owner, necessary for completion of the draft



Start-up and Commissioning Plan. Provide a written draft Start-up and Commissioning Plan a minimum of 100 working days prior to the commencement of Start-up and Commissioning. The finalized Start-up and Commissioning Plan incorporating all the Engineer and Owner comments shall be submitted by the Contractor a minimum of 40 days prior to the commencement of Start-up and Commissioning.

1.2.4 Testing and commissioning shall proceed as follows:

- .1 Off-site system programming factory acceptance testing (FAT);
- .2 Off-site control panel factory acceptance testing (Panel FAT);
- .3 Off-site equipment factory acceptance testing (Equipment FAT);
- .4 Complete pre-commissioning checks, start-up commissioning and performance testing of individual pieces of equipment and equipment sub-systems;
- .5 On-site control system site acceptance testing (SAT);
- .6 Continuous operation testing, as detailed within this document, demonstrating that the work of this contract has been commissioned in its entirety and that the Contract is substantially complete, and;
- .7 Turn over the work to the Owner.

1.2.5 Testing and commissioning shall be performed by the Contractor in the presence of the Engineer and the Owner.

**1.3 Quality Assurance Testing Program**

1.3.1 The Contractor shall appoint an engineer or qualified operations specialist as Testing Manager to manage, coordinate and supervise the Contractor's Quality Assurance Program. The Testing Manager shall have at least 5 years' experience in managing start-up and commissioning of mechanical, electrical, instrumentation, HVAC and piping systems. The Contractor shall forward a copy of the Testing Manager's resume to the Engineer prior to the commencement of the testing program.

1.3.2 The Quality Assurance Testing Program for this project shall include:

- .1 A calibration program for all instruments, gauges and meters used for determining the performance of equipment and systems installed under the Contract.
- .2 A calibration program for all instruments, gauges and meters installed under the Contract.
- .3 A testing program for all mechanical, electrical, instrumentation and HVAC equipment and process systems installed under the Contract. The testing program shall be divided into two phases: performance testing and operational testing.
- .4 A comprehensive testing plan detailing the procedure of the testing program of all works required under this QA. The test plan shall include all equipment and process systems.

- .5 The test plan shall include procedures for the evaluation of the performance of the equipment and process system, including the required specified performance criteria.
  - .6 A schedule providing date, time, sequence and duration of the performance and operational testing for each equipment and process system. The Critical Path Method shall be used for the scheduling of the test plan and shall be updated as required to reflect changes.
  - .7 A documentation program to record the results of all equipment and system tests.
- 1.3.3 All test equipment, gauges, thermometers, meters, analysis instruments and other equipment used for calibrating or verifying the performance of equipment installed under this Contract shall be calibrated to within  $\pm 2\%$  of actual value at full scale. Test equipment employed for individual test runs shall be selected so that expected values as indicated by the detailed performance specifications will fall between 60 and 85 percent of full scale.
- 1.3.4 Pressure gauges shall be calibrated in accordance with ANSI/ASME B40.1.
- 1.3.5 Thermometers shall be calibrated in accordance with ASTM E77 and shall be furnished with a calibration curve.
- 1.3.6 Liquid flowmeters installed in pipelines with diameters greater than 50mm shall be calibrated in-situ using the pitot tube velocity averaging method. Calibration tests for flow metering systems shall be performed over a range of not less than 10% to at least 75% of system full scale. At least five confirmed valid data points shall be obtained within this range. Confirmed data points shall be validated by not less than three (3) test runs with results which are in agreement within  $\pm 2\%$ .
- 1.3.7 The following documents referred to in this Quality Assurance Program take precedence over requirements that may be listed in other parts of the Contract. In case of a conflict between the requirements of this QA Program and that of the Contract Document, the QA Program shall take precedence:
- .1 ANSI/ASME B40.1 Gauges Pressure Indicating Dial Type – Elastic Element
  - .2 ASTM E77 Method for Verification and Calibration of Liquid-in-Glass Thermometers
  - .3 ASHRAE 41.8 Standard Methods of Measurement of Flow of Gas
  - .4 Flow Measurement in Sewer Lines by The Dye Dilution Method, Journal of the Water Pollution Control Federation, Vo. 55, Number 5, May 1983, pg. 531.
  - .5 Flow Measurement in Open Channels and Closed Conduits, Vo. 1, US Dept. of Commerce, National Bureau of Standards, pg. 361
  - .6 Techniques of Water Resources Investigation of the US Geological Survey, Chapter 16, Measurements of Discharge Using Tracers
  - .7 Other standards as applicable
  - .8 If the above listed standards are revised, the most recent version will be applicable

#### **1.4 Submittals**

##### **1.4.1 Submittal material shall consist of the following:**

- .1 Detailed testing plans, setting forth step-by-step descriptions of the procedures proposed by the Contractor for the systematic testing of all equipment and systems installed under this contract.
- .2 Sample test acceptance forms for documenting the results of testing, for each test to be performed, that shall be submitted as Shop Drawings as per these specifications.
- .3 The credentials and certification of the testing laboratory proposed by the Contractor for calibration of all test equipment.
- .4 A testing and commissioning schedule.
- .5 Test forms documenting the results of testing and commissioning completed to the satisfaction of the Engineer.

##### **1.4.2 Prepare and submit test plan for the Engineer's review and approval at least 15 working days prior to commencing pre-commissioning checks.**

##### **1.4.3 Submit reports on testing, adjusting, balancing and performance tests promptly after execution of those services.**

#### **1.5 Test Plan**

##### **1.5.1 All testing and commissioning work shall be covered by a test plan to be prepared by the Contractor, which shall take into consideration the sequence of construction and the necessity to sequentially commission certain components and place them in operation prior to completion of other components.**

##### **1.5.2 Meet with the Engineer and the Owner as necessary to review the testing and commissioning sequence and to establish responsibilities of each party during testing and commissioning. The test plan must be approved by the Engineer and the Owner.**

##### **1.5.3 Approval to proceed with pre-commissioning checks shall be contingent upon approval of the test plan. Coordinate all construction and testing activities as generally outlined in Section 01120 Coordination with Existing Operations and Sequence of Construction.**

##### **1.5.4 The test plan shall include:**

- .1 The name and contact arrangements for the person assigned by the Contractor to have managerial responsibility for coordination of the entire testing and commissioning period.
- .2 The names and contact arrangements for the persons in charge of particular disciplines and manufacturer representatives.
- .3 Confirmation that all persons involved in the testing and commissioning are suitably qualified, including a licensed operator.

- .4 A list of all tests to be performed; the nature of the test; test objectives and required results.
- 1.5.5 A written description of the methods to be used to test and commission each component and system and to conduct the overall performance and reliability run.
- 1.5.6 A written description of the methods to be used to test and commission all instrumentation and control equipment.
- 1.5.7 Copies of all site testing and commissioning report sheets to be used for each component. All report sheets must be approved by the Engineer and the Owner.
- 1.5.8 Copies of all factory test reports to be used for components where factory testing is required.
- 1.5.9 A schedule for all testing and commissioning work.

## **2 PRODUCTS**

### **2.1 Documentation**

- 2.1.1 The Contractor shall develop and implement a record keeping system to document compliance with the requirements of this Section.
- 2.1.2 Test acceptance forms as a minimum shall include date of test, equipment number or system name, nature of test (performance or operational), test objectives, test results, test instruments employed for the test and signature spaces for the Engineer's witness and the Contractor's Testing Manager. A file shall be established for each system and item of equipment. It is suggested that files be maintained separately for pipe pressure testing, mechanical equipment performance testing, instrumentation equipment performance testing (loops), and electrical equipment.
- 2.1.3 It shall be the requirement of this Contract that the Contractor shall produce test documentation forms specific for each system and associated equipment items installed under this Contract. Acceptable documentation forms for all systems and items of equipment shall be produced for review by the Engineer a minimum of four weeks prior to any performance testing. Once the Engineer has reviewed and taken no exception to the forms proposed by the Contractor, the Contractor shall produce sufficient forms, at his expense, to provide documentation of all testing work to be conducted as a part of this Contract.
- 2.1.4 The Contractor shall develop test plans detailing the coordinated, sequential testing of each item of equipment and system installed under this contract. The test plans shall also be specific as to support systems required to complete the test work, temporary systems required during the test work, subcontractors' and manufacturers' representatives to be present and expected test duration. The test plans shall include the following features, as required:
  - .1 FAT(s);
  - .2 Panel FAT(s);
  - .3 Equipment FAT(s);

- .4 Performance testing including but not limited to:
  - .1 Pressure and/or leak tests.
  - .2 Functional checkout of all electrical tests.
  - .3 Electrical circuit ringouts.
  - .4 Resistance tests of all electrical equipment and electrical systems.
  - .5 Instrument calibration, loop test, loop commissioning and tuning.
  - .6 Preoperational check out for all mechanical and HVAC equipment.
  - .7 Functional tests of all mechanical, electrical, HVAC and instrumentation equipment and systems to demonstrate compliance with the performance requirements.
  - .8 Control network testing.
- .5 In general, performance tests for any individual system shall be performed in the order listed above. The order may be altered as authorized by the Engineer in writing after receipt of a written request, complete with justification of the need for the change in sequence.
- .6 SAT(s);
- .7 Continuous operation performance test.
- 2.1.5 Test plans shall contain a complete description of the procedures to be employed to achieve the desired test environment.
- 2.1.6 Four weeks in advance of the date the Contractor wishes to begin performance testing of equipment and/or systems (whichever occurs earliest in the project schedule), the Contractor shall have submitted the test plan(s) required for the systematic field performance tests for the equipment and/or system installed under this contract. Once the Engineer has reviewed and taken no exception to the Contractor's test plan(s), the Contractor shall reproduce the plan(s) in sufficient number for the Contractor's purposes and an additional three copies for delivery to the Engineer. No test work for the equipment, system or facility shall begin until the Contractor has delivered the specified number of approved final test plans to the Engineer.
- 2.1.7 The Contractor shall produce a testing schedule setting forth the sequence contemplated for performing the test work. The schedule shall be in bar chart form, plotted against calendar time, and shall detail the equipment and/or systems to be tested. The schedule shall show the contemplated start date, duration of the test and completion of each test. The test schedule shall be submitted no later than four weeks in advance of the date testing is to begin. The Engineer will not witness any testing work for the purpose of acceptance until the Contractor has submitted a schedule to which the Engineer takes no exception. The test schedule shall be updated weekly, showing actual dates of test work, indicating systems and equipment testing completed satisfactorily.

## **2.2 Equipment and System Performance Tests**

- 2.2.1 Each item of process, mechanical, electrical, instrumentation, and HVAC equipment installed under this contract shall be tested to demonstrate compliance with the performance requirements of this project manual. Each electrical, instrumentation, mechanical, piping, and HVAC system installed or modified under this contract shall be tested in accordance with the specified requirements.

## **3 EXECUTION**

### **3.1 Testing**

- 3.1.1 The completed works shall be subject to testing and trial operation to determine whether works function as required for the intended purpose. The Contractor shall give the Engineer at least four days prior notice of the testing program. The Contractor shall conduct tests only in the presence of the Engineer or Engineer's appointed representative and under his general direction. The Contractor shall provide all equipment, gauges, materials, water and labour required to conduct the tests.
- 3.1.2 Testing and commissioning shall be completed in accordance with the manufacturer's recommendations and the Contract Documents.
- 3.1.3 Test results shall be within the tolerances set forth in the detailed specification sections. If no tolerances have been specified, test results shall conform to tolerances established by recognized industry practice. Where, in the case of an otherwise satisfactory installed test, any doubt, dispute, or difference should arise between the Engineer and the Contractor regarding the test results or the methods or equipment used in the performance of such test, and then the Engineer may order the test to be repeated.
- 3.1.4 If under test, any portion of the work should fail to fulfill the contract requirements and is adjusted, altered, renewed, or replaced, tests on that portion when so adjusted, altered, removed, or replaced, together with all other portions of the work as are affected thereby, shall, unless otherwise directed by the Engineer, be repeated within reasonable time and in accordance with the specified conditions. The Contractor shall pay to the Owner all reasonable expenses incurred by the Owner, as a result of repeating such tests.

### **3.2 Pre-commissioning Checks**

- 3.2.1 Obtain all approvals and clearances from authorities prior to energizing any components of the work.
- 3.2.2 Ensure that relevant operations and maintenance instructions are on site.
- 3.2.3 Obtain the Engineer's approval to proceed with Pre-commissioning checks of relevant systems in accordance with the test plan. The Engineer will make all necessary arrangements for the Owner's personnel to be present at tests.
- 3.2.4 Perform all necessary Pre-commissioning checks and tests prior to commissioning any components of the work in accordance with the test plan, including:
- .1 Check installations are in accordance with manufacturer instructions.

- .2 Check all piping connections and related piping systems are complete and pressure tested.
  - .3 Check all electrical, instrumentation and control cable connections and related power and control panels are complete and tested.
  - .4 Check and calibrate all related protective devices.
  - .5 Check all pre-run maintenance and installation conditions have been completed such as oil and grease addition.
  - .6 Clean and flush all related piping systems.
  - .7 Disinfect all related piping systems.
  - .8 Check rotation of all rotating equipment.
  - .9 Obtain written clearance from manufacturers/suppliers to place equipment or systems in operation. Each manufacturer/supplier must allow one full day for pre-commissioning.
- 3.2.5 Resolve all installation and pre-commissioning test discrepancies and retest as necessary to the satisfaction of the Engineer.
- 3.2.6 Submit two copies of all Pre-commissioning check sheets and reports to the Engineer including all initial test reports containing discrepancies and final test reports where components are retested. This is in addition to the copies incorporated into the Maintenance Manual.
- 3.2.7 Obtain the Engineer's approval to proceed with commissioning of relevant systems in accordance with the test plan, after successfully pre-commissioning.
- 3.2.8 Arrange for the Owner to open valves or connect to existing systems where applicable. Do not operate any of the Owner's equipment or valves, unless directed by the Engineer or the Owner.
- 3.2.9 Conform to requirements of all suppliers.
- 3.2.10 The intent of the pre-commissioning checks is to test and demonstrate all equipment and controls to the Engineer, and resolve and correct all deficiencies prior to final commissioning with the Owner.
- 3.3 Off-Site Testing**
- 3.3.1 Perform all necessary off-site testing as required by the specifications. A FAT test for the ICP panel is required.
- 3.3.2 Notify the Engineer at least 15 working days in advance of any planned off-site tests and confirm the test at least 72 hours in advance.
- 3.3.3 Provide a copy of the planned test procedure and test result form to be used to the Engineer at least 15 working days in advance of any off-site test.

- 3.3.4 Do not pay any costs associated with travel and accommodation for the Engineer or the Owner's personnel to attend any off-site testing.
- 3.3.5 Where off-site testing is not successful, and the Engineer and/or the Owner is required to witness repeat testing, the Owner reserves the right to deduct all fair and reasonable charges and expenses incurred by the Owner in respect of this retesting from monies owed to the Contractor under this Contract.
- 3.3.6 Submit two copies of all off-site testing reports to the Engineer in addition to the copies incorporated into the Maintenance Manual.

### **3.4 Commissioning**

- 3.4.1 The roles and responsibilities during commissioning are defined as follows:

- .1 Contractor:

- .1 The Contractor will make all arrangements for testing, coordinate all personnel involved, issue all required notifications, perform all commissioning tests, record results, make all necessary adjustments and retest as necessary until equipment and systems perform as intended. The Contractor will sign and submit all test results.
- .2 The Contractor will coordinate all the work required by suppliers.
- .3 The Contractor shall supply and pay for all required chemicals for the construction and commissioning of the works.
- .4 The Contractor shall coordinate all testing and commissioning with the Engineer and the Owner, and co-operate fully with the System Programmer for testing and commissioning.
- .5 Ensure that the facility is cleaned and ready for commissioning per Section 01740 Cleaning.

- .2 The Engineer:

- .1 The Engineer will witness all tests and sign test reports as a witness.
- .2 The Engineer will assist the Contractor in resolving deficiencies.

- .3 The Owner:

- .1 The Owner will assign relevant staff to witness all tests and will operate existing equipment, valves and systems.
- .2 The Owner will supply water once to fill the tank for testing and commissioning of the Works. Any subsequent fills will be the responsibility of the Contractor. The Contractor will meter this supply and reimburse the Owner for subsequent fills at the completion of the works.



.4 System Programmer:

- .1 The System Programmer will witness all relevant control panel tests, (FAT, loop checks, SAT, etc.). The System Programmer will be responsible for all SCADA and RPU programming and will work within the Contractors' schedule for pre-commissioning and commissioning checks.
- .2 Perform all necessary commissioning of the works in accordance with the test plan including:
  - .1 Run equipment and systems as intended sufficiently to make all necessary adjustments and balancing and to obtain all necessary test readings.
  - .2 Provide all equipment and instruments to perform tests and obtain all necessary readings.
  - .3 Check all related instruments and control devices and perform all necessary adjustments and calibrations.
  - .4 Confirm and test all control set points.
  - .5 Confirm operation under normal operating conditions; by-pass conditions; emergency conditions and under power failure remote, control system, communications system and key component failure.
  - .6 Confirm operation of all protective devices.
  - .7 Cooperate with and permit system programmer to perform all necessary tests on control systems.
  - .8 Allow ten working days for control system commissioning.
  - .9 Arrange for and pay all costs for equipment manufacturer services as necessary to complete commissioning work.
  - .10 Arrange for all temporary diversions of flow and other utilities necessary to complete commissioning of individual systems.
  - .11 Arrange for disposal of all wastes resulting from commissioning works.

3.4.2 Co-ordinate requirements for commissioning in accordance with the test plan.

3.4.3 Make available all required supervisory personnel, mechanics, electricians, plumbers and other trades, as well as manufacturer personnel to attend to any adjustments, corrections or repairs that may be required during pre-commissioning.

3.4.4 The commissioning period for each component shall be of sufficient duration to ensure that the equipment is ready for full time operation.

3.4.5 Provide ten (10) working days notice of all commissioning tests where these tests are in accordance with the test plan.

- 3.4.6 Provide a request 15 working days in advance for all commissioning tests where these tests are not in accordance with the test plan.
- 3.4.7 Allow five working days for input-output checks by the Engineer and System Programmer.
- 3.4.8 Check oil and grease and maintain equipment and instruments at completion of commissioning prior to commencing performance and reliability run.
- 3.4.9 Resolve all commissioning test discrepancies and retest as necessary to the satisfaction of the Engineer.
- 3.4.10 Submit two copies of all commissioning test reports to the Engineer, including all initial test reports containing discrepancies and final test reports where components are retested, in addition to the copies to be incorporated into the Maintenance Manual.
- 3.4.11 Obtain the Engineer's approval to proceed with Performance and Reliability Run.

**3.5 14 Day Performance and Reliability Run**

- 3.5.1 Once equipment and/or systems have been tested individually, the Contractor shall co-ordinate the continuous operation test with the Engineer and Owner.
- 3.5.2 The performance test shall not start on a Monday or Friday.
- 3.5.3 The test shall be either live i.e. supplying treated effluent water to the system/handling wastewater or off-line in recirculation mode or discharge-to-waste mode. The Owner will dictate whether the test shall be live or off-line, based on system demands and the need to keep the system in-service.
  - .1 For live testing, the Contractor shall ensure that the system has been properly disinfected or cleaned, as applicable.
  - .2 For off-line testing, the Contractor shall install temporary connections, bulk heads, and other provisions as required to effect the testing and simulate anticipated operating conditions.
- 3.5.4 The Contractor shall provide continuous site supervision for the duration of this test.
- 3.5.5 During the period of continuous performance testing, the Contractor shall coordinate, mechanics, electricians, and other maintenance personnel to attend to any adjustments, corrections or operations which may be required.
- 3.5.6 During this test, the Contractor's Testing Manager and testing team shall monitor the characteristics of each piece of equipment, instrumentation and each control device according to the Manufacturer's specifications and report any unusual conditions to the Engineer.
- 3.5.7 The continuous operation test shall run for minimum 14 day calendar period. Should the Engineer deem that the test needs to be stopped as a result of the non-performance of any work completed under this Contract, the Contractor shall make good the non-performing component and restart the test at time zero. Should the Engineer or Owner stop the test for any other reason, the test will be restarted and run for the remaining balance of this period.

- 3.5.8 The Contractor recognizes and agrees that the Performance and Reliability Run is for the purpose of establishing that the works can be operated as intended and that it shall be successfully completed prior to Substantial Performance.
- 3.5.9 Meet with the Engineer and the Owner to finalize the test plan for the performance and reliability run.
- 3.5.10 Modify the test plan to suit prevailing operating conditions if necessary.
- 3.5.11 Provide all instruments and test devices necessary to record operating parameters where they are not part of the works.
- 3.5.12 The roles and responsibilities during the Performance and Reliability Run are defined as follows:
- .1 The Contractor:
    - .1 The Contractor will place all systems on-line ready for continuous operation and complete all cleaning, disinfection and preparatory works to permit the works to be operated as intended.
    - .2 The Contractor will provide supervisory personnel, tradesmen and manufacturer representatives as necessary during the test period to support the Owner's operations staff in maintaining the works in full time operation.
  - .2 The Engineer:
    - .1 The Engineer will monitor the performance and reliability run on behalf of the Owner. The Engineer will assess whether any abnormalities affect the integrity of the test during the test period. The Engineer will assess the results of the test run and determine whether additional testing is required.
  - .3 The Owner:
    - .1 The Owner will operate the works as intended and record all required operating parameters. The Owner's staff will report any abnormalities to the Engineer promptly throughout the test period.
  - .4 System Programmer
    - .1 The programmer of the control system will ensure that the control programs are placed on line ready for continuous operation and will provide support to operations staff throughout the test as required to maintain the control systems in full time operation.
    - .2 The Contractor will be required to coordinate with the SCADA programmer throughout the test period as required.
    - .3 The Contractor agrees to accept the Owner or agents of the Owner as the operating authority for the performance and reliability run. The Owner will provide the qualifications of staff or agents appointed to conduct tests to the Contractor upon request.

- .4 The works will perform as outlined below for a continuous period of 14 calendar days.
- .5 The performance and reliability run requirements will be provided by the Engineer.
- .6 The performance and reliability run will commence on a Tuesday unless otherwise approved by the Engineer.
- .7 Abnormalities and/or component failures during the performance and reliability run may result in the entire test being repeated or extended or components being repeated or extended at the discretion of the Engineer.
- .8 Investigate the cause of all abnormalities such as vibration overloading, overheating, unexpected operating results and provide reports as necessary to the Engineer to demonstrate that the abnormalities have been resolved and eliminated.
- .9 The Scope of Work of this Contract includes the performance and reliability run and Substantial Performance is conditional on completion of this test to the satisfaction of the Engineer.

### **3.6 Test Forms**

- 3.6.1 It is a condition of acceptance for commissioning by the Owner that all equipment test forms be signed by the Contractor, Engineer, and the Owner indicating acceptance.
- 3.6.2 Prepare all test forms for use in advance of system performance and operational testing.

### **3.7 Equipment and System Performance Tests**

- 3.7.1 Each item of process, mechanical, electrical, and instrumentation equipment installed under this contract shall be tested to demonstrate compliance with the performance requirements of this project manual. Each electrical, instrumentation, mechanical, and piping system installed or modified under this contract shall be tested in accordance with the specified requirements.

### **3.8 Cleaning**

- 3.8.1 Following completion of the continuous operational testing period, the Contractor shall replace all HVAC filters; dewater and clean all sumps; dewater all process units for the deficiency inspection, and other tasks as required to return the installation to an as new condition. The system shall be completely cleaned to the satisfaction of the Engineer and the Owner prior to turning over to the Owner.

### **3.9 Utilities and Consumables**

- 3.9.1 The Contractor is required to provide and pay for all services, water, electricity and any other temporary services required during the construction and commissioning period. The Owner shall pay for all electricity costs following the date of commencement of operation of the Works.
- 3.9.2 Prior to the commencement of operation and at the end of the start-up operation period the Contractor shall ensure that all the equipment has been thoroughly greased and oiled with

materials approved by the manufacturer and in accordance with the manufacturer's written instructions.

- 3.9.3 At the end of the start-up operation period, all manuals, parts and supplies which are required by the Contract shall be turned over to the Owner.
- 3.9.4 During the period of operation, the Contractor shall have at the site supervisory personnel, mechanics, electricians, and other maintenance personnel to attend to any adjustments, corrections or operations which may be required.
- 3.9.5 Before the Owner takes over the station from the Contractor or issues the Certificate of Substantial Performance, the Contractor's period of operation shall have been successfully completed and the certificates required by the Contract Documents shall have been submitted.

### **3.10 Documentation**

- 3.10.1 It is a condition of acceptance for commissioning by the Owner that all equipment test forms be signed by the Contractor, Engineer, and the Owner indicating acceptance.
- 3.10.2 At the end of the continuous performance test period, all manuals, parts and supplies which are required by the Contract shall be turned over to the Owner.
- 3.10.3 Before the Owner takes over the station from the Contractor or issues the Certificate of Substantial Performance, the Contractor's period of operation shall have been successfully completed and the certificates required by the Contract Documents shall have been submitted.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Intent**

- 1.1.1 The specification outlines the requirements for demonstration, training and instruction in the operation and maintenance of equipment and systems to the Owner and plant personnel.
- 1.1.2 The Contractor shall provide demonstration, training and instruction for all pieces of equipment specified to be installed under the Contract.

### **1.2 Qualified Trainer**

- 1.2.1 The Contractor shall provide the specified on-the-job training of the Owner's operating or maintenance staff for the maintenance of equipment. The training sessions shall be conducted by qualified, experienced (3 years minimum) factory-trained representatives from the various equipment manufacturers. Training shall include instruction of operation personnel in equipment operation and preventative maintenance and instruct plant mechanics, electricians and electronics technicians in normal maintenance up to major repair.

### **1.3 Submittals and Schedule**

- 1.3.1 Submit outline of all demonstration and training sessions 20 working days in advance of the planned start date.
- 1.3.2 Submit schedule of time and date for all demonstration and training sessions 20 working days prior to the planned start dates for the Engineer's approval.
- 1.3.3 Maintain a record of all attendees for demonstration and training sessions and submit to the Engineer, along with a report on all sessions prior to Substantial Performance.
- 1.3.4 Allow sufficient time in the construction schedule and test plan for completion of demonstration and training.
- 1.3.5 Coordinate attendance of demonstration and training specialists with availability of Owner and plant personnel.
- 1.3.6 Where the same personnel are used for testing and commissioning and for demonstration and training, ensure that the testing and commissioning work is completed to the satisfaction of the Engineer before the demonstration and training commences and that sufficient time is set aside to complete the demonstration and training.
- 1.3.7 All training shall occur on site. Contractor to coordinate and pay for all cost associated with bringing qualified trainers to the site.
- 1.3.8 All training programs shall be completed prior to the start of commissioning.
- 1.3.9 Feedback training sessions may be required at a later date.
- 1.3.10 All field training programs shall be fully co-ordinated with construction, testing and commissioning. Where projects are phased, training for each phase shall be completed before acceptance of that work. Separate training sessions shall be conducted for each

phase as required. Separate training sessions may be required as a result of shift work by operations staff, customize to suit.

- 1.3.11 All training sessions will be conducted Monday to Friday between 8:00 a.m. to 3:00 p.m.

#### **1.4 Pre-Conditions for Demonstrations and Training**

- 1.4.1 Where appropriate, components shall be pre-commissioned and ready for final testing and commissioning. Equipment and Instruments shall be capable of operating as intended, during demonstration and training sessions.

- 1.4.2 Training materials will be approved by the Engineer and available to trainees.

- 1.4.3 Final Operation and Maintenance Manual shall be complete.

#### **1.5 Required Demonstration and Training Sessions**

- 1.5.1 Provide the following demonstration and training sessions:

- 1.5.2 Provide sufficient demonstration to cover start-up, operation, control, adjustment, calibration, trouble-shooting, servicing, maintenance and shut down of all components of the works.

- 1.5.3 Provide two (2) training sessions for Operation and Maintenance staff, scheduled at different times to accommodate for all work hours shifts.

## **2 TRAINING SESSIONS**

- 2.1.1 General:

- .1 Every equipment training session shall be recorded with a professional video camera. The Contractor shall provide high quality videos of each equipment training session to the Owner.
- .2 The Contractor shall be responsible to set up the training sessions with the manufacturer.

- 2.1.2 Lesson Plan: prepare for each required course, containing the following minimum information:

- .1 Title and objectives.
- .2 Recommended types of attendees (e.g., managers, Engineers, operators, maintenance).
- .3 Course description and outline of course content.
- .4 Format (e.g., lecture, self-study, demonstration, hands-on).
- .5 Instruction materials and equipment requirements.
- .6 Resumes of instructors providing the training.

### 2.1.3 Training Schedule

- .1 List specified equipment and systems that require training services and show:
  - .1 Name of manufacturer.
  - .2 Estimated dates for installation completion.
  - .3 Estimated training dates.
- .2 Allow for multiple sessions when several shifts are involved.
- .3 Adjust schedule to ensure training of appropriate personnel as deemed necessary by Operation manager and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
- .4 Coordinate with Section 01330 - Submittals and Section 01810 – Testing and Commissioning.

## 2.2 Training Requirements

- 2.2.1 The Contractor shall conduct training sessions for the Owner's staff to instruct on the proper operation, care and maintenance of the equipment and systems installed under this contract. Training shall take place at the site of the work and under the conditions as specified.
- 2.2.2 Field training session shall take place at the site of the equipment.
- 2.2.3 Formal written lesson plans shall be prepared for each training session. Lesson plans shall contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan shall contain a time allocation for each subject. One complete set of the originals of the lesson plans; training manuals, handouts, visual aids and reference material shall be the property of the Owner and shall be properly bound and organized for easy reproduction of any section as required. The Contractor shall furnish ten (10) copies of training manuals, handouts, visual aids and reference materials at least one week prior for each training session.
- 2.2.4 Each training session shall be comprised of time spent both in the classroom and training session shall cover the following topics for each item of equipment or system:
  - .1 Familiarization
  - .2 Safety
  - .3 Operation
  - .4 Troubleshooting
  - .5 Preventive maintenance
  - .6 Corrective maintenance
  - .7 Parts



- .8 Local representatives
- .9 Operation and maintenance manuals

2.2.5 Video Recording:

- .1 Retain the services of a commercial video recording service provider to record the training session, not repeated sessions. After completion of the video recording, the material may be edited and supplemented with professionally produced graphics to provide a permanent record. The Contractor shall advise all manufacturers or suppliers who are providing training sessions that the training sessions will be video taped
- .2 Use single DVD for each training course.
- .3 Quality of Video: 720 Dpi, 30 fps, aspect ratio: 4:3.

2.2.6 The Consultant shall specify the time required for the proper training of Owner's Operating and Maintenance staff that is required for each equipment or process system. To permit shift Operators to attend training sessions, the Contractor shall provide for off-hours and multiple sessions.

**2.3 Classroom Equipment Training – Operating/Maintenance Staff**

2.3.1 As a minimum, the Contractor shall provide classroom equipment training for operating and maintenance staff and shall include the following:

- .1 Videos, slides and or drawings, for discussion of the specific equipment, its location in the plant and an operation overview.
- .2 Purpose and function of the equipment.
- .3 A working knowledge of the operating theory of the equipment.
- .4 Start-up, shutdown, normal operation, and emergency operation procedures, including a discussion on system integration and electrical interlocks, if any.
- .5 Identify and discuss safety items and procedures.
- .6 Routine preventative maintenance, including specific details on lubrications and maintenance of corrosive protection of the equipment and ancillary components.
- .7 Operator detection, without test instruments, of specific equipment trouble symptoms.
- .8 Required equipment exercise procedures and intervals.
- .9 Routine disassembly and assembly of equipment, if applicable, (as judged by the Owner on a case-by-case basis) for purposes such as operator inspection of equipment.
- .10 Normal and major repair procedures.
- .11 Equipment inspection and trouble shooting procedure including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

.12 Routine and long-term calibration procedures.

.13 Safety procedures.

## **2.4 Hands on Training for Operating/Maintenance Staff**

2.4.1 Hands-on training of equipment shall include:

.1 Location of the equipment in the facility and review its function.

.2 Identify piping and flow options.

.3 Identify valves and its function.

.4 Identify field instrumentation, particularly with respect to:

.1 Location of primary element.

.2 Location of instrument readout.

.3 Discuss purpose, basic operation and interpretation of operating data.

.5 Discuss, demonstrate, and perform standard operating procedures and outline checks.

.6 Discuss and perform the preventative maintenance activities.

.7 Discuss and perform start-up and shutdown procedure.

.8 Perform routine equipment exercise procedure.

.9 Perform disassembly and assembly of equipment if applicable.

2.4.2 Identify and review hazardous operation and demonstrate safety procedures, where applicable.

2.4.3 Contractor must be able to turn on equipment and demonstrate operation of the equipment for training session to be considered complete.

2.4.4 Review normal repair procedures.

2.4.5 Review and perform the safety procedures.

2.4.6 Perform Owner's-approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and trouble shooting equipment problems.

2.4.7 Review and use equipment manufacturer's manual in the hands-on training.

## **3 EXECUTION (NOT APPLICABLE)**

**END OF SECTION**

## **DIVISION 2 – SITE WORKS**

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Section No.	Title
02061	Tank Draining and Cleaning
02140	Yard Piping Cleaning
02150	Temporary Pumping Facilities

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## **1 GENERAL**

### **1.1 Scope**

- 1.1.1 The owner will remove each secondary clarifier from service. The contents of Secondary Clarifiers 1-4 shall be completely drained by the Contractor. The owner will have Secondary Clarifiers 7&8 drained to the top of the sloped floor or to a depth of approximately 1.3m (4.2ft); see as-built drawings for additional information. The contractor shall be responsible for draining all identified chambers and yard piping.
- 1.1.2 The Contractor will supply all equipment, labour, material and consumables necessary to for the dewatering, cleaning, and temporary isolation of all infrastructure (e.g. secondary clarifiers, chambers, yard piping, etc.) required to complete the CCTV and visual inspection, including:
- .1 Complete dewatering and disposal of remaining deposited solids of:
    - .1 Secondary Clarifier 1-4 Distribution Chamber
    - .2 Secondary Clarifier 3-4 Sludge Chamber
    - .3 Secondary Clarifier 1-4 Effluent Manhole 2
    - .4 Secondary Clarifier 7-8 Feed Chamber
    - .5 Secondary Clarifier 7-8 Distribution and Waste Sludge Chamber

### **1.2 References**

- 1.2.1 OSHA and related Regulations
- 1.2.2 O.Reg. 632/05 - Confined Spaces

### **1.3 Submittals**

- 1.3.1 Provide copies of Confined Space Entry Plans and a copy of each Entry Permit to the City and Engineer prior to entering into any confined space.
- 1.3.2 Complete list of all controlled products, hazardous materials, products containing hazardous materials, and all biological or chemical agents or devices or equipment producing or emitting a physical agent and any substance, compound, product or physical agent that is deemed to be or contains a designated substance as defined under the Act and the Regulations, which will be or may be used for the work, prior to the commencement of the work.
- 1.3.3 Provide appropriate information and Safety Data Sheets, where required, for the substances used in the performance of the work.
- 1.3.4 Provide a Spills Contingency Plan, outlining the notification requirements and procedures for rapid clean-up of spills that may occur.

#### **1.4 Permits, Fees and Inspection**

- 1.4.1 The Contractor shall apply for, obtain and pay for all permits, licenses, inspection, examination testing and fees required.
- 1.4.2 Any work rejected or required correction shall be rectified at the Contractor's expense and any additional inspection caused by the deficient work shall also be paid by the Contractor.

#### **1.5 Spills**

- 1.5.1 The Contractor shall submit procedures for inspection and rapid clean up of spills that may occur. Be prepared at all times to intercept, clean up and dispose of any spill that may occur. Keep all materials required for clean-up of spills readily accessible on the site.
- 1.5.2 Report immediately any spills causing damage to environment to:
  - .1 Spills Action Centre of the Ministry of Environment and Climate Change
  - .2 Any other authority having jurisdiction or an interest in the spill including any Conservation Authority, water supply authority, drainage authority, road authority, fire department.
  - .3 The owner of the pollutant and the person having control over the pollutant, if known.
- 1.5.3 Contact the manufacturer of the pollutant, if know, and ascertain the hazards involved, precautions required and best measures to be used in any clean up or mitigating action.
- 1.5.4 Take immediate action using any available resource to contain and mitigate the effects on the environment from any accidental spill.

### **2 PRODUCTS (NOT APPLICABLE)**

### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 Prior to commencement of this task, plant operators will isolate each secondary clarifier and dewater (where applicable). The contents of Secondary Clarifiers 1-4 will be completely drained by the Contractor. The plant operators will drain Secondary Clarifiers 7&8 will be drained to the top of the sloped floor or a depth of approximately 1.3m (4.2ft) from the floor; see as-built drawings for additional information.

#### **3.2 Records**

- 3.2.1 The Contractor shall maintain accurate minutes of all meetings, records, memos, site inspection reports, site progress reports identifying the volumes of solids removed, and other relevant document related to Tank Draining and Cleaning.
- 3.2.2 A daily log, hard cover book with permanent pages, shall be kept on site and maintained by the Contractor. The daily logbook shall be available at any time for review by the Owner, the Contract Administrator, and/or the MOL. The daily logbook shall be submitted to the Owner at upon completion of work under this contract.

### **3.3 Protection Of Utilities, Structures and Property**

- 3.3.1 The Contractor shall ensure that his/her operations do not interfere with or damage existing utilities, equipment, structures and property. The Contractor will be held fully responsible for any damage to utilities, properties and/or structures adjacent or in the general area of the work through settlement of ground, vibration or shock resulting from any cause relating to work carried under this contract.
- 3.3.2 The Contractor shall support and protect from direct or indirect damage existing utilities, equipment, structures and property which occur within or over contractor's operations, or adjacent to the work. The methods of protecting and temporary supporting utilities, structures and other items, where required, shall be satisfactory to the City and or utility owner concerned. Such work and costs shall be included in and considered to be part of payment under this contract.

### **3.4 Measurement And Payment**

- 3.4.1 Work outlined in this section is included in the lump sum tender price.

### **3.5 Sludge Removal**

- 3.5.1 Prior to commencement of this task for each secondary clarifier, plant operators will dewater each secondary clarifier. Secondary Clarifiers 1-4 will be drained by the Contractor. Secondary Clarifiers 7&8 will be drained to a depth of approximately 1.3m (4.2ft) or to the top of the sloped floor; see as-built drawings for additional information. The Contractor will provide a portable pump to drain the remaining liquid portion (approximately 0.2 to 1.0% solids) and discharge to the adjacent process drain for treatment.
- 3.5.2 The remaining heavy solids (assume 110 m3 total between all chambers and yard piping at an average 8% solids concentration) shall be slurried by the contractor to allow for vacuum truck removal and disposal at Manholes #12, #13, or #14 dependent on access; see as-built drawings for additional information.

### **3.6 Tank, Pipe, And Chamber Cleaning**

- 3.6.1 The Contractor will give notice in writing to the Owner seven (7) days prior to the commencement of tank cleaning operation.
- 3.6.2 The Contractor shall cooperate with plant operating personnel to minimize interference with plant operations.
- 3.6.3 Contractor is responsible for cleaning the chambers to accommodate the necessary works.
- 3.6.4 The Contractor shall provide proper equipment, temporary piping and all other required equipment in order to remove all liquid and remaining solids in the chambers, yard piping, and secondary clarifiers.
- 3.6.5 Before commencing work and while working in areas which may contain an explosive, toxic, or oxygen deficient atmosphere, the Contractor shall test for explosive or toxic gases, or oxygen deficiency in accordance with applicable statutes and acceptable practice. If a hazardous condition is found, the Contractor shall make the work area safe before commencing or continuing work.

3.6.6 Upon removal of all waste material, the Contractor shall pressure wash the tank interior including all piping, fittings, pipe hangers and brackets. Remove all rags, debris, sand, solid waste and any other matter from all fittings and piping.

3.6.7 All costs associated with the cleanout and disinfection of the tanks, chambers, and yard piping are deemed to be included in the total lump sum tender price.

### **3.7 Supply Of Water**

3.7.1 The City will supply free of charge effluent water to the Contractor for the cleaning of the chambers. The Contractor shall pay for the temporary pump and piping required to transport the effluent water to the site(s) for cleaning. Effluent water source shall be the chlorine contact chamber located onsite. The Contractor and City will agree on the source of effluent water to be used.

3.7.2 If the preferred supply of water for cleaning is from a nearby City hydrant, the Contractor shall supply, install, and pay for a backflow preventer and meter for record and billing purposes. The Contractor must employ all reasonable steps and precautions to conserve water supplied. The connection point and method of connection will be subject to the approval of the Engineer and the Owner. The Contractor shall pay for any temporary pump and piping required to transport the water to the site(s) for cleaning. The Contractor and City will agree on the method of payment on hydrant usage.

3.7.3 Contractor is responsible for supply of any potable water and/or pressure washing of surfaces to make suitable for preparation prior to application of any coating systems.

### **3.8 Disposal Method**

3.8.1 Pump all liquid and solids contents from the clarifiers into the adjacent process drains (Manholes #12, 13, or 14) which flows to the raw sewage pump station. The Contractor is deemed to have taken into consideration variation of the quality and composition of the chamber contents.

3.8.2 The Contractor shall submit to the City prior to commencement a detailed work plan schedule of the proposed works.

### **3.9 Equipment**

3.9.1 The use of the City's machinery, equipment or services will not be permitted.

3.9.2 All electrical devices and wiring used inside the clarifier tank shall be explosion proof and carry appropriate C.S.A. approval. All lighting and wiring shall be made secure from damage or falling. All electrical installation and equipment shall comply with electrical codes.

3.9.3 In hazardous areas, provide intrinsically safe mechanical devices and equipment such as non-sparking aluminum wheels for fans, pneumatic operators for dampers and aluminum clappers for check valves on pipelines conveying gaseous fuels.

3.9.4 Keep equipment clean so that no debris is deposited on the plant roadways or any public roadway. Contain debris in a designated area within the working limits. Dispose of debris off-site as specified.



- 3.9.5 Use only vehicles and equipment equipped with effective muffling devices. Provide noise barriers on stationary engines and compressors.
- 3.9.6 Provide, mount and maintain signs warning all of the hazards and of the proper procedures required for working in the hazardous areas.
- 3.9.7 The Contractor will be responsible to supply power and or fuel and hook up any equipment required such as but not limited to transformers, wiring, etc.

**3.10 Damage And Contamination**

- 3.10.1 The Contractor shall be liable to the owner of the sites used for waste disposal in the event that any damage or contamination is done to the property due to improper waste disposal. The Contractor shall make good and restore the site at no additional cost to the City.
- 3.10.2 In the event of improper disposal or accidental spillage, the Contractor shall immediately clean the area affected to the satisfaction of the City and all other authorities having jurisdiction.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This specification covers the flushing and cleaning of existing yard pipe segments including the removal of debris, encrustations and intrusions.
- 1.1.2 Yard Piping Cleaning shall conform to City of Brantford "Design and Construction Manual Linear Municipal Infrastructure Standards", Section 24.0 Cleaning and Inspection and as specified herein.

## **2 CONSTRUCTION METHODS**

### **2.1 High Velocity Cleaning Equipment**

- 2.1.1 High velocity cleaning equipment is to be minimally capable of producing a flow rate of 4.1 litres per second at 13,800 kPa of pressure complete with the following:
  - .1 Selection of nozzles capable of effectively scouring and removing grease from the sewer pipe wall and transporting debris in all sizes of the sewers to be cleaned.
  - .2 Water tank.
  - .3 Auxiliary engines.
  - .4 Pumps.
  - .5 Hydraulically driven hose reel with a wash down gun for cleaning manholes.
  - .6 Approved backflow prevention device for filling water tank from a hydrant.

### **2.2 Debris Removal Equipment**

- 2.2.1 Vacuum unit(s) used for removing sewer debris sewer to be complete with the following.
  - .1 Positive displacement pumps or fans producing a minimum 700 litres per second of air movement.
  - .2 Storage tank.
  - .3 Minimum 150 millimetre diameter suction hoses attached to a hydraulic boom.
- 2.2.2 Configure the storage tank to allow the liquid portion of the debris to be returned to the sewer.

### **2.3 Solid Debris Cutting Equipment**

- 2.3.1 Solid debris cutting equipment shall consist of remote controlled hydraulically driven saw or blade cutters, remotely operated robots or other types of equipment capable of removing heavy roots and solid debris such as encrustation and grease.
- 2.3.2 Select the cutting equipment to be used considering debris type, yard pipe condition and yard pipe material.

## **2.4 Solid Debris Cutting and Removal**

- 2.4.1 Cut and remove encrustation and solid debris from the yard piping segments indicated on the Drawings.
- 2.4.2 Remove solid debris to within 10 millimetres of the inside surface of the pipe.
- 2.4.3 Monitor the entire cutting operation and while the cutting equipment is travelling within the pipe to reach the work area by closed circuit television (CCTV).
- 2.4.4 Inspect the entire sewer section in accordance with Section 24.0 Cleaning and Inspection after completion of solid debris cutting.

## **2.5 Acceptance of Work**

- 2.5.1 Submit required video inspections performed according to Section 24.0 Cleaning and Inspection. The Consultant will review the inspection videos within 14 days of submission.
- 2.5.2 Perform remedial cleaning, cutting of solid debris and a re-inspection for the locations where the work was determined by the Consultant as not being acceptable.

# **3 MEASUREMENT AND PAYMENT**

## **3.1 Yard Piping Cleaning and Solid Debris Cutting and Removal**

- 3.1.1 Yard Piping Cleaning and Solid Debris Cutting and Removal will be measured on a length basis for each size and type of sewer and paid for at the Contract Unit Price for "Yard Piping Cleaning and Solid Debris Cutting and Removal. The length paid for will be the total yard piping segment cleaned in accordance with this specification, accepted and measured by the Consultant.
- 3.1.2 Only one yard piping length payment for each segment to be cleaned will be made. All other cleaning, multiple cleaning passes, solid debris cutting and rectification of deficient or insufficient cleaning is the responsible of the Contractor and is incidental to the Contract.
- 3.1.3 Measurement will be made horizontally at grade above the affected pipe or based on the distance measurements indicated in the Contractor's sewer inspections.
- 3.1.4 50% of the payment will be made upon satisfactory completion of the cleaning work. The remaining 50% of the payment will be made upon final acceptance of the sewer cleaning as determined by the review of the corresponding video inspection performed in accordance with the specifications.
- 3.1.5 Measurements will be taken from the pre and post sewer cleaning inspections conducted in accordance with the specifications.

## **3.2 Debris Removal and Disposal**

- 3.2.1 Debris Removal and Disposal will be considered incidental to the Contract and shall be included in other affected measurement and payments items.

**END OF SECTION**

Segment	Defects	Comments	Recommendation
PLANT 2 AERATION EFFLUENT CHAMBER EFFLUENT PIPE_PLANT 2 AERATION EFF CHAM_202212071155	Line right was intended. Deposits attached 15%.	66" CPP. Remove deposits from elbow to Chamber.	SPG 2 Re-inspect 5 years
PLANT 2 AERATION EFFLUENT CHAMBER EFFLUENT PIPE_PLANT 2 AERATION EFF CHAM_202212071310	Line right was intended.	Same segment as above. Deposits were removed successfully.	SPG 2 Re-inspect 5 years
PLANT 2 AERATION EFFLUENT CHAMBER EFFLUENT PIPE_PLANT 2 AERATION EFF CHAM_202212071330	Line right was intended.	Same segment as above. Deposits were removed successfully.	SPG 2 Re-inspect 5 years
PM1 AERATION TANK EFFLUENT PIPE TO 1-4 DIST. CHAMBE. PM1 AERATION TANK_202301041333	Encrustation 10 to 2 <<5%	42" RCPP.	SPG 2 Re-inspect 5 years
S.C 5-6 DIST & S. CHAMB TRANS PIPE TO S.C 7-8 F.C. SECONDARY CLAR 7-8 F.C_202212071618	Encrustation 2 to 10 <<5%	48" CPP.	SPG 2 Re-inspect 5 years
S.C 7-8 FEED CHAMB TRAN PIPE TO S.C 7-8 DWSC_SECONDARY CLAR 7-8 F.C_202212071442	Minor CL. Autogeneous healing evident.	66" CPP.	SPG 2 Re-inspect 5 years
SECONDARY CLARIFIER 2 INFLUENT FEED PIPE_SECONDARY CLARIFIER 1-4 D_202301041553	Encrustation <10% full length/circumference.	24" CI. Consider solid debris removal entire length.	SPG 2 Re-inspect 5 years. Solid debris removal supplementing standard specification 24.3 (per lin. M)
SECONDARY CLARIFIER 2 SLUDGE PIPE_PM1 SLUDGE CHAMBER_202301041624	Line up was intended. Encrustation <10% full length/circumference.	14" CI. Consider solid debris removal entire length.	SPG 2 Re-inspect 5 years. Solid debris removal supplementing standard specification 24.3 (per lin. M)
SECONDARY CLARIFIER 3-4 SLUDGE CHAMBER_PM1 SLUDGE CHAMBER_202301051016	Encrustation 4 to 8<<5%	24" AC.	SPG 2 Re-inspect 5 years
SECONDARY CLARIFIER 4 INFLUENT FEED PIPE_SECONDARY CLARIFIER 1-4 D_202301041444	Encrustation <10% full length/circumference.	24" CI. Consider solid debris removal entire length.	SPG 2 Re-inspect 5 years. Solid debris removal supplementing standard specification 24.3 (per lin. M)
SECONDARY CLARIFIER 4 SLUDGE PIPE_SECONDARY CLAR 3-4 S.C_202301041416	Line up was intended. Encrustation <10% full length/circumference.	14" CI. Consider solid debris removal entire length.	SPG 2 Re-inspect 5 years. Solid debris removal supplementing standard specification 24.3 (per lin. M)
SECONDARY CLARIFIER 7 INFLUENT FEED PIPE_SECONDARY CLAR 7-8 DWSC_202301131507	Line down and up was intended.	36" CPP.	SPG 2 Re-inspect 5 years
SECONDARY CLARIFIER 7 WASTE SLUDGE PIPE_SECONDARY CLAR 7 SUMP_202212151304	Line up was intended. Encrustation <20% full length/circumference.	8" DI. Consider solid debris removal entire length.	SPG 3 Re-inspect 5 years. Solid debris removal supplementing standard specification 24.3 (per lin. M)
SECONDARY CLARIFIER 7 WASTE SLUDGE PIPE_SECONDARY CLAR 7-8 DWSC_202212191151	Line down was intended.	24" CPP. Report says 36" Wood, if's CPP, confirm diameter.	SPG 2 Re-inspect 5 years
SECONDARY CLARIFIER 8 INFLUENT FEED PIPE_SECONDARY CLAR 7-8 DWSC_202301131442	Line down and up was intended. One localized encrustation at 12m.	36" CPP. Consider localized solid debris removal.	SPG 2 Re-inspect 5 years. Solid debris removal supplementing standard specification 24.3 (spot)
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 7-8 DWSC_202212191247	Same segment as above, it's the influent. Line down and up was intended. One localized encrustation at 12m.	36" CPP. Consider localized solid debris removal.	SPG 2 Re-inspect 5 years. Solid debris removal supplementing standard specification 24.3 (spot)
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 8 SUMP_202212141446	Line up was intended. Encrustation <20% full /circumference. Settled debris 50%. Only 4m inspected.	8" DI. Consider solid and settled debris removal entire length.	SPG 2 Re-inspect 5 years. See follow up CCTV below.
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 8 SUMP_202212151051	Same segment as above. Line up was intended. Encrustation <20% full /circumference. Settled debris 50%. Only 1.5m inspected.	8" DI. Consider solid and settled debris removal entire length.	SPG 2 Re-inspect 5 years. See follow up CCTV below.
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 8 SUMP_202212151240	Same segment as above. Line up was intended. Encrustation <20% full /circumference. Settled debris 50%. Only 4m inspected.	8" DI. Consider solid and settled debris removal entire length.	SPG 2 Re-inspect 5 years. See follow up CCTV below.
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 8 SUMP_202212161439	Line down was intended. Only 5 m inspected, rest MWL 100%.	24" CPP. Report says 36" DI, it's CPP, confirm diameter.	SPG 2 Re-inspect 5 years
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 8 SUMP_202302160955	Same 8" SC8 waste sludge with 29.5m of debris and encrustation removed. Line up was intended. Encrustation <10% full /circumference. 33m inspected. Encrustation >20% and settled deposits last 3.5m	8" DI. Consider solid and settled debris removal last 3.5m.	SPG 2 Re-inspect 5 years. See follow up CCTV below.
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 8 SUMP_202302161113	Same 8" segment as above with all debris and encrustation removed. Line up was intended.	8" DI.	SPG 2 Re-inspect 5 years. See follow up CCTV below.
SECONDARY CLARIFIER 8 WASTE SLUDGE PIPE_SECONDARY CLAR 8 SUMP_202302161231	Same 8" segment as above with all debris and encrustation removed and less fog in CCTV. Line up was intended.	8" DI.	SPG 2 Re-inspect 5 years
SECONDARY CLARIFIERS 1-4 EFF PIPE MH 1-2_SEC CLARIFIER 1-4 EF MH 1_202301041210	Small joint offset, localized encrustation <5%	42" RCP.	SPG 2 Re-inspect 5 years

## **1 GENERAL**

### **1.1 Scope**

- 1.1.1 The Contractor is required to furnish all materials, labour, equipment, power, maintenance, etc., to implement a temporary bypass system, including but not limited to temporary pumps, flow meters, valves, level controls, portable diesel generator, etc., for the purpose of diverting secondary clarifier effluent around the isolated chambers and channels to the chlorine contact tank.
- 1.1.2 The Contractor is responsible for the design, supply, installation and maintenance of the equipment and controls, and decommissioning and removal of the bypass system, to ensure a reliable and functional temporary system which operates continuously throughout the construction period.

### **1.2 Related Sections**

- 1.2.1 Section 01000 - General Requirements
- 1.2.2 Section 01120 – Coordination and Sequence of Work

### **1.3 General**

- 1.3.1 Equipment furnished under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering instructions and recommendations of the temporary pumping system supplier, unless exceptions are noted by the Engineer.
- 1.3.2 Coordination. The Contractor shall verify that proposed installation is compatible with the design of the pump over the entire range of flows considered. The Contractor is responsible for overall coordination, installation, and operation of the temporary pumping system.
- 1.3.3 Power and Fuel. Contractor is responsible to supply power and/or fuel to all temporary equipment for the duration of operation. Make any temporary electrical connections as required in compliance with Electrical Safety Authority. Any electrical power feed from the plant shall be metered to allow billing to the contractor.
- 1.3.4 The Contractor shall design the temporary bypass facility and submit the shop drawing for the Engineer's review.
- 1.3.5 Contractor to be responsible for the continuous operation of the temporary pumping facilities.
- 1.3.6 The temporary bypass system will be located outside in climatic conditions consistent with the City of Brantford.
- 1.3.7 The temporary system is to be properly restrained in accordance with stamped engineering design submission of the bypass system.

**1.4 Contractor's Responsibility**

- 1.4.1 Contractor shall perform the upgrades in stages to reduce the amount of time required for the temporary system to be in service. A suggested sequence of work has been described in Section 01120.
- 1.4.2 The Contractor shall be responsible for providing all necessary materials, fuel, power and labour for operating and maintaining a reliable and functional temporary bypass system including temporary pumping. Continuous operation of the temporary system remains the sole responsibility of the Contractor. Contractor to fully review site conditions to ensure proposed system equipment can be safely installed.
- 1.4.3 Contractor to provide suitable spill containment for the temporary bypass pumping systems.
- 1.4.4 Contractor shall be responsible for scheduling their work and to provide and maintain all necessary temporary facilities. Submit a construction schedule and provide a temporary system arrangement for approval prior to starting any work.
- 1.4.5 Contractor is responsible to pay for all fuel charges for maintaining the operation of the temporary system and standby power system.
- 1.4.6 An automatic dialer connected to the mobile network is to be included in the bypass package.
- 1.4.7 Alarming priorities are as follows (if applicable):
  - .1 High level
  - .2 Pump failure
  - .3 Failure of generator/power supply
  - .4 Emergency bypass pump activation
  - .5 Low fuel level on generator (if applicable)
  - .6 General fault
- 1.4.8 Dialer to be programmed to notify alarms in the following order:
  - .1 Contractor
  - .2 City of Brantford Plant Operator
  - .3 Engineer
  - .4 City of Brantford Project Manager
- 1.4.9 Following an alarm event, the Contractor is responsible to respond in a timely manner and restore operation of the bypass system (within 30 minutes) in coordination with the City. Once the issue is resolved, Contractor is to provide to the City and the Engineer a full report including alarm, response means and resolution. The Contractor shall note that the extended failure of the temporary system may result in the plant being unable to meet disinfection compliance requirements and may cause an overflow event. Proper redundancy in the form

of functional duty and standby pumps are required to be in place. The Contractor shall be liable for damages arising from such a scenario should they fail to promptly respond to an alarm event.

- 1.4.10 Contractor shall be responsible to report to the City's staff immediately when the temporary system malfunctions or when a spill has occurred. Contractor shall be responsible to report to MECP immediately any sewage spill and provide the necessary clean up, and to pay any fine for the associated environmental offence.
- 1.4.11 The Contractor cannot change the proposed temporary system or temporary system pumping arrangement without approval of the Engineer. In the event emergency modifications are required to maintain functionality, changes will be communicated within one day to the Engineer and Owner.
- 1.4.12 The Contractor shall confirm that the proposed temporary piping system is appropriate for the proposed works. Provide shop drawings sealed by the Contractor's Engineer licensed to practice in the Province of Ontario for the proposed temporary piping system and transient analysis for the Engineer's review.
- 1.4.13 The piping system (including valves, fittings, etc.) will be installed in accordance with the Manufacturer's recommendation. Provide adequate restraints for proper functioning of the temporary system.
- 1.4.14 Any damage done to the existing facility (including existing pavement, grass and facilities) during operation of the temporary system shall be repaired by the Contractor to the Engineer's satisfaction at no additional cost to the Owner.
- 1.4.15 Contractor should not consider any of the existing facility components as part of the temporary unit and should provide a standalone temporary system that is fully compliant with the requirements set in the contract documents.

## **1.5 Owner's Operator's Responsibility**

- 1.5.1 Designated plant staff (including the Engineer's Representative) shall be provided full access and full cooperation for operation of the temporary system.
- 1.5.2 In case of lack of response from the Contractor, the Plant Operations team shall have the right to intervene and conduct all necessary works to restore the temporary unit's operation. The Contractor is to pay for associated costs that will be deducted in the following progress payment.

## **1.6 Submittals**

- 1.6.1 Submit the drawings for review in accordance with Section 01330 - Submittal Procedures.
- 1.6.2 Contractor to provide drawings of the proposed temporary bypass system, and contingency plan to ensure uninterrupted temporary bypass operation for approval from the Engineer and the City prior to installing the temporary system.
- 1.6.3 The drawing submission shall include, but not be limited to, the following for each temporary bypass facility required:

- .1 Drawings showing proposed flow meter, pump and piping layout plan

- .2 Design information on the proposed pumps including curves, noise information, temporary pipe supports and anchoring required, etc. Temporary bypass system design to be signed and sealed by a Professional Engineer licensed to practice in Ontario
- .3 Information on power supply source for the pumps (diesel, electric, etc.).
- .4 System headloss curves for the proposed installation.
- .5 Controls and instrumentation for the installation including operating levels.
- .6 Anticipated duration and schedule of temporary pumping.
- .7 Standby power generator size and location, if applicable.
- .8 Downstream discharge plan.
- .9 Method of noise control for each pump and/or generator.
- .10 Calculation for selection of temporary pumping pipe size.
- .11 Submission shall be stamped by a Professional Engineer retained by the Contractor.

## **1.7 Protection Of Existing Installation**

- 1.7.1 Prevent any damage to pipes, maintenance holes, other structures, ground cover and grades within and in the immediate vicinity of the area of work. Make good any damage.
- 1.7.2 Provide spill control materials and equipment on site to deal with fuel spillage.

## **1.8 System Requirements**

- 1.8.1 All equipment and systems must comply with all codes and regulatory requirements.
- 1.8.2 Provide electric heat tracing and insulation to protect surface pipes and equipment from freezing during winter operation.
- 1.8.3 Provide all necessary start/stop and level controls (floats) to allow automatic operation of the temporary bypass system.
- 1.8.4 Provide an alarm dialer as per clause 1.4 if the system fails to operate or the pumps fail to start.

## **1.9 Applicable Codes and Standards**

- 1.9.1 Requirements from the following organizations shall be considered as a minimum in the design of the temporary pumping system:
  - .1 OSHA - Occupational Safety and Health Act
  - .2 CSA - Canadian Standards Association
  - .3 City, Regional, Provincial Codes.



## **1.10 Basis Of Payment**

1.10.1 All costs related to the temporary bypass system specified herein will not be measured separately for payment but shall be included in the pricing submitted for the related works and shall include, but not limited to, the following related items:

- .1 Supply, installation, operation, and commissioning of all equipment.
- .2 Site preparation to accommodate temporary equipment installation (i.e., provision of packed gravel surface flat surface for temporary system per supplier's recommendations).
- .3 Decommissioning, removal, and site restoration.
- .4 Troubleshooting and prompt response to alarm conditions.

## **2 PRODUCTS**

### **2.1 Service Conditions**

2.1.1 The temporary bypass system will be located outside in climatic conditions consistent with the City of Brantford.

2.1.2 The pumps shall be capable of pumping secondary clarifier effluent without clogging. The pumps shall be competent to handle minimum 75 mm (3") solids.

2.1.3 Channel Isolation and Temporary Bypass System Description:

- .1 Provide temporary bulkheads, cofferdams, pipe plugs or other means for upstream and downstream channel isolation.
- .2 Each pump to be housed in a dedicated, critically silenced, sound enclosure.
- .3 Provide minimum of one (1) start-stop float for each pump to be installed in each suction area and one (1) high-level float complete with auto-dialer for alarming purposes.
- .4 Provide a temporary pump system with a firm capacity capable of operating between 26,000 m<sup>3</sup>/d (300 L/s) to 150,000 m<sup>3</sup>/d (1,736 L/s) (average flows of 34,000 m<sup>3</sup>/d or 394 L/s) A flow meter shall measure all pumped flows.
  - .1 Estimated Max Static Head: approximately 3m. Contractor shall confirm the required TDH.

### **2.2 Performance And Design Requirements**

2.2.1 The temporary pumping systems shall be capable of operation over the range of flows, static heads indicated. Contractor shall ensure that the pumps can operate over an entire system curve. Contractor is responsible for installation of temporary pump discharge lines, valving, insulation/heat tracing if required.

2.2.2 All electrical systems shall be CSA approved for the area classification.

2.2.3 All bypass equipment shall be maintained as required to ensure trouble free operation for the duration of temporary bypassing. The Contractor is responsible for responding to all alarms and to restore system operation within 30 minutes.

2.2.4 The design, rental, coordination, installation, operation, maintenance and troubleshooting of the temporary bypass system shall be the Contractor's responsibility. The system shall meet the requirements of all codes and regulatory agencies having jurisdiction.

### **2.3 Temporary Piping**

2.3.1 The Contractor shall provide semi-rigid flexible pipes to transfer liquid. Quick disconnect piping is not acceptable. Lay-flat type systems are not acceptable. The contractor shall provide a magnetic flow meter, pressure gauges, check valves and isolation valves for each pump discharge pipe. Provide a spill containment to contain leaks. It is the Contractor's responsibility to clean up after any spills. The Contractor shall bear all costs for clean up after a spill.

#### **2.3.2 Flexible Connection**

- .1 Provide steel wire reinforced flexible connections that are rated for the required lift and discharge pressures.
- .2 Use rigid fittings (elbows and wye branches) on flexible hose especially where hoses turn from vertical to horizontal to prevent hose collapse.
- .3 Hydrostatically pressure test the discharge connections to 900 kPa and repair any leak prior to commencing the temporary bypass pumping.

#### **2.3.3 Rigid Connection**

- .1 Provide all above ground pump discharge connections with rigid steel piping with quick couplings.
- .2 Hydrostatically pressure test the discharge connections to 900 kPa and repair any leak prior to commencing the temporary bypass pumping.

### **2.4 Acceptable Vendors**

2.4.1 Rain For Rent

2.4.2 Continental Carbon

2.4.3 KSP Solutions

2.4.4 Aquatech Dewatering

2.4.5 Or approved equivalent.

### **3 EXECUTION**

#### **3.1 Mobilization And Installation Inspection**

- 3.1.1 Install the temporary pumping system as outlined within this specification and indicated on the submittals to the engineer. Provide a qualified representative to inspect each temporary pumping system installation to ensure proper functionality. Inspect and repair any leaks in the piping and connections to no leakage of wastewater to the surrounding property. Perform site simulation tests to verify that all alarms and controls are functioning properly.
- 3.1.2 Do not obstruct operator traffic and activities.
- 3.1.3 Set pump control float/ultrasonic control level set points per shop drawings approved by the Engineer.
- 3.1.4 Properly maintain and monitor the temporary system to ensure reliable service.

#### **3.2 Site Preparation**

- 3.2.1 The Contractor shall complete all site preparation required for the installation of temporary systems on a level surfaces and at the elevation identified on the drawings. Repair any damage to the existing site which may occur during installation of the temporary bypass system and restore the site after the work has been completed.

#### **3.3 Operation**

- 3.3.1 Provide all labour, energy and materials to maintain and provide a reliable, operating system. Contractor shall be responsible for all costs relating to power or fuel to run the temporary bypass system. Inspect the system daily to ensure there are no leaks and that the system is functioning properly.
- 3.3.2 The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- 3.3.3 The Contractor shall respond to and address all alarms from the temporary systems. Contractor shall issue a summary of the alarm and corrective action taken.
- 3.3.4 The Contractor shall provide all necessary means to safely convey the flows. The Contractor will not be permitted to stop or impede flows under any circumstances.
- 3.3.5 The Contractor shall maintain flow around the work area in a manner that will not cause damage to other areas of the plant and that will protect public and private property from damage and flooding.
- 3.3.6 The Contractor shall protect water resources and other natural resources.

#### **3.4 Demobilization**

- 3.4.1 Once temporary bypass system is no longer required, decommission all components and restore the property and plant operations to the same condition as prior to the installation of the temporary bypass. Remove all temporary electrical connections as required and restore

works area surface. The Contractor is responsible for coordinating pickup and/or return of the temporary system to the supplier(s).

**END OF SECTION**

## **DIVISION 3 – CONCRETE AND ACCESSORIES**

DIVISION 3 – CONCRETE AND ACCESSORIES

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Section No.	Title
03100	Concrete Forms and Accessories
03200	Concrete Reinforcement
03300	Cast-in-Place Concrete
03800	Polyurethane Injection
03905	Concrete Repairs

## **1 GENERAL**

### **1.1 Scope of Work**

- 1.1.1 Work supplied under this section includes the supply and installation of concrete formwork and falsework.

### **1.2 Related Sections**

- 1.2.1 Section 03200 – Concrete Reinforcement  
1.2.2 Section 03300 – Cast-in-Place Concrete

### **1.3 Measurement and Payment**

- 1.3.1 No measurement will be made under this section. Include costs in items of work for which concrete formwork and falsework is required.

### **1.4 References**

- 1.4.1 Canadian Standards Association (CSA):
- .1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
  - .2 CSA O86-19 - Engineering Design in Wood
  - .3 CSA O121-17 - Douglas Fir Plywood
  - .4 CSA S269.1-16- Falsework and formwork
- 1.4.2 International Organization for Standardization
- .1 ISO 16893 (2016) – Wood-Based Panels – Particleboard

### **1.5 Submittals**

- 1.5.1 Make submittals in accordance with Section 01330 Submittals
- 1.5.2 Submit formwork drawings.
- 1.5.3 Submit both typical arrangements and specific configurations for each pour.
- 1.5.4 Show layout and dimensions of construction joints, drop beams, pipe encasements, and all other concrete edges in the structure.
- 1.5.5 Show materials and layout of panels for formwork.
- 1.5.6 Comply with CSA-S269.1 for formwork drawings.
- 1.5.7 Show design loads, maximum allowable rate of pouring and material specifications.

- 1.5.8 Have a Professional Engineer, licensed in the jurisdiction of the construction, sign and seal the formwork and falsework design and inspection during construction.

## **2 PRODUCTS**

### **2.1 Materials**

#### 2.1.1 Formwork materials:

- .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA O121, CSA O86 and ISO 168693 Type P-HLB HMR.

#### 2.1.2 Form ties:

- .1 For concrete not designated 'Architectural', use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
- .2 All water/wastewater retaining structures ties are to have interior tie members that are cast into the structure complete with water stops and cone ends.
- .3 All below grade structures ties are to have interior tie members that are cast into the structure complete with water stops and cone ends.

#### 2.1.3 Form panels:

- .1 Plywood: high density overlay Douglas Fir to CSA O121 No.1 grade, square edge, 20mm thick.

#### 2.1.4 Form release agent: non-toxic, biodegradable, low VOC.

#### 2.1.5 Preformed joint filler: Ceramar flexible foam expansion joint filler by W.R. Meadows c/w joint cap.

## **3 EXECUTION**

### **3.1 Fabrication and Erection**

#### 3.1.1 Verify lines, levels and centres before proceeding with formwork and ensure dimensions agree with drawings.

#### 3.1.2 Fabricate and erect formwork in accordance with CAN/CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations, and levels indicated within tolerances required by CAN/CSA A23.1/A23.2.

#### 3.1.3 Align form joints and make watertight. Keep form joints to minimum.

#### 3.1.4 Form chases, slots, openings, drips, recesses, expansion, and control joints as indicated.

#### 3.1.5 Build in anchors, sleeves, and other inserts required to accommodate work specified in other sections. Assure that all anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.



3.1.6 Clean formwork in accordance with CAN/CSA A23.1/A23.2, before placing concrete.

**3.2 Removal and Reshoring**

3.2.1 Leave formwork in place for the following minimum periods of time after placing concrete.

.1 Seven (7) days for walls and sides of beams.

.2 Seven (7) days for beam soffits, slabs, decks and other structural members

.3 Contractor Note: Concrete requires additional curing after form removal. The ambient environmental conditions may require additional curing at the discretion of the Engineer.

3.2.2 After removing formwork, provide shoring under beams and suspended slabs for a minimum of 21 days.

3.2.3 Re-use formwork subject to requirements of CAN/CSA A23.1/A23.2.

3.2.4 All concrete surfaces, to be finished with a sack rubbed parge coat to the satisfaction of the Engineer. Refer to Section 03300 Cast in Place Concrete for concrete finish requirements.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Scope of Work**

- 1.1.1 Work supplied under this section includes the supply and installation of concrete reinforcement.

### **1.2 Related Sections**

- 1.2.1 Section 03100 – Concrete Forms and Accessories
- 1.2.2 Section 03300 – Cast-in-Place Concrete

### **1.3 Measurement and Payment**

- 1.3.1 No measurement will be made under this section. Include costs in items of concrete work for which reinforcement is required.

### **1.4 References**

- 1.4.1 Canadian Standards Association (CSA):

- .1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction / Test Methods and Standard Practices for Concrete
- .2 CSA A23.3-19 - Design of Concrete Structures
- .3 CAN/CSA G30.18-09 (R2019) - Carbon Steel Bars for Concrete Reinforcement
- .4 CSA G40.20-13/G40.21-13 (R2018)- General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
- .5 CSA W186-M1990 (R2016) - Welding of Reinforcing Bars in Reinforced Concrete Construction

- 1.4.2 American Concrete Institute (ACI):

- .1 ACI SP-66 (04) - ACI Detailing Manual-2004

- 1.4.3 Reinforcing Steel Institute of Canada (RSIC):

- .1 RSIC Manual of Standard Practice 2018

- 1.4.4 American Society for Testing and Materials (ASTM):

- .1 ASTM A1064/A1064M-15 - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
- .2 ASTM A276/A276M-16 - Standard Specification for Stainless Steel Bars and Shapes
- .3 ASTM A995/A995M-16 - Standard Specification for Deformed and Plain Stainless Steel Bars for Concrete Reinforcement

- .4 ASTM A775/A775M-07b (2014) - Standard Specification for Epoxy-Coated Steel Reinforcing Bars

## **1.5 Shop Drawings**

- 1.5.1 Submit shop drawings in accordance with Section 01330 – Submittals.
- 1.5.2 Coordinate shop drawings with construction joint locations, and pour schedules. Not all construction joints are shown on the drawings.
- 1.5.3 Indicate on shop drawings bar bending details, lists, quantities of reinforcement, sizes, spacing, locations of reinforcement and mechanical splices if approved by engineer, with identifying code marks to permit correct placement without reference to structural drawings. Indicate sizes, spacing and locations of chairs, spacers and hangers.
- 1.5.4 Prepare reinforcement drawings in accordance with Reinforcing Steel Manual of Standard Practice – by Reinforcing Steel Institute of Canada.
- 1.5.5 Detail lap lengths and bar development lengths to CAN/CSA A23.3. Provide Type B tension lap splices, unless otherwise indicated.

## **2 PRODUCTS**

### **2.1 Materials**

- 2.1.1 Substitute different size bars only if permitted in writing by Engineer.
- 2.1.2 Reinforcing steel: billet steel, grade 400 MPa, deformed bars to CAN/CSA G30.18, unless indicated otherwise.
- 2.1.3 Welded steel wire fabric: to ASTM A1064/A1064M. Provide in flat sheets only.
- 2.1.4 Chairs, bolsters, bar supports, spacers: to CSA A23.1/A23.2.
- 2.1.5 Mechanical splices: subject to approval of Engineer.
- 2.1.6 Plain round bars: to CAN/CSA G40.21.

### **2.2 Fabrication**

- 2.2.1 Fabricate reinforcing steel in accordance with CAN/CSA A23.1, ACI SP-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada, unless indicated otherwise.
- 2.2.2 Obtain Engineer's approval for locations of reinforcement splices other than those shown on placing drawings.
- 2.2.3 Upon approval of Engineer, weld reinforcement in accordance with CSA W186.
- 2.2.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

**2.3 Source Quality Control**

- 2.3.1 Upon request, provide Engineer with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum four weeks prior to commencing reinforcing work.
- 2.3.2 Upon request, inform Engineer of proposed source of material to be supplied.

**3 EXECUTION**

**3.1 Field Bending**

- 3.1.1 Do not field bend or field weld reinforcement, except where authorized in writing by Engineer.
- 3.1.2 When field bending is authorized, bend without heat, applying a slow and steady pressure.
- 3.1.3 Replace bars that develop cracks or splits.

**3.2 Placing Reinforcement**

- 3.2.1 Use sufficient chairs and other supports to prevent movement of reinforcement during concrete placement.
- 3.2.2 Use of spreader bars and chairs are required to maintain wall steel in the proper position, reduction of the clear space between inside and outside cage is to be avoided.
- 3.2.3 Place reinforcing steel as indicated on the structural drawings, on reviewed placing drawings and in accordance with CSA A23.1.
- 3.2.4 Prior to placing concrete, provide 72 hours' notice to Engineer and facilitate access for Engineer to review reinforcement placement. Make all necessary corrections before concrete is placed and allow re-inspection by Engineer, if requested.
- 3.2.5 Ensure cover to reinforcement is maintained during concrete pour.
- 3.2.6 Touch-up damaged and cut ends of epoxy coated rebar with compatible finish to provide
- 3.2.7 Bend tie wire away from concrete surface. Ensure a cover for tie wires, form tie bolts etc. are same as the reinforcing bars. Do not let reinforcing tie wire touch formwork or be exposed in the finished concrete structure.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Scope of Work**

- 1.1.1 Work supplied under this section includes the supply, testing and installation of cast-in-place concrete.

### **1.2 Related Sections**

- 1.2.1 Section 03100 – Concrete Forms and Accessories
- 1.2.2 Section 03200 – Concrete Reinforcement
- 1.2.3 Section 05550 – Anchorage in Concrete and Masonry
- 1.2.4 Section 05500 – Metal Fabrications
- 1.2.5 Section 05510 – Metal Stairs and Ladders
- 1.2.6 Section 07900 – Joint Sealants

### **1.3 References (Latest Edition at the Time of Tender)**

- 1.3.1 Ontario Building Code (OBC) 2012
- 1.3.2 National Building Code of Canada (NBC) 2015
- 1.3.3 Canadian Standards Association (CSA):
- .1 CSA A23.1-19/A23.2-19 - Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
  - .2 CSA A23.3-19 - Design of Concrete Structures
  - .3 CAN/CSA A3000-18 - Cementitious Materials Compendium
  - .4 CSA A23.2-21C-19 - Test Method for Length Change of Hardened Concrete
  - .5 CSA S900.2-21 - Structural Design of Wastewater Treatment Plants
- 1.3.4 American Concrete Institute (ACI):
- .1 ACI 207.1R-05, Guide to Mass Concrete
  - .2 ACI 207.4R-05, Cooling and Insulating Systems for Mass Concrete
  - .3 ACI 214R-11 - Guide to Evaluation of Strength Test Results of Concrete
  - .4 ACI 237R-07 - Self Consolidating Concrete

- .5 ACI 350-20 - Code Requirements for Environmental Engineering Concrete Structures and Commentary
- .6 ACI 350.1M-10 - Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures
- .7 ACI 523.1R-06 - Guide for Cast-in-Place Low-Density Cellular Concrete
- 1.3.5 American National Steel Institute (ANSI) and National Sanitation Foundation (NSF):
  - .1 NSF/ANSI 61-2013 - Drinking Water System Components - Health
- 1.3.6 Ontario Water Resources Act
- 1.3.7 American Society for Testing and Materials (ASTM):
  - .1 ASTM C260/C260M-10a - Specification for Air-Entraining Admixtures for Concrete
  - .2 ASTM C309-11 - Specification for Liquid Membrane-Forming Compounds for Curing Concrete
  - .3 ASTM C494/C494M-15 - Specification for Chemical Admixtures for Concrete
  - .4 ASTM C1017/C1017M-13e1 - Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
  - .5 ASTM C1611-14 - Standard Test Method for Slump Flow of Self-Consolidating Concrete
- 1.3.8 Concrete Ontario - Environmental Product Declaration, Concrete Ontario Member Industry-Wide EPD for Ready-Mixed Concrete.
- 1.3.9 Concrete Ontario - A Guideline for Specifying Low Carbon Ready Mixed Concrete in Ontario
- 1.3.10 ISO 14025:2006 - Environmental Labels and Declarations - Type III environmental declarations - Principles and Procedures
- 1.4 Measurement and Payment**
  - 1.4.1 The total volume of the Cast-in-Place concrete will not be measured and the work will be paid for at the price included in the Schedule of Prices for this section based on the percentage of the work completed.
  - 1.4.2 Heating of water and aggregates and providing cold weather protection will not be measured but considered incidental to work.
  - 1.4.3 Cooling of concrete and providing hot weather protection will not be measured but considered incidental to work.
  - 1.4.4 Coordination with other trades for the supply of hardware, pipe sleeves, and other embedded materials including the related layout drawing and installation will not be measured but considered incidental to work.

- 1.4.5 Supply and installation of waterstops, construction joints, and expansion joints will not be measured but considered incidental to work.
- 1.4.6 Repair of all cracks will not be measured but considered incidental to work.
- 1.4.7 Repair of any deficiencies in the concrete will not be measured but be considered incidental to work.

## **1.5 Quality Assurance**

### **1.5.1 Performance of Concrete Mixes**

- .1 Concrete will be tested as identified in the mix performance part of this specification which includes Section 1.6.5 "Prequalification Test Results", Section 1.6.6 "Trial Mixes" and Section 1.6.10 "Testing of Ready Mix Concrete".
- .2 Cracking of concrete in the structure is generally considered to be detrimental to the long-term performance. All cracks resulting in any visible leakage, and cracks greater than or equal to 0.3 mm must be repaired. Even though "low shrinkage concrete" is specified, cracking will occur and must be repaired by the Contractor at no cost to the Owner.

### **1.5.2 Concrete Production Facility**

- .1 The concrete production facility shall meet industry standard programs meeting plant and truck certifications with an ECO certification status in accordance with the RMCAO (Ready Mixed Concrete Association of Ontario).

## **1.6 Submittals**

- 1.6.1 All submittals to conform with Section 01330.
- 1.6.2 Submit a current, valid Certificate of Ready Mixed Concrete Production Facilities as issued by RMCAO for plants supplying concrete to the Contract.
- 1.6.3 Submit certification that ready mix concrete manufacturer has current qualification for RMCAO Seal of Special Quality Concrete.
- 1.6.4 Certification of Materials and Concrete Producer statements identifying the sources and certifying:
  - .1 Cement types, sources, and conformance to CSA A23.1/A23.2 and CAN/CSA-A3000
  - .2 Aggregates comply with CSA A23.1/A23.2 and are from M.T.O. designated sources list; submit gradations.
  - .3 Admixture product names and certification that they comply with CSA A23.1/A23.2 and ASTM C260, ASTM C494/C494M, or ASTM C1017/ C1017M. State type or class of admixture.
  - .4 Materials, plant, and equipment to be used in concrete work comply with the requirements of CSA A23.1/A23.2.

- .5 Compliance with Ontario Water Resources Act with respect to toxicity.
- .6 Proposed mix designs including complete details of product additives and certification that all additives are compatible with all other additives.

#### 1.6.5 Prequalification Test Results

- .1 Submit prequalification test results to the Engineer for each Ready-Mix Concrete Mix proposed, showing adequate performance for:
  - .1 Compressive strength
  - .2 The standard deviation for the concrete compressive strength tests in conformance with ACI 214R.
  - .3 Linear shrinkage
  - .4 Air entrainment
- .2 Prequalification tests must have occurred within three (3) months of the first concrete pour or they will not be considered valid.
- .3 Submit test results from each trial mix confirming concrete strength, air-content and linear shrinkage. Submit one (1) linear shrinkage test result for structural concrete mix for all HPC mixes. Linear shrinkage tests must be current to within three (3) months of project commencement. The tested concrete must contain all materials that will be supplied to the site and be from the batch plant that will supply the site.
- .4 Adjust mixes that do not provide adequate performance, retest and resubmit the test results as noted above.

#### 1.6.6 Trial Mixes

- .1 Prior to the start of on-site concrete construction of any structure, prepare trial mixes of each structural concrete mix design to confirm the mix-design satisfies the performance and workability requirements. The test for the workability of the mix must involve a full truckload of the proposed concrete mix, transported from the truck, placed and consolidated in an area of the Contractor's choosing, using the proposed conveyance system. Trial mixes and related workability proof testing must have occurred within three (3) months of the first concrete pour or they will not be considered valid.
- .2 Trial mixes will be tested for slump, concrete strength, air-content, wet cast density and linear shrinkage by an independent testing agency arranged by the Owner.

#### 1.6.7 Low Carbon Embodied Concrete

- .1 Submit Type III Environmental Product Declarations (EPD), verified under ISO 14025, showing Global Warming Potential (GWP) of all specified concrete materials.
- .2 Prepare and submit a Concrete Carbon Project Budget (CCPB) to outline the CO<sub>2</sub>e Baseline for the anticipated concrete mixes and the CO<sub>2</sub>e Project for the actual used concrete mixes.



- .3 The CCPB shall be continuously adjusted and updated based on the actual concrete volumes used for the project.
  - .4 After completion of all concrete works, calculate and submit final CCPB including the calculated Green House Gas (GHG) reduction for the concrete works.
- 1.6.8 After review and acceptance of the mix designs, supply concrete in accordance with the reviewed mixes.
- 1.6.9 Concrete Work Plan
  - .1 Prior to the start of on-site concrete construction, prepare a concrete work plan in accordance with the requirements in section 3.2.1.4 and 3.2.2.2, including concrete mix production, concrete placing procedures and casting sequence, and curing and protection procedures.
  - .2 Submit the work plan to the Consulting Engineer for approval at least 10 days prior to the pre-construction concrete meeting as outlined in 3.2.1.
- 1.6.10 Testing of Ready Mix Concrete
  - .1 Testing will be performed by an independent testing agency arranged by the Owner.
  - .2 Testing of Ready Mix Concrete trucks on delivery will include:
    - .1 Slump
    - .2 Air content
    - .3 Concrete temperature
    - .4 Wet cast density
  - .3 Samples will be cast for laboratory testing for:
    - .1 Compressive strength
    - .2 Linear shrinkage as requested by the engineer
  - .4 Initially 3, 7, 14, and 2-28 day cylinder samples (one set) will be taken and tested. However, upon achieving acceptable results the testing will be reduced to 7 and 2-28 day tests. Where design strengths are based on 56 days, 2-56 day cylinder samples are required.
  - .5 A set of Concrete cylinder samples and wet cast density shall be tested once per pour or once every 100 m<sup>3</sup>, whichever is more frequent.
  - .6 Concrete slump, air, and temperature shall be tested once per pour or once every 50 m<sup>3</sup>, whichever is more frequent.
  - .7 Additional samples may be taken for other testing as determined by the Engineer.

- .8 Copies of all concrete testing carried out by the Engineer will be made available to the Contractor upon request.
- .9 The use of testing services does not relieve the Contractor of the responsibility to furnish materials and construction in compliance with the performance requirements of the contract documents.
- .10 The Contractor shall take samples and carry out testing as part of their quality control procedures to verify that the concrete satisfies the performance requirements set out in these specifications. Where possible, these tests shall be carried out on the same batches as tested by the independent testing agency.
- .11 Copies of the test results for all tests carried out by the Contractor must be made available to the Engineer for review and records.

## **2 PRODUCTS**

### **2.1 Materials for Concrete Mixes**

- 2.1.1 Use materials conforming to CSA A23.1/A23.2, and to the performance requirements which have been established in this section.

#### **2.1.2 Cement**

- .1 Normal Portland Cement (Type GU) blended with cementitious slag. Use Portland cement and Slag cement conforming to CSA A3000 and comply to the following conditions and requirements:
  - .1 For structural and architectural concrete mixes, the supplier may incorporate cementitious slag into the proposed mix design as a replacement for up to 50 percent by mass of the quantity of Type GU Portland cement.
  - .2 For lean concrete, slag cannot be used to replace any of the Portland cement.
  - .3 For mass concrete, HVSCM concrete may be used.

#### **2.1.3 Water**

- .1 Use only potable water in all concrete mixes.

#### **2.1.4 Additives**

- .1 Conform to CSA A23.1/A23.2 and ASTM C260, ASTM C494/C494M, or ASTM C1017/C1017M. State type or class of admixture.
- .2 Use admixtures from one manufacturer and satisfy the intent and, where practical, the specific recommendations of that manufacturer.
- .3 Ensure admixtures are compatible with each other and with any construction materials used that will be in contact with concrete. Ensure that the mix remains workable with the inclusion of such admixtures.
- .4 Do not use calcium chloride nor admixtures containing chlorides.

- .5 Shrinkage Reducing Admixture (not covered by CSA or ASTM standards).
  - .1 A shrinkage reducing admixture shall be used in all topping mixes and in elements with thickness of 125 mm or less.
  - .2 A shrinkage compensating admixture may be used where appropriate or as necessary to meet linear shrinkage testing requirements specified herein.
    - .1 Integral Crystalline Waterproofing Admixture: Permeability-reducing admixture for hydrostatic conditions (PRAH) as defined by ACI 212.3R-10 Chapter 15; Provide as a powdered waterproofing admixture for use in ready-mix concrete.

2.1.5 Performance Requirements:

- .1 Permeability:
  - .1 When tested to BS EN 12390-8 or DIN 1048-5 at 0.5 MPa (72.5 psi) for 72 hours, permeability of treated concrete will be reduced by 70% over untreated concrete.
  - .2 When using the Taywood / Valenta method of testing to be modified BS EN 12390-8 at 1 MPa (150 psi) for 96 hours and then measuring and calculating the coefficient of permeability, the permeability of treated concrete will be reduced by a minimum of 70% over untreated concrete.
  - .3 When tested to USACE CRD C48, no passage of water through treated samples when exposed to a vertical water head equal to 200 psi (460 foot head pressure) for 14 days.
- .1 Compressive Strength: Treated concrete must have compressive strength equal or higher than plain concrete when tested to ASTM C39/C39M at 28 days.
- .2 Drying Shrinkage: Minimum 20% reduced drying shrinkage for treated concrete when tested to ASTM C157.
- .3 Self-Sealing: Autogenous crack sealing of treated concrete for cracks with width of 0.4mm or greater; verified by independent testing.
- .4 Chemical Resistance: The waterproofing admixture shall improve sulphuric acid resistance of cement-based materials by blocking capillary pores to reduce acid penetration.
- .5 Corrosion of Reinforcing Steel: The waterproofing admixture shall provide enhanced corrosion resistance to embedded steel such that no noticeable signs of corrosion shall be evident after 10 years exposure to corrosive environment.
- .6 Acceptable products: Krystol Internal Membrane (KIM) by Kryton International Inc., Concentrate C500 by Xypex Chemical Corporation., or approved equivalent.

#### 2.1.6 Aggregate

- .1 All mixes for concrete elements with thicknesses of 125 mm or less shall contain 14 mm aggregate.
- .2 Mixes for mass concrete shall contain aggregate sizes up to 40 mm.
- .3 Use 20 mm aggregate in the remainder of the mixes, unless approved or otherwise specified by the Engineer.

#### 2.2 Concrete Mixes

- 2.2.1 Supply concrete to meet the project performance requirements. Structural Concrete specified herein is required to be "High Performance Concrete" for increased durability and watertightness, and reduced shrinkage and cracking, compared to regular structural concrete.
- 2.2.2 The high performance concrete mix shall be manufactured under the requirements of Clause 8.8 "Low Shrinkage Concrete" of CSA A23.1/A23.2 which include a shrinkage limit of 0.04% based on modified CSA A23.2-21C.
- 2.2.3 This is considered to be a Performance Specification in accordance with CSA A23.1/A23.2 - Table 5 Alternative Methods for Specifying Concrete.
- 2.2.4 Lightweight concrete mix shall be manufactured in accordance with ACI 523.1R.
- 2.2.5 Meet or exceed the requirements in the following tables:

Mix Number	1	2
Mix Description	Toppings, screeds, benching for tankage, int./ext. floors or roofs & thin concrete sections	HPC for walls
Special Performance	HPC – Low Shrinkage	
Min. Specified Strength, 28 days	30 MPa	30 MPa
Min. Specified Strength, 56 days	35 MPa	-
Max. Aggregate Size	14mm	20mm
Slump Range (see 2.2.7)	-	120-180
SCM	Max. 50% slag	Max. 50% slag
Max. W/C Ratio	0.40	0.40
CSA Exposure Class	A-1	A-1

Mix Number	1	2
Mix Description	Toppings, screeds, benching for tankage, int./ext. floors or roofs & thin concrete sections	HPC for walls
Plastic Air Range (%)	5-8	5-8
Additives	Super plasticizer admixture, and shrinkage reducing admixture	Super plasticizer admixture

- 2.2.6 HPC herein means high performance concrete with reduced shrinkage, reduced cracking and increased durability.
- 2.2.7 Final selection of slump for each mix is the responsibility of the contractor to suit specific site needs for workability and finishing.
- 2.2.8 Super plasticizer admixture to be added to the mix at the batching plant. Additional superplasticizer may be added on site to meet the workability requirements of the Contractor placing the concrete in accordance with the manufacturers published recommendations.
- 2.2.9 The total project Concrete Carbon Project Budget (CCPB) emissions from ready-mix concrete shall be at least 10% less than those calculated using GWP's of the baseline mix in the Ontario Industry Average EPD for the strength class of each mix and the volume of each mix placed.
- 2.2.10 For mass concrete, proportion mix to reduce the heat of hydration. When HVSCM concrete is used, follow the requirements of this specification and CSA A23.1/A23.2, whichever is more stringent.
- 2.2.11 Utilize the same mix proportions throughout the project.
- 2.2.12 Where the performance of a mix deteriorates to values below the Contract requirements, cease supply of the mix. Re-evaluate the mix, propose revised proportions to meet the performance requirements for the mix, submit trial mix results, and after review, utilize the revised mix.

### **2.3 Materials for Crack Injections**

#### **2.3.1 Epoxy Grout Injection**

.1 Acceptable products include:

.1 Sikadur 35 Hi-Mod LV

.2 Sikadur 52

- .3 MasterInject 1500, by BASF Master Builders Solutions
- .4 or an approved equivalent

2.3.2 Flexible Polyurethane Grout Injection

- .1 For non-potable water, acceptable products include:
  - .1 Sika Fix PU LV
  - .2 Sika Fix PU
  - .3 MasterInject 1210 IUG, by BASF Master Builders Solutions
  - .4 or an approved equivalent
- .2 Polyurethane Sealant
  - .1 Sikaflex 2C NS,
  - .2 MasterSeal NP2, by BASF Master Builders Solutions
  - .3 or an approved equivalent

2.3.3 No crack injections shall be carried out without the approval of the Engineer.

**2.4 Polyethylene Sheets**

- 2.4.1 Preformed Joint Fillers - See Section 03100.
- 2.4.2 Bond Breakers - 810-07 Non-Fibred Asphalt Roof and Foundation Coating by Henry Company Canada Inc.
- 2.4.3 Curing Membrane - 6 mil polyethylene sheet
- 2.4.4 Curing Compounds - The curing compound, if permitted by the engineer, shall conform to the requirements of ASTM C309. NSF/ANSI 61 approved materials where in contact with potable water.

**3 EXECUTION**

**3.1 Standard of Workmanship**

- 3.1.1 Comply with CSA A23.1/A23.2.
- 3.1.2 Undertake all aspects of the Work to meet watertight requirements.

### **3.2 Preparation**

#### **3.2.1 Preconstruction Concrete Meeting**

- .1 Prior to concrete construction, hold a meeting to discuss all design requirements and any potential production or construction issues to avoid delays during the implementation of the works.
- .2 Have representatives of every party involved in the concrete work attend the meeting, including but not limited to the following:
  - .1 Contractor's superintendent
  - .2 Concrete subcontractor's Foreman and Cement Finisher
  - .3 Ready-mix concrete producer
  - .4 Admixture manufacturer(s)
  - .5 Laboratory responsible for the concrete design mixes and trial mixes
  - .6 Concrete pumping subcontractor, if applicable
- .3 The representative of the Owner, the Engineer and the Independent Laboratory responsible for field quality control will also attend the meeting. Coordinate with the Engineer at least 10 days prior to the scheduled date of the meeting.
- .4 Provide a description of the intended procedures and Quality Assurance for:
  - .1 Concrete mix production, delivery and discharge
  - .2 Concrete mix testing including storage facilities provided by the Contractor and procedures
  - .3 Formwork construction and alignment
  - .4 Installation of Formliners and waterstops
  - .5 Concrete handling, pumping, and placement
  - .6 Concrete finishing
  - .7 Curing procedures
  - .8 Concrete protection in hot, cold or windy weather
  - .9 Watertightness
- .5 Ensure that each party's interests are discussed, and procedures refined to provide optimum concreting practices for this project.
- .6 Distribute minutes of the meeting to all parties present and with related individuals within five (5) days of the meeting.

- .7 Ensure that procedures established and agreed at this meeting are carried out during construction.
- .8 If additional procedures are required, meet again, discuss, develop, submit and follow the revised procedures.

### 3.2.2 Pre-planning Requirements

- .1 Two weeks (14 calendar days) prior to placing of concrete, obtain Engineer's approval of the proposed method for the protection of the concrete during placing and curing.
- .2 Submit the proposed sequence of casting for review by the Engineer including the location of the proposed construction joints. Where possible sequence the casting schedule so that walls are cast as soon as possible after their supporting footings or slabs are cast.
- .3 Complete and submit the Concrete Pour Release Form prior to placing any concrete.
- .4 Provide three (3) working days' notice of the proposed time of commencing of concrete placement. The Contractor will be responsible for the Engineer's testing companies standby time costs in the event a concrete pour does not commence within 90 minutes of the proposed time indicated in the three (3) day notice.
- .5 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .6 Coordinate with the concrete supplier with respect to the workability requirements for the concrete. Do not add water to the concrete after the initial batching unless approved by the Engineer, and the concrete supplier. If approval is granted, a record of the amount of water added must be kept and a copy submitted to the Engineer within three (3) days for their records.
- .7 Establish and maintain accurate records of poured concrete items to indicate date, location and size of pour, air temperature, concrete temperature, previously placed concrete temperature, batch ticket and test samples taken.
- .8 Do not place load upon new concrete until authorized by the Engineer.

### 3.3 Summer Concreting

- 3.3.1 Between June 1st and September 30th, except when the air temperature is below 3°C and winter concrete requirements dictate, the Contractor must prepare and submit their procedures for curing the concrete based on and to suit the ambient conditions anticipated during the curing period. Most cracking is a result of excessive water content in the concrete, rapid drying and thermal effects that including thermal shock during or shortly after the removal of the formwork, ambient conditions or shape considerations. The requirements are designed to minimize those effects and, thereby, to minimize the cracking of the concrete.
- 3.3.2 The maximum temperature of the concrete delivered to the site must be maintained at or below 26°C. This may require the addition of ice to the mix at the Ready Mix Concrete Plant. An amount of water, equivalent to the volume of the ice, must be removed from the mixing water.



- 3.3.3 For each pour exceeding 20 m3 provide and install temperature probes to measure the temperature of the concrete. The probes must be installed to measure the temperature of the concrete, 150 mm below the surface, at two (2) locations for each day of placement or type of concrete, locations to be established by the Engineer. These probes shall be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data.
- 3.3.4 For formed structures: The forms for walls, columns and related structures and for suspended slabs shall remain in place for a minimum period of seven (7) days after placing the concrete. If the temperature differential between the concrete and the ambient air is greater than 10°C, the forms shall remain in place until the temperature differential is less than 10°C. Immediately after the removal of a form, the concrete shall be thoroughly wetted down and be covered with a 6 mil polyethylene sheet or equivalent and this sheet shall remain in place for a minimum of seven (7) days.
- 3.3.5 For slabs: Slabs must be misted during the placing and finishing work. After the finishing has been completed, the slab must be flooded and be covered completely with tarpaulins for seven (7) days. When temperatures are above 30°C the slab must be covered for a total of 14 days.
- 3.3.6 The surface of slabs, against which new concrete is to be placed, shall be cooled using intermittent wetting techniques and the temperature shall not be more than 5°C greater than the new concrete at the time of placing the new concrete.
- 3.3.7 The use of curing compounds is not to be considered normal practice and the use will be at the discretion of the Engineer. Curing compound shall be applied immediately after the removal of the forms for walls and similar structures. In addition, its use may be considered for slabs after the initial seven (7) day curing period has been completed.
- 3.4 Winter Concreting**
- 3.4.1 Between October 1st and May 31st of the following year, and at any time when the air temperature is below 3°C, or when, in the opinion of the Engineer, there is a probability of its falling to that limit during the placing period, place concrete in accordance with the requirements of CSA A23.1/A23.2, "Cold Weather Requirements".
- 3.4.2 The temperature of the concrete, when deposited, shall not be less than 10°C and not more than 25°C. To accomplish this, the mixing water and, if necessary, the aggregates, shall be heated. Aggregates shall not be heated above 85°C.
- 3.4.3 For each pour exceeding 20m3 provide and install temperature probes to measure the temperature of the concrete. The probes must be installed to measure the temperature of the concrete 150 mm below the surface at two (2) locations per day of placement and type of concrete, locations to be established by the Engineer. These probes shall be used to measure the temperature of the concrete prior to the removal of the forms. In addition, the probes shall be maintained to establish the temperature of that concrete when new concrete is placed against it. The probes must be of a type that will record the temperature continuously and will allow for the downloading of that data by the Engineer.
- 3.4.4 The temperature difference between concrete being placed and the concrete against which it is placed is of primary importance during winter concreting. The temperature of the base

concrete, measured 150 mm below the contact surface, must be within 5°C of the concrete being placed against it, but no lower than 5°C. The Contractor, to satisfy this requirement, must provide a 5000 mm wide underslab heating system. This system must:

- .1 Be continuous along the full length of the wall
- .2 Heat the slab from bottom up.
- .3 Include insulated tarpaulin placed on the slab over the area which is to be heated.
- .4 Meet the above temperature requirements before the new concrete is placed.
- .5 Be left in operation for at least 72 hours after the new concrete has been placed.
- .6 Include the insulated tarpaulins being left in place over the heated area until the forms are removed.

3.4.5 If uninsulated metal forms are to be used or if the temperature within the form falls below -5°C prior to placing the concrete, an insulated cover must be provided over the formwork and heat must be provided to raise the temperature to +5°C before pouring the concrete. All snow or ice must be removed from the form prior to placing the concrete. Insulated cover and heat must remain in place for the cure period.

3.4.6 The forms for walls, columns and suspended slabs shall remain in place for a minimum for seven (7) days after placing the concrete. Additional protection is to be provided as per 3.4.7

3.4.7 The temperature of the concrete shall be monitored and when the form is to be removed, the temperature differential between the concrete and the ambient conditions shall be recorded and:

- .1 If the temperature differential is less than 10°C and the winds is less than 20 km/h, the forms must be left on for seven (7) days and when they are removed, the concrete must be covered tightly with a 6mil polyethylene sheet or suitable new tarpaulin. The covering must remain in place for a minimum of seven (7) days.
- .2 If the temperature differential is 10°C or greater, the forms cannot be removed. Once the temperature differential is less than 10°C follow clause 3.4.7.1.

3.4.8 If an enclosure is required to meet the requirements of clauses 3.4.1 through 3.4.7, provide an enclosure.

- .1 The enclosure shall be kept between 10°C and 18°C for a minimum period of seven (7) days after placing the concrete. The temperature shall be gradually reduced at the end of the period of protection at a rate not greater than 10°C per day until the outside ambient temperature is reached.
- .2 Combustion type heaters may be used but they shall be constructed and placed so that their combustion gases are not directed toward the surfaces of the "green" concrete.

3.4.9 Slip forming: curing and form removal in accordance with CSA A23.1/A23.2 for curing type 2.

### **3.5 Vibrators**

- 3.5.1 The use of mechanical vibrators is required for all structural concrete.
- 3.5.2 A sufficient number of vibrators shall be employed so complete compaction is ensured.
- 3.5.3 At least one (1) extra gasoline powered vibrator shall be on hand for emergency use.
- 3.5.4 Vibration shall not be continued to the extent that water forms on the surface.
- 3.5.5 Avoid any disturbance to concrete that has become too stiff to regain plasticity when vibrated.
- 3.5.6 Vibration shall not be applied directly to steel which extends into partially hardened concrete.

### **3.6 Construction**

- 3.6.1 Do cast-in-place concrete work in accordance with CSA A23.1/A23.2.
- 3.6.2 At construction joints, all loose debris/items must be removed/cleaned and laitance must be mechanically removed from the face of concrete from previous castings and the joint shall be saturated surface dry before adjacent concrete is placed.
- 3.6.3 Sleeves and Inserts:
  - .1 No sleeves, ducts, pipes, or other openings shall pass through joists, beams, column capitals or columns, except where indicated or approved by the Engineer.
  - .2 Where approved by the Engineer, set sleeves, ties, pipe hangers, and other inserts and openings as indicated or specified elsewhere. Sleeves and openings greater than 100 mm x 100 mm not indicated, must be approved by the Engineer.
  - .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain approval of modifications from the Engineer before placing of concrete.
  - .4 Check locations and sizes of sleeves and openings shown on drawings.
  - .5 Sleeves and openings shall be placed at a minimum of three sleeve diameters centre to centre unless noted otherwise.
  - .6 Box out for penetrations are not permitted, unless agreed to in writing form the Engineer. If requested by the contractor, additional reinforcement and waterstops will be required to compensate for the construction of the box out. Supply and install of these additional reinforcements and waterstops shall be at no additional cost to the Owner.
- 3.6.4 Anchor Rods:
  - .1 Set anchor rods to templates under supervision of appropriate trade prior to placing concrete.
  - .2 Protect anchor rod holes from water accumulations, snow, and ice build ups.

- .3 When using proprietary anchor systems set rods and fill holes with epoxy grout, in accordance with the manufacturer's requirements. All proprietary anchors must be approved by the Engineer.
- .4 Locate anchor rods used in connection with expansion shoes, rollers, and rockers with due regard to ambient temperature at time of erection.
- .5 Under special circumstances, with approval of the Engineer, grouted anchor rods may be installed into preformed holes or holes drilled after concrete has set. Formed holes or sleeves to be minimum 100 mm diameter and be deformed.

3.6.5 Coordination:

- .1 Adjust the work to suit final shop drawings of the equipment being supplied. Verify all sizes with the trade supplying and installing the equipment. Obtain, utilize and submit data on relevant sizes to suit any change in equipment. Confirm the adjustments with the Engineer.

3.6.6 Curing Compounds - Dependant on the location and situation, the use of curing compounds may be approved by the engineer.

**3.7 Finishes**

3.7.1 Formed finishes specified herein shall be finished as defined by CSA A23.1/A23.2.

- .1 The surfaces exposed to view shall be given a smooth form finish with sack-rubbed finish.
- .2 Interior surfaces of tanks including the portion of those structures above the high water level to the top of the structure, shall be given a smooth form finish with a "sack rubbed" finish.
- .3 All buried surfaces shall be given a rough form finish. All buried surfaces that receive water proofing or damp proofing to have all voids and bugholes filled.
- .4 In type C-1, A-1 and A-2 type concrete all bugholes shall be filled.
- .5 All exposed and non-exposed corners shall be rubbed with a carborundum stone to remove any loose concrete fins and edges and to create a smooth and rounded profile.

3.7.2 Unformed surfaces shall be finished as defined by CSA A23.1/A23.2.

- .1 The floor surface of occupied spaces shall be "floated" and "trowelled" to create a Class A Floor finish as defined by Table 21 in CSA A23.1/A23.2.
- .2 The floor surface of exterior or interior walkways, stairs and tankage or chambers, shall be "swirl trowelled" to create a non-slip surface.

**3.8 Examination of Completed Structures**

3.8.1 Undertake, with the Engineer, review of concrete surfaces for defects and finishes.

- 3.8.2 Undertake, with the Engineer, assessments and measurements of the concrete structures for cracking.
- 3.8.3 Provide a written summary of defects noted complete with a plan showing locations of each defect.
- 3.8.4 Submit a plan for repair of each defect in accordance with these specifications.
- 3.8.1 Actively leaking cracks and joints shall be left to self-heal. Contractor to allocate a minimum of 2 weeks in the contract schedule to allow cracks to self-heal prior to attempting repairs. Depending on job site and ambient conditions crack healing can be expected to take several days to weeks.
- 3.8.2 All active leaks must be either self-healed or repaired prior to return to service. Repair to follow procedures specified in Clause 3.9.

### **3.9 Patching or Repairs**

- 3.9.1 No patching or repairing shall be carried out without the approval of the Engineer.
- 3.9.2 All preparation for repairs is to be reviewed by the engineer.
- 3.9.3 All patches, bug holes, and suspected honeycomb are to be reviewed by the engineer prior to patching.
- 3.9.4 All repairs shall be colour matched to the parent concrete.
- 3.9.5 Visible pour lines in the finished concrete walls shall be considered defective and shall be repaired by the contractor at no additional cost to the owner, regardless of structural or water retaining characteristics of the wall. Provide a methodology to repair all visible pour lines, for submission and approval by the engineer.
- 3.9.6 Surface defects such as honeycombing, sand streaking, lift lines, variations in colour, soft areas, and large surface voids in the finished concrete walls shall be considered defective and shall be repaired by the contractor at no additional cost to the Owner, regardless of structural or water retaining characteristics of the wall. Provide a methodology to repair all visible pour lines, for submission and approval by the Consultant.
- 3.9.7 All bug holes to be filled for concrete mixes with exposure classes of C-1, A-1 and A-2 at no additional cost to the Owner.
- 3.9.8 All honeycombing shall be chipped out to sound concrete. The edge around the perimeter of the area shall be sawcut to a depth of 20 mm minimum to eliminate all "feather" edges. All repairs of honeycomb shall be a proprietary repair material. If honeycombing extends to the depth of the reinforcement, the chipping shall be continued to a depth of 1.4 times the diameter of the largest reinforcing bar and 40 mm minimum beyond the layer of reinforcement.
- 3.9.9 The patch shall be continuously covered with a 6 mil polyethylene sheet and heated to above 15°C for 14 days.
- 3.9.10 Chips and edge breaks in the concrete shall be repaired as noted above.

- 3.9.11 All visible cracks in liquid retaining structures shall be repaired. Submit a detailed plan and details for review by Engineer before beginning any repair or injection. As the standard repair methodology, unless otherwise approved by the Engineer, cracks shall be injected with epoxy or polyurethane, depending on the application. Clean face of concrete after injection is complete.
- 3.9.12 In the event that injection cannot seal the leak, with the approval of the Engineer, the crack shall:
- .1 Be routed out square to a depth and width of 20 mm
  - .2 Be thoroughly cleaned
  - .3 Have a bond breaker placed in the bottom of the routed slot
  - .4 Be primed in accordance with the manufacturers recommendations
  - .5 Be sealed with a polyurethane sealant such as Sikaflex 2C NS EZM ix Sika Canada, or approved equal.
- 3.9.13 Sealant shall be allowed to cure in accordance to the manufacturers written procedures.
- 3.9.14 Repair leaking cracks or joints having width greater than 0.4 mm in concrete containing waterproofing admixture. Follow waterproofing admixture manufacturer's written instructions and as follows:
- .1 Chase the length of joints and cracks to a minimum depth of 40 mm (1.5 inch). Provide rectangular-shaped chase that is deeper than wide.
  - .2 Use waterproofing admixture manufacturer's recommended water stop plug to stop water leakage.
  - .3 Use waterproofing admixture manufacturer's recommended repair grout to completely fill the chase flush with adjacent surfaces.
- 3.10 Site Tolerances**
- 3.10.1 Concrete tolerance in accordance with CSA A23.1/A23.2.
- 3.10.2 The Contractor shall survey the site and shall provide a drawing layout of the concrete work to be included in the "as built" drawings.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Scope of Work**

- 1.1.1 Furnish all labour, materials, tools and equipment and perform all operations necessary for the repair of leaking construction joints or cracks in concrete using injection resin.
- 1.1.2 Engineer approval must be obtained prior to using crack injection to new concrete containing crystalline waterproofing admixture.

### **1.2 Related Sections**

- 1.2.1 Division 1 - General Requirements
- 1.2.2 Section 01450 - Quality Control
- 1.2.3 Section 03300 - Cast-in-Place Concrete

### **1.3 Quality Assurance**

- 1.3.1 In addition to the requirements of Section 01450 - Quality Control, the following measures are required:
  - .1 The applicator shall have a minimum of three (3) years of experience performing similar work and be authorized by the supplier for performing resin injection of the nature specified. Contractor shall maintain qualified personnel who have received product training by a manufacturer's representative.
  - .2 A technical specialist representing the product manufacturer shall visit the site to examine site specific conditions and to make recommendations regarding material selection, injection equipment and application techniques.
  - .3 Contractor must arrange for a field visit with the manufacturer's technical specialist to review and approve all surface preparation prior to applying the product.
  - .4 Install materials in accordance with all safety and weather conditions required by the manufacturer. Consult Material Safety Data Sheets for complete handling recommendations.

### **1.4 Submittals**

- 1.4.1 General:
  - .1 Applicator shall submit certificate authorized by the supplier for performing resin injection of the nature specified.
  - .2 Prior to start of work, discuss with engineer the type and location of crack repairs.
  - .3 Submit a work plan indicating the materials and method of preparation, repair, and clean up.

1.4.2 Product Data:

- .1 Submit manufacturer's data and application instructions for each product specified.

**1.5 Delivery, Storage and Handling**

- 1.5.1 All materials shall be delivered to the site in undamaged, unopened containers bearing the supplier's original labels. Store materials in protected location prior to use, in accordance with manufacturer's directions.

- 1.5.2 Condition the specified product as recommended by the manufacturer.

**1.6 Environmental and Site Conditions**

1.6.1 Environmental Conditions:

- .1 Workplace Hazardous Materials Information System (WHMIS) labels on all containers shall conform to Canadian regulations, proper chemical name, shipping class, packing group and UN number.
- .2 Material Safety Data Sheets (MSDS) for all materials shall conform to Canadian regulations.
- .3 No materials shall be used that are manufactured from or contain toluene diisocyanate (TDI), toluene, acetone or methyl ethyl ketone.
- .4 No materials shall be used that are flammable or that display shipping Class 3 Red warning labels.
- .5 Do not apply material if it is raining or snowing or if such conditions appear to be imminent. Minimum application temperature to be 40°F (5°C) and rising.

1.6.2 Workplace Safety:

- .1 Supply workers with appropriate safety equipment for performing injection of resins and associated tasks.
- .2 Supply safety devices, traffic control barriers, drop sheets and other items to protect the site, other contents and other personnel from contact with the Contractor's material or equipment.

**1.7 Site Services**

- 1.7.1 The Contractor shall attend the site and evaluate the present electrical supply that is available for their use. The Contractor will be responsible to modify those services, if required, without affecting the pumping operations and to restore those services after the work is complete. As an alternative, the Contractor can supply their own power source but must control the noise to the satisfaction of the Owner.

- 1.7.2 All construction debris and empty containers are to be removed from the site by the Contractor and disposed of in accordance with applicable regulations.



**1.8 Measurement and Payment**

- 1.8.1 Repair of cracks in new concrete placed under this contract will not be measured but considered incidental to the work. Engineer approval must be obtained prior to using crack injection to new concrete containing crystalline waterproofing admixture.
- 1.8.2 Repair of all cracks in existing concrete will be paid under lump sum tender price and provisional items as described in the contract.

**2 PRODUCTS**

**2.1 Approved Manufacturers**

- 2.1.1 Sika Canada Inc., 6915 Davand Drive, Mississauga, Ontario, L5T 1L5 Toll free: 1-800-933-4758, URL: [www.sika.ca](http://www.sika.ca)
- 2.1.2 Aquafin, 505 Blue Ball Rd., #160, Elkton, MD 21921, Phone: 410-392-2300, URL: <https://www.aquafin.net/us/en> Euclid Chemical, 19215 Redwood Road, Cleveland, OH, 44110, Phone: (800) 321-7628, URL: <https://www.euclidchemical.com/>
- 2.1.3 Simpson Strong-Tie, 5 Kenview Blvd., Brampton, Ontario L6T 5G5, Phone: (905) 458-5538, URL: <https://www.strongtie.com/>
- 2.1.4 Avanti International, 822 Bay Star Blvd., Webster, TX 77598, Phone: 281.486.5600, URL: <https://www.avantigrout.com/>
- 2.1.5 Or an approved equivalent

**2.2 Materials**

**2.2.1 Active Leaking Cracks:**

- .1 Acrylate Injection, with the following specifications:
- .1 Water activated type
  - .2 Flexible gel end product
  - .3 Hydrophilic
  - .4 Solvent-free and non-flammable
  - .5 Fast-acting with variable cure rate
  - .6 Cured product shall not shrink
  - .7 Suitable for cold temperature use above 5°C
  - .8 Viscosity - 15 cps or less at 25°C
  - .9 Acceptable products meeting this specification:
    - .1 Aquafin InjectPro-PM3811

- .2 Sika Injection-307
- .3 Avanti AV-150 Acrylate Gel
- .4 Or approved equivalent
- .2 Polyurethane Injection, with the following specifications:
  - .1 Water activated type
  - .2 Flexible foam end product
  - .3 Hydrophobic
  - .4 Solvent-free and non-flammable
  - .5 Fast-acting with variable cure rate
  - .6 Cured product shall not shrink
  - .7 MDI-based polyurethane pre-polymer with accelerator
  - .8 Suitable for cold temperature use above 4°C
  - .9 Viscosity - 600 cps at 20°C
  - .10 Resistant to chlorine concentration up to 3 mg/L
  - .11 Acceptable products meeting this specification:
    - .1 SikaFix PU LV
    - .2 BASF MasterRoc MP 355 1K

2.2.2 Non-Leaking Cracks:

- .1 Epoxy injection resins for dry cracks shall conform with the following specifications:
  - .1 Non-shrink
  - .2 Compressive Strength: 50MPa at 7 days at 5°C
  - .3 Suitable for cold temperature use above 5°C
  - .4 Minimum bond strength: 14 MPa at 5°C
  - .5 Acceptable product meeting this specification:
    - .1 Sika Sikadur 55 SLV injection resin, with Sikadur 31 crack sealant
    - .2 Simpson Strong-Tie CI-LV injection resin, with CIP crack sealant
    - .3 Euclid Dural Injection Gel

.4 Or approved equivalent

### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 Injection to be completed as per injection resin supplier's requirements.
- 3.1.2 If unusually large quantities of injection material are required, there may be honeycomb or other structural issues present, contact the engineer immediately before proceeding.
- 3.1.3 Avoid the use of excessive injection pressures. Pressures shall be as per manufacturer's recommendations.
- 3.1.4 Continue injection until a permanent watertight seal has been created.

#### **3.2 Mixing and Handling of Injection Resins**

- 3.2.1 Follow recommended guidelines as per supplier's product data sheets.
- 3.2.2 Measure all materials using graduated containers and in appropriate quantities to suit site requirements.

#### **3.3 Cleaning Cracks Prior to Injection**

- 3.3.1 Acid and potable water flush is required prior to proceeding with injection of acrylate resin. Use crack flushing agent diluted to a 5 percent solution in water and flush with copious quantities of water following acid injection.
- 3.3.2 Use compressed air to clean and prepare cracks for epoxy injection.

#### **3.4 Acrylate or Polyurethane Injection**

##### **3.4.1 Drilling Injection Holes**

- .1 Drill 9 mm injection holes at a distance from the crack equal to half the thickness of the slab, at an angle of 45 degrees to intersect cracks beyond the mid-point of the wall or slab being injected.
- .2 Drill hole spacing shall not exceed 300mm under any condition.
- .3 All drill holes shall be flushed with copious quantities of water to remove all dust and drilling debris from the hole prior to installing the injection packers.

##### **3.4.2 Installation of Injection Packers**

- .1 Install 9.5mm plastic injection packers, complete with metal fittings, in accordance with supplier's instructions.

##### **3.4.3 Installation of Sealing Materials**

- .1 Install appropriate sealing materials along the crack or joint to be injected, where required, to minimize the loss of injection resin.

- .2 Suitable sealing materials may include hydraulic cement, epoxy bonders, polyester bonders, wooden shims, grout pads or backer rod, depending on site conditions.

#### 3.4.4 Injection Equipment

- .1 Use an electrically-operated airless pump, modified specifically for resin injection.
- .2 The pump shall be equipped with gravity feed suction containers.
- .3 The pump controls shall feature an adjustable pressure and to provide automatic on/off pump operation.
- .4 A multiple grout header shall be used to control the flow of injection resin and shall include a 0-2 MPa pressure gauge, flow control valves and a bypass pressure relief valve.

#### 3.4.5 Injection of Acrylate or Polyurethane Resins

- .1 Follow recommended guidelines as per supplier's product data sheets and technical literature.
- .2 Start injection procedure from the bottom of a crack and inject until resin can be seen in the next port above, then move to that port and inject.
- .3 Inject sufficient resin at each location to completely fill all cracks, and injection material can be seen in the adjacent port.

### 3.5 Epoxy Injection

#### 3.5.1 Surface preparation

- .1 Prepare surface area around crack by abrasive blasting or other mechanical means to remove all surface laitance.
- .2 Thoroughly clean all dust and debris from surface with compressed air.

#### 3.5.2 Installing porting device

- .1 Set porting devices by drilling as required by the manufacturer. Spacing of the porting devices should not exceed the thickness of the substrate or 300mm c/c whichever is less.
- .2 On structures open on both sides, provide porting devices on opposite sides at staggered elevations.

#### 3.5.3 Installation of Sealing Materials

- .1 Apply the epoxy resin adhesive over the cracks and around each porting device to provide an adequate seal to prevent the escape of the epoxy resin adhesive for the injection grouting.
- .2 Do not begin injection until epoxy adhesive has fully cured.

3.5.4 Injection of Epoxy Resins

- .1 Dispense the epoxy resin adhesive for grouting under constant pressure in accordance with procedures recommended by the equipment manufacturer as required to achieve maximum filling and penetration of the prepared cracks without the inclusion of air pockets or voids in the epoxy resin adhesive.

**3.6 Clean-up**

- 3.6.1 Remove all injection resin and adhesive material on the surface of the concrete.
- 3.6.2 Remove all injection packers, plug and repair openings with manufacturer approved products. Grind surface smooth after repair material has completely cured.
- 3.6.3 Clean the substrate and produce a finish to match surrounding concrete surfaces.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Scope of Work**

#### **1.1.1 This work comprises:**

- .1 The preparation of concrete surfaces, including patching of spalled concrete and damaged concrete edges.
- .2 Removal of the deteriorated surface of concrete, and disposal of all wastes off site.

### **1.2 Related Sections**

#### **1.2.1 Section 03300 – Cast-in-Place Concrete**

#### **1.2.2 Section 03800 – Crack Injection.**

### **1.3 Basis of Payment**

#### **1.3.1 Payment of this item shall be based on the lump sum price bid.**

#### **1.3.2 Include in the price all costs of labour, stages, materials, equipment, etc. to:**

- .1 Remove deteriorated surface material
- .2 Prepare the specified surfaces using hand-chipping tools for the removal of loose, soft, flaked or otherwise defective material and carrying out repairs of spalls.

### **1.4 Quality Assurance**

#### **1.4.1 Pre-Repair Meeting; hold a meeting prior to start of work to discuss the work plan. Attendants must include but not be limited to Engineer, repair foreman, general contractor and manufacturer's representative.**

### **1.5 Submittals**

#### **1.5.1 Make all submittals in accordance with Section 01330.**

#### **1.5.2 Work plan: Prior to the start of work, submit the methods of preparation, repair, and curing and a list of repair locations.**

#### **1.5.3 Technical Data Sheet for each material applied.**

### **1.6 Warranty**

#### **1.6.1 5 years leak free, combined manufacturers and contractors warranty**

## **2 PRODUCTS**

### **2.1 Materials**

#### **2.1.1 Spall Repair**

.1 Polymer-modified, cementitious, trowel grade mortar:

.1 SikaTop 122 Plus

.2 Or approved equivalent

.2 Self-consolidating, cement-based concrete:

.1 Sikacrete-08 SCC

.2 Or approved equivalent

#### **2.1.2 Resurfacing Mortar**

.1 Sikagard 75 Epocem

.2 Or approved equivalent

#### **2.1.3 . Bonding Agent**

.1 SikaTop Armatec110 EpoCem

.2 Or approved equivalent

## **3 EXECUTION**

### **3.1 General**

3.1.1 All preparation and repair techniques should be in accordance with the International Concrete Repair Institute (ICRI).

### **3.2 Surface Preparation**

3.2.1 Remove deteriorated concrete, dirt, grease, oil and other bond inhibiting materials from surface.

3.2.2 Prepare surface by chipping and/or other appropriate mechanical means.

3.2.3 Obtain a minimum profile of  $\pm 3\text{mm}$  (CSP 6 to 9) on the substrate to be patched.

3.2.4 Sawcut repair area edges to provide a vertical edge.

3.2.5 Dampen surface to be repaired with clean water.

3.2.6 Substrate should be saturated surface dry with no standing water during application using a sponge or air pressure for larger areas.

### **3.3 Environmental Conditions**

- 3.3.1 Patching shall only be applied in sufficient quantity to allow complete filling of the spalled or honeycombed areas in accordance with the manufacturer's requirements.
- 3.3.2 Ambient, substrate temperature and rising temperature at time of application to follow the requirements of the manufacturer.
- 3.3.3 Cover all floor drains to prevent grit and debris from entering the drain.

### **3.4 Application**

- 3.4.1 At time of application, surfaces shall be saturated surface dry without glistening water.
- 3.4.2 Mortar must be scrubbed into the substrate filling all pores and voids. Alternatively, bonding agent can be applied.
- 3.4.3 Apply mortar by hand patching:
  - .1 Follow manufacturer's requirements for minimum and maximum lifts. Mortar layer greater than 38mm up to maximum of 100mm can be applied with extended aggregates.
- 3.4.4 Apply concrete by forming and pouring:
  - .1 Follow manufacturer's requirements for minimum and maximum application thicknesses.
- 3.4.5 Allow mortar to reach initial set then finish using a steel trowel to obtain a uniform, consistent, smooth and even profile.
- 3.4.6 Cover with poly sheet and cure according to the requirements of the manufacturer.

### **3.5 Field Quality Control**

- 3.5.1 Substrate shall be inspected by Engineer prior to application of repair mortar.
- 3.5.2 Repair mortar shall be mixed so that it does not sag or flow when applied on vertical surfaces.
- 3.5.3 Surfacing mortar shall be mixed in accordance with the manufacturer's requirements.
- 3.5.4 Repair mortar to be placed with respect to the maximum and minimum thicknesses as per the manufacturers written instruction.
- 3.5.5 Excess mortar surfacing thickness remaining on the concrete surface after patching the spalls shall be removed.
- 3.5.6 The manufacturer shall be represented during the preparation and the application of the patch repair.
- 3.5.7 Manufacturer to provide a letter stating that the repair mortar has been used following manufacturer's quality procedures to complete the repair.



**3.6 Post Application**

- 3.6.1 Clean all tools and equipment after use with water.

**END OF SECTION**

## **DIVISION 5 – METALS**

DIVISION 5 – METALS

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Section No.	Title
05500	Metal Fabrications
05510	Metal Stairs and Ladders
05530	Grating
05550	Anchorage in Concrete and Masonry

## **1 GENERAL**

### **1.1 Scope of Work**

1.1.1 Design, supply and install the following items including bolts, nuts, washers, anchors, hardware,

- .1 Lintels and embedded grating supports
- .2 All other miscellaneous metal items shown on the drawings.

### **1.2 Related Sections**

- 1.2.1 Section 01330 – Submittals
- 1.2.2 Section 03300 – Cast-in-Place Concrete
- 1.2.3 Section 05510 – Metal Stairs and Ladders
- 1.2.4 Section 05550 – Anchorage in Concrete and Masonry

### **1.3 References**

1.3.1 All products shall conform to the following standards and regulations:

1.3.2 ASTM International (ASTM).

- .1 ASTM A53/A53-20 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
- .2 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
- .3 ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes
- .4 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength
- .5 ASTM A780/A780M-20 Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings
- .6 ASTM D1187/D1187M - 97(2018) - Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal
- .7 ASTM D5360-15 - Standard Practice for Design and Construction of Bituminous Surface Treatment
- .8 ASTM D6511/D6511M-18 - Standard Test Methods for Solvent Bearing Bituminous Compounds
- .9 ASTM F1554-20 - Standard Specifications for Anchor Bolts

- .10 ASTM F3125-15 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength
- .11 ASTM F593-17 - Standard Specification for Stainless Steel bolts, Hex Cap Screws, and Studs.

1.3.3 Canadian Standards Association (CSA):

- .1 CSA G40.20-13/G40.21-13 (R2018) - General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
- .2 CAN/CSA S16-19 - Design of Steel Structures
- .3 CAN/CSA S157-17/S157.1-17 - Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum
- .4 CSA W47.2-11 (R2020) - Certification of Companies for Fusion Welding of Aluminum
- .5 CSA W48-18 - Filler Metals and Allied Materials for Metal-Arc Welding
- .6 CSA W59.2 -M1991 (R2018) - Welded Aluminum Construction
- .7 CSA W59-18 - Welded Steel Construction (Metal-Arc Welding)

1.3.4 American Institute of Steel Construction (AISC):

- .1 AISC 370-21 Specifications for Structural Stainless Steel Buildings

1.3.5 American Welding Society (AWS)

- .1 AWS D1.6/D1.6M-17 - Structural Welding Code - Stainless Steel

1.3.6 The National Association of Architectural Metal Manufacturers (NAAMM):

- .1 NAAMM-AMP 521-01(R2012) - Pipe Railing System Manual (Fourth Edition)

**1.4 Shop Drawings**

- 1.4.1 Submit shop drawings in accordance with Section 01330 - Submittals.
- 1.4.2 Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details and accessories.
- 1.4.3 Design loads and general arrangement shall be clearly identified on the shop drawings.
- 1.4.4 In preparing shop drawings, the fabricator shall verify that all component parts and assembly of each item will support the superimposed loads without deflection detrimental to function, appearance or safety.
- 1.4.5 Provide signed and sealed shop drawings certified by a Professional Engineer licensed in the Province of Ontario.

- 1.4.6 Upon request, submit design calculations signed and sealed by a Professional Engineer licensed in the Province of Ontario.

## **1.5 Protection**

- 1.5.1 Cover exposed stainless steel surfaces with pressure sensitive heavy protection paper or apply strippable plastic coating, before shipping to job site.
- 1.5.2 Leave protective covering in place until final cleaning of building. Provide instructions for removal of protective covering.

## **2 PRODUCTS**

### **2.1 Materials**

- 2.1.1 Steel angles, channels and plates: to CSA G40.20/G40.21, Grade 300W.
- 2.1.2 Hollow Structural Sections (HSS): conform to CAN/CSA G40.21, Grade 350W, Class C.
- 2.1.3 Welding materials:
- .1 To CSA W59 for Steel.
  - .2 To CSA W59.2 for Aluminum.
  - .3 To AWS D1.6 for Stainless Steel
- 2.1.4 Welding electrodes: to CSA W48 Series.
- 2.1.5 Anchor Rods: to ASTM F1554.
- 2.1.6 High Strength Bolts and Nuts: to ASTM F3125
- 2.1.7 Aluminum shall conform to the following alloy designations of the Aluminum Association:
- .1 Extruded Shapes - Structural: 6061-T6.
  - .2 Smooth Plates: 5083-H34.
  - .3 Rivets and Bolts: 6061-T6.
- 2.1.8 Stainless steel shapes: to ASTM A276, Type 316
- 2.1.9 Stainless steel bolts and nuts: to ASTM F593, Type 316
- 2.1.10 Grout: non-shrink, non-metallic, flowable, 24h, 15 MPa at 24 hours, pull-out strength 7.9 MPa.
- ### **2.2 Fabrication**
- 2.2.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

- 2.2.2 Use self-tapping shake-proof screws on items requiring assembly by screws or as indicated.
- 2.2.3 Where possible, fit and shop assemble work, ready for erection.
- 2.2.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

### **2.3 Finishes**

- 2.3.1 Galvanizing: hot-dipped galvanizing with zinc coating 610 g/m<sup>2</sup> to ASTM A123M.
- 2.3.2 Zinc primer: zinc rich, ready mix in accordance with Section 09900 Paint.
- 2.3.3 Bituminous Paint: quick-drying asphalt utility enamel.

### **2.4 Isolation Coating**

- 2.4.1 Isolate aluminum from following components, by means of bituminous paint:
  - .1 Dissimilar metals except stainless steel, zinc or white bronze of small area.
  - .2 Concrete, mortar and masonry.
  - .3 Wood.

### **2.5 Shop Painting**

- 2.5.1 Apply one (1) coat of primer to metal items, with exception of galvanized or concrete encased items.
- 2.5.2 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7°C.
- 2.5.3 Clean surfaces to be field welded. Do not paint.

### **2.6 Platform Framing**

- 2.6.1 All aluminum and/or steel angles, channels, beams and related connection hardware as indicated.
- 2.6.1 Design live load as indicated on drawings.
- 2.6.2 Limit live load deflection of beams to 1/360th of the span or 6mm, whichever is smaller.

### **2.7 Slab Corner Guards**

- 2.7.1 Cast-in Stainless steel angles complete with welded studs as indicated on drawings.
- 2.7.2 Embedded Support Frames for Floor Plate, Precast Stair Landing and Grating
- 2.7.3 Embedded angle support frames which are to be embedded in concrete shall be stainless steel, A276, AISI Type 316, unless indicated otherwise in the Contract Documents.

- 2.7.4 Welded stainless steel Type 316 stud anchors for stainless steel support frames.

**2.8 Miscellaneous Items**

- 2.8.1 Review all drawings and include all other metal fabrication not included in the above noted list.

**3 EXECUTION**

**3.1 Erection**

- 3.1.1 Do welding work in accordance with CSA W59, unless specified otherwise.
- 3.1.2 Erect metal work square, plumb, straight and true, accurately fitted with tight joints and intersections.
- 3.1.3 Provide suitable means of anchorage acceptable to engineer such as dowels, anchor clips, bar anchors, expansion bolts and shields, chemically anchored bolts and toggles.
- 3.1.4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- 3.1.5 Provide components for building by other sections in accordance with shop drawings and schedule.
- 3.1.6 Make field connections with bolts to CAN/CSA S16 or weld.
- 3.1.7 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- 3.1.8 Touch-up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- 3.1.9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Scope of Work**

- 1.1.1 Fabricate and install metal ladder assemblies in accordance with the requirements set forth in this section.

### **1.2 Related Sections**

- 1.2.1 Section 01330 – Submittals
- 1.2.2 Section 03300 – Cast-in-Place Concrete
- 1.2.3 Section 05500 – Metal Fabrications

### **1.3 Reference Standards**

- 1.3.1 American Society for Testing and Materials (ASTM):
  - .1 ASTM A123/A123M-17 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
  - .2 ASTM A276/A276M-17 - Standard Specification for Stainless Steel Bars and Shapes
  - .3 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength
  - .4 ASTM A53/A53M-20 - Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless
  - .5 ASTM F1554-20 - Standard Specifications for Anchor Bolts
  - .6 ASTM F3125-15 - Standard Specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 830 MPa and 1040 MPa Minimum Tensile Strength
- 1.3.2 The National Association of Architectural Metal Manufacturers (NAAMM):
  - .1 NAAMM AMP 510-92 - Metal Stair Manual (Fifth Edition)
- 1.3.3 American National Standards Institute (ANSI):
  - .1 ANSI/NAAMM AMP 521-01 (R2012) - Pipe Railing Systems Manual (Fourth Edition)
  - .2 ANSI/NAAMM MBG 531-17 - Metal Bar Grating Manual
- 1.3.4 Canadian Standards Association (CSA):
  - .1 CSA G40.20-13/G40.21-13 (R2018)- General Requirements for Rolled or Welded Structural Quality Steel / Structural Quality Steel
  - .2 CSA S16-19 - Design of Steel Structures

- .3 CAN/CSA S157-17/S157.1-17 - Strength Design in Aluminum / Commentary on CSA S157-05, Strength Design in Aluminum
- .4 CSA W59-18 - Welded Steel Construction (Metal-Arc Welding)
- .5 CSA W59.2-M1991 (R2018) - Welded Aluminum Construction

1.3.5 Ontario Building Code (OBC) 2012

**1.4 Quality Assurance**

1.4.1 In addition to the requirements of 01450 - Quality Control, the following measures are required:

1.4.2 Fabricator Qualifications

- .1 Work of this section shall be carried out by a fabricator specialized in the type of work specified herein.
- .2 Fabricator must have been producing stair systems for at least ten (10) years.

1.4.3 Installer Qualifications

- .1 Work of this section shall be carried out by a firm specialized in the type of work specified herein. Use competent installers, experienced, trained and approved by fabricator for application of materials being used. Installers shall have a minimum five (5) years of experience in installation and provide documentation of examples minimum of (5) five previous projects completed more than (1) year since construction closeout upon request by engineer.

1.4.4 Mock-up

- .1 Coordinate mock-up requirements with specifications listed in section 1.2 - Related Specification Sections.
- .2 Purpose: To judge quality of work and material installation.

**1.5 Submittals**

1.5.1 Complete submittals in accordance with Specification Section 01330.

1.5.2 Samples:

- .1 Submit duplicate samples of railing showing style and finish. Once approved, sample will be returned to contractor.

1.5.3 Shop Drawings

- .1 Submit engineered and certified shop drawings in accordance with Section 01330 - Submittals.
- .2 Indicate construction details, sizes of aluminum and/or steel sections and thickness of aluminum and/or steel sheets.

- .3 Show sections and plans of ladders, dimensions and assembly of components.
  - .1 Struts, columns and hangers
  - .2 Railings
  - .3 Handrails
  - .4 Brackets
  - .5 Reinforcements
  - .6 Anchors
  - .7 Welded and bolted connections
- .4 Comply with NAAMM minimum standards for construction, proportions and dimensions of fixed metal stairs.
- .5 Indicate NAAMM stair classification
- .6 Show all field connections.
- .7 Provide setting diagrams for installation of anchors, location of pockets, weld plates for attachment of stairs and rails to structure, and blocking for attachment of wall rail.
- .8 Specify adequate back-up support for anchoring handrail bracket.
- .9 Indicate all required field measurements.
- .10 Indicate all design loadings.
- .11 Provide shop drawings certified by a Professional engineer licensed in the Province of Ontario.

1.5.4 Delivery Storage and Handling

- .1 Refer to Specification Section 01610 – Basic Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Deliver materials to the job site in good condition and properly protected against damage to finished surfaces.
- .4 Storage On Site
  - .1 Store material in a location and in a manner to avoid damage. Stacking shall be done in a way, which will prevent bending and damage to factory finishes.
  - .2 Store aluminum, steel and stainless steel components and materials in clean, dry location, away from uncured concrete and masonry. Cover with waterproof paper, tarpaulin or polyethylene sheeting in a manner that will permit circulation of air inside the covering.

- .3 Keep handling on-site to a minimum. Exercise particular care to avoid damage to finishes of materials.
- .4 Replace defective or damaged materials with new.

## **2 PRODUCTS**

### **2.1 Design Requirements**

- 2.1.1 Detail and fabricate handrails and guardrail finishes to NAAMM Pipe Railing Systems Manual.
- 2.1.2 Design handrails to resist lateral force obtained from the nonconcurrent application of:
  - .1 A concentrated load not less than 0.9kN applied at any point and in any direction for all handrails and,
  - .2 A uniform load not less than 0.7kN/m applied in any direction to handrails.
- 2.1.3 Design Guardrail to resist lateral force obtained from the nonconcurrent application of:
  - .1 A concentrated load not less than 1.0kN applied horizontally at any point, at the minimum required height, and
  - .2 A uniform load of 0.75kN/m applied horizontally at any point, at the minimum required height, and
  - .3 A uniform load not less than 1.5kN/m applied vertically on the top rail.
- 2.1.4 Detail and Design ladders and anchorage in accordance with Ontario Building Code MMAH Supplementary Standard SB-8 requirements.
  - .1 Factor of safety for designing components with fall arrest systems - 10:1
  - .2 Factor of safety for designing components for normal use - 4:1

### **2.2 Materials**

- 2.2.1 Steel sections: to CSA G40.21, Grade 350W.
- 2.2.2 Steel plate: to CSA G40.21, Grade 300W.
  - .1 Pattern: [checkered] [Plain].
- 2.2.3 Floor plate: to CSA G40.21, Grade 300W.
  - .1 Width: 1200 mm maximum.
- 2.2.4 Steel pipe handrails: to ASTM A53/A53M, standard weight, schedule 40, seamless black.
- 2.2.5 HSS Steel: to CSA G40.21, Grade 350W, Class C.
- 2.2.6 Metal bar grating: to ANSI/NAAMM MBG 531, [steel] [aluminum], Type [W-19] [P-19], with abrasive nosings.

- 2.2.7 Welding materials: to CSA W59.
- 2.2.8 Anchor Rods: to ASTM F1554.
- 2.2.9 High Strength Bolts and Nuts: to ASTM F3125
- 2.2.10 Aluminum shall conform to the following allowable designations of the Aluminum Association:

Extruded Shapes – Structural	6061-T6
Smooth Plates	5083-H34
Rivets and Bolts	6061-T6
Grating	6061-T6
Checkered or Tread Plate	6061-T6
Castings	356-T2
Hand Railing (clear anodized)	6351-T6

- 2.2.11 All stainless steel to ASTM A276, Type 316.

### **2.3 Fabrication**

- 2.3.1 Fabricate to NAAMM, Metal Stair Manual.
- 2.3.2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- 2.3.3 Accurately form connections with exposed faces flush, mitres and joints tight. Make risers of equal height.
- 2.3.4 Grind or file exposed welds and steel sections smooth.
- 2.3.5 Shop to fabricate ladders in sections as large and complete as practicable.

### **2.4 Guardrail and Handrail System**

- 2.4.1 Fabricate to NAAMM Pipe Railing Systems Manual.
- 2.4.2 Construct posts and handrails from aluminum tubing, as indicated.
- 2.4.3 Form rail-to-end post connections and all changes in rail direction by radius bends.
- 2.4.4 Remove burrs from all exposed cut edges.
- 2.4.5 Form elbow bends and wall returns to uniform radius, free from buckles and twists, with smooth finished surfaces, or use prefabricated bends.
- 2.4.6 Locate intermediate rails equally spaced per OBC requirements between top rail and finish floor or nosing line of tread.
- 2.4.7 Close exposed ends of pipe and tubing by welding metal closure in place or by use of prefabricated fittings.

- 2.4.8 Terminate at abutting wall with end flange.
- 2.4.9 For posts set in concrete, furnish matching sleeves or inserts not less than 125mm.
- 2.4.10 Welding:
  - .1 Accurately miter and cope intersections of posts and rails and weld all around.
  - .2 Weld joint to match Type 2 as described in page 7 of NAAM AMP 521.
- 2.4.11 Provide vent/drain holes at ends of all closed sections of pipe for railing systems.
- 2.4.12 Fabricate joints which will be exposed to the weather so as to exclude water, or provide weep holes where water may accumulate.
- 2.4.13 Provide kick plate to extend no less than 125mm above the walking surface.
- 2.4.14 Touch up welds and abraded areas on galvanized pipe with zinc-rich paint.
- 2.4.15 If the expected discoloration, due to welding, of anodized aluminum and the resulting color discrepancies are not acceptable, they shall be touched up using an acceptable lacquer.
- 2.4.16 All welded areas on stainless steel railing systems shall be ground and finished to blend with adjacent areas.
- 2.4.17 Top-rail outside diameter, formed to shapes and sizes as indicated on drawings.

## **2.5 Ladders**

- 2.5.1 Stainless steel or aluminum ladders and related hardware as shown on the drawings.
- 2.5.2 Stainless steel or aluminum "grab" bars as shown on the drawings.

## **2.6 Finishes**

- 2.6.1 Aluminum shall be clear anodized.
- 2.6.2 Galvanizing: hot-dipped galvanizing with zinc coating 610 g/m<sup>2</sup> to ASTM A123M.
- 2.6.3 Zinc primer: zinc rich, ready mix primer as per section 9900 - Paint.

## **2.7 Shop Painting**

- 2.7.1 Clean surfaces in accordance with Steel Structures Painting Council SSPC-SP2.
- 2.7.2 Apply two (2) coats of primer of different colours to parts inaccessible after final assembly.
- 2.7.3 Use primer as prepared by manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale and grease. Do not paint when temperature is below 7°C.
- 2.7.4 Do not paint surfaces to be field welded.

### **3 EXECUTION**

#### **3.1 Installation of Ladders**

- 3.1.1 Prior to installation, field check and verify structural framing, ensure enclosures, weld plates, blocking, size and location of pockets are as called for on drawings.
- 3.1.2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting ladders to structure.
- 3.1.3 Hand items over for casting into concrete or building into masonry to appropriate trades, together with setting templates.
- 3.1.4 Do welding work in accordance with CSA W59, unless specified otherwise.
- 3.1.5 Touch-up shop primer to bolts, welds and burned or scratched surfaces at completion of erection.

#### **3.2 Installation of Handrail/Guardrail Systems**

- 3.2.1 Install in accordance with NAAMM, Pipe Railing Systems Manual.
- 3.2.2 Provide holes, pre-set sleeves, or inserts of sufficient depth in concrete to develop required post strength. Make hole diameter at least 19mm larger than O.D. of post.
- 3.2.3 Ends of aluminum posts to be in direct contact with grout, concrete or masonry shall be coated with bituminous paint.
- 3.2.4 Setting posts:
  - .1 Clean dust and foreign matter from sleeves.
  - .2 Moisten interior of holes and surrounding surfaces.
  - .3 Prepare and use grout in accordance with manufacturer's directions.
  - .4 Place posts in position and brace until grout sets.
  - .5 Pour mixture into annular space until it overflows the hole.
  - .6 Wipe off excess and leave 3mm build-up, sloped away from post.
- 3.2.5 Set posts plumb and aligned to within 1:576.
- 3.2.6 Set rails horizontal or parallel to rake of steps or ramp to within 1:576.
- 3.2.7 Assemble connections end to end and splice joints by using internal sleeves, bonded by adhesive or mechanical connectors, or by field welding.
- 3.2.8 Support wall handrails on brackets to withstand design loads as required but not more than [1.50 m] [1.8 m] on centers.

3.2.9 Cleaning

- .1 As installation is completed, was thoroughly using clean water and soap, rinse with clean water.
- .2 Do not use acid solution, steel wool or other harsh abrasives.
- .3 If stain remains after washing, remove finish and restore in accordance with fabricator's recommendations.
- .4 Protective wrappings shall not be removed until items are no longer subject to subsequent construction damage, at which time any necessary cleaning shall be performed.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Scope**

1.1.1 This section covers the fabrication and installation of metal grating.

### **1.1 References**

1.1.1 American National Standards Institute (ANSI):

.1 ANSI/NAAMM MBG 531-09 - Metal Bar Grating Manual

1.1.2 American Society for Testing and Materials (ASTM):

.1 ASTM A1011/A1011M-18a - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

.2 ASTM A123/A123M-17 - Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products

.3 ASTM A153/A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

.4 ASTM A385/A385M-20 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)

.5 ASTM B221-14 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes

.6 ASTM A108-18 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished

### **1.2 Submittals**

1.2.1 Make submittals in accordance with Section 01330 – Submittals.

1.2.2 Drawings shall indicate locations of grating supports, profiles, thicknesses, markings of panels and fastening methods.

### **1.3 Delivery, Storage and Handling**

1.3.1 Materials shall be handled, transported and delivered in a manner that will prevent bends, dents, scratches or damage of any kind. Damaged materials shall be promptly replaced. Materials shall be stored off the ground.

## **2 PRODUCTS**

### **2.1 Performance and Design Requirements**

2.1.1 Design Criteria: Except as modified herein, the manufacture and fabrication of metal grating shall comply with recommendations in the "Metal Bar Grating Manual" of the National

Association of Architectural Metal Manufacturers (NAAMM). Minimum grating depth shall be as indicated on the drawings.

- 2.1.2 Design for distributed loads and point loads as indicated on the drawings.
- 2.1.3 Deflections shall be limited to L/360 or 6mm whichever is smaller.
- 2.1.4 Carbon Steel Grating: Carbon steel grating shall be the welded type. Bearing bars shall be at least 5 mm thick with centre-to-centre spacing of 30 mm. Grating shall be galvanized.
- 2.1.5 Aluminum Grating: Aluminum grating shall be pressure locked type, with cross bars deformed or swaged to prevent turning. Bearing bars shall be at least 5 mm thick flat stock or equivalent I-bars, with centre-to-centre spacing of 30 mm. Cross bar centre-to-centre spacing shall be 100 mm maximum. Grating shall be a mill finish.

## **2.2 Materials**

- 2.2.1 Carbon Steel Grating: NAAMM MBG 531, ASTM A1011/A1011M, rectangular, welded, galvanized after fabrication.
- 2.2.2 Galvanizing: hot-dipped galvanizing with zinc coating 610 g/m<sup>2</sup> to ASTM A123/A123M.
- 2.2.3 Aluminum Grating: NAAMM MBG 531, ASTM B221, 6063-T6 or 6061-T6 alloy, pressure or swage locked, mill finish.
- 2.2.4 Grating Stair Treads: Grating stair treads shall match the material and finish of grating in adjacent platforms and floors. Treads shall have a permanently attached or integral non-skid nosing.
- 2.2.5 Grating Fasteners: Manufacturer's standard, AISI Type 316 stainless steel.
- 2.2.6 Clips, Bolts, Nuts, Washers: Manufacturer's standard, AISI Type 316 stainless steel.
- 2.2.7 Welded Threaded Steel Studs: ASTM A108 fully threaded studs automatically welded with compatible nuts and washers; TRW Nelson Type CFL or acceptable equal.
- 2.2.8 Stepped Locking Fasteners: Non-penetrating, non-welded mechanical fasteners, with stainless steel clips and bolts, galvanized cast iron body, Lindaptor "Grate-Fast" or Grating Specialty Co. "G-Clip".

## **2.3 Fabrication**

- 2.3.1 Grating shall be fabricated in panels that can be easily handled by plant personnel. Unless otherwise indicated on the drawings, the weight of individual panels shall not exceed 35 kg.
- 2.3.2 Panels shall be within 6 mm of authorized length and 6 mm of authorized width, and shall have a maximum difference in length of opposite diagonals of 6 mm. The spacing of bearing bars shall be within 1 mm of authorized spacing. Cross bars and edge bars of adjacent panels shall align.
- 2.3.3 After installation, there shall be not more than 6 mm clearance between panels. All bearing bars shall be parallel. Bands and toe plates shall align within 3 mm tolerance, vertical and horizontal.

- 2.3.4 Angular, circular and re-entrant cuts in steel grating may be made by flame cutting. All other cuts in steel grating shall be sawed or sheared. Cuts shall be clean and smooth, without fins, beads or other projections. Any damaged protective coating shall be fully restored.
- 2.3.5 All cuts in aluminum grating shall be sawed or sheared and banded.
- 2.3.6 Grating panels shall be arranged so that openings are centred on a joint between panels. Toe plates extending the full depth of the grating and 125 mm above the top shall be provided around openings. Toe plates shall be welded to each bearing bar. The ends of bearing bars shall be banded. Bands shall be welded to the first, the last and every fourth intermediate bar. Bands and toe plates shall be 5 mm thick. Crossbars shall be cut off flush with the outside face of side bars.
- 2.3.7 Metal frames anchored to or cast in concrete to support grating shall be stainless steel or hot-dipped galvanized after fabrication.

## **2.4 Shop Coating**

- 2.4.1 Finish painting of grating, if required, is covered in the protective coatings section.
- 2.4.2 Galvanizing: All galvanizing shall be done by the hot-dipped process after fabrication, in conformity with the requirements of ASTM A123/A123M, A153/A153M and A385M.
- 2.4.3 Aluminum: All surfaces of aluminum that will be in contact with concrete, mortar or dissimilar metals shall be given a coat of epoxy enamel on the contact surfaces.

## **3 EXECUTION**

### **3.1 General**

- 3.1.1 All grating shall lie flat, with no tendency to rock when installed. Poorly fitting or damaged grating shall be rejected.
- 3.1.2 Grating openings may be field cut with the approval of Engineer, provided that no more than four (4) adjacent bearing bars are cut. If the grating is cut or modified in the field, affected surfaces shall be repaired or sealed to assure restoration of the corrosion resistance of the grating. Field cut openings must be spaced so that there are at least as many continuous bars between each opening as there are cut bars at the opening.
- 3.1.3 After installation of grating panels, gap between grating panels shall not exceed 6mm.

### **3.2 Attachments to Supporting Structure**

- 3.2.1 All grating shall have adequate bearing as per the manufacturers printed recommendations, but not less than 50mm.
- 3.2.2 All grating supported on steel, aluminum or fibreglass structures shall be attached. Grating shall be attached to the supporting structure in accordance with the grating manufacturer's recommendations and submittals.
- 3.2.3 Single span grating over flumes, manholes, pits or other openings in concrete floors may rest unattached in recesses constructed for that purpose.

- 3.2.4 To preclude excessive accumulation of tolerances, an extra-long panel shall be provided for each unanchored grating cover that exceeds 6 m in length. The panel shall be cut to the required dimension after the remainder of the grating panels have been installed.
- 3.2.5 Prime Painted Steel Supports: Unless otherwise required or indicated on the drawings, clip or flange block fasteners or stepped locking fasteners shall be used to attach grating to prime painted steel supports. Clip fasteners shall be secured to the supporting steel with through bolts in drilled holes. Through bolts shall be stainless steel. Fusion welded threaded studs may be utilized if the primer is removed before welding or if a suitable weldable primer is used. Welded studs shall be cleaned and prime painted to match the support steel prior to finish painting.
- 3.2.6 Galvanized Steel Supports: Unless otherwise indicated on the drawings, stepped locking fasteners shall be used to attach grating to galvanized steel supports. The galvanized coating shall not be damaged.
- 3.2.7 Stainless Steel, Aluminum and Fibreglass Supports: Unless indicated otherwise on the drawings, clip or flange block fasteners or stepped locking fasteners shall be used to attach grating to stainless steel, aluminum, or fibreglass supports. Fasteners shall be secured to the supporting structure with stainless steel through bolts in drilled holes. Welded fasteners shall not be used.

### **3.3 Finish Touch-up**

- 3.3.1 After erection, all grating shall be cleaned. Damaged coatings shall be touched-up in accordance with the grating manufacturer's recommendations to fully restore the corrosion resistance of the grating. Cut ends shall be sealed with sealant of equal or superior corrosion resistance to the grating itself or repaired in accordance with the manufacturer's recommendations to assure full undamaged performance.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Scope of Work**

- 1.1.1 This section covers the procurement and installation of anchors in concrete and masonry. It includes cast-in-place anchor bolts, adhesive anchors, expansion anchors and epoxy grouted anchor bolts and reinforcing steel to be installed in concrete and masonry.

### **1.2 Related Sections**

- 1.2.1 Comply with requirements of Division 1.
- 1.2.2 Section 03300 – Cast-in-Place Concrete
- 1.2.3 Section 05500 – Metal Fabrications

### **1.3 General**

- 1.3.1 Unless otherwise specified or indicated on the drawings, all anchors and anchor bolts shall be cast-in-place anchor bolts with forged heads or embedded nuts and washers. Unless otherwise indicated, bolts in concrete shall have a diameter of at least 16 mm and bolts in grouted masonry shall have a diameter of at least 13 mm.

- 1.3.2 Unless otherwise indicated on the drawings, anchors and anchor bolts used in the following locations and applications shall be of the indicated materials. Other anchors and anchor bolts shall be as indicated on the drawings. Where stainless steel is indicated, use type 316 stainless steel.

- .1 Cast-in-Place Anchor Bolts: Carbon Steel
- .2 Submerged locations: Stainless steel
- .3 Locations subject to splashing: Stainless steel
- .4 Buried locations: Stainless steel
- .5 Anchorage of structural steel columns: Galvanized steel
- .6 Other exterior locations: Galvanized steel

- 1.3.3 Adhesive anchors may be used instead of cast-in-place anchors where with the specific acceptance by the Engineer.

### **1.4 Submittals**

- 1.4.1 Letters of certification indicating the manufacturer and types of adhesive anchors and epoxy grouts to be supplied shall be submitted in accordance with Section 01330 - Submittals.

## **1.5 References**

### **1.5.1 Canadian Standards Association (CSA):**

- .1 CAN/CSA-G30.18-09 (2019) - Carbon Steel Bars for Concrete Reinforcement

### **1.5.2 American Society for Testing and Materials (ASTM):**

- .1 ASTM A307-14e1 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 psi Tensile Strength
- .2 ASTM F593-17 - Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs
- .3 ASTM F594-09 (2020) - Standard Specification for Stainless Steel Nuts
- .4 ASTM A153/A153M-16a - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
- .5 ASTM A385/A385M-20 - Standard Practice for Providing High-Quality Zinc Coatings (Hot-Dip)

### **1.5.3 American National Standards Institute (ANSI):**

- .1 ANSI/ASME B18.22M-1981 (R2010) - Metric Plain Washers

## **1.6 Delivery, Storage and Handling**

- 1.6.1 Materials shall be handled, transported and delivered in a manner that will prevent damage or corrosion. Damaged materials shall be promptly replaced. Materials shall be shipped and stored in original manufacturer's packaging.

## **2 PRODUCTS**

### **2.1 Materials**

#### **2.1.1 Materials shall be as indicated below:**

- .1 Expansion Anchors: Hilti "Kwik-Bolt"; Red Head "Trubolt Wedge Anchor"; Powers Fasteners "Power-Stud Anchor".
- .2 Reinforcing Bars: CAN/CSA G30.18 grade 400.
- .3 Anchor Bolts and Nuts:
  - .1 Carbon Steel: ASTM A307 or grade 300 rod, with compatible nuts.
  - .2 Stainless Steel: Bolts, ASTM F593, Alloy Group 2 (316 SS); nuts, ASTM F594, Alloy Group 2.
  - .3 Galvanized Steel: Carbon steel bolts and nuts; hot-dipped galvanized, ASTM A153/A153M and ASTM A385/A385M.

- .4 Flat Washers: ANSI/ASME B18.22M; of same material as anchor bolts and nuts.

## **2.2 Anchors**

- 2.2.1 Cast-in-Place Anchor Bolts: Cast-in-place anchor bolts shall be delivered in time to permit setting before the structural concrete is placed. Anchors bolts shall be provided with sufficient threads to permit a nut to be installed on the concrete side of the concrete form or the supporting template. Two (2) nuts, a jam nut and a washer shall be furnished for cast-in-place anchor bolts indicated on the drawings to have locknuts; two (2) nuts and a washer shall be furnished for cast-in-place anchor bolts without locknuts. Installation of anchor bolts is covered in the cast-in-place concrete section.
- 2.2.2 Adhesive Anchors: When adhesive anchors are indicated on the drawings, only acceptable systems shall be used. Acceptable systems shall include only those systems and products specified or specifically indicated by product name on the drawings. Alternative anchoring systems may be used only when specifically accepted by Engineer. An acceptable adhesive anchor system may be used as an alternative in locations where epoxy grouted anchor bolts are specified or indicated.
- .1 Adhesive anchors in hollow masonry shall utilize screen tubes as recommended by the manufacturer.
- 2.2.3 Epoxy Grouted Anchor Bolts and Reinforcing: Epoxy grout for installing reinforcing steel dowels and anchor bolts not indicated to be adhesive anchors shall consist of a two-component liquid epoxy adhesive of viscosity appropriate to the location and application and an inert aggregate filler component, if recommended by the adhesive manufacturer. Components shall be packaged separately at the factory and mixed immediately before use.
- .1 Anchor bolts and reinforcing steel shall be as indicated on the drawings.

## **3 EXECUTION**

### **3.1 General**

- 3.1.1 Anchor bolts shall be installed at the locations indicated on the drawings.
- 3.1.2 Anti-seize thread lubricant shall be liberally applied to projecting, threaded portions of stainless steel anchors immediately before final installation and tightening of the nuts.
- 3.1.3 Anchors shall be located at least 100 mm away from conduits, sleeves and drains bodies at their largest point measured on top of the slab above the anchor, and the like, embedded in the concrete.
- 3.1.4 Anchors shall be installed in drilled holes with a minimum depth and diameter specified by the manufacturer unless noted otherwise.
- 3.1.5 Anchors shall be assumed, for determining required anchor size, to be installed in an unreinforced concrete mass.
- 3.1.6 If, when drilling the holes for the anchors, reinforcement is encountered and the hole must be shifted to clear the reinforcement, the abandoned hole shall be patched with non-shrink grout of similar properties as the base concrete.

### **3.2 Cast-In-Place Anchors and Anchor Bolts**

- 3.2.1 Cast-in-place anchors and anchor bolts shall be carefully positioned with templates and secured in the forms prior to placing concrete. Contractor shall verify that anchorage devices are positioned in accordance with the design drawings and with applicable equipment submittal drawings. Anchors and bolts shall be positioned sufficiently in advance of the concrete placement so that an on-site representative of Engineer or Owner will have sufficient time to inspect the bolts prior to placing concrete. If special inspection of the anchor bolts is required by the local building code, anchorage shall be placed in sufficient time and with sufficient notification so that such inspection can take place without delaying progress of the work.
- 3.2.2 Threads, bolts and nuts spattered with concrete during placement shall be cleaned prior to final installation of the bolts and nuts.

### **3.3 Epoxy Grout**

- 3.3.1 Epoxy grout components shall be packaged separately at the factory and shall be mixed immediately before use. Proportioning and mixing of the components shall be done in accordance with the manufacturer's recommendations.
- 3.3.2 An acceptable adhesive anchoring system may be used where epoxy grouted threaded rod anchors are indicated on the drawings.
- 3.3.3 Preparation: Where indicated on the drawings, anchor bolts, threaded rod anchors and reinforcing bars shall be epoxy grouted in holes drilled into hardened concrete. Diameters of holes shall be as follows:

<b>Item</b>	<b>Diameter of Hole</b>
Reinforcing Bars and Threaded Rod Anchors	3 mm larger than the outside diameter of the bar or the rod
Headed Anchor Bolts	Bolt diameter plus 50 mm and sufficient to clear the bolt head.

- 3.3.4 The embedment depth for epoxy grouted anchor bolts, threaded rod anchors and reinforcing bars shall be at least 15 bolt, rod or bar diameters, unless otherwise indicated on the drawings.
- 3.3.5 Holes shall be prepared for grouting as recommended by the epoxy grout manufacturer.
- 3.3.6 Installation: Anchor bolts, threaded rod anchors and reinforcing bars shall be clean, dry and free of grease and other foreign matter when installed. The bolts, rods and bars shall be set and positioned, and the epoxy grout shall be placed and finished in accordance with the recommendations of the grout manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with epoxy grout, without voids.

### **3.4 Adhesive Anchors**

- 3.4.1 When adhesive anchors are indicated on the drawings, only an acceptable system shall be used. Alternative anchoring systems may be used only when acceptable to Engineer. An acceptable adhesive anchor system may be used as an alternative in locations where epoxy



grouted anchor bolts and threaded rod anchors are specified or indicated. The embedment depth for adhesive anchors shall be at least 15 rod diameters unless a greater depth is indicated on the drawings or as required by the product manufacturer.

- 3.4.2 Adhesive for adhesive anchors shall be statically mixed in the field during application. All proportioning and mixing of the components shall be in accordance with the manufacturer's recommendations.
- 3.4.3 Anchors shall be installed in holes drilled into hardened concrete or grout filled masonry. Diameter of holes shall be 3 mm larger than the outside diameter of the rod unless recommended otherwise by the anchor system manufacturer. Holes shall be prepared for insertion of the anchors by removing all dust and debris using procedures recommended by the adhesive manufacturer.
- 3.4.4 Adhesive anchors and holes shall be clean, dry and free of grease and other foreign matter at the time of installation. The adhesive shall be placed, the rods shall be set and positioned and the adhesive shall be finished, all in accordance with the recommendations of the material manufacturer. Care shall be taken to ensure that all spaces and cavities are filled with adhesive, without voids and remain filled with adhesive until completion of the curing period. Adhesive shall be cured in accordance with the recommendations of the adhesive manufacturer.

### **3.5 Quality Control**

- 3.5.1 Implement a system of quality control to ensure that the minimum standards specified herein are attained.
- 3.5.2 Bring to the attention of the Consultant any defects in the work or departures from the contract documents that may occur during construction. The Consultant will decide upon corrective action and give his recommendations in writing.
- 3.5.3 The Consultant's general review during construction and inspection and testing by independent inspection and testing agencies reporting to the Consultant are both undertaken to inform the Owner of the Contractor's performance and shall in no way augment the Contractor's quality control or relieve the Contractor of contractual responsibility.

### **3.6 Notification**

- 3.6.1 Prior to commencing significant segments of the work, give the Consultant and independent inspection and testing agencies appropriate notification, so as to afford them reasonable opportunity to review the work. Failure to meet this requirement may be cause for the Consultant to classify the work as defective.

### **3.7 Inspection and Testing**

- 3.7.1 Appointment of Independent Inspection and Testing Companies:
  - .1 The Owner will appoint the independent inspection and testing companies to make inspections or perform tests as the Consultant directs. The independent inspection and testing companies shall be responsible only to the Consultant and shall make only such inspections or tests as the Consultant may direct.

- .2 When defects are revealed, the Owner may request, at the Contractor's expense, additional inspection or testing to ascertain the full extent of the defect.

3.7.2 Tests on Installed Anchors:

- .1 Anchors: The independent inspection and testing company may test up to 10 percent of some of the installed anchors to the manufacturer's specified working load. Should defective anchors or under-capacity installations be found a higher percentage will be tested at the Contractor's expense.

**3.8 Defective Materials and Work**

- 3.8.1 Where evidence exists that defective work has occurred or that work has been carried out incorporating defective materials, the Consultant may have tests, inspections or surveys performed, analytical calculations of structural strength made and the like in order to help determine whether the work must be repaired or replaced. Tests, inspections or surveys or calculations carried out under these circumstances will be made at the Contractor's expense, regardless of their results, which may be such that, in the Consultant's opinion, the work may be acceptable.
- 3.8.2 All testing shall be conducted in accordance with the requirements of the Ontario Building Code, except where this would in the Consultant's opinion cause undue delay or give results not representative of the rejected material in place. In this case, the tests shall be conducted in accordance with the standards given by the Consultant.
- 3.8.3 Materials or work which fails to meet specified requirements may be rejected by the Consultant whenever found at any time prior to final acceptance of the work regardless of previous inspection. If rejected, defective materials or work shall be promptly removed and replaced or repaired to the satisfaction of the Consultant, at no expense to the Owner.

**END OF SECTION**

## **DIVISION 6 – WOOD AND PLASTICS**

DIVISION 6 – WOOD AND PLASTICS

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Section No.	Title
06610	Fibreglass Reinforced Plastics

## **1 GENERAL**

### **1.1 Scope of Work**

- 1.1.1 The Contractor shall furnish, fabricate (where necessary) and install all fibreglass reinforced plastic (FRP) items, with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein and in accordance with the requirements of the Contract Documents.

### **1.2 References**

- 1.2.1 American Society for Testing and Materials (ASTM):
- .1 ASTM D495-14 - Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
  - .2 ASTM D635-14 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position
  - .3 ASTM D638-14 - Standard Test Method for Tensile Properties of Plastics
  - .4 ASTM D696-16 - Standard Test Method for Coefficient of Linear Thermal Expansion of Plastics Between -30°C and 30° with a Vitreous Silica Dilatometer
  - .5 ASTM D790-15e2 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials
  - .6 ASTM D2344/D2344M-16 - Standard Test Method for Short-Beam Strength of Polymer Matrix Composite Materials and Their Laminates
  - .7 ASTM E84-16 - Standard Test Method for Surface Burning Characteristics of Building Materials
- 1.2.2 Ontario Building Code 2012
- 1.2.3 The Occupational Health And Safety Act (OHSA):
- .1 R.R.O. 1990, Regulation 851: Industrial Establishments

### **1.3 Submittals**

- 1.3.1 The Contractor shall furnish shop drawings of all fabricated gratings and accessories in accordance with the provisions of this section.
- 1.3.2 All submittals, calculations and drawings sealed by a Professional Engineer registered in the province of Ontario.
- 1.3.3 Submit baseplate sizes, anchor bolt spacing, diameter and projection complete with baseplate loads on each plate. Loads are to be broken down into each load case for vertical loads and shear loads, not a design envelope.

- 1.3.4 The Contractor shall furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalogue numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes and connection details.
- 1.3.5 The Contractor shall submit the manufacturer's published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables and design calculations for systems not sized or designed in the Contract Documents.
- 1.3.6 The Contractor may be requested to submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the work.
- 1.3.7 Submit Environmental Product Declarations (EPD) showing Global Warming Potential (GWP) impact category.

#### **1.4 Quality Assurance**

- 1.4.1 All items to be provided under this section shall be furnished only by manufacturers having experience in the design and manufacture of similar products and systems. If requested, experience shall be demonstrated by a record of at least five (5) previous separate, similar successful installations in the last five (5) years.

#### **1.5 Product Delivery and Storage**

- 1.5.1 Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry, indoor storage facility.
- 1.5.2 Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations and other types of damage. Store items in an enclosed area and free from contact with soil and water. Store adhesives, resins and their catalysts and hardeners in dry indoor storage facilities between 21°C to 29°C until they are required.

#### **1.6 WARRANTY**

- 1.6.1 Submit a two-year warranty for work for this Section against in materials and workmanship including, but not limited to:
- .1 Performance failure of units.
  - .2 Fading, discoloration or evidence of other defects of exterior surface.

## **2 PRODUCTS**

### **2.1 Design Criteria**

#### **2.1.1 General**

- .1 FRP shall be designed and constructed for a “post-disaster” importance category as defined in the OBC.
- .2 FRP shall be designed to support dead and live loads.

#### **2.1.2 Deflections**

- .1 Maximum deflection for total load is  $L/180$ .
- .2 Maximum deflection for live load is  $L/360$ , but no more than 6mm.

#### **2.1.3 Live Load**

- .1 FRP to support live loads as shown on drawings.
- .2 All guardrails, handrails and their supports to be designed in accordance with the OBC, and withstand the nonconcurrent application of:
  - .1 A concentrated load not less than 1.0 kN applied horizontally at any point, at the minimum required height, and
  - .2 A uniform load of 0.75 kN/m applied horizontally at any point, at the minimum required height, and
  - .3 A uniform load not less than 1.5kN/m applied vertically on the top rail.

#### **2.1.4 Environmental Conditions**

- .1 Exposed to UV
- .2 Temperature: ambient, exposed to the elements.

### **2.2 Manufacturer**

#### **2.2.1 Acceptable manufacturers:**

- .1 Fibergrate Composite Structures Inc., Telephone: 1-800-263-3112
- .2 Strongwell and distributed in Canada by Southwell Corp, Telephone: 1-877-984-7788
- .3 Access Industrial Inc., Telephone: 905-602-4020

#### **2.2.2 Products listed are by Fibergrate Composite Structures Inc., equal FRP Products by the approved manufacturers will be accepted.**

- .1 Guardrail system shall be Dynarail™

## **2.3 General**

- 2.3.1 All FRP items furnished under this section shall be composed of fibreglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
- 2.3.2 Fibreglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.
- 2.3.3 Resin shall be Isophthalic Polyester for all systems, except molded grating used in chemical storage or containment areas, which shall be Vi-Corr®, (vinyl ester resin system), with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.
- 2.3.4 All finished surfaces of FRP items and fabrications shall be smooth, resin-rich, and free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibres shall be well covered with resin to protect against their exposure due to wear or weathering.
- 2.3.5 All FRP products shall have a tested flame spread rating of 25 or less per ASTM E84 Tunnel Test.

## **2.4 Structural Shapes**

- 2.4.1 All structural shapes are to be manufactured by the pultrusion process with a glass content minimum of 45 percent, maximum of 55 percent by weight for maximum sunlight and chemical resistance. The structural shapes shall be composed of fibreglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.
- 2.4.2 Fibreglass reinforcement shall be a combination of continuous roving, continuous strand mat and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
- 2.4.3 Resins shall be DYNAFORM® ISOFR, fire retardant isophthalic polyester with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.
- 2.4.4 Pultruded structural shapes are to have the minimum longitudinal mechanical properties listed below:

<b>Property</b>	<b>ASTM Method</b>	<b>Value</b>	<b>Units</b>
Tensile Strength	D638	206 (30,000)	MPa (psi)
Tensile Modulus	D638	17.2 (2.5 x 10 <sup>6</sup> )	GPa (psi)
Flexural Strength	D790	206 (30,000)	MPa (psi)
Flexural Modulus	D790	12.4 (1.8 x 10 <sup>6</sup> )	GPa (psi)
Flexural Modulus (Full Section)	N/A	19.3 (2.8 x 10 <sup>6</sup> )	GPa (psi)



Property	ASTM Method	Value	Units
Short Beam Shear (Transverse)	D2344/D2344M	31 (4,500)	MPa (psi)
Shear Modulus (Transverse)	N/A	3.1 (4.5 x 10 <sup>5</sup> )	GPa (psi)
Coefficient of Thermal Expansion	D696	1.4 x 10 <sup>-6</sup> (8.0 x 10 <sup>-6</sup> )	Cm/cm/°C (In/in/°F)
Flame Spread	E84	25 or less	N/A

## 2.5 Guardrail and Handrail

- 2.5.1 All guardrail and handrail systems shall be compliant to the OBC and OHSA Reg. 851.
- 2.5.2 All posts and rails are to be DYNAFORM® FRP structural shapes manufactured by the pultrusion process. The structural shapes shall be composed of fibreglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions specified in the Contract Documents.
- 2.5.3 Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.
- 2.5.4 Resins shall be DYNAFORM® ISOFR, a fire-retardant isophthalic polyester resin with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.
- 2.5.5 Top and mid rails are to be 44.4 mm x 3.2 mm wall square tube, the posts are to be 53.9 mm x 4.8 mm wall square tube and kick plate is to be 12.7 mm deep x 102 mm high with two (2) reinforcing ribs. The bases of the posts are to be reinforced to a height of 609 mm using a high strength epoxy compound.
- 2.5.6 The guardrail post/rail connection is to be fabricated such that the rails are unbroken and continuous through the post without the use of packs or splices. The mid rail is to be installed through the post at a prepared hole made to fit the outside dimensions of the rail. The top rail is to fit into a machined, U-shaped pocket formed into top of the post such that the rail is located at the centre of the post. All exposed post corners are to be radiused to eliminate sharp edges. The rails are to be joined to the post through a combination of bonding and riveting. No sharp, protruding edges are to remain after assembly of the guardrails and handrails. Spacing of the posts shall not exceed 1.52 m, unless a more stringent spacing is specified on the drawings.
- 2.5.7 All rails, posts and kick plates are to be integrally pigmented yellow.
- 2.5.8 Guardrails and handrails to be located outdoors in direct UV shall be shop coated with a two-part polyurethane coating, 2 mils thick minimum, for improved durability and UV resistance.

- 2.5.9 All fasteners used in the railing system are to be 316 stainless steel. Rivets will be 18-8 stainless steel.

### **3 EXECUTION**

#### **3.1 General**

##### **3.1.1 Measurements**

- .1 FRP Structures and systems supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in the field for work fabricated to fit field conditions as required by manufacturer to complete the work. When field dimensions are not required, Contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

##### **3.1.2 Sealing**

- .1 All shop fabricated cuts, drilled holes, etc. shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated cuts, drilled holes, etc. shall be coated similarly by the Contractor in accordance with the manufacturer's instructions.

##### **3.1.3 Hardware**

- .1 All hardware, except rivets in the handrail system, shall be Type 316 stainless steel. Rivets in handrail shall be stainless steel. Type 316 stainless steel hold-down clips shall be provided and spaced at a maximum of 1220 mm apart with a minimum of four (4) per piece of grating or as recommended by the manufacturer.

#### **3.2 Guardrail and Handrail**

- 3.2.1 The base of the posts is to be attached according to the Contract Drawings.

- 3.2.2 When required, rails are to be spliced at a distance of 1/4 to 1/3 of the post spacing from the posts using a 152.4 mm length of 38.1 mm x 3.2 mm FRP square tube bonded and riveted into place using epoxy adhesive and non-metallic fasteners.

#### **3.3 Structural Systems**

- 3.3.1 Structural systems shall be assembled and erected in accordance with the manufacturers erection drawings. The Contractor shall ascertain that plumbness, level and alignment are within acceptable tolerances.

- 3.3.2 Normal erection operations include the correction of minor misfits by moderate amounts of reaming or cutting to draw the elements into line. Errors which cannot be corrected by the foregoing means or require major changes in member configuration should be immediately reported to the Owner and fabricator to enable whoever is responsible to either correct the error or approve the most efficient and economic method of correction to be used.

**3.4 Inspection**

- 3.4.1 Shop inspection is authorized as required by the Owner and shall be at Owner's expense. The fabricator shall give ample notice to Contractor, prior to the beginning of any fabrication work, so that inspection may be provided. The grating shall be as free as commercially possible from visual defects such as foreign inclusions, delamination, blisters, resin burns, air bubbles and pits. The surface shall have a smooth finish (except for grit top surfaces).

**3.5 Installation**

- 3.5.1 Contractor shall install FRP structures in accordance with manufacturer's assembly drawings. Lock grating panels securely in place with hold-down fasteners as specified herein. Field cut and drill fibreglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions when cutting or drilling fibreglass products or using resin products; provide adequate ventilation.

**END OF SECTION**

## **DIVISION 7 – THERMAL AND MOISTURE PROTECTION**

DIVISION 7 – THERMAL AND MOISTURE PROTECTION

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Section No.	Title
07900	Joint Sealers

## **1 GENERAL**

### **1.1 Section Includes**

- 1.1.1 Labour, Products, equipment, and services necessary for construction joint and expansion joint sealants on concrete structures in accordance with Contract Documents.

### **1.2 Related Specification Sections**

- 1.2.1 In addition to the general project requirements in Division 1, the following sections are referenced in this section:

- .1 Division 1 - General Requirements
- .2 Section 03300 - Cast-in-place Concrete

### **1.3 Code and Regulatory Requirements**

- 1.3.1 All products shall conform to the following standards and regulations:

- .1 ASTM International Inc.
  - .1 ASTM C510-16, Standard Test Method for Staining and Color Change of Single-or Multicomponent Joint Sealants.
  - .2 ASTM C920-18, Standard Specification for Elastomeric Joint Sealants.
  - .3 ASTM C1193-16, Standard Guide for Use of Joint Sealants.
  - .4 ASTM C1248-18, Standard Test Method for Staining of Porous Substrate by Joint Sealants.
  - .5 ASTM C1311-14 - Standard Specification for Solvent Release Sealants
  - .6 ASTM C1330-18, Standard Specification for Cylindrical Sealant Backing for Use with Cold Liquid-Applied Sealants.
  - .7 ASTM D5893/D5893M-16, Standard Specification for Cold Applied, Single Component, Chemically Curing Silicone Joint Sealant for Portland Cement Concrete Pavements.
- .2 Department of Justice Canada (Jus)
  - .1 Canadian Environmental Protection Act, 1999 (CEPA).
- .3 General Services Administration (GSA) - Federal Specifications (FS)
  - .1 FS-SS-S-200-E(2)1993, Sealants, Joint, Two-Component, Jet-Blast-Resistant, Cold Applied, for Portland Cement Concrete Pavement.

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)

.1 Material Safety Data Sheets (MSDS).

.5 Transport Canada (TC)

.1 Transportation of Dangerous Goods Act, 1992 (TDGA).

#### **1.4 Submittals**

##### **1.4.1 General:**

.1 Submit in accordance with Section 01330.

.2 Work plan: Prior to the start of work, submit the methods of preparation, application, and curing and a list of repair locations.

##### **1.4.2 Manufacturer's Certification**

.1 Submit certified letter indicating surface preparations have been followed and are acceptable.

.2 Submit certified letter indicating repair procedures are followed and complete repairs are acceptable.

##### **1.4.3 Product Data:**

.1 Submit manufacturer's Technical Data Sheet and application instructions for each product specified.

.2 Submit appropriate Material Safety Data Sheets.

#### **1.5 Quality Assurance**

##### **1.5.1 Applicator qualifications:**

.1 Execute Work by applicators trained and approved by the manufacturer and having 5 years proven experience.

##### **1.5.2 In addition to the requirements of Section 01400 - Quality Assurance and Quality Control, the following measures are required:**

.1 A technical specialist representing the product manufacturer shall visit the site to examine site specific conditions and to make recommendations regarding material selection, injection equipment and application techniques.

.2 Contractor must arrange for a field visit with the manufacturer's technical specialist to review and certify all surface preparation prior to applying the product.

.3 Install materials in accordance with all safety and weather conditions required by the manufacturer. Consult Material Safety Data Sheets for complete handling recommendations.

- .4 Contractor must arrange for a field visit with the manufacturer's technical specialist throughout the repair process to verify completion as per manufacturer's instructions.

## **1.6 Delivery, Storage, And Handling**

- 1.6.1 Deliver materials to the Site in their original, unopened containers, with Product labels intact.

- .1 Product labels: Identify the manufacturer's name, brand name, date of manufacture, grade, and type, application directions, and expiry date or shelf life.

- 1.6.2 Store flammable materials in safe containers to eliminate fire hazards.

- 1.6.3 Store materials in accordance with manufacturer's recommendations.

- 1.6.4 Maintain materials to prevent deterioration or contamination by foreign materials.

- 1.6.5 Keep materials dry and free from snow, ice and frost.

## **1.7 Site Conditions**

- 1.7.1 Do not proceed with installation of joint sealants when:

- .1 Ambient air temperatures are less than 5°C.
- .2 Joint substrates and recesses are wet or damp.
- .3 Where contaminants which may interfere with adhesion have not been removed from joint substrates.
- .4 Site conditions do not meet manufacturer's recommendations.

## **1.8 Measurement and Payment**

- 1.8.1 Application of sealant at concrete joints will be paid under lump sum tender price and provisional items as described in the contract.

- 1.8.2 Include in the price all costs of labour, stages, materials, equipment, etc. to:

- .1 Remove deteriorated material.
- .2 Prepare the specified surfaces and carry out sealant repairs.

# **2 PRODUCTS**

## **2.1 Materials - Sealants**

- 2.1.1 Two-component, non-sag, silicone joint sealant, in accordance with ASTM C920, Type M, Grade NS, minimum Class 25, and non staining when tested in accordance with ASTM C510 or ASTM C1248.



2.1.2 Manufacturer's Products:

- .1 Sikaflex 2C NS EZ Mix
- .2 Or approved equivalent

**2.2 Accessories**

2.2.1 Primers:

- .1 Type recommended by sealant manufacturer for substrate, to promote adhesion and to prevent staining of adjacent surfaces for conditions encountered.

2.2.2 Cleaning agents:

- .1 Recommended by sealant manufacturer.
- .2 Free of oily residues or other substances capable of staining or harming joint substrates and adjacent surfaces.

2.2.3 Masking tape:

- .1 Non-staining, non-absorbent material compatible with joint sealants and surfaces adjacent to joints.

**3 EXECUTION**

**3.1 Examination**

- 3.1.1 Verify substrate conditions and dimensions of previously installed Work upon which this Section depends.
- 3.1.2 Report defects to Owner. Commencement of Work means acceptance of existing conditions.

**3.2 Preparation**

- 3.2.1 Ensure joint sealants, primers, joint backing, bond breaker and cleaning agents are compatible with one another and with joint substrates.
- 3.2.2 Prior to the commencement of sealant application, arrange for sealant manufacturer's representative to perform a site adhesion test on each substrate type to which each sealant will be applied.
- 3.2.3 Ensure surface preparation and primer recommendation is compatible with each substrate type.
- 3.2.4 Ensure concrete substrates have cured a minimum of 28 Days prior to proceeding with sealant Work.
- 3.2.5 Clean joints to receive sealants in accordance with the manufacturer's recommendations and as specified in this Section.

- 3.2.6 Remove foreign matter from joint substrates that could interfere with adhesion of joint sealant, including surface dirt, dust, old joint sealants, oil, grease, waterproofing, water repellents, water, sealers, curing compounds, mortar, loose material, frost, and other substances detrimental to sealant's performance.
- 3.2.7 Remove paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer.
- 3.2.8 Remove laitance and form-release agents from concrete.
- 3.2.9 Remove rust, mill scale, and coatings from ferrous metals.
- 3.2.10 Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants.
  - .1 Remove loose particles remaining after porous joint cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
  - .2 Porous joint substrates include, but are not limited to the following:
    - .1 Cast-in-place concrete.
- 3.2.11 Joint priming:
  - .1 Prime joint substrates and apply primer in accordance with sealant manufacturer's recommendations.
  - .2 Confine primers to areas of joint-sealant bond.
  - .3 Spillage or migration to adjoining surfaces is not permitted.
- 3.2.12 Masking tape:
  - .1 Prior to performing Work, use masking tape or other means to protect adjacent exposed surfaces from damage including, but not limited to smearing and staining.
  - .2 Remove protection immediately upon completion and clean adjacent, exposed surfaces of any compound deposited upon such surfaces.
- 3.3 Installation**
  - 3.3.1 Perform Work in accordance with manufacturer's recommendations for Products and applications indicated, unless more stringent requirements apply.
  - 3.3.2 Use Products without additives or adulteration. Use one manufacturer's Product for each location in accordance with Article 0.
  - 3.3.3 Perform Work in accordance with ASTM C1193.

3.3.4 Joint backing:

- .1 Install joint backing to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
  - .1 Depth of recess: Maintain 2:1 joint width to depth ratio.
  - .2 Where recess is less than specified depth, cut back surface of recess to specified depth.
- .2 Do not leave gaps between ends of joint backings.
- .3 Do not stretch, twist, puncture, or tear joint backings.
- .4 Remove absorbent joint backings that have become wet before sealant application, and replace with dry materials.
- .5 Support joint backing on horizontal surfaces against vertical movement which might result from pedestrian or vehicular traffic loads.

3.3.5 Install bond breaker tape between sealant and back of joints where joint backing is not used.

3.3.6 Apply sealant immediately after adjoining Work is in condition to receive sealant Work and as follows:

- .1 Apply sealant in a continuous bead using gun with correctly sized nozzle. Use sufficient pressure to completely fill joint recess.
- .2 Ensure sealant has full, direct uniform contact with, and adhesion to, side surfaces of recess. Superficial pointing with skin bead is not acceptable.

3.3.7 Tooling:

- .1 Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified to form smooth, uniform sealant bead, free from ridges, wrinkles, sags, air pockets, embedded impurities, dirt, stains, or other defects.
- .2 At recesses in angular surfaces, finish sealant with flat profile, flush with face of material at each side.
- .3 At recesses in flush surfaces, finish sealant with concave face and flush with face of material at each side.

3.3.8 Immediately remove excess sealant and droppings.

3.3.9 Ensure sealant bead is uniform in colour.

3.3.10 Cure in accordance with the sealant manufacturer's recommendations. Do not cover up sealants or immerse in water until proper curing has taken place.

3.3.11 Remove defective sealant and reapply.

**3.4 Field Quality Control**

- 3.4.1 Retain an independent inspection and testing agency to conduct field inspection and testing of sealant.
- 3.4.2 Prepare and submit inspection reports to Owner.

**3.5 Cleaning**

- 3.5.1 Clean surfaces adjacent to joints. Immediately remove sealant smears or other soiling resulting from application of sealants.
- 3.5.2 Remove masking tape and other residue.
- 3.5.3 Do not mar or damage finishes on materials adjacent to joints. Repair or replace marred or damaged materials.

**3.6 Protection**

- 3.6.1 Protect joint sealants:
  - .1 During and after curing period from contact with contaminating substrates.
  - .2 From damages by construction operations or other causes.
- 3.6.2 If damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated sealants immediately.

**END OF SECTION**

## **DIVISION 11 – EQUIPMENT**

**DIVISION 11 – EQUIPMENT**

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<b>Section No.</b>	<b>Title</b>
11010	Equipment General Requirements
11015	Installation of Pre-Purchased Equipment
11280	Fabricated SS Slide Gates
11280S1	Slide Gate Schedule
11290	Valve and Gate Actuators

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 The work of this section covers the general clauses for the supply and installation of all process equipment and other works as specified herein and/or indicated on the Drawings.
- 1.1.2 Provide all labour and materials, obtain all necessary permits and pay all fees as may be required.

### **1.2 Related Sections**

- 1.2.1 Division 1 – General Requirements
- 1.2.2 Division 2 – Site Works
- 1.2.3 Division 3 – Concrete
- 1.2.4 Division 5 – Metals
- 1.2.5 Division 11 - Equipment
- 1.2.6 Division 13 – Instrumentation, Control & SCADA
- 1.2.7 Division 16 – Electrical

### **1.3 References, Standards and Codes**

- 1.3.1 Wherever standards and regulations are mentioned, refer to the latest issues thereof at time of Tender.
- 1.3.2 The materials and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the ASTM, AWWA, CEC, COSB and CSA. Canadian Standards shall take precedence over American Standards in the case of duplication or conflicting requirements.
- 1.3.3 All electrical motors and equipment shall be built to EEMCA (Electrical and Electronic Manufacturers' Association of Canada) standards with Canadian threads and bearings throughout and all motorized and electrical equipment shall be CSA approved or supplied in accordance with the rules and regulations of the local inspection authority and subject to its approval.
- 1.3.4 In case of conflicting specification requirements between sections, the more stringent provisions shall apply.
- 1.3.5 Other references/standards as applicable:
  - .1 OSHA - Occupational Safety and Health Act
  - .2 Materials - conform to ASTM (American Society for Testing and Materials) and CSA (Canadian Standards Association) unless specified otherwise.

- .3 Equipment - conform to ASME (American Society of mechanical Engineers) unless specified otherwise.
- .4 Welding - conform to CSA (Canadian Standards Association). See, also, Part 3 herein for weld test examination requirements.
- .5 CSA (Canadian Standards Association).
- .6 Ontario Building Code.
- .7 City and Provincial Codes/Standards.
- .8 Others as may be applicable and as part of good engineering, design, fabrication practice.

#### **1.4 General**

- 1.4.1 Equipment installed under this section shall be erected and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- 1.4.2 When pumping units are being installed, hydraulic considerations and definition of terms shall be as set forth in the Hydraulic Institute Standards.
- 1.4.3 Any equipment identified as being provided by others will be furnished complete for installation by Contractor. Technical specifications under which the equipment will be purchased are available.
- 1.4.4 Any existing equipment which is removed shall be handled as specified and indicated on the contract drawings.
- 1.4.5 Provide all labour and materials, obtain all necessary permits and pay all fees as may be required.
- 1.4.6 If there is a discrepancy between the process, mechanical, electrical, instrumentation drawings and piping and instrumentation drawings (P&IDs), the P&ID shall take precedence for piping and valves design. If any items, cables or connections are missing, provide them at no extra costs as per the P&IDs. The electrical drawings shall dictate for the panel design. Any deviations from the Specifications or piping locations shown on the Contract Drawings require prior review and approval by the Engineer.
- 1.4.7 Small piping and valves, such as less than 80mm, may not be presented on the Contract Drawings. The Contractor shall provide all small piping and valves with supports as per P&IDs. No extra costs are allowed for those piping and valves shown on the P&IDs as the Contractor shall verify the size, location and length.
- 1.4.8 The Contractor shall repair the existing concrete wall, roof or floor when the existing piping or valve is replaced with the new one or abandoned. Submit the shop drawings for the Engineer's review and approval if there is no detail drawing.
- 1.4.9 All equipment and instruments to be installed within classified areas shall be explosion proof.



- 1.4.10 Other than stainless steel, all other metal surfaces shall be protected by an approved, corrosion resistant coating.
- 1.4.11 Flange connections shall be provided for different pipe materials.
- 1.4.12 The Contractor shall be responsible for providing the same flange type to connect the instrument and pipe flanges. If the number of holes on the flanges is different as per different code requirements, provide the same number of holes or change flange type as per the Engineer's review. No extra cost to the Owner shall be permitted to change the flange type.
- 1.4.13 Where any buried piping is extended from inside building to outside, double dresser couplings shall be installed on the line as per the contract detailed drawings. The coupling material shall be the same as pipeline.
- 1.4.14 Unless otherwise specified, all sludge, water and chemical pipelines shall be located below 1.8m of freezing depth.
- 1.4.15 The Manufacturer shall be assigned unit responsibility for coordinating, supplying, testing and commissioning of the individual equipment and their respective accessories as a complete package.
- 1.4.16 Unless the pipe elevation or location is changed more than 0.2 m due to any interferences, no extra cost to the Owner shall be permitted.
- 1.4.17 In case of conflicting specification or drawing requirements, the more stringent clause shall apply.

## **1.5 Coordination**

- 1.5.1 The Contractor shall coordinate with the system and equipment manufacturers, the Vendor's installation and supply scope or work because the Contractor shall be responsible for the entire installation and commissioning.
- 1.5.2 If there is a discrepancy for the Vendor's supply scope or work shown on the process drawings, the Contractor shall provide all required piping, power cables and communication cables for the complete commissioning and controls.
- 1.5.3 Fully coordinate the work of all related specification sections. Use equipment specifications together with all sitework, concrete, building, electrical and controls specifications as necessary in order to produce a fully coordinated product meeting all necessary specifications.
- 1.5.4 When manufacturers field services are provided by the equipment manufacturer, the Contractor shall coordinate the services with the equipment manufacturer. The Contractor shall give the Engineer written notice at least 30 days prior to the need for manufacturer's field services furnished by others.

## **1.6 Submittals**

- 1.6.1 Refer to Section 01330 – Submittal Procedures.

- 1.6.2 Submit Shop Drawings for all electric motors together with respective equipment indicating motor dimensions and characteristics, including efficiency, power factor, insulation class and details of winding protection.
- 1.6.3 Submit Shop Drawings for all equipment in this Division, including relevant installation and fabrication details.
- 1.6.4 Submit Operating and Maintenance Data for all equipment in this Division, in accordance with Section 01780 – Closeout Submittals.

## **1.7 Handling and Storage**

- 1.7.1 Provide all necessary equipment, materials and labour to off-load equipment at the site. The methods employed for off-loading and handling must be to the satisfaction of the Engineer.
- 1.7.2 Before taking delivery of equipment, examine the equipment for any damage. Rectify damage to the equipment to the satisfaction of the Engineer or remove damaged material from the site.
- 1.7.3 If not required for immediate use, adequately store and protect all equipment against weather damage and theft. Store mechanical and electrical equipment as recommended by the manufacturer and to the satisfaction of the Engineer.

## **1.8 Standards**

- 1.8.1 The materials and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the ASTM, AWWA, CEC, COSB and CSA. Canadian Standards shall take precedence over American Standards in the case of duplication or conflicting requirements.
- 1.8.2 All electrical motors and equipment shall be built to EEMCA (Electrical and Electronic Manufacturers' Association of Canada) standards with Canadian threads and bearings throughout and all motorized and electrical equipment shall be CSA approved or supplied in accordance with the rules and regulations of the local inspection authority and subject to its approval.
- 1.8.3 In case of conflicting specification requirements, the more stringent provisions shall apply.

## **1.9 Factory Testing**

- 1.9.1 Where witnessed factory testing is specified, the Supplier is to give 10 working days notice of the date when equipment will be ready for testing. Confirmation of the test date and time is to be provided three (3) working days in advance of the tests. Equipment is not to be delivered to the site until factory testing has been satisfactorily completed.
- 1.9.2 When certified factory testing of the equipment or any component is specified, the supplier shall provide the Engineer with two (2) copies of required certified test reports showing that the equipment complies with the Specification, before the equipment is delivered to site. Additional copies are required for the Maintenance Data Manuals.

**1.10 Protection of Openings**

- 1.10.1 Protect equipment and systems from dirt, dust and other foreign materials with materials appropriate to the system.

**1.11 Special Tools**

- 1.11.1 Provide one set of special tools required to service equipment as recommended by manufacturers and in accordance with Section 01780 – Closeout Submittals.

**1.12 Cleaning**

- 1.12.1 Clean interior and exterior of all systems including piping, valves and strainers. Vacuum interior of ductwork and air handling units.

**1.13 Spare Parts**

- 1.13.1 Furnish all spare parts in accordance with Section 01780 – Closeout Submittals.

**1.14 As-Built Information**

- 1.14.1 Submit as-built information as per Section 01780 – Closeout Submittals.

**1.15 Warranties and Bonds**

- 1.15.1 Guarantee all equipment in accordance with Section 01780 – Closeout Submittals.

**1.16 Measurement and Payment**

- 1.16.1 The lump sums included in the Bid Form for each equipment section shall be deemed to include the cost of all equipment general requirements.

**2 PRODUCTS (NOT APPLICABLE)**

**3 EXECUTION**

**3.1 Delivery, Receiving and Storage of Equipment**

- 3.1.1 Arrange with the suppliers for delivery of all items of equipment to the site of the work as required to meet the schedule.
- 3.1.2 Arrange for delivery of all anchor bolts, templates, embedded metals, and other materials required during the concreting placement and assembly of equipment.
- 3.1.3 Receive equipment at the site, unload and examine it upon arrival for damage or defects and be responsible for its safekeeping, storage and installation. Immediately notify the Engineer and the supplier of any damages or defects in the equipment delivered.
- 3.1.4 Special measures shall be taken to ensure that electrical motors do not suffer from moisture, dust, dirt or mechanical damage if stored or installed and inactive.

- 3.1.5 Equipment storage, safekeeping and relocation of equipment from one area of the site to another, for whatever reason, shall be the sole responsibility of the Contractor from the time of initial off-loading at the site until the date of completion and acceptance by the Owner.

### **3.2 Time of Completion**

- 3.2.1 Delay in delivery of equipment or installation materials does not relieve the Contractor of the responsibility to complete the Contract within the agreed date for contract completion.

### **3.3 Manufacturers Services and Certification of Installation**

- 3.3.1 Provide for all necessary services and expenses of trained personnel representing the manufacturers of various pieces of specified equipment, to ensure correctness of installation and include any start-up costs required by suppliers necessary to ensure satisfactory installation, testing and commissioning of the equipment.
- 3.3.2 Provide all materials, labour and equipment necessary to make any adjustments to the installation as required by the manufacturer or the Engineer until the equipment is fully tested and commissioned.
- 3.3.3 On completion of installation and testing, obtain from the suppliers or the manufacturers concerned, certification that the equipment is installed correctly, is in full operational condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer and all copies necessary to comply with other submitted requirements. Certificates are to include a statement to the effect that any adjoining pipe is properly and independently supported and does not cause undue stress that would be detrimental to the equipment performance.
- 3.3.4 Co-ordinate the work of all equipment suppliers, fully commission all equipment and provide representatives from various manufacturers during plant testing and commissioning as required by the Engineer.

### **3.4 Acquaintance With Work**

- 3.4.1 The Contractor shall be fully acquainted with all work involved in the complete installation of all equipment. At no time shall the Contractor make any claim that any misunderstanding existed in regard to the nature or amount of work to be done in relation to the installation, testing and commissioning of all specified equipment.
- 3.4.2 Obtain all necessary details from Equipment suppliers including dimensions and other information pertinent to the Work of this Contract.

### **3.5 Materials and Workmanship**

- 3.5.1 Material and equipment is to conform to the latest edition of applicable standards in force at the time of tendering. In the case of any conflict between the Specifications with any standards, the more stringent of the two applies.
- 3.5.2 Provide materials and equipment in conformance with the following:
- .1 First class in every respect.
  - .2 Constructed and finished in a workmanlike manner.

- .3 Fully suitable for the service intended.
- .4 Selected and fabricated to best engineering practice.
- 3.5.3 Furnish safety devices, including shear pins, flexible coupling guards, beltguards and other pertinent items with the equipment.
- 3.5.4 Design machinery such that working parts are readily accessible for inspection and repair, and each part is suitable for the service required.
- 3.5.5 Carefully pack and crate equipment for shipment. Protect polished and machined metal surfaces from corrosion and damage during shipment. Specially pack electrical equipment to prevent damage by moisture. Cover equipment having exposed bearings and glands to exclude foreign matter.
- 3.5.6 Design equipment to have adequate strength, power and capacity for both continuous and intermittent service and have motors and other parts capable of starting and operating under any conditions or loading likely to occur under normal plant operating conditions.
- 3.5.7 Design the general mechanical and electrical equipment and particularly gearings, contacts and other wearing parts to satisfy the need for long periods of operation without frequent maintenance or attention.
- 3.5.8 Provide adequate and, as far as practicable, authentic means of lubrication for working parts. Arrange lubrication grease nipples, grease boxes and other lubrication devices so that they are readily accessible for routine greasing.
- 3.5.9 Indicate on the working Drawings submitted, the type of lubricants to be used (readily available in Canada). Use grease nipples of a consistent type (Alemite button head type or equivalent).
- 3.5.10 Make lubrication points readily accessible using grease nipples and Type 316 stainless steel or copper tubing extensions where required. Secure the nipples and tubing to the equipment at appropriate locations.
- 3.5.11 Design equipment installed outdoors for service under climatic conditions typical for the area. Give particular attention to winter operating conditions.
- 3.6 Special Tools and Accessories**
- 3.6.1 Furnish a set of any special tools, wrenches and accessories required for removing worn parts, for carrying out maintenance and for making adjustments. Special tools are those tools which, because of their limited use or purpose-made design, are not normally readily available, but which are necessary for maintaining the equipment.
- 3.7 Temporary Supports**
- 3.7.1 Provide all necessary temporary supports and bracing to prevent the overloading of all floors and walls, while equipment is being installed. Ascertain the weights of all pieces of equipment from the manufacturer, and move equipment into position in a manner and at a time approved by the Engineer.

- 3.7.2 Provide eye bolts or hooks for the safe handling of the equipment during installation. Eyebolts are to be left in place.

**3.8 Lubricants, Grease, Oil and Fuel**

- 3.8.1 Provide the complete initial lubrication of all equipment in accordance with the manufacturer's recommendations. Provide a complete schedule of all manufacturer's recommended lubricants. Fill grease, oil and fuel tanks, as required for the initial operation of the equipment.
- 3.8.2 All lubricants coming in contact with water (potable and non-potable) shall be NSF certified.

**3.9 Small Piping**

- 3.9.1 Supply and install all small connecting pipework, fittings and valves whether shown on the Drawings or not. Perform all such Work strictly in accordance with the instructions of the manufacturer whose equipment is being installed or connected.

**3.10 Balancing**

- 3.10.1 Balance, adjust and test all process and odorous air lines in accordance with Section 15043.
- 3.10.2 The Contractor shall confirm the air flowrates with the Engineer.

**3.11 Vibration**

- 3.11.1 All system vibration testing in accordance with Section 01810 – Testing and Commissioning.

**3.12 Anchor Bolts**

- 3.12.1 Unless otherwise specified, supply all stainless steel anchor bolts, such anchor bolts being of a diameter and size as recommended by the manufacturers of the equipment and machinery being installed. Generally use expansive type anchorages in setting small equipment. Set large pumps by means of bolts with sleeves cast into the concrete to a minimum depth of 150 mm. Elsewhere, cast in place anchor bolts may be used subject to the approval of the Engineer; these must be properly positioned by means of substantial templates.

**3.13 Field Welding and Fabrication**

- 3.13.1 Ascertain details of field welding and fabrication to be carried out for the erection and installation of the various items of equipment.
- 3.13.2 Fabricate the equipment in accordance with CSA Standard S16, Steel Structures for buildings and the manufacturer's instructions.
- 3.13.3 Have the welding shielded, conforming to CSA Standard W59.0, General Specifications.

**3.14 Equipment Guards**

- 3.14.1 Provide removable protective guards for all open rotating equipment including pulleys, belts, drives, shafts and couplings, etc.

- 3.14.2 Ascertain the extent of the work for the installation and/or the supply etc., of equipment guards by direct contact with the equipment suppliers.

**3.15 Protection of Equipment**

- 3.15.1 After the equipment has been installed and prior to final acceptance, protect the equipment from damage. Ensure that protection measures are to the satisfaction of the manufacturer and the Engineer.

**3.16 Testing and Commissioning**

- 3.16.1 Unless otherwise specified, provide commissioning and startup in accordance with Section 01810 - Testing and Commissioning.
- 3.16.2 Unless otherwise specified, furnish a certificate of final inspection and approvals from the electrical inspection authority to the Engineer.

**3.17 Training**

- 3.17.1 Unless otherwise specified, provide Demonstration and Training in accordance with Section 01820 – Demonstration and Training.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Work of This Section**

- 1.1.1 The work of this section includes the supply, delivery, unloading, storage, handling, installation, testing, start-up and commissioning, and warranty of the following pre-purchased equipment from WesTech Engineering:
- .1 Six (6) spiral blade secondary clarifier mechanisms and associated appurtenances for Secondary Clarifiers #2-6 and #8, including:
    - .1 Center drive unit, complete with reducer, motor, microswitch overload device, shear pin and torque control.
    - .2 Full span access bridge and enlarged platform with handrail, grating and toe plate. Bridge shall span across secondary clarifier rings of the existing clarifier structure to the centre influent column.
    - .3 Stationary center influent column, anchor bolt template, and grout shield.
    - .4 Energy dissipating inlet (EDI).
    - .5 Influent feedwell.
    - .6 Rotating drive cage and truss arms.
    - .7 V-notch effluent weir
  - .2 Density current baffles (Secondary Clarifiers #1-4)
- 1.1.2 The Owner has entered into a separate contract with the equipment supplier for purchase of the pre-purchased equipment. The contract obligations are to be assumed by the Contractor, with execution of the respective novation agreements.
- .1 Pre-selection of equipment was made by Proposal P2022-92 Request for Supply of Secondary Clarifier Mechanism Equipment (Brantford WWTP)
  - .2 Scope of Supply: Review Proposal P2022-92 contract documents to determine exact extent of supply for the Clarifier Mechanism Equipment.
- 1.1.3 In general, the equipment supplier will provide the following work:
- .1 Design, fabrication, supply, and delivery of the pre-purchased equipment.
  - .2 Inspection of installation and supervision of testing and commissioning of the pre-purchased equipment.
- 1.1.4 In general, the Contractor shall provide the following work:
- .1 Coordinate with the pre-selected equipment Supplier, the scope of work for all requirements specified herein and Contract Document for pre-selection.



- .2 Accepting and offloading of pre-purchased equipment at the Brantford WWTP.
  - .3 Storing the equipment in accordance with manufacturer's instructions and assuming responsibility of relevant insurance for the pre-purchased equipment until the completion of this Contract.
  - .4 Installation of the pre-purchased equipment, including provision of all necessary equipment and labour.
  - .5 Assume or ensure the performance bonding of the equipment suppliers is maintained.
  - .6 Assistance with initial operation, testing, and commissioning of the pre-purchased equipment.
- 1.1.5 Review in detail the pre-purchased documents to determine the extent of responsibility of the equipment supplier.
- 1.1.6 All work outside the requirements of pre-purchased equipment supply that is required for successful installation and operation of the pre-purchased equipment is the full responsibility of the Contractor.
- 1.1.7 Consult with the equipment suppliers during the tender period regarding the intricacies of installation, the extent of work required, coordination requirements, etc., of all of the suppliers' equipment.
- 1.2 Submittals**
- 1.2.1 Shop drawings submitted by the equipment suppliers for the pre-purchased equipment were reviewed by the Engineer. Copies of the approved shop drawings are appended to the Contract Documents.
- 1.3 Storage Of Equipment**
- 1.3.1 Assume the costs incurred from the date that the pre-purchased equipment is delivered to the Brantford WWTP and maintain the equipment in proper storage, including insurance, for all the suppliers' equipment.
- 1.3.2 After delivery, provide routine maintenance on all the suppliers' equipment as required by the equipment supplier from the date of earliest delivery to the time of initial start-up of the equipment.
- 1.4 Receiving The Suppliers' Equipment into Storage**
- 1.4.1 If required, place suppliers' equipment into secure on-site storage or offsite storage in a bonded warehouse.
- 1.4.2 Examine all shipments during offloading for damage and check against shipping papers to ensure that all parts, boxes, crates, bundles or items have been received. Do not unpack if not installed for use immediately.
- 1.4.3 Unloading of the equipment shall be performed by the Contractor, at their expense, in accordance with the equipment manufacturers' written instructions and utilizing methods

which will not damage the equipment. Contractor shall furnish all rigging necessary to unload the equipment.

- 1.4.4 File a written claim for any damage or shortage immediately with the equipment supplier.
- 1.4.5 Repair or replace all damage or shortages that may occur during the period of storage.
- 1.4.6 Provide all necessary equipment and labour to move all items supplied by the equipment suppliers and stored at the Brantford WWTP when equipment is ready for installation.
- 1.4.7 Move equipment only according to the equipment suppliers' instructions and under the equipment suppliers' direct supervision.
- 1.4.8 Provide surveillance to ensure no equipment is removed by other than the Contractor's forces nor damaged by vandalism.

## **2 PRODUCTS (NOT APPLICABLE)**

## **3 EXECUTION**

### **3.1 Coordination Of Pre-Purchased Equipment Contracts**

- 3.1.1 Review the contracts for supply of the pre-purchased equipment and coordinate all requirements with the requirements of this Contract.

### **3.2 Product Delivery, Storage and Handling**

- 3.2.1 Shipment is not to be made until the Equipment vendor coordinates shipment to the jobsite with the Installation Contractors, assuring that the equipment will be properly received and stored.
- 3.2.2 Arrange for a representative of the Equipment vendor to be present at the job site during the unloading to inspect the delivered equipment and witness the unloading process.
- 3.2.3 Provide all necessary equipment, materials and labour to off-load equipment at the site. The methods employed for off-loading and handling must be to the satisfaction of the Engineer.
- 3.2.4 Before taking delivery of equipment, examine the equipment for any damage. Rectify damage to the equipment to the satisfaction of the Engineer or remove damaged material from the site.
- 3.2.5 Coordinate with vendor any special items necessary for unloading any of the system equipment, such as blades, etc. Supplying these special items for unloading shall be the responsibility of the General Contractor.
- 3.2.6 Coordinate with vendor to receive any special instruction for storage and pre-installation maintenance.
- 3.2.7 All equipment shall be skid mounted or crated to protect against damage during shipment. All parts shall be properly protected so that no damage or deterioration will occur during a prolonged delay from the time of shipment until installation is completed, and the units and equipment are ready for operation.

### **3.3 Installation Of Equipment**

- 3.3.1 Install equipment in accordance with the equipment manufacturers' written instructions and approved shop drawings.
- 3.3.2 Provide all labour for installation of the equipment.
- 3.3.3 Provide all necessary external piping, pneumatic and/or electrical connections and panels, where not supplied, to all the suppliers' equipment. Piping connections to be made to permit ready disconnection of equipment with minimum disturbance of adjoining piping and equipment and in accordance with manufacturer's instructions.
- 3.3.4 Where instruments, ancillary equipment, control panels, receptacles, switches or other devices are supplied by the equipment suppliers, provide all piping, electrical and instrument wiring and connections required for the devices.
- 3.3.5 Install equipment in accordance with the applicable Specification sections and Drawings of this Contract.
- 3.3.6 Locate, level, and align all equipment and set all lines and levels of equipment to the accuracy required.
- 3.3.7 Set, align and assemble equipment in conformance with the manufacturer's drawings or instructions. Runout tolerance by dial indicator method of alignment or other approved method shall be plus or minus 0.002 inches or as directed by the manufacturer, whichever is more stringent.
- 3.3.8 Furnish all blocking, wedges, shims, filling pieces, or other materials required for the proper support and leveling of equipment during installation. Grind as required to bring parts to proper bearing after erection.
- 3.3.9 Provide all anchor bolts required for installation of the equipment if such anchor bolts are not furnished by the equipment supplier. Anchor bolts and nuts shall be Type 316 stainless steel unless specified otherwise.
- 3.3.10 Rotate rotating assemblies and all other moving parts a minimum of once per week to ensure proper lubrication and prevent "flat-spotting" of bearings.
- 3.3.11 Apply an anti-seize compound to all threads in mechanical connections such as bolts, studs, cap screws, tubing, etc.
- 3.3.12 Coating: Touch up all damage to finish paint caused during unloading, storage, handling, and installation of the equipment. Obtain matching coatings from manufacturer.

### **3.4 Workmanship**

- 3.4.1 Use proper tools for assembly of equipment and materials to prevent marring the surface of shafts, nuts or other parts.
- 3.4.2 Tighten all connections requiring gaskets evenly all around to ensure uniform stress over the entire gasket area.

- 3.4.3 Do not weld or burn any parts with machined surfaces except upon written permission of the Engineer.

**3.5 Lubrication**

- 3.5.1 Lubricate equipment in accordance with the lubrication specifications and instructions provided by the manufacturer.

**3.6 Installation And Field Quality Control**

- 3.6.1 Installation Check. The Equipment vendor shall provide the services of a qualified field representative according to the quality control section to assist during installation of the equipment by the General Construction Contractor. Because each primary clarifier shall be independently tested, as a minimum, the equipment vendor's field representative shall be made available as follows:

- .1 Installation Inspection 3 trips, 6 days total
- .2 Startup Assistance 3 trips, 6 days total

3.6.2 Torque Test

- .1 The clarifier mechanism shall be field torque tested. The testing shall be carried out under the supervision of the equipment manufacturer's representative and as approved by the Engineer before the mechanism is accepted and placed into operation.
- .2 The torque test shall consist of securing the rake arms by cables to anchor bolts installed by the Contractor in the tank floor at locations specified by the equipment manufacturer. A load shall be applied to the scraper arm in small increments by means of a ratchet lever and cylinder connected to the cable assembly the drive mechanism. The magnitude of the applied load shall be measured by calculating the torque from the distance of the line of action of each cable to the centre line of the mechanism. A reading shall be taken at the drive design torque.
- .3 The manufacturer's service representative shall verify that the alarm, motor cut-out, and back-up safety motor cut-out switches are properly set and are in proper operation to protect the clarifier mechanism as specified.

- 3.6.3 Field Evaluation Tests. A performance test shall be run on the equipment after the installation is completed to ensure the equipment are operating properly as determined by the representative of the equipment manufacturer. The performance test shall be conducted by a capable representative of the manufacturer and accepted by the Engineer. The Owner's operating personnel shall assist the manufacturer's representative in the performance test. A designated representative of the Owner and/or the Engineer shall observe the performance test. As a minimum, the manufacturer's field representative shall be made available as follows:

- .1 Performance testing 3 trips, 6 days total

- 3.6.4 An experienced, competent, and authorized representative of the equipment vendor shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. It is not intended that the Equipment Vendor must be onsite to oversee the entire installation process of the equipment. However, as the Equipment vendor is required to

certify proper installation prior to placing equipment into service, the authorized representative of Equipment vendor, or subcontracted equipment vendor, shall attend site as required to inspect the General Contractor's work and satisfy themselves that components are in acceptable condition, that key installation tasks have been carried out correctly, and that appropriate QC documentation has been assembled.

- 3.6.5 At least two (2) weeks prior to the proposed testing date, the Contractor shall notify the Engineer of the testing date and shall submit a report from the equipment manufacturer detailing the proposed performance testing procedure and analyses. Testing shall be performed between 8:00 a.m. and 5:00 p.m. and shall begin on Monday or Tuesday. If more than one (1) day of testing is required, the testing shall be done on consecutive days. The Engineer's initial observation of tests shall be at the Owner's expense. All costs of subsequent visits by the Engineer to witness or observe additional tests necessary because of failure of the initial tests or inability to conduct the initial tests will be at no extra cost to the Owner.
- 3.6.6 Should the equipment not achieve consistent compliance during the tests, then the manufacturer shall modify the equipment and repeat the field evaluation tests. Costs of modifying equipment, reducing or furnishing additional equipment, or subsequent retesting shall be borne by the General Contractor and Manufacturer. Should the equipment fail to meet all the design requirements after retesting, the equipment shall be rejected and shall be replaced by the Construction Contractor at the manufacturer's expense with acceptable equipment at no additional cost to the Owner.
- 3.6.7 Performance Test and Field Evaluation Report. The manufacturer shall prepare a formal test report, including all measured data and other recorded data and observations. One (1) electronic copy of the report shall be submitted to the Engineer within 30 days after completion of the tests.

### **3.7 Training**

- 3.7.1 In addition to the installation and operation check required by the General Equipment Stipulations and the manufacturer's field services required by the quality control section, the manufacturer shall furnish the services of a competent and experienced operator of the equipment, who is directly employed by the manufacturer, to instruct the Owner's operating personnel in the proper operation and maintenance of the equipment. Training shall be provided as specified in Section 01820 - Demonstration and Training.

### **3.8 Warranty**

- 3.8.1 Each unit shall be new and shall carry the full Manufacturer's warranty on parts, service, and performance. Warranty shall begin at substantial completion. The warranty shall include replacement of all defective equipment and shall extend two (2) years beyond substantial completion.
- 3.8.2 Corrective Work. Any location where corrosion is evident shall be considered a failure of the material or the protection system. Before starting corrective work, the Manufacturer shall submit to the Engineer for review any analysis of the cause of the failure and details of the proposed corrective work. The Manufacturer shall make repairs acceptable to the Engineer at all points where failures are observed within the Warranty Period.
- 3.8.3 Inspection. Each unit shall be inspected at the end of the warranty period by representatives of the Owner, the Engineer, and the Manufacturer to identify any failures that may have

occurred. The Manufacturer shall establish the date of each inspection and shall notify the Owner at least 30 days in advance. The scheduled inspection shall not relieve the Manufacturer from the obligation to perform corrective work whenever needed.

- 3.8.4 The Manufacturer shall prepare and deliver to the Owner an inspection report covering each inspection, indicating the number and type of failures observed, material and part where materials have failed, the percentage of the surface area where corrosion protection system failure has occurred, and the names of the persons making the inspection. Colour photographs illustrating each type of failure shall be included in the report.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Scope**

- 1.1.1 This section covers slide gates and actuators. Slide gates shall be furnished complete with wall thimbles, frames, slides, seals, operating stems, stem guides, actuators, baseplates, anchor bolts, and appurtenances.
- 1.1.2 Each gate shall have a clear waterway, shall consist of a gate, guides, frames, brackets, wall thimbles with mounting bolts, stems and stem guides, manual actuators, electric actuators, and all other necessary appurtenances.
- 1.1.3 The contractor shall furnish all labour, materials, equipment and incidentals required to install, ready for operation and field test stainless steel gates and appurtenances as shown on the Gate Schedule and/or Contract Drawings and as specified herein.
- 1.1.4 The equipment provided under this section shall be fabricated to repeatable quality build norms, assembled, factory stroked and leak tested with signed and dated results. It shall be erected and placed in proper operating condition in full conformity with the drawings, engineering data, instructions and recommendations of the equipment manufacturer.
- 1.1.5 Gates and operators shall be supplied by the gate manufacturer with all necessary parts and accessories indicated on the drawings, specified or otherwise required for a complete, properly operating installation and shall be the latest standard product of a manufacturer regularly engaged in the production of fabricated gates.
- 1.1.6 Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA C561, latest edition.

### **1.2 Related Sections**

- 1.2.1 Division 1 – General Requirements
- 1.2.2 Section 11280-S1 – Slide and Channel Gate Schedule
- 1.2.3 Section 11290 – Valve and Gate Actuators

### **1.3 General**

- 1.3.1 Equipment furnished and installed under this section shall be fabricated, assembled, erected, and placed in proper operating condition in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer unless exceptions are noted by the Engineer.
- 1.3.2 Gates and actuators shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest product of a manufacturer regularly engaged in the production of slide gates.
- 1.3.3 Provide the maintenance platforms as per the Contract Drawings.

- 1.3.4 General Equipment Stipulations: The General Equipment Stipulations shall apply to the equipment furnished under this section.
- 1.3.5 Governing Standard: Except as modified or supplemented herein, all gates and operators shall conform to the applicable requirements of AWWA C561, latest edition.
- 1.3.6 Design: Liberal factors of safety shall be used throughout the design and especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one-third of the yield point or one-fifth of the ultimate strength of each material:
- .1 Gates shall be designed to fit into the structures as indicated on the drawings.
- 1.3.7 Minimum Metal Thickness: Where so indicated in the governing standard, the design safety factors pertaining to tensile, compressive, and shear strength of materials used shall be observed. In addition, unless otherwise acceptable to the Engineer, all portions of submerged components of each gate, exclusive of stem guide wall brackets, shall have a metal thickness of at least 6.4mm.
- 1.3.8 Number Plates: Each gate shall be provided with a number plate, with at least 25mm high black baked enamel numerals on anodized aluminum plate. The location of number plates and the method of attachment shall be acceptable to the Engineer. The number assigned to each gate shall be as indicated in the Gate Schedule Section 11280-S1 Slide and Channel Gate Schedule and as on the Drawings.
- 1.3.9 Shop Painting: Actuators and other ferrous metal surfaces, except stainless steel, shall be shop painted as specified in the General Equipment Stipulations.
- 1.3.10 Shop Testing. All sluice gates shall be completely assembled in the shop to ensure that all parts fit together properly. All four sided sealing slide gates are to be leak tested in the factory, prior to shipment. the factory leak testing procedure shall be submitted for approval with the gate shop drawings. The factory operation and leak test reports shall be submitted prior to delivery of any four sided sealing gates to site.
- 1.3.11 The torque required to obtain the low leakage sealing shall not cause the actuator to lose its safety factor or overheat.
- 1.4 Submittals**
- 1.4.1 In accordance with Section 01330 – Submittals.
- 1.4.2 For new gates to be installed within existing channels, chambers or gate frames, Contractor and gate manufacturer to field verify the required gate dimensions and provide this information as part of shop drawing submittal. Submittal must identify review and acceptance of dimensions by gate manufacturer.
- 1.4.3 Complete drawings, details, design calculations, and specifications covering the slide and channel gates and appurtenances shall be submitted in accordance with Section 01330 – Submittals. Each drawing shall be identified with the corresponding slide or channel gate designation.
- 1.4.4 Shop drawings shall be stamped and signed by a professional engineer (P.Eng.) licensed in the Province of Ontario.



- 1.4.5 Certification to ISO 9001 demonstrating a repeatable building methodology to assure pre-designated quality level as well as to provide for documented procedures for any deviant occurrences.
- 1.4.6 Manufacturer shall demonstrate longevity of design and provide testing results for a 25,000-abrasive media accelerated life cycle test demonstrating leakage rates are still below allowable AWWA C561 leakage rates.
- 1.4.7 The manufacture shall demonstrate the sturdiness of the gate, as well as conformance to the latest edition of AWWA C561 by providing design calculations, confirming stress and deflection of the slide, yoke, and stem. Provide a P.Eng. stamped design validation that the slide shall consist of a flat plate reinforced with formed plates or structural members to limit its deflection of 1/720 of the gate's span under the design head.

## **2 PRODUCTS**

### **2.1 Service Conditions**

- 2.1.1 Slide gates shall be installed as shown on contract drawings.

### **2.2 Performance And Design Requirements**

- 2.2.1 Dimensions indicated are nominal sizes. Review the Drawings and coordinate with the concrete Subcontractor to finalize gate dimensions. Coordinate with the concrete Subcontractor for the installation of embedded gate bottom seals and/or wall thimbles where applicable.
- 2.2.2 Slide gates, actuators, and appurtenances shall be designed for the conditions and requirements listed in the Gate Schedule in Section 11280-S1.
- 2.2.3 Gates shall be designed for the max water level as indicated in the gate schedule. Actuators, regardless of type, shall be sized to produce the torque or thrust required to operate the applicable gate when the gate is subject to the seating and unseating operating heads set forth in the schedule. The Contractor shall be responsible for confirmation of seating and unseating water depth when a tank or channel is empty which may be different from them on the gate schedule.
- 2.2.4 Where an electric operator is used, the stem design force shall not be less than 1.25 times the output thrust of the hydraulic or pneumatic cylinder with a pressure equal to the maximum working pressure of the supply, or 1.25 times the output thrust of the electric motor in the stalled condition.
- 2.2.5 Both the design head and the operating head shall be measured from the surface of the liquid to the bottom line of the gate.

### **2.3 Acceptable Suppliers**

- 2.3.1 The equipment furnished under this section shall be by Fontaine, Whipps, BNW, Dynamic or approved equivalent.

## 2.4 Materials

Frames, Guides, Slides, Reinforcing Members, and Yoke Beams	Stainless steel, AISI Type 304L
Slide Seats and Bearing Bars	Ultra-high Molecular Weight (UHMW) Polyethylene
Closure Seal	Compressible neoprene
Load Pads	Compressible neoprene
Seal Retainer Bar and Hardware	Stainless steel, AISI Type 304
Operating Stems and Couplings	Stainless steel, AISI Type 303 mx and or 316
Actuator Cross Shafts	Stainless steel, AISI Type 304
Stem Covers	Transparent butyrate plastic pipe
Stem Support Brackets	Stainless steel, AISI Type 304L
Cover Plate (Gate Enclosure)	3 mm, Stainless steel, AISI Type 304
Actuators	
Gear and Bearing Housing, and Floorstand	Stainless steel, AISI Type 304L
Gears	Aluminium bronze, ASTM B148, CA 952, CA954, or CA 958; manganese bronze, ASTM B584, CA 865 or CA 867; or carbon steel, AISI 8620 or 4140
Assembly Fasteners	Stainless steel, ASTM F593 and F594, Type 304
Anchor Bolts, Nuts, Washers	Stainless steel, as specified and in the Anchor Bolts and Expansion Anchors section
Actuator Baseplates and Supports	Stainless steel, AISI Type 304L
Grout	As specified in the Grout section
Thread Lubricant	John Crane "Thred Gard Nickel" or Crawford "Silver Goop" antiseize compound

## 2.5 Construction

- 2.5.1 All stainless steel shall be pickled at the mill in accordance to ASTM A380 before being shipped. After fabrication, surfaces shall be cleaned of all lubricants, grease pencil marks, magic marker, oils, tape, paint, or other organic materials of any type.
- 2.5.2 All stainless steel surfaces after fabrication shall be given a uniform abrasive grit blast to a profile of 50 to 75 µm [2 to 3 mils], providing a uniform matte finish, using only new blast media which is certified iron-free. Blasting grit shall be black beauty non-metallic 20-40 grit as manufactured by Reed Mineral Company or equal. Blasting shall clean the entire surface and produce an even color, texture, and sheen.

- 2.5.3 The presence of residual embedded iron shall be determined by using either the 24 hour water test or the ferroxyl test. The method of touch-up, spot pickling, and pickling paste used to remove embedded iron, heat tint, and weld oxides shall comply with ASTM A380, Table A2.1, Part II.
- 2.5.4 All surfaces shall be adequately protected during fabrication, handling, shipping, and installation to prevent contamination from iron or carbon steel objects, tools, cables, or surfaces.
- 2.5.5 Frames: Each frame shall be an integral unit of extruded or welded structural shapes having a thickness of not less than 6.4mm [1/4 inch]. Frames shall be cast into concrete or designed for installation on the face of concrete walls. The gate frame shall be manufactured with a flat back and provided with a separate spacer to ensure the gate/slide sealing mechanism is independent from the gate frame/wall sealing area.
- 2.5.6 The frame thickness shall not be less than 9.5mm (3/8 inch) if head difference between seating and unseating head is more than 4.0m.
- 2.5.7 Guides shall be provided on each side of each frame. Guides shall be sufficiently strong so that no further reinforcing will be required where the guides extend above the operating floor. Guides shall support the entire height of the slide in all positions.
- 2.5.8 Full-length plastic slide seats or bearing bars shall be provided on both sides of the slide. Seats and bars shall be securely held in the guides by permanent mechanical fasteners evenly spaced along the height of the guides. The guide shall be of such length as to retain and support at least two-thirds (2/3) of the vertical height of the slide in the fully open position.
- 2.5.9 Slides.
- .1 Slides shall have a thickness of not less than 6.4 mm in case the seating or unseating head is less than 6 m. A minimum of 9.5 mm thick shall be applied to deeper than 6 m of the seating or unseating head. The Supplier shall assume that the seating or unseating head may be zero as a tank or channel may be empty while the other side is still at high water level. Provide the calculation sheets for the required thickness.
- .2 The slides shall be provided with welded stiffeners to limit deflection to 1/720 of the gate width under the maximum seating or unseating head specified. Slides shall be adequately reinforced to withstand, without permanent distortion, the maximum thrust, which can be transmitted by the operating stem.
- .3 Each slide shall have a reinforced pocket or internally threaded nut welded to the slide for connection of the stem. The pocket or nut shall be designed to withstand the maximum thrust, which can be transmitted by the operating stem. A minimum safety factor of 5 shall be used with regard to tensile, compressive and shear strength of the plate, members, and welds.
- 2.5.10 Seals: Gates shall be provided with full-length plastic seats or bearing bars on both faces of the slide. Seats and bars shall be securely attached to the frame with stainless steel retainers and/or stainless steel bolts.
- 2.5.11 If a retainer bar is used to fasten the seal to the frame or slide, it shall have adjustable screws keeping the seal in compression. The seal design shall be the standard design of the manufacturer, provided it meets the leakage requirements of the governing standard.

- 2.5.12 The top seal shall be self-adjusting, utilizing a cup shaped UHMWPE seal with twin contact surfaces and compression cord. The cup shaped seal with twin contact surfaces shall be designed with the outer seal acting as a wiper to remove debris from the slide when raising the gate thereby protecting the primary seal.
- 2.5.13 Seating Faces: Seat bearing area shall have a minimum width of 13mm±. Seating faces shall be secured to either the gate frame or slide, but not both, to ensure that they will remain in place without becoming distorted or loose during the life of the gate. On site replacement of the seating faces must be possible without removing the gate frame from the structure.
- 2.5.14 Closures: The bottom of each slide and channel gate frame shall be of the configuration listed in the Gate Schedule. A compressible seal shall be securely attached to the bottom of the slide or to the frame invert. The seal shall be of sufficient length to seal the bottom corners of each slide.
- 2.5.15 Weir slides may be lowered below the bottom of the opening. A frame member shall be provided at the bottom of the opening to seal the space between the slide and the adjacent concrete. The side guides shall be extended below the bottom of the wall opening. A resilient seal shall be attached to the frame along the invert of the opening and up both sides to seal the slide in all positions.
- 2.5.16 Each seal shall be provided with a full-length retainer bar which shall compress the seal and prevent leakage between the seal and the frame member. Seals shall be securely attached to the frame and shall permit replacement of the seals without disassembling or removing the gate.
- 2.5.17 Operating Stems: Operating stems shall conform to the requirements of Section 4.4.11 of AWWA C561-14 except as modified herein. Stems shall be designed so that the slenderness ratio (L/R) shall be less than 200. Contact surfaces of threads shall be rolled or machined and polished to a 63 microinch finish, or smoother. Each stem shall be securely attached to the slide. Stems shall be of sufficient size to withstand, without damage or permanent distortion, the tensile and compressive stresses resulting from the application of 1.25 times the output thrust of the actuator in the stalled motor condition.
- 2.5.18 Gates having a width greater than two (2) times their height shall be provided with two (2) lifting mechanisms connected by a tandem shaft whether or not it is indicated on the Contract Drawings.
- .1 If the gate width is 1.8 m or larger, the gate shall be furnished with two (2) lifting mechanisms.
- .2 If two stems are required for any size gates as per the Manufacturer's recommendations, the Contractor shall provide two operation stems at no extra costs. The Manufacturer shall be responsible for the number of operating stems.
- 2.5.19 Anchor Bolts: The gate manufacturer shall furnish suitable SS304 anchor bolts for each item of equipment supplied herein. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed.
- 2.5.20 Anchor bolts shall be stainless steel, and alloy type shall be as required. The anchor bolts shall be at least 19 mm diameter. Anchor bolts shall be accurately located and a length

approximately 8 times the bolt diameter. Two nuts and a washer shall be furnished with each anchor bolt.

- 2.5.21 Gates having a width greater than two times their height shall be furnished with two (2) stems connected by gear and dual actuator.
- 2.5.22 Self-Contained gates shall be provided with a wrought stainless steel yoke designed in accordance with Section 4.4.6 - AWWA C561-14. Yoke deflection shall not exceed 1/360 of gate width or a maximum of 1/4", whichever is less at maximum operation load.

## **2.6 Manual Actuators**

- 2.6.1 General Requirements: Electric actuators shall conform to the requirements of Section 11290 – Valve and Gate Actuators.
- 2.6.2 The Gate Supplier shall coordinate gate requirements with the actuator manufacturer and be responsible for gate and actuator assembly.
- 2.6.3 Floorstands: Floorstands shall be designed to transfer operating thrusts to the supporting structure or yoke beam. Each floorstand shall be designed to position the crank or handwheel approximately 915mm above the supporting surface.
- 2.6.4 Stem Covers: Unless otherwise specified, each manual actuator shall be equipped with a stem cover. Stem covers shall conform to the requirements of AWWA C561.
- 2.6.5 Stem covers shall be constructed of transparent plastic pipe and shall be furnished with a removable end cap, condensation vents, and a clear Mylar position-indicating marking tape. The marking tape shall be adhesive backed and shall be permanently marked and calibrated in meters and centimeters. The tape shall be field applied to the stem cover after the gate has been installed. The tape shall be positioned so that the height of the slide will be indicated by reference to the top of the stem.

## **2.7 Cover Plate (Gate Enclosure):**

- 2.7.1 Gates shall be completely covered with 3mm thick stainless steel 304 covers.
- 2.7.2 Provide the required rubber gasket and SS304 anchor bolts for the gate cover plates (enclosures) to be installed on concrete slab. A minimum of 75x75x6 mm stainless steel angle framing to be welded construction and anchored to the concrete slab.
- 2.7.3 If the cover plate is placed on the checkered plate of conduits or channels, provide SS304 bolt connections for the plates with gasket.
- 2.7.4 If the gate cover plates consist of several sections, provide SS bolts/nuts connections with rubber gaskets.
- 2.7.5 Provide the shop drawing to present the dimensions and associated items for anchoring for the Engineer's review.

## **2.8 Shop Painting**

- 2.8.1 All iron and steel surfaces, except machined surfaces and stainless steel surfaces, shall be shop cleaned by blasting in accordance with the coating manufacturer's recommendations

and finish painted with an epoxy or epoxy/polyurethane coating system. Actuators and other non-submerged components shall be painted with one coat of epoxy paint having a dry film thickness of at least 125 µm [5 mils] and one topcoat of polyurethane having a dry film thickness at least 50 µm [2 mils].

- 2.8.2 All components subject to submergence shall be painted with two coats of epoxy paint having a total combined dry film thickness of at least 250 µm [10 mils]. Finish color shall be medium gray, except for handwheels, levers, and other operating devices, which shall be safety red. Field painting of gates, actuators, and appurtenances, other than touchup painting, will not be required. A sufficient quantity of additional coating materials shall be furnished by the gate manufacturer to permit field touchup of damaged coatings.

## **2.9 Spare Parts**

- 2.9.1 The Gate Supplier shall furnish the following spare parts:
- .1 Stem collar for all gate stems (one of each different size)
  - .2 Lift nuts (one of each different size)
  - .3 One complete set of special tools required to maintain gates

## **2.10 Accessories**

- 2.10.1 Provide lifting lugs for handling of equipment.
- 2.10.2 For the wall mounted slide gate, the Contractor shall provide additional SS brackets with SS anchors to cover the remaining openings on the checkered plates, which shall be located on both side of the actuator support bracket.
- 2.10.3 If there are any openings on the checkered plates, the Contractor shall provide the removable checker plates to cover the openings on the top slab or channel cover plates. The required dimensions shall be based on the channel width and gate sizes. The Contractor shall coordinate with the gate Supplier, the supply scope of work for the removable checker plates.

# **3 EXECUTION**

## **3.1 Inspection**

- 3.1.1 All gates and accessories shall be inspected for damage and cleanliness before being installed. Any material damaged or contaminated in handling on the job shall not be used unless it is repaired and recleaned to the original requirements by the Contractor. Such material shall be segregated from the clean material and shall be inspected and approved by the Engineer or Owner before its use.

## **3.2 Installation**

- 3.2.1 Slide gates and appurtenances shall be handled and installed in accordance with the manufacturer's recommendations and as specified in the Gate Installation section.
- 3.2.2 Wall thimbles shall be accurately positioned and supported to prevent shifting during placement of surrounding concrete. Square or rectangular thimbles shall be carefully braced both horizontally and vertically to prevent distortion.

- 3.2.3 Each slide gate shall be carefully installed and adjusted for proper operation. Care shall be taken to avoid warping the gate frames and to maintain tolerances between seating faces.
- 3.2.4 Each actuator shall be accurately set and plumbed and shall be in proper alignment with the gate and stem before the actuator is grouted in place. Operating stems shall be installed in proper alignment and shall not bind in the lift nut or stem guides.
- 3.2.5 The threaded portion of each plastic stem cover shall be wrapped in at least two layers of Teflon thread tape and immediately before installation of the cover on the actuator.
- 3.2.6 All bolts shall be tightened and all items requiring lubrication shall be lubricated. Anti seize thread lubricant shall be liberally applied to the threaded portion of stainless steel anchor bolts during installation and tightening of nuts. Excess lubricant shall be thoroughly removed following final tightening.
- 3.2.7 After installation, each gate shall be operated through at least two complete open close cycles, readjusted and re-operated as necessary, and left in a condition acceptable to the Engineer.

### **3.3 Installation Check**

- 3.3.1 Installation Check: Gate manufacturer shall provide the services of a qualified field representative according to the quality control section to assist during installation of the equipment by the Contractor. As a minimum, the manufacturer's field representative shall be made available as follows:
  - .1 Installation Inspection 3 trips, 3 days total
  - .2 Startup Assistance 3 trips, 3 days total
- 3.3.2 Field Evaluation Tests: A performance test shall be ran on the gates after the installation is completed using clean water to ensure the gates are operating properly as determined by the representative of the equipment manufacturer. The performance test shall be conducted by a capable representative of the gate manufacturer and accepted by the Engineer. The Owner's operating personnel shall assist the manufacturer's representative in the performance test. A designated representative of the Owner and/or the Engineer shall observe the performance test. As a minimum, the manufacturer's field representative shall be made available as follows:
  - .1 Performance Testing 3 trips, 3 days total
- 3.3.3 An experienced, competent, and authorized representative of the gate manufacturer shall visit the site of the Work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the manufacturer's representative shall be present when the equipment is Field Leakage Tested in accordance with standard industry procedure. The manufacturer's representative shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of Engineer.
- 3.3.4 Each manufacturer's representative shall furnish to Owner, through Engineer, a written report certifying that the equipment has been properly installed and lubricated; is in accurate alignment; is free from any undue stress imposed by connecting piping or anchor bolts; and has been operated under full load conditions and that it operated satisfactorily.

3.3.5 All costs for these services shall be included in the Contract Price.

### **3.4 Field Quality Control**

3.4.1 Field Leakage Testing: After installation, all gates shall be tested for leakage.

3.4.2 Leakage exceeding the specified limits which is discovered within the correction period stipulated in the General Conditions shall be repaired by and at the expense of the Contractor. This requirement applied whether pressure testing is required or not.

3.4.3 For the maximum seating heads, the leakage shall not exceed 0.5 L/min/meter (0.05 gpm per foot) of seating perimeter.

### **3.5 Training**

3.5.1 In addition to the installation and operation check required by the General Equipment Stipulations and the manufacturer's field services required by the quality control section, the manufacturer shall furnish the services of a competent and experienced operator of the equipment, who is directly employed by the manufacturer, to instruct the Owner's operating personnel in the proper operation and maintenance of the equipment. Training shall be provided as specified in Section 01820 - Demonstration and Training.

### **3.6 Warranty**

3.6.1 In agreement with Section 01760 – Warranty Work.

3.6.2 Each unit shall be new and shall carry the full manufacturer's warranty on parts, service and performance.

3.6.3 Warranty shall begin at the completion of the intermediate contractual milestone associated with the work. The warranty shall include replacement of all defective equipment and shall extend two (2) years beyond the date of completion of the intermediate contractual milestone.

3.6.4 Corrective Work: Any location where corrosion is evident shall be considered a failure of the material or the protection system. Before starting work, the manufacturer shall submit to the Engineer for review, an analysis of the cause of the failure and details of the proposed corrective work. The manufacturer shall make repairs acceptable to the Engineer at all points where failures are observed within the Warranty Period.

3.6.5 Inspection: Each unit shall be inspected at the end of the warranty period by representatives of the Owner, the Engineer and the manufacturer to identify any failures that may have occurred. The manufacturer shall establish the date of each inspection and shall notify the Owner at least 30 days in advance. The scheduled inspection shall not relieve the manufacturer from the obligation to perform corrective work whenever needed.

3.6.6 The manufacturer shall prepare and deliver to the Owner an inspection report covering each inspection, indicating the number of type of failures observed, material and part where materials have failed, the percentage of the surface area where corrosion protection system failure has occurred, and the names of the persons making the inspection. Colour photographs illustrating each type of failure shall be included in the report.

**END OF SECTION**



Item No.	Gate Description	Tag Number	Gate Type	Stem Configuration	Mount	Yoke/Frame Construction & Opening Direction	Opening Width (mm) <sup>(1)</sup>	Opening Height (mm) <sup>(1)</sup>	Opening Invert Elevation (m)	Max. WL (m)	Operating Floor Elevation (m)	Actuator Type	Actuator Functionality	Classification	Drawing No. for Locations	Remarks
PRIMARY CLARIFIERS																
1	Secondary Clarifier 1 RAS Gate	SC1_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	350	350	196.06	198.93	198.40	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Process Module 1 Sludge Chamber
2	Secondary Clarifier 2 RAS Gate	SC2_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	350	350	196.06	198.93	198.40	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Process Module 1 Sludge Chamber
3	Secondary Clarifier 3 RAS Gate	SC3_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	350	350	196.06	198.93	198.40	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 3-4 Sludge Chamber
4	Secondary Clarifier 4 RAS Gate	SC4_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	350	350	196.06	198.93	198.40	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 3-4 Sludge Chamber
5	Secondary Clarifier 5 RAS Gate	SC5_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	450	450	196.38	198.93	199.63	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 5-6 Distribution and Sludge Chamber
6	Secondary Clarifier 6 RAS Gate	SC6_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	450	450	196.38	198.93	199.63	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 5-6 Distribution and Sludge Chamber
7	Secondary Clarifier 5 Feed Gate	SC5_INF_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	900	900	193.33	198.93	199.63	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 5-6 Distribution and Sludge Chamber
8	Secondary Clarifier 6 Feed Gate	SC6_INF_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	900	900	193.33	198.93	199.63	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 5-6 Distribution and Sludge Chamber
9	Process Module 1 / 2 Secondary Clarifier Connection Gate	SCPM1-2_CC_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	1250	1250	193.33	198.93	199.63	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 5-6 Distribution and Sludge Chamber
10	Secondary Clarifier 7 Feed Gate	SC7_INF_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	900	900	193.57	198.93	199.61	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 7-8 Distribution and Waste Sludge Chamber
11	Secondary Clarifier 8 Feed Gate	SC8_INF_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	900	900	193.57	198.93	199.61	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 7-8 Distribution and Waste Sludge Chamber
12	Secondary Clarifier 7 WAS Gate	SC7_WAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	200	200	196.04	198.93	199.61	Electric	Open/Close	Unclassified	D9	Located in Secondary Clarifier 7-8 Distribution and Waste Sludge Chamber
13	Secondary Clarifier 8 WAS Gate	SC8_WAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	200	200	196.04	198.93	199.61	Electric	Open/Close	Unclassified	D9	Located in Secondary Clarifier 7-8 Distribution and Waste Sludge Chamber
14	Secondary Clarifier 7 RAS Gate	SC7_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	600	600	197.18	198.93	199.62	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 7-8 Return Sludge Chamber
15	Secondary Clarifier 8 RAS Gate	SC8_RAS_SGV	Slide Gate	Non-rising	Wall Mounted	Stainless Steel Upward Opening	600	600	197.18	198.93	199.62	Manual - Handwheel	Open/Close	Unclassified	D9	Located in Secondary Clarifier 7-8 Return Sludge Chamber

Notes: 1. All gate measurements and elevations to be field confirmed.

2. 'Wall mounted' indicates surface mount on existing walls.

3. In case of conflict, details included in the P&IDs shall take precedence to those presented in this table.

## **1 GENERAL**

### **1.1 Scope**

- 1.1.1 This section covers furnishing manual gate actuators and accessories.

### **1.2 General**

- 1.2.1 Equipment provided under this section shall be fabricated and assembled in full conformity with drawings, specifications, engineering data, instructions, and recommendations of the equipment manufacturer, unless exceptions are noted by Engineer.
- 1.2.2 Actuators shall be furnished with all necessary parts and accessories indicated on the drawings, specified, or otherwise required for a complete, properly operating installation and shall be the latest standard products of a manufacturer regularly engaged in the production of actuators.
- 1.2.3 General Equipment Requirements. The General Equipment Requirements shall apply to the equipment furnished under this section.
- 1.2.4 Governing Standards. Except as modified or supplemented herein, all powered actuators shall conform to applicable requirements of ANSI/AWWA C540, Class 150B.
- .1 Except as modified or supplemented herein, all manual and cylinder actuators for butterfly and eccentric plug valves shall conform to the applicable requirements of ANSI/AWWA C504.
- .2 Except as modified or supplemented herein, all manual actuators for ball valves shall conform to the applicable requirements of ANSI/AWWA C507.
- .3 Except as modified or supplemented herein, all manual actuators for sluice gates shall conform to the applicable requirements of ANSI/AWWA C560.
- 1.2.5 Marking. Each actuator shall be marked with the manufacturer's name, model number, and the country of origin. An identifying serial number shall be stamped on a corrosion-resistant plate attached to the actuator.
- 1.2.6 Temporary Number Plates. Each actuator shall be factory tagged or marked to identify the actuator and the applicable valve or gate by number or service as indicated in the valve or gate schedule.
- ### **1.3 Submittals**
- 1.3.1 Complete drawings, details, and specifications covering the actuators and their appurtenances shall be submitted in accordance with the submittals section. Submittal drawings shall clearly indicate the country of origin of each actuator and its components.
- 1.3.2 For electric or cylinder actuators, certified copies of reports covering proof of design testing of the actuators as set forth in Section 5 of ANSI/AWWA C540, together with an affidavit of compliance as indicated in Section 6.3 of ANSI/AWWA C540, shall be submitted to Engineer before the actuators are shipped.

## **1.4 Delivery, Storage, and Handling**

- 1.4.1 Shipping shall be in accordance with the shipping section. Handling and storage shall be in accordance with the handling and storage section.

## **2 PRODUCTS**

### **2.1 Performance and Design Requirements**

- 2.1.1 General. Actuators and appurtenances shall be designed for the conditions and requirements as indicated in the respective valve and gate sections.
- 2.1.2 Liberal factors of safety shall be used throughout the design, especially in the design of parts subject to intermittent or alternating stresses. In general, working stresses shall not exceed one third of the yield point or one fifth of the ultimate strength of each material.
- 2.1.3 Gate Actuators. Actuators shall be sized to produce the torque or thrust required to operate the gate when subject to the seating and unseating operating heads as indicated in the gate schedule.
- 2.1.4 Both the design head and the operating head shall be measured from the surface of the liquid to the center line of the gate.

### **2.2 Materials**

- 2.2.1 Except as modified or supplemented herein, materials used in the manufacture of actuators shall conform to the requirements of ANSI/AWWA C504 and C540.

### **2.3 Gate Manual Actuators**

- 2.3.1 General. Manual actuators of the types listed in the gate schedule shall be provided by the gate manufacturer.
- .1 All bearings and gears shall be totally enclosed in a weathertight housing having a sufficient number of fittings to permit periodic lubrication of all internal moving components without partial or total disassembly of the mechanism. The pinion shaft of crank operated mechanisms shall be supported by roller bearings or needle bearings.
  - .2 The direction of rotation of the wheel, crank, or wrench nut to open the gate shall be to the left (counterclockwise).
  - .3 Actuators for rising stem self contained gates shall be designed for mounting directly on the frame yoke.
- 2.3.2 Remote Actuators. Remote actuators shall be operated by a frame mounted handwheel and chain drive. An extension shaft suitable for connection to the pinion shaft of the benchstand shall be provided complete with a roller chain, shaft couplings, support bearings, and a roller chain sprocket keyed or bolted to the end of the shaft. A handwheel with bearing housing and sprocket shall be bolted to the side frame approximately 1200 mm [48 inches] above the operating floor. Removable aluminum or stainless steel weathertight covers shall be provided to protect the extension shaft, drive chain, and sprockets. Handwheel and sprocket diameters shall be selected to operate the gate under the maximum specified seating

pressure with an effort of not more than 178 N [40 lbs] applied to the rim of the handwheel. Handwheels and sprockets shall be able to withstand a 445 N [100 lb] effort without damage.

- 2.3.3 Floorstands. Floorstands shall be designed to transfer operating thrusts to the supporting structure. Each floorstand shall be designed to position the crank or the handwheel approximately 900 mm [36 inches] above the frame yoke, supporting surface, or adjacent operating floor or platform.
- 2.3.4 Stem Covers. Rising stem manual actuators shall be provided with a stem cover as indicated in the gate schedule. Stem covers shall conform to Section 4.4 of ANSI/AWWA C560.
- 2.3.5 Plastic Covers. Covers shall be constructed of transparent plastic pipe and shall be furnished with an end cap, condensation vents, and a clear mylar position-indicating marking tape. The marking tape shall be adhesive backed and shall be permanently marked and calibrated in meters and millimeters [feet and inches]. The tape shall be applied to the stem cover after the gate has been installed and shall be so positioned that the height of the slide will be indicated by reference to the top of the stem.

## **2.4 Actuator Accessories**

- 2.4.1 Extension Stems. Extension stems and stem guides shall be furnished when indicated in the respective valve schedules, indicated on the drawings, or otherwise required for proper valve operation. Extension stems shall be of solid steel and shall be not smaller in diameter than the stem of the actuator shaft. Extension stems shall be connected to the actuator with a single Lovejoy "Type D" universal joint with grease filled protective boot. All stem connections shall be pinned.
- .1 At least two stem guides shall be furnished with each extension stem, except for buried valves. Stem guides shall be of cast iron, bronze bushed, and adjustable in two directions. Stem guide spacing shall not exceed 100 times the stem diameter or 3 m [10 feet], whichever is smaller. The top stem guide shall be designed to carry the weight of the extension stem. The extension stem shall be provided with a collar pinned to the stem and bearing against the stem thrust guide.
  - .2 Extension stems for chemical resistant butterfly valves located in drainage sumps shall be the two-piece type with stainless steel stem, PVC housing, wall support, and collar. Unless otherwise indicated on the drawings, the length of the stem extension shall be as necessary to position the valve operator 300 mm [12 inches] above the maximum liquid level in the immediate area.
  - .3 Extension stems for buried valve actuators shall extend to within 150 mm [6 inches] of the ground surface, shall be centered in the valve box using spacers, and shall be equipped with a wrench nut.
  - .4 Extension stems for buried valve actuators shall be provided with position indicators as specified in the valve schedules.
- 2.4.2 Position Indicators. Unless otherwise specified, each valve actuator shall be provided with a position indicator to display the position of the plug or disc relative to the body seat opening.
- .1 For quarter turn plug, ball, or cone type valves installed in interior locations, the indicating pointer shall be mounted on the outer end of the valve operating shaft extension and shall operate over an indicating scale on the operating mechanism cover.

Where the shaft passes through the cover, a suitable stuffing box or other seal shall be provided to prevent the entrance of water.

- .2 Each actuator for butterfly valves, except where located in manholes, buried, or submerged, shall have a valve disc position indicator mounted on the end of the valve shaft. A disc position indicator shall also be provided on each operating stand or the actuator mounted thereon.

## **2.5 Portable Valve Operator**

- 2.5.1 Provide two (2) portable valve operators with electric drive gun.
- 2.5.2 The LCD display indicates information on direction of drive and the current torque output; 100 Nm (74 lbf ft) to 100,100 Nm (73,700 lbf ft).
- 2.5.3 Hose length supplied: 5 metres.
- 2.5.4 CE and EMC certified.
- 2.5.5 Acceptable Suppliers: Smith flow Control Ltd., or approved equivalent.

## **2.6 Shop Painting**

- 2.6.1 All ferrous metal surfaces, except bearing and finished surfaces and stainless steel components of valve actuators and accessories, shall be shop painted for corrosion protection. The valve manufacturer's standard coating will be acceptable, provided it is functionally equivalent to the specified coating and is compatible with the specified field painting.
- 2.6.2 The following surfaces shall be painted:
  - .1 Polished or Machined Surfaces: Rust Preventive compound.
  - .2 Other Surfaces: Epoxy enamel.
  - .3 Actuators and Accessories: Universal primer.

# **3 EXECUTION**

## **3.1 Installation**

- 3.1.1 Actuators will be installed on the gates in accordance with Section 11280.

**END OF SECTION**

**DIVISION 13 – INSTRUMENTATION, CONTROL &  
SCADA**

DIVISION 13 – INSTRUMENTATION, CONTROL & SCADA

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Section No.	Title
13100	Control & Instrumentation
13110	SCADA Integration Services
13560	Instrumentation General Requirements

## **1 GENERAL**

### **1.1 Intent**

- 1.1.1 It is the intent of this section to provide new I/O and programming for the existing PLC Control Panels (MSBCB\_PAC01 in the Blower Building; MSSPB\_PAC01 in the Screw Pump Building) and developing new and/or modified HMI screens for the Brantford WWTP. The upgrades will include instrumentation to monitor and control process parameters and equipment to be supplied and installed under this contract, as shown on the drawings or specified. This equipment shall be integrated into the existing control and SCADA system of the WWTP.

### **1.2 Description**

- 1.2.1 Retain the services of the Control System Integrator/Programmer (CSIP) for the scope described herein and in Section 13110 including programming of all non-packaged PLCs and development of graphical user interface for existing SCADA HMI computers.
- 1.2.2 The work consists of the supply and installation of all instrumentation, controls, SCADA system automation components specified herein and shown on the drawings, and commissioning by the Contractor to suit the WWTP.
- 1.2.3 The CSIP and the Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. The word "provide" shall be defined to mean supply, install, start up, test and commission.

### **1.3 General Requirements**

- 1.3.1 The Contractor shall supply and install all power, control, and communications wire interconnecting the control panels, and electrical and electronic pieces of the instrumentation equipment, under Division 16. Final wiring shall be as required by the reviewed shop drawings, (See Division 16).
- 1.3.2 At all times, ensure that work being carried out by the Engineer or the plant operations staff is properly coordinated with all ongoing construction activities and are unhampered by unnecessary delays or obstructions.
- 1.3.3 All functionality described in the Tender Documents and Process Narrative shall be fully implemented.
- 1.3.4 All control wiring shall be continuous and without splices. All control wiring is required to transition through or terminate to DIN rail mounted terminal blocks. No marrrret connections of control wiring is permitted.
- 1.3.5 All equipment performance requirements shall be based upon worst case scenarios and/or to the maximum capabilities of the equipment.
- 1.3.6 Provide documentation in a timely manner and as specified.



1.3.7 The Contractor shall prevent the following from occurring:

- .1 Scheduling of Commissioning & Site Inspection, prior to the completion of all site works including, loop checks, instrument calibration, wire or installation, resulting in delays and repeat site visits.
- .2 Lack of maintenance works to suit field equipment/devices including instruments, control hardware, motor starters, valve actuators, and all essential process systems required for the facility to run in a safe and fully automated fashion.

#### **1.4 Related Work Specified Elsewhere**

1.4.1 Section 13560 - Instrumentation General Requirements

1.4.2 Section 13110 - SCADA Integration Services

1.4.3 Section 16010 - Electrical General Requirements

1.4.4 Power and control wire interconnecting the control panels, and electrical and electronic pieces of the instrumentation equipment, under Division 11 and 16. Final wiring shall be as required by the reviewed shop drawings (See Division 16).

#### **1.5 Standards**

1.5.1 Equipment furnished under this section shall be designed, constructed, and tested in accordance with the latest edition and requirements of the followings:

- .1 Canadian Standards Association (CSA)
- .2 Canadian Electrical Manufacturers Association (CEMA)
- .3 National Electrical Manufacturers Association (NEMA), and NEMA ICS-1-109.60
- .4 The Instrumentation, Systems, and Automation Society (ISA)
- .5 FCC Part 15 - Class A / Canadian's Interference-Causing Equipment Standards (ICESs)
- .6 Institute of Electrical and Electronics Engineers IEEE-519
- .7 ANSI C37.90

#### **1.6 Glossary**

1.6.1 FAT "Factory Acceptance Test": The purpose of FAT is to demonstrate that the system programming meets the plant operational requirements before being installed at site and to provide the City with a level of confidence that the system, once on site, will perform as expected.

1.6.2 SAT "Site Acceptance Test": The purpose of SAT is to complete the full implementation of the system and to perform a final exhibit of the implemented control philosophies.

## **1.7 Quality Assurance**

- 1.7.1 The materials, design, and workmanship employed in the manufacture of all equipment shall conform to the applicable standards established by the A.S.T.M. (American Society for Testing Materials), A.S.A. (American Standards Association), C.E.C. (Canadian Electrical Code) including the Ontario Supplement, C.G.S.B. (Canadian Government Specifications Board), C.S.A. (Canadian Standards Association), and the I.S.A. (The Instrumentation, Systems, and Automation Society). Canadian Standards shall take precedence over American Standards in the case of duplication or conflict.

## **1.8 Submittals**

- 1.8.1 Conform with requirements of Division 1.
- 1.8.2 Conform with Section 13560 - Instrumentation General Requirements.
- 1.8.3 Drawing Index: Prepare a clear, typed index listing the number and title of all proposed purpose-made drawings and submit for review within 20 days after award of contract.
- 1.8.4 Milestone Schedule: Prepare and submit a proposed schedule of instrumentation and control work per General Conditions, indicating the following major milestones as a minimum:
- .1 Completed and signed Calibration Form for each field instrument, in accordance with Section 13560;
  - .2 Completed and signed Instrumentation Installation Checklist Form for each field instrument in accordance with Section 13560;
  - .3 Report on proper site installation, inspection, and loop check;
  - .4 Final submission and sign-off of Product Data Sheets as per this Section and 13560;
  - .5 Maintenance training sessions on filed instruments.
- 1.8.5 Application Specific Drawings:
- .1 Prepare application specific drawings neatly and accurately by means of the latest version of AutoCAD or as otherwise advised. Do not use external references or customized file extensions. Provide fully portable electronic file copies of all drawings.
  - .2 Make submission on reproducible material such as legal-size paper, complete with a title block containing the Project Contract number, your contract number and company logo, a drawing and Contract title as stated in the Contract drawings, and a referenced drawing number (related to a file name if applicable). Provide tabular columns to record the original submission date, a revision number, date and reason for subsequent revisions, and signature of authorized issuing staff member.
  - .3 Submit, as a minimum, the following application specific drawings:
    - .1 Scaled, reference, front of panel layouts, and general arrangements drawings;
    - .2 Scaled, referenced, internal panel layouts (may be combined with the above);

- .3 Equipment or panel block wiring diagrams showing termination identification at each item of equipment, inter-wiring and cable numbering, all peripheral equipment, all PLC module DIP switch settings, pin assignments for D-shell connectors, plugs and jacks, and instrument/equipment tag numbers;
- .4 Where issued, loop drawings are typical for guidance only. Submit itemized instrument wiring drawings for all analog process loops and discrete connections, generally in accordance with ISA S5.4 format and as a minimum incorporating the following details: PLC terminal numbers, PLC I/O Address, PLC Slot & Rack identification, Control Cabinet terminal numbers, field terminal numbers, wire numbers, contact orientation, power source identifications and equipment numbers. The "AutoCAD" files for these drawings are to be edited with "Record Drawing" detail and made accessible to the Engineer during the Contract. Include wiring by others that form part of the system or circuit.
  - .1 List of expendable materials and quantities;
  - .2 List of Instrument, Equipment and Panel Identification Nameplates, including all panel mounted component name plates.
  - .3 Project name and job numbers.
  - .4 Cable and wire requirements inclusive of specifications.
  - .5 Input and output signal ranges and calibrated ranges.
  - .6 Installation details including: material list, dimensions, process and electrical connection sizes and external wiring requirements.

1.8.6 Vendor Equipment Shop Drawings:

- .1 Submit Shop Drawings for all field and panel mounted instruments, controllers, gauges and similar products. Manufacturer documentation will be accepted only if the following information is clearly indicated and highlighted for the equipment proposed. Submit the following:
  - .1 An itemized listing of proposed instrument or equipment, including tag numbers, quantities, options being provided and a full description and performance data;
  - .2 Installation details depicting mounting assemblies, physical dimensions, process connection size (e.g. flange ratings & styles);
  - .3 Termination details clearly indicating the type and lengths of external wiring required and electrical connections;
  - .4 Power supply rating input and output signal ranges, maximum measured process range and calibrated scale, physical, electrical and environmental requirements;
  - .5 Exact catalogue model numbers of each piece of equipment and its accessory options, and clearly referenced by the respective instrument or equipment tag name given in this document (improperly tagged items shall be rejected);

- .6 A separate sheet with manufacturer's recommended list of spare parts including individual pricing with the shop drawings;
- .2 The Contractor shall note compliance and variance in writing or the specification shall have precedence over approved vendor drawings. Stamp the shop drawings submitted as either "COMPLIES WITH SPECIFICATION" or "DEVIATES FROM SPECIFICATION" as appropriate. In the latter case, describe deviations exactly and indicate how they impact the specified duty of the component. The Engineer will assess acceptability of submission.

1.8.7 Product Data Sheets:

- .1 Provide Product Data Sheets for all instruments and equipment to suit shop drawing submissions in accordance with Section 13560 and as specified herein. Product data sheets to include the information noted below and all other data pertinent to the equipment and the application.
- .2 Initial submission for review to accompany Shop Drawings:
  - .1 The product manufacturer and the supplier or representative;
  - .2 The complete model or catalogue numbers including all special options;
  - .3 The available adjustment ranges and the operating ranges.
  - .4 Supporting product documentation as indicated in Section 13560 and specified herein.
- .3 Second submission during pre-commissioning, testing and calibration period:
  - .1 Serial numbers, part numbers, dates of installation and calibration;
  - .2 All special procedures required to duplicate calibration;
  - .3 This submission is for signature by the Contractor and the Engineer following acceptance of the operation of each instrument.
  - .4 The second submission shall include completed and signed Instrumentation Installation Checklist forms and Instrumentation
- .4 Final Submission of signed-off Product Data Sheets included with Operating and Maintenance Instruction Manuals:
  - .1 All of the above information; and
  - .2 Phone and fax numbers of contact person for product support/service.
- .5 Where there is any discrepancy, the description provided on the Product Data Sheet takes precedence over the model number given in the data sheet.

1.8.8 Record Copies of Purpose-made Drawings & Electronic Files:

- .1 Submit six white print "as-built" copies of each Purpose-made drawing and document specified above, as well as electronic copies (on CD or comparable media). Under certain circumstances during the course of the contract, instead of paper, drawing and document files may be exchanged with the Engineer to streamline coordination.

1.8.9 Submission Format:

- .1 A complete set of Purpose-made Drawings, Shop Drawings, and the initial submission of the Product Data Sheets shall be bound into one volume and issued for approval before the commencement of work.
- .2 Comply with the instrumentation submission requirements identified in Section 13560.
- .3 The Contractor shall prepare a product description sheet for each item or package submitted for shop drawing approval.
- .4 Each shop drawing submission by the Contractor must be accompanied by a submission overview sheet that lists the individual items described in the respective individual product description sheets.
- .5 The product description sheet shall conform with submission requirements identified in section 13560 and shall include the following information as a minimum:
  - .1 Submission date: Project:
  - .2 Submission #: Prepared by:
  - .3 Quantity: Instrumentation P&ID Tag:
  - .4 Manufacturer: Model No.:
  - .5 Description: Contractor ID No.:
  - .6 P&ID Drawing Number (i.e. Instrument Contract Drawing Reference):
- .6 Each shop drawing submission shall include a shop drawing overview submission sheet that identifies information related to the project. The shop drawing overview submission sheet shall include the following information:
  - .1 Date of submission:
  - .2 Project:
  - .3 Prepared by:
  - .4 Submission Number: (i.e. identify if it is first submission or resubmission)
  - .5 Equipment P&ID Tags: (summarize all P&ID Tags for equipment submitted for review)

- .7 Any deviation from the above noted submission requirements and Section 13560 will result in the rejection of the submission.

## **1.9 Operations And Maintenance Manuals**

1.9.1 Provide Operations and Maintenance (O&M) Manuals in accordance with Section 01780.

1.9.2 The following printed materials shall be provided a minimum:

- .1 Detailed (O&M) manuals shall be provided with complete information concerning the operation of the system and support necessary with diagnostics.
- .2 Data sheets shall be supplied for all equipment used in the system. The data shall include, as a minimum, the component name; manufacturer; model number, quantity and all special (O&M) characteristics.
- .3 Final as-built drawings of equipment shall be provided and as a minimum include:
  - .1 Overall dimensions details for each equipment and all door mounted operator devices including nameplate designations.
  - .2 Interconnecting wiring diagrams of all control equipment, communications networks, and remote switchgear control panels.

## **1.10 Work Included**

1.10.1 The Contractor shall be responsible for the:

- .1 Supply, installation and commissioning of all Controls & Instrumentation equipment and devices specified herein and/or shown on drawings.
- .2 Development of the custom graphical user interface application for the purpose of control and monitoring of the treatment plant processes that are being upgraded. Updates to the existing PLC automation system and existing SCADA HMI. This task is to be performed by the approved Control System Integrator/Programmer (CSIP).
- .3 Preparation of all descriptive data, schematic layout, interconnecting wiring diagrams, and communications architectures for submission and review as herein specified and in accordance with the requirements of the contract.
- .4 Supply and installation of new PLC I/O modules specified herein and to suit contract drawing requirements +20 per cent spare capacity for each type of I/O. Work shall be in accordance with the City's control panel design requirements.
- .5 Installation of wiring and wiring terminations to suit connection of field devices as shown on contract drawings.
- .6 Testing, calibration, and commissioning of each signal loop.
- .7 Supply and installation of all Terminal Blocks, control wiring, and auxiliary relays as shown on the drawings.

- .8 The installation, wiring and point by point checkout of proposed field devices and instrumentation.
- .9 The installation and wiring of all control and instrumentation equipment supplied under this contract.
- .10 Provide complete record drawings. Drawings to be produced using AutoCAD (Version 2018 or newer), program and supplied to the customer on USB drive. Also provide one print set of reproducible record drawings (size A1). The Contractor shall also be responsible for providing detailed wiring diagrams, and equipment manual, upon satisfactory commissioning and certification of work.
- .11 Division 16 to provide power to all electrical equipment whether equipment supplied by this Division or by others, or pre-selected. Provide local disconnect switches (fused or un-fused) as required by code whether shown or not. Coordinate this equipment supply and wiring with the Electrical Contractor.
- .12 Commissioning of all equipment to be by the manufacturer's representative.
- .13 Detailed control loop wiring drawings for the proposed hardware in AutoCad (version 2018 or newer) as per contract drawings.

#### **1.11 Standards**

- 1.11.1 Comply with the requirements of the latest edition of the applicable CSA Standards, the requirements of the Authorities, Federal, Provincial and Municipal Codes, the applicable standards of the Underwriter's Association and all other authorities having jurisdiction. These codes and regulations constitute an integral part of these Specifications. In case of conflict, the codes take precedence over the Contract Drawings.

#### **1.12 Coordination**

- 1.12.1 It will be the responsibility of the Contractor to coordinate work to be wired under this division.
- 1.12.2 The Contractor will coordinate work with other Divisions where there is an impact or overlap of work with this Division.
- 1.12.3 Ensure that other Divisions provide all necessary material and work required by this Division for the installation of equipment and wire, which falls under the responsibility of this division.
- 1.12.4 Conform with Division 1.

#### **1.13 Control System Integrator/Programmer**

- 1.13.1 The Contractor shall retain the pre-approved Control System Integrator/Programmer (CSIP) to provide all PLC/SCADA programming as stated in section 13110 and inclusive of the following:
  - .1 Prepare detailed control narratives based on existing and new process narratives.
  - .2 Programming of all existing PLC's and SCADA Computers.

- .3 Development of graphical user interface applications to suit the SCADA Computers and related custom HMI SCADA application
  - .4 Verification of all new I/O on site.
  - .5 Assist with start-up & commissioning of all PLC/SCADA controlled equipment.
  - .6 Software Factory Acceptance Testing - Complete system automation and SCADA software application. Software Factory Acceptance testing shall be performed at the offices of the specified CSIP.
  - .7 PLC/SCADA Programming documentation
  - .8 PLC/SCADA Manual
  - .9 PLC/SCADA Training - on site
- 1.13.2 The Contractor shall provide the following:
- .1 Verification and demonstration of all I/O on site.
  - .2 Start-up & commissioning of all PLC/SCADA controlled equipment.

#### **1.14 Job Conditions**

- 1.14.1 Examine the site and contract documents in accordance with Instructions to Bidders.
- 1.14.2 Attend site visits during the tender period to verify the existing conditions to suit the required works shown on the drawings and specified herein.

## **2 PRODUCTS**

### **2.1 General Requirements**

- 2.1.1 All line voltage powered instruments are to be suitable for a 120VAC power supply. All line voltage AC powered instrument not CSA certified must bear an ESA Special Approvals Branch label.
- 2.1.2 Normal instrument and control power supply for the Contract is 120VAC. Emergency power supply is from associated UPS. Provide all line powered instruments suitable for use on these supplies with appropriate CSA approval. All UPS power feeds are to be sourced from the treatment plant existing emergency generator electrical distribution system.
- 2.1.3 As applicable, instrument control output is to be from 4 to 20 mA, linear, isolated capable of driving a maximum load of 750ohms, unless otherwise specified.
- 2.1.4 Provide all the necessary mounting hardware, electrical connections, transducer junction boxes, power supplies, and all accessory items or options required to satisfy each application.
- 2.1.5 Provide corrosion resistant stainless steel or epoxy coated screws, bolts, fasteners, etc. in all applications.



- 2.1.6 Provide all special instrumentation communication cables, transducer cables, power cables, process sensing/sampling lines and capillary tubing in field measured lengths without joins as required by manufacturer. Allow adequate cable/capillary etc. to allow removal of instrument/transducer from process. Agree instrument-mounting locations with Engineer to ensure accurate field measurements.
- 2.1.7 Provide mechanical protection for capillaries and transducer cables and adequately secure to eliminate sagging.
- 2.1.8 All instruments shall be provided with process isolation valves. Valves must be utilized on all instrument lines for easy removal without disruption to the process.
- 2.1.9 All readouts, indicators, recorders, etc., shall be in metric units, whether shown or not and in engineering scales. All final units, ranges, set points, colours, etc., will be finalized on the shop drawings.
- 2.1.10 The Contractor shall be responsible for supplying all required communications setup and/or wiring, etc., and all other appurtenances which may be required, in order for the entire control and instrumentation system to operate as intended by this specification and as designed. Unless specifically stated otherwise, all control and readout signals, etc., shall be linear.
- 2.1.11 For wiring, see Division 16.
- 2.1.12 Equipment specified includes automation hardware, communications hardware and control equipment (including panels/enclosures) as specified herein and shown on drawings.
- 2.1.13 Without limitation to the following sections of this item, the equipment supplied shall be complete with all accessory items, whether specifically mentioned or not, so as to provide completeness of installation, and operation as intended.
- 2.1.14 The equipment specified shall generally be an "all electronic" control system, with linear isolated outputs from all instruments, 4-20 mA DC unless otherwise noted, and suitable for 115 volts, 60Hz, single phase operation.
- 2.1.15 No instruments shall be included in the design which utilize mercury or all other highly toxic substances, which through error or otherwise may enter and endanger the water supply.
- 2.1.16 All instruments and control elements shall be fully pre-wired and pre-piped in the factory and shall be equipped complete with terminal, terminal blocks and taps suitable for direct connection in the field.
- 2.1.17 Mounting brackets, hooks, plates, screws, bolts, anchors, etc., shall be stainless steel or epoxy coated and of sufficient size to permanently mount the equipment.
- 2.1.18 All process controls and instrumentation shall be complete with all necessary appurtenances to perform the functions indicated on the control schematics and electrical drawings with respect to inputs, outputs, etc.
- 2.1.19 Equipment specified includes instrumentation (including appropriate mounting hardware) and control equipment (including panels/enclosures) as specified herein and shown on drawings. Primary devices, transmitters, receivers, signal protection, conditioning equipment, indicators, switches (pressure/flow/temp.) etc. is to be included.

## **2.2 Service Conditions and Environmental Requirements**

- 2.2.1 The equipment provided for the control system shall be suitable for the service conditions specified in the equipment sections.
- 2.2.2 All equipment shall be designed and selected to operate without degradation in performance throughout the environmental extremes specified. Equipment shall be designed to prevent the generation of electromagnetic and radio frequency interference and shall be in compliance with FCC Rules and Regulations, Part 15, for Class A computing devices.
- 2.2.3 All control system equipment located in air conditioned rooms shall be suitable for operation in ambient temperatures from 10°C to 35°C and a relative humidity of 10 to 80 per cent, noncondensing. All equipment located in non air conditioned indoor areas shall be suitable for an ambient temperature range of 0°C to 50°C and a relative humidity of 10 to 95 per cent, noncondensing. All equipment located outdoors shall be suitable for operation in an ambient temperature range -20°C to 60°C and a relative humidity of 5 to 100 per cent. Heaters and air conditioning/cooling equipment shall be provided where essential to maintain equipment within its manufacturer-recommended operating ranges.
- 2.2.4 All input/output hardware shall meet or exceed, without false operation, all requirements of NEMA ICS-1-109.60, Electrical Noise Tests.

## **2.3 PLC & Automation Equipment**

- 2.3.1 The existing PLC within MSBCB\_PAC01 in the Blower Building, is comprised of an Allen Bradley ControlLogix 1756-L73 CPU complete with associated I/O cards. The existing PLC within MSSPB\_PAC01 in the Screw Pump Building, is comprised of an Allen Bradley SLC5/05 1747-L552 CPU complete with associated I/O cards. The CSIP shall ensure all new connections correspond with the City's SCADA standards, including but not limited to:
  - .1 All Inputs shall be optically isolated.
  - .2 All discrete Outputs shall transition through DIN rail mounted interposing relays complete with 2A, 120VAC dry contacts and LED operation indication.
  - .3 Analog transmitters located outside of the main building must transition through a 24VDC loop Isolator/surge suppressor. Isolator to be 24VDC DIN rail mounted, Pribusin or equal.
- 2.3.2 Supply and install quantity of I/O modules to suit I/O for all field devices and transmitters as shown on control drawings, plus 20 per cent spare capacity for each type of I/O. 20 per cent spare capacity to be calculated based on I/O requirements for field devices and instrumentation terminated as per this contract and including instrumentation to be terminated as part of future works.
- 2.3.3 I/O modules identified for future/spare capacity I/O on the control shop drawings shall all be brought to terminal blocks.

## **2.4 System Software Configuration**

- 2.4.1 The existing SCADA HMI and the system software will be configured by the CSIP as detailed in section 13110.

## **2.5 Surge And Lightning Protection**

- 2.5.1 In addition to other environmental protection specified herein, the complete control system shall be provided with lightning protection. Lightning protection measures shall include the following.
- .1 Surge and lightning arresters shall be non-faulting, non-interrupting, and shall protect against line-to-line and line-to-ground surges. Devices shall be solid-state metal oxide varistor (MOV) or silicon junction type, with a response time of less than 50 nanoseconds. Surge protective devices shall be applied for the following:
    - .1 All power connections to RTUs, PLCs, instruments and control room equipment. Surge arresters shall be Transtector "ACP-100 Series", Power Integrity Corporation "ZTA Series", or MCG Surge Protection "400 Series".
    - .2 All analog signal circuits where any part of the circuit is outside of the building envelope. Circuits shall be protected at both the transmitter and the control system end of the circuit. Surge protection devices shall not impede or interfere with the use of smart transmitter calibration/communication. Protection devices located near the transmitter shall be Telematic "TP48." Protection devices in control panels shall be Transtector "TSP Series", Telematic "SD Series", or Citel "BP1-24."
- 2.5.2 Supply and install surge and lightning protection on all individual I/O and communications terminations that originate from instrumentation or devices located outside of the building.
- 2.5.3 Each 120VAC panel or terminal junction box to have individual DIN rail mounted protection units.
- 2.5.4 Each 120VAC/DC discrete input originating from devices outside of the building to be protected by DIN rail mounted surge protection units located in the respective new control panels at the field wiring terminal blocks.
- 2.5.5 Each analog input originating from instrumentation and/or devices outside of the building to be protected by DIN rail mounted surge protection units.
- 2.5.6 Provide a dedicated ground to suit the lightning protection.

## **2.6 Instrumentation, Control, Communication, And Special Field Wiring**

- 2.6.1 Conform to the requirements of Division 16.
- 2.6.2 Run all wiring in conduit or duct (underground wire) unless otherwise specified. Refer to this division and to the drawings for additional information, requirements and details.
- 2.6.3 Provide minimum 20 per cent spare wiring or two conductors (one pair) whichever is greater for each control conduit. Spare control wire shall be tagged as spare at both ends.
- 2.6.4 All wires must be tagged with pre-numbered slip-on markers. Allow for up to 10 characters per individual wire. No wrap around markers will be accepted.

2.6.5 Control Wiring (Field)

- .1 All control wiring to be stranded, annealed copper conductors, 600V minimum rating 14 AWG, RW90 XLPE, 600V rated conductors to be provided.
- .2 Where conductors to be buried in conduit 14 AWG, RWU90, XLPE, 600V rated conductors to be provided.

2.6.6 Instrumentation Cable (Field)

- .1 Cable to be 300 V rated and meet CSA, C22.2 No. 239 standard with the following features:
  - .1 Seven strand copper conductor with TW75 (-40°C) 105°C dry PVC insulation formed into pairs or triads.
  - .2 Aluminum/polyester tape shield over individual pairs or triads.
  - .3 Individual shield, seven strand tinned copper drain wire.
  - .4 Aluminum/polyester tape shield over cable.
  - .5 Overall shield, seven strand tinned copper drain wire.
  - .6 Ripcord.
  - .7 90°C (-40°C) FRPVC jacket.
- .2 Cable to be as manufactured by SHAWFLEX LTD. or BELDEN LTD.

2.6.7 Communication and Special Wire and Cable (Field)

- .1 The Contractor shall provide all wiring and cable, including connectors, plugs and termination devices required for the wiring of the systems and equipment shown on the drawings, unless otherwise specified.
- .2 Provide quantities and lengths of cable and wire type as recommended by the system equipment manufacturers. Do not de-rate any cabling and wire. No wire/cable to be sized less than 18 AWG unless approved by the Engineer or unless a specific requirement of the equipment manufacturer.
- .3 Coordinate with the manufacturer and other sections of these specifications to ensure proper conduit type (i.e. metal) and sizes are provided.
- .4 All cables and wire to be continuous runs.
- .5 Provide, as part of shop drawing submittal, cable and wire specifications and data for each system. Include written proof that cable and wire meets requirements of equipment supplier.
- .6 Any wire and cable installed that does not meet the wiring specifications of the equipment manufacturer shall be removed and replaced (including conduits, if necessary), at the Contractor's expense.

## **2.7 Field Devices and Control Equipment**

- 2.7.1 Unless specified otherwise, transmitters shall be two-wire, suitable for operation on 24VDC, with 4-20 mA DC linear output, complete with direct reading local indicators in engineering scales.
- 2.7.2 Calibration and scale range data indicated may vary during shop drawing review.
- 2.7.3 Provide quantity and tagging to suit the drawings.
- 2.7.4 Acceptable manufacturers of control equipment transmitters shall be as specified for the respective field devices.

### **.1 Control Relays:**

- .1 Relays indicated to be provided in panels, enclosures, or systems furnished under this section shall be of the plug-in socket base type with dustproof plastic enclosures unless noted otherwise. Relays shall be ULC recognized and shall have not less than double-pole, double-throw contacts.
- .2 Control circuit relays shall have silver cadmium oxide contacts rated 10 amperes at 12 VAC. Electronic switching-duty relays shall have gold-plated or gold alloy contacts suitable for use with low-level signals. Relays used for computer input, alarm input, or indicating light service shall have contacts rated at least three amperes. Latching and special purpose relays shall be as required for the specific application. Unless otherwise indicated, all relays shall have an integral pilot light that illuminates to indicate an energized condition.
- .3 Heavy duty type, electrically held.
- .4 11 pin, DIN rail mounted.
- .5 Contacts: DPDT 1 NO, rated 8A at 120V.
- .6 LED illumination to indicate relay operation.
- .7 Supply Voltage: 24VDC
- .8 Approved Manufacturer:
  - .1 Releco
  - .2 Struthers-Dunn
  - .3 Potter & Brumfield
  - .4 OMRON
  - .5 Approved Equal

### **.2 Timing Relays (General):**

- .1 Heavy duty type, solid state, electrically held, automatic reset after de-energizing.

- .2 Time delay relays shall have dials or switch settings engraved in seconds and shall have timing repeatability of  $\pm 2$  per cent of setting
- .3 Latching and special purpose relays shall be as required for the specific application. Unless otherwise indicated, all relays shall have an integral pilot light that illuminates to indicate an energized condition
- .4 Range and setting to be as shown and field adjustable.
- .5 8 or 11 pin, DIN rail mounted.
- .6 Contacts: 2 NO and 2 NC, rated 8A at 120V.
- .7 LED illumination to indicate timing start.
- .8 LED illumination to indicate relay operation.
- .9 Supply voltage: 120VAC.
- .10 Approved Manufacturer:
  - .1 Relco
  - .2 Struthers-Dunn
  - .3 Potter & Brumfield
  - .4 OMRON
  - .5 Approved Equal
- .3 Panel Circuit Breakers:
  - .1 Supply and install rail mount type circuit breakers as shown on drawings, suitable for voltage shown and load requirements.
  - .2 Breakers to be Thermal-Magnetic type complete with auxiliary contacts, (close on trip) on/off switch, test switch, and trip indication.
  - .3 Breakers to be ETA Series 2210-T.
- .4 Loop Isolators (ISO)
  - .1 Provide and install loop isolation for 4-20mA analogs where more than one device is receiving the analog as an input.
  - .2 Input to output isolation to take place through an optical coupler and input/output to power isolation to take place through isolated power supplies.
  - .3 Operating voltage: 24VDC.

.4 Acceptable product:

.1 PRIBUSIN ITC-XX or approved Phoenix Contact equal.

.5 Analyzers (AIT)

.1 To be supplied and installed in accordance with Division 13.

.2 To be wired for 120V power supply and control wiring associated with alarm set point contacts by Division 16.

.3 Wiring to suit installation location as directed by the Engineer.

.4 Sensor cable length to be coordinated so that wiring between the sensor and controller is without splices.

.5 If meter is not CSA, then it will require special inspection by the Electrical Safety Authority (ESA).

.6 Flow Indicator Transmitter (FIT)

.1 To be supplied and installed in accordance with Section 13566.

.2 All power and control wiring by Division 16.

.3 Output: Isolated 4-20mA

.4 Sensor cable length to be coordinated so that wiring between the sensor and controller is without splices.

.5 If any instrument or device is not CSA, then it will require special inspection by the Electrical Safety Authority (ESA). The Contractor shall coordinate and pay for each inspection as required.

.7 Mechanical Float Switches - wastewater

.8 To be supplied and installed in accordance with Section 13563.

2.7.5 Level Measurement (LIT)

.1 To be supplied and installed in accordance with Section 13563

2.7.6 Level Primary Element: (LE)

.1 To be supplied and installed in accordance with Section 13563.

.2 Transducer cable to be installed in a dedicated conduit OR two cable in the same conduit provided the level indicator units are synchronized.

.3 Installation to suit manufactures specification (allow for ease of maintenance and cleaning).

## **2.8 Terminal Blocks**

- 2.8.1 Supply and install additional terminal blocks and mounting rails as shown on drawings (or as required to accommodate the new I/O) complete with slip on marking strips (No hand written markers).
- 2.8.2 Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labelled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than 200mm of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space
- 2.8.3 Supply and install 30 per cent spare terminals or minimum of 10 spare terminals whichever is greater, evenly distributed in pairs across terminal blocks in the junction cabinets (JC). Spare wires to be terminated on spare terminals.
- 2.8.4 All terminals are to be easily accessible with ample room for termination of field and panel wiring. Supply terminal block partitions for separating instrument analog loops (4-20mA, etc.) from 120VAC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and grounding points are partitioned by terminal block barriers.
- 2.8.5 Terminal blocks to be as manufactured by Phoenix Contact Ltd. or Wiedmuller or ENTRELEC Terminal Block Ltd. Field & PLC/RTU /JC terminals to be of the disconnect type UK5-MTK-P P or M6/8 SN and, USLKGIO or M6/8P or W series type for ground termination.
- 2.8.6 All terminal block groupings to be complete with printed sequentially numbered type marking strips (black on white for field term. and black on yellow for PLC/RIO/RTU /JC term.), partition plates, end covers and end clamps. Mounting rail to be DIN 1 type as supplied by polyamide.
- 2.8.7 All terminals shall be easily accessible with ample room for termination of field and panel wiring. Terminal block partitions shall be supplied for separating instrument loop (4-20mA, etc.) from 120 VAC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and ground points are partitioned by terminal block barriers. In panels with large numbers of terminals, separate rails shall be provided for 120VAC blocks.
- 2.8.8 Common connection of wires at terminal blocks to be generally connected by jumper bar.
- 2.8.9 Group markers shall be used for major group, e.g. all signals from an MCC starter.
- 2.8.10 Knife-switch field terminal blocks shall be provided on all analog 4-20 mA loops to permit easy electrical isolation of loop and connection of ammeter into loop.
- 2.8.11 Fused terminal blocks with neon "fuse blown" indicator on a knife switch shall be provided for all digital loops to electrically isolate the loop. One spare fuse shall be provided per each 10 digital connection. All fuses or circuit breakers shall be clearly labelled and located for easy maintenance.
- 2.8.12 One side of each terminal strip shall be reserved for field incoming conductors. No common connections and jumpers required for internal wiring shall be allowed on the field side of the terminal.



2.8.13 250ohm precision resistors shall be provided at terminal blocks where required.

2.8.14 Acceptable Terminal Block Manufacturers:

- .1 Weidmuller
- .2 Phoenix Contacts
- .3 Entrelec

### **3 EXECUTION**

#### **3.1 Coordination**

- 3.1.1 Carefully examine and monitor for compatibility, any instrumentation and control work provided as part of the work of Sections of the specification, other than the Sections governed by this Section and ensure that all trades involved are aware of any coordination problems or details.
- 3.1.2 Incompatible work, such as instrument process connections, mounting of equipment, analog, discrete or communication wiring, voltages, or inconsistencies resulting from insufficient coordination of other related work, is to be satisfactorily resolved at no additional cost to the Contract.
- 3.1.3 When scheduling site inspection or commissioning with the Engineer, allow at least 10 working days advance notice.

#### **3.2 Manufacturer's Services and Certification Of Installation**

- 3.2.1 Comply with the requirement of Section 01000 - Clean Up, Commissioning, and Training.
- 3.2.2 Allow in the tender for all the necessary services and expenses of a trained, qualified manufacturer's representative for each device to ensure correctness of installation, testing, start-up commissioning and training. The qualified representative is to:
  - .1 Provide onsite supervision of installation for the initial and critical stages of the work as agreed to with the manufacturer/supplier and as require by the Engineer.
  - .2 Supervise testing of equipment. Supervise retesting of equipment at no additional cost.
  - .3 Provide written certification stating that the work has been completed satisfactorily.
  - .4 Provide a complete Installation, Start-up Checklist and sign off on the start-up work completed.
  - .5 Provide operation and maintenance instruction to the City of Brantford operating staff.
- 3.2.3 Provide supervision of installation as required by the manufacturers for all equipment in this Division.
- 3.2.4 Provide all materials, labour and equipment to make any adjustments to the installation as required by the manufacturer or the Engineer to effect performance.

- 3.2.5 On completion of installation and testing, obtain certification from the manufacturers that the equipment is installed correctly, is in full operating condition, and is operating in accordance with its design rating. Submit the original certificate to the Engineer.
- 3.2.6 Include the service of the trained personnel to inspect and commission the equipment when ready for starting and to instruct the operating personnel in the operation and maintenance of the equipment. Time spent on site by the trained personnel must be witnessed by the Engineer.
- 3.2.7 Include above services for all equipment specified in relation to this Section and as a minimum provide commissioning and training as follows:
  - .1 Major process equipment - See the list below. Split the specified time into three stages: inspection during installation, start up and commissioning, staff training.
    - .1 Flow Meters.
    - .2 Level Instruments
    - .3 Analyzers
  - .2 One four hour day for all other process instrument, where not specially mentioned

### **3.3 Identification And Tagging**

- 3.3.1 Identify systems and equipment in accordance with the provisions of this specification. Systems and equipment include:
  - .1 All items furnished under this contract.
  - .2 Items defined in this contract that require identification;
    - .1 Identification of wiring and electrical equipment as specified and tagged in the PLC I/O list.
    - .2 Provide a Tag text list to Engineer for approval prior manufacturing.
  - .3 Provide tags of the following materials:
    - .1 Field instrument tags are 10 gauge, stainless steel with black lettering.
    - .2 Equipment tags are 10 gauge, stainless steel with green lettering.
    - .3 Control panels tags are to be Lamicoid, black background with white lettering.
  - .4 Size tags as 100 x 40 with maximum three lines, front height as 6.5mm.
  - .5 Use text with the following characteristics:
    - .1 Lettering - Uppercase
    - .2 Font - Times New Roman

- .3 Style - Regular
- .4 Size - Maximum to fit label width, minimum 3mm
- .5 Character spacing - Normal
- .6 Justification - Center lettering on each line
- .6 Submit with the Shop Drawings, a typed list indicating all nameplates wording as well as proposed types, sizes and styles.
- .7 Prior to installation of new items, apply identification nameplates to each instrument, panel, telemetry device and controller. Where existing instruments are re-used, or connected into the new system/control panel, provide identification nameplates for these instruments also.
- .8 Lamacoid nameplates shall be provided for each piece of instrumentation equipment. (For interior or exterior panel mounted equipment).
- .9 Mount tags so that they are readily apparent and legible. Place tags within a height range of 1200mm to 1650mm if possible. Do not obscure or mount over other nameplates, labels or tags.
- .10 Nameplates shall be fastened with corrosion resistant screws.
- .11 Nameplates on field equipment and external to control panels to be black background with white lettering. Internal panel labels to be black background and white lettering.
- .12 Identify transducer and miscellaneous hardware with stainless steel labels denoting tag name only, permanently fastened to either the transducer housing or cable.
- .13 Wiring:
  - .1 Identify all PLC I/O signals on field terminal rails with appropriate tag.
  - .2 Identify all wiring at both ends with appropriate, permanent wire markers.

### **3.4 Controller Application Program Installation, Testing & Control System Commissioning**

- 3.4.1 When field pre-commissioning of the instrumentation and control system has been completed as specified above, the system is ready to load control application program.
- 3.4.2 Coordinate all commissioning activities. Supply all labour and materials required to coordinate instrument and controls commissioning with other trades.
- 3.4.3 Provide all labour and materials necessary to commission and operate the system for the duration of the run or period. During this time all equipment is expected to run in automatic mode.
- 3.4.4 Perform the commissioning activities associated with operation of the treatment plant process equipment under control by the software program, as directed by the programmer.

- 3.4.5 Take all necessary steps to ensure that all equipment or parts of the system successfully tested and deemed ready for their intended use stay in operation.
- 3.4.6 Provide clear signs/markings as to required status on the equipment that is to remain powered up, left in Auto, or remain Off, etc., during the commissioning period. Agree with the Engineer on the method for achieving this and ensure safe and compliant operation of the equipment at all times.
- 3.4.7 Adopt a recognized lock-out policy and agree to it with the Engineer. Coordinate the requirement for lock-out for safety reasons with the scheduled commissioning program so that all equipment needed to commission a process/area is available concurrently.
- 3.4.8 Make minor corrections/additions to wiring, terminations, instrument calibrations and settings as normally expected necessary to resolve operational problems during commissioning at no additional cost.

### **3.5 HMI & PLC Acceptance Testing**

#### **3.5.1 General**

- .1 The acceptance testing procedures must thoroughly exercise and demonstrate all system functions including HMI and PLC programs. Acceptance testing includes FAT (Factory Acceptance Testing) and SAT (Site Acceptance Testing).
- .2 A Factory Acceptance Test (FAT) is intended to prove that the system meets the design specifications in both product(s) and functionality and conforms to the relevant local, professional and legislative regulations.
- .3 After the factory test, the equipment is shipped to the job site, where it is installed and wired to field devices and process equipment by a contractor. This results in the requirement for a Site Acceptance Test (SAT), which attempts to confirm the FAT results but now with the equipment connected to its final real-world process components.

#### **3.5.2 References**

- .1 This document references and should be read in conjunction with the following additional documentation:
  - .1 City of Brantford Document: 54008 - PLC Software Standards and Guidelines;
  - .2 City of Brantford Document: 54007 - HMI Software Standards and Guidelines;
  - .3 Section 13100A: Appendix A - 54012A FAT Test Plan Template;
  - .4 Section 13100B: Appendix B - 54012B FAT Signoff Form;
  - .5 Section 13100C: Appendix C - 54012C SAT Test Plan Template; and,
  - .6 Section 13100D: Appendix D - 54012D SAT Signoff Form.
- .2 The FAT and SAT templates as noted above include the required layout and examples. The example information is to be removed when it is created for a given project.

### **3.6 Factory Acceptance Testing (FAT)**

- 3.6.1 The purpose of FAT is to demonstrate that the system programming meets the plant operational requirements before being installed at site and to provide the City with a level of confidence that the system, once on site, will perform as expected. The FAT also ensures that the transition to the online system will be as smooth as possible. FAT should be done on large sections of a process (i.e. minimum of one major process).
- 3.6.2 The FAT takes place at the CSIP's office. The FAT team consists of both the Consultant, and designated representatives from the City's project team. All software and devices (i.e. PLC and SCADA Workstation) are connected to simulate the final system onsite. All testing shall be performed on hardware of the same make, model and revision level as will be used once field installed.
- 3.6.3 The FAT test must follow a documented test plan, including a FAT test case section as per the template in Section 13100A\_Appendix A. In addition, there is a signal checklist template provided in Section 13100B\_Appendix B. The test plan shall be prepared by the Consultant and provided to the City for approval no later than two weeks prior to the scheduled start of FAT. At minimum, the test plan must outline the following:
- .1 Roles and responsibilities of FAT team participants;
  - .2 FAT schedule;
  - .3 Simulation Environment; and,
  - .4 Procedure for performing tests.
- 3.6.4 The standard FAT document is formalized to confirm the operation of each device (i.e. pump, valve, analog signal, etc.) on an individual basis as well as the overall automatic control (if applicable). The FAT test cases are basically a formalized, documented version of the initial testing procedure. The FAT document is used for the recording of all FAT test results including device operation, alarming, automatic control, and fault response. Each test case for the automatic operation is intended to demonstrate the functionality of the automatic control. The system checks should be grouped into common elements to test in a logical order. In general, this includes the following:
- .1 Test Case Area (i.e. Device Control, Duty Control, Pump Operation etc.);
  - .2 Description of expected result for automatic operation; and,
  - .3 Checkboxes for compliance/non-compliance checkmark and comments.
- 3.6.5 The test cases must be designed in such a fashion as to simulate all possible logic and programming permutations as possible to catch as many logic and programming problems as possible. The test cases must follow a logical flow and confirm all modes of operation. Each condition in the process narrative must be demonstrated to be working. Include a wide range of operating scenarios, with all process setpoints, interlocks and alarm limits. Demonstrate that all SCADA and controller software is working properly and that all software configurations match the requirements identified in the control narratives. Test each automated process control algorithm under all possible process conditions in order to ensure that the software contains no defects. Confirm that the individual device logic operates all field equipment correctly and safely as described in the control narrative.

- 3.6.6 The CSIP shall incorporate any suggested modifications to the test plan and/or checklist from the City in advance to the start of FAT. All present at the FAT will be issued a copy of the approved FAT test plan and checklist.
- 3.6.7 During the FAT, a designated City representative shall witness the performing of each test case. Any areas of non-conformance are noted in the deficiency list. If the test case is successful, the witness will sign off on the case. Upon completion of the FAT if it is successful, the witness shall sign off on the FAT document.
- 3.6.8 No later than one week after the completion of FAT, a FAT test report shall be submitted to the City. The test report shall:
- .1 Describe any deviations from the FAT test plan;
  - .2 Summarize test results; and,
  - .3 Explain any discrepancies and plans for corrective action.
- 3.6.9 Every effort will be made by the CSIP to correct any deficiencies found at the FAT in a timely manner. Once all defects have been corrected and successfully retested, the City representative will complete a FAT signoff form as per Section 13100B\_Appendix B. Sign off is provided to the effect that all control philosophies are correct, that the City has witnessed all devices operating as outlined in the process narrative, and that permission is granted to begin system tests on site.

### **3.7 Site Acceptance Testing (SAT)**

- 3.7.1 When initial site inspections and commissioning of the instrumentation and the control system is satisfactorily complete and a Software FAT has been completed, schedule with the Engineer to demonstrate the entire system is ready to start control application program commissioning.
- 3.7.2 Include for the presence of qualified instrument technicians and equipment manufacturer's representatives to supervise the test if requested by the Engineer. Testing is to demonstrate the proper operation of all field physical input and output signals of the PLC system under actual operating conditions to the satisfaction of the Engineer. This includes proper operations between PLCs, and all peripheral devices. Supply all labour, instruments and materials to perform the testing.
- 3.7.3 The SAT must be satisfactorily complete prior to applying for a Certificate of Substantial Performance.
- 3.7.4 Deliver all testing software, panel keys etc. to the Engineer.
- 3.7.5 Provide test programming to suit all PLC applications, and provide the same I/O and communications demonstration performed during the FAT.
- 3.7.6 The purpose of SAT is to complete the full implementation of the system and to perform a final exhibit of the implemented control philosophies. The SAT demonstrates the operation of the actual plant equipment under SCADA control once the system has been installed and commissioned in the field. It provides a final opportunity for the CSIP to locate and correct any issues in the control logic. Additionally, the SAT is a final opportunity to fine-tune any programmed parameters within the control system. Also during the SAT the software is

confirmed against the physical installation including the checking of interlocks, backup control, fault response, and power failure.

- 3.7.7 The SAT is similar to the FAT except that it is performed on-site with the actual equipment. Individual alarm and virtual point testing for analogs and device control is not duplicated rather a focus on the interaction between the software and the field is tested. Some of the FAT tests cannot be repeated as they could cause equipment damage. Generally, a team approach works best for SAT, since rarely does one individual have the breadth of knowledge required to oversee these tests. The SAT test team should be comprised of both Consultant, City representatives, and the Installation Contractors.
- 3.7.8 A SAT test plan must be developed and submitted to the City for approval no later than two weeks prior to the scheduled start of SAT. The SAT plan may be a modified version of the FAT plan. At minimum, the following items must be included in the SAT plan:
- .1 Roles and responsibilities of SAT team participants;
  - .2 SAT schedule;
  - .3 Any safety or process related considerations; and,
  - .4 Procedure for performing tests.
- 3.7.9 All present at the SAT will receive a copy of the approved SAT test plan and checklist for recording test results.
- 3.7.10 During the SAT, a designated City representative shall witness the performing of each test case. This may or may not be the same individual that witnessed the FAT test cases. Ideally, there should be no outstanding programming deficiencies at this point in the testing. Thus, all test cases are to be signed off at this point. If any defects are identified, they are to be logged on the deficiencies list. It should be noted that during the SAT items not specifically related to the PLC or SCADA system may be identified as deficiencies and requiring correction by the contractor.
- 3.7.11 No later than week after the completion of SAT, a SAT test report shall be submitted to the City. Like the FAT test report, the SAT test report shall:
- .1 Describe any deviations from the SAT test plan;
  - .2 Summarize test results; and,
  - .3 Explain any discrepancies and plans for corrective action.
- 3.7.12 Once deficiencies are corrected and successfully retested the SAT signoff form shall be presented to the City. The City representative will sign that they have witnessed the system working as outlined in the SAT test plan and that they are prepared to perform the system handover.
- 3.7.13 The programmers shall update the process control narrative and submit it to the designers as the As-Programmed narrative so that any and all SCADA changes implemented during the course of the project are recorded.

### **3.8 Training**

- 3.8.1 Comply with the requirements of Section 01820 - Demonstration and Commissioning.
- 3.8.2 Supply a site training program for the plant operating personnel consisting of:
  - .1 Maintenance Training (2 hours) by Instrument Supplier and/or appropriate equipment manufacturer's representatives.
  - .2 Operator training (2 hours) by Instrument Supplier.
- 3.8.3 Dates personnel receiving training will be coordinated by the City of Brantford.
- 3.8.4 The training program is to be conducted by qualified instrument technicians and competent manufacturer's personnel experienced both with the product and with instruction, using system operation and maintenance manual data as the basis for demonstrations and instructions.
- 3.8.5 Training shall take place at the site or at the equipment itself. Operation and maintenance manuals shall be submitted to the City of Brantford a minimum of 30 days prior to the training occurring.
- 3.8.6 The training program is to include routine maintenance of the equipment.
- 3.8.7 The site training program must be complete prior to application for a Certificate of Substantial Performance of the work.
- 3.8.8 Pay all costs associated with the training program, with the sole exception of salaries associated with the operating personnel being trained.

### **3.9 Process Performance Operation**

- 3.9.1 Provide all labour and materials necessary to support the process and the instrumentation and control system for the duration of the contract performance run. During this operation all equipment is expected to run in automatic mode.

### **3.10 Warranty And Guarantee Period Activities**

- 3.10.1 During the warranty period, hardware service should be provided by a factory trained service representative who shall be on-site within 24 hours of a service request, seven days/week, including weekends and holidays. The service representative shall be equipped with all necessary tools, testing equipment, spare parts, and expertise to perform the service in one visit.
  - .1 For each service call submit a report giving the following information:
    - .1 Part numbers, description and prices for items replaced.
    - .2 Revised hard copy/soft copy listings of program changes.
    - .3 Hours worked by maintenance personnel.



- .4 Reason for the service call, and whether preventative, unscheduled or corrective maintenance was carried out.
  - .5 Name of City representative present during repairs. Explain the problem and solutions to the City's representatives.
  - .6 Description of problem as discovered on arrival at site and itemized report of activities performed to isolate and correct problem.
  - .7 Identification of any required actions to prevent similar future occurrence.
  - .8 Name of attending operations representative, time of call and time of arrival on site.
- .2 A single contact point shall be provided for all hardware such that the City's representative need only call a single phone number irrespective of which piece of hardware has failed.

### **3.11 Installation Of Equipment**

- 3.11.1 Provide all necessary labour, equipment, tools, anchor bolts, etc., for the complete installation of all equipment specified under this Division.
- 3.11.2 Install all equipment in a workmanlike manner and in accordance with the manufacturer's drawings, instructions and/or under the direction of his qualified technical representative unless otherwise specified or instructed by the Engineer.
- 3.11.3 Existing PLC automation, SCADA HMI's and communications networks must remain in service for the duration of the contract. The Contractor must obtain written approval from the Engineer and owner prior to integrating the new I/O and communications links into the existing RPU control panels.
- 3.11.4 A representative from the Owner must be present during any interruption to the existing PLC, RPU and/or SCADA networks to suit the clarifier upgrades. The Contractor shall coordinate the attendance of the Owners representatives.

### **3.12 Supervision And Commissioning**

- 3.12.1 A supervision and commissioning period shall be allowed for by the Contractor for his supplier to thoroughly check the final installation and performance of each individual piece of equipment, to check each loop control, to start up the equipment and to instruct the Plant Operator on the operation and maintenance of the system. The work shall also include site supervision of the installations where necessary, repair and/or adjustments to the supplier's equipment, and co-ordinate the field supervision by other suppliers and the Contractor within their areas of responsibility.
- 3.12.2 The start-up procedures will not be carried out without the cooperation and presence of the Engineer. The Contractor shall be responsible for co-ordinating the work, and for making his supplier available to completely commission the entire control and instrumentation system so that it is in perfect running order. The cost of this supervision and commissioning by the supplier for the Contractor shall be total included for in the Contractor's tender. No extra accommodation or meal expenses will be paid. The Contractor remains responsible for a complete and working system, in full accordance with these documents, and at the price bid in his tender.

- 3.12.3 The Contractor shall obtain written approval from the Engineer, Owner, and Operator prior to modifying the existing system.
- 3.12.4 The commissioning will not be considered complete without a complete, final, and up-to-date test software listing being supplied.
- 3.12.5 The complete control system and instrumentation must be fully operational and without deviancies prior to implementation of the client supplied custom automation programming.
- 3.12.6 The Contractor shall provide the services of the installing electrician, on site for a period of not less than 15 non-consecutive days to assist in the testing of the client supplied custom automation applications. Any changes or adjustments to field wiring, setpoints, and system operation shall be at no cost.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- 1.1.1 Section 13100 - Control & Instrumentation

### **1.2 Intent**

- 1.2.1 All work described in this section shall be performed by the Control System Integrator/Programmer (CSIP).
- 1.2.2 It is the intent of this section to provide upgrades to existing PLC's and programming, as shown on the drawings or specified.
- 1.2.3 The SCADA updates shall integrate seamlessly into the existing system and be complete, fully functional system and designed and developed to meet the control requirements of the process design indicated on the contract drawings.

### **1.3 Description**

- 1.3.1 The CSIP shall coordinate, develop and implement all system parameters, data tables and programs within the SCADA system to make the SCADA function as intended and to suit the process and automation objectives outlined in the Process Control Narrative and the contract documents.
- 1.3.2 The CSIP is required to develop a detailed Automation System Control Narrative (ASCN), based on the process performance requirements outlined in the Process Control Narrative. The ASCN is to include but not be limited to the following information:
  - .1 Describe each upgraded process to be monitored and/or controlled by the wastewater treatment plant automation system
  - .2 Provide a tag database for all real and virtual signals that will be included in the automation system. Identify the mode/type/units/range for each real or virtual signal.
  - .3 Identify all automation systems to be integrated into the existing main plant HMI/SCADA application. Produce custom graphical HMI applications to match the full functionality of the status/control/alarm features provided by the respective applications, where applicable.
  - .4 Identify detailed control logic required in the operation of each process including, interlock logic, delay logic, adjustable variables, high/low limits, modes of operation, failure modes, and base conditions
- 1.3.3 The CSIP shall coordinate and implement the necessary configurations in the SCADA system to integrate and interface the SCADA system with the control systems provided by the suppliers of packaged equipment.
- 1.3.4 Develop a work plan with an itemized list of all deliverables.
- 1.3.5 SCADA tag name assignments will be developed and confirmed during the integration meeting process, but shall be consistent with City of Brantford Standards.

- 1.3.6 The CSIP and the Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. The word "provide" shall be defined to mean supply, install, start up, test and commission.
- 1.3.7 The Contractor shall obtain written approval from the Owner, Operator and the Engineer prior to implementing any modifications and/or interruptions to the existing Brantford WWTP operations.
- 1.3.8 The CSIP shall provide the software, programs, parameter and hardware settings as required to integrate the following new systems into the existing Brantford WWTP SCADA system:

.1 MSBCB\_PAC01

.2 MSSPB\_PAC01

- 1.3.9 The custom process automation PLC programming of any non-packaged RPU/PLC control panels is to be provided by the vendors.

#### **1.4 Standards**

- 1.4.1 Equipment furnished under this section shall be designed, constructed, and tested in accordance with the latest edition and requirements of the followings:

.1 Canadian Standards Association (CSA)

.2 Canadian Electrical Manufacturers Association (CEMA)

.3 National Electrical Manufacturers Association (NEMA), and NEMA ICS-1-109.60

.4 International Society for Measurement and Control

.5 The Instrumentation, Systems, and Automation Society (ISA)

.6 FCC Part 15 - Class A / Canadian's Interference-Causing Equipment Standards (ICESs)

.7 Institute of Electrical and Electronics Engineers IEEE-519

.8 ANSI C37.90.

#### **1.5 Submittals**

- 1.5.1 Conform with requirements of Division 1, including Sections 01330.
- 1.5.2 A detailed submittal package as per section 13100.

#### **1.6 Operation And Maintenance Manuals**

- 1.6.1 Provide as per section 13100.

**1.7 Work Included**

1.7.1 The Control System Integrator/Programmer (CSIP) shall be responsible for:

- .1 Coordinating with the contractor and executing the verification of the SCADA system including all PLC control panels.
- .2 Providing and implementing test PLC programming to verify and demonstrate monitoring of all new inputs and control of all new outputs. Test programming shall demonstrate that all communications links identified on the SCADA architecture drawings operate as required.
- .3 Providing and implementing a test OIT procedure or application to demonstrate and verify that the respective points in the PLC data table are correctly configured and operating. The OIT test application shall display the status of all I/O and include the ability to toggle discrete outputs and to adjust analogue input words between 0 to 100% to facilitate the verification of analogue outputs. Once verified, this shall be tested on the full plant SCADA application with the additions made to the system to demonstrate its compatibility with the complete application.
- .4 Demonstrating the operation of the SCADA system and placing into service all SCADA equipment to the satisfaction of the Engineer.
- .5 Provide a controls description for the process control logic, based on the Process Control Narrative.
- .6 Development of the City standard screens for the purpose of control and monitoring of the new and upgraded treatment plant process(es).
- .7 Modifications to existing remote alarming application to suit the specific requirements of new treatment process systems being added/modified.
- .8 Development of SCADA system to provide daily reports, trends, alarm functions, historic data collection, and the associated displays, etc.
- .9 Providing a manual that fully documents the operation, features and functions of the upgraded PLC system.
- .10 Demonstrating the complete specified functionality of the SCADA system to show compliance with these specifications through Site Acceptance Testing (SAT).
- .11 Providing training/familiarization courses in the operation, trouble-shooting, and maintenance of the complete PLC system. Training to take place at Brantford WWTP or another location specified by the City.
- .12 Providing support to the Engineer and Contractor during site acceptance testing (SAT).
- .13 Assisting with the start-up & commissioning of all PLC/SCADA controlled equipment.
- .14 Providing documentation, custom PLC programming and SCADA HMI integration in accordance with the City requirements.
- .15 Prepare detailed control narrative based on process narrative.

- .16 Factory Acceptance Testing
- .17 I/O checks
- .18 PLC/SCADA Manual
- .19 PLC/SCADA Training - on site

#### 1.7.2 Programming

- .1 The CSIP shall be responsible for programming of the new process systems, database creations, and generation of all new graphic display screens, alarm configurations, instantaneous trend, historical trends and reporting.
- .2 The CSIP configuration engineer shall meet with the Engineer, Owner and Operations Staff to review the new plant control system display configurations. The following should be provided for review to the Engineer/Owner/Operator prior to confirming acceptance:
  - .1 HMI Screens (PDF)
  - .2 Database (Excel)
  - .3 Any changes to the PLC communications driver
  - .4 Any additional file changes to the SCADA application not highlighted above
  - .5 PLC code modifications detailing changes made including comments for all parts of code added.

#### 1.7.3 Operating Displays

- .1 Process Screen Development:
  - .1 Process equipment shall be illustrated on process screens to closely resemble their appearance and function. Utilize the City's library of graphic symbols to represent piping, valves, devices, and equipment for process screens and submit for approval and acceptance by the City and Engineer. All screen shots shall be submitted to the City and Engineer for approval. No commissioning shall be scheduled until these are approved.
  - .2 The colour scheme for the process screen shall generally conform to the process equipment and pipe painting colour schedule selected for the process and match existing screens.
  - .3 All analog values and status of process equipment and devices pertaining to the process shall be displayed on the corresponding process screen. Analog values and status information shall be displayed on several screens as directed by the Engineer. The status of equipment shall be displayed by changing the colour:
    - .1 GREEN = Motor Running, Valve Open
    - .2 RED = Motor Stopped, Valve Closed

- .3 AMBER = Alarm
- .4 BLUE = Valve Intermediate Position, Equipment Requested to Start
- .4 Animate the change of analog values with respect to its graphical representation and display the actual numerical value. (i.e. the dial of a pressure gauge moving as pressure changes).
- .5 Develop graphical techniques for changing operating set points, such as a slide rule, entering a numeric value from the keyboard, incremental, push-to-run, etc.
- .6 The Engineer shall assign specific valves and gates, which are manually operated and do not communicate their status to the PLC control system, to be included in relevant screens. The open/close status of these manual valves, etc., shall be "set" and animated on the screen by the Operator. Primarily, this function is to alert the Operator to equipment that has been isolated for maintenance, etc., and is not available for duty.
- .7 The process screens shall be developed in such a manner to allow for the operator to perform all tasks with a mouse without the aid of a keyboard.
- .8 A Button Bar shall be provided at the top of each screen to allow operators to navigate through the HMI program to access all screens (matching existing screens).
- .9 Select a process screen as a trial screen and review it with the Engineer and Owner for format, spacing, colour, displays, etc. After the final revisions to this screen are accepted, develop, and submit a general layout for each screen to the Engineer and Owner for review. The layouts shall be corrected and resubmitted until accepted by the Engineer at no additional cost to the Owner.

1.7.4 Trending:

- .1 The trend displays shall be capable of tracing up to four trends per graph. Each trend database shall be displayed in a different colour along with its legend. The time range, on the x-axis and the units of measurement on the y-axis is defined for each graph.
- .2 Graphs shall be capable of being printed in either colour or black and white, depending on the printer's capability; colours shall match the colours used for various parameters in trend graphics.
- .3 The trend types shall include short term, historical analog, and historical event trends.
- .4 The addition, removal or disabling of trends shall in no instance disrupt the database collection process or configuration.

1.7.5 Reports:

- .1 Report files shall be developed from the real-time database within the software and the data file structures are to be compatible with the latest version of Microsoft Excel.

- .2 Reports shall include but not be limited to the following:
  - .1 Maintenance reports shall consist of total run time of pumps, drives, etc. (daily, monthly, and total)
  - .2 Yearly and monthly plant operation reports as per Ministry of the Environment, Conservation and Parks requirements.
  - .3 Weekly and daily reports consisting of maximum value, minimum value, average value, etc. for flows, etc.
  - .4 Generate event logs for time of occurrence when starting and stopping pumps, major equipment, etc. and opening, closing or repositioning gates and valves.

## **1.8 Warranty**

- 1.8.1 Provide written warranty for all work completed under this contract. The warranty shall provide for corrections of any documented software errors within two (2) business days of formal notification by the Owner.
- 1.8.2 The term of the warranty shall be one year, commencing at final acceptance of the work undertaken under this contract.
- 1.8.3 Modification of any software programming or configuration originally completed by this contractor shall be undertaken only by this contractor for the period of the warranty

## **1.9 License**

- 1.9.1 All software created for use on the subject project shall be licensed to the City of Brantford for their non-exclusive, royalty-free use on the device/system where first installed for the subject project.

## **1.10 Process Control Narrative And I/O List**

- 1.10.1 The Process Control Narrative document prepared by CIMA+ is provided as part of the tender documents. The PCNs and P&IDs are draft and subject to minor changes throughout the detailed design process.
- 1.10.2 The CSIP is required to produce a ASCN based on the integration meeting discussions and the information in the tender documents including PCN, P&ID, I/O lists. The ASCN must be approved prior to any FAT activity or submission of SCADA screen shots, etc.

## **1.11 Acceptable Suppliers/Integrators**

- 1.11.1 The pre-approved system integrators for this project are:
  - .1 NLS Engineering  
Rick Vanleeuwen  
416-771-2486
  - .2 Eramosa Engineering Inc. (A CIMA+ Company)  
David Chamberlin, P.Eng.  
226-780-2340



- .3 Brock Solutions  
Alexander Beverly  
604-351-7223

## **2 PRODUCT (NOT APPLICABLE)**

## **3 EXECUTION**

### **3.1 Documentation**

- 3.1.1 All documentation detailed below shall be provided in hard copy form (one copy) and in digital form:

- .1 Operating Manuals for the new SCADA system(s) provided under the contract
- .2 A copy of all system and database files in their final form
- .3 Database listings for all SCADA work
- .4 Updated manual for the custom HMI application, Historian, MOECP compliance reporting, and alarming applications
- .5 An update of the modified SCADA system I/O list equivalent to the as-built condition at the completion of this contract, including all database tags, analog point ranges, analog point engineering units, and digital state words.

### **3.2 Coordination**

- 3.2.1 Attend all meetings as necessary and as requested by the client or consulting engineer to ensure complete coordination and integration of all equipment and systems. The estimated number is provided in this section above.

### **3.3 Testing**

- 3.3.1 Site Acceptance Tests (SAT): Upon completion of termination of field wiring by the installing Contractor the CSIP will be required to verify all field wiring I/O connections between all field devices, local control panels, RPUs and the SCADA system including all individual control loops and communication links. The CSIP shall assist with plant commissioning to ensure complete functionality of all control logic.

### **3.4 Training/Familiarization**

- 3.4.1 The training/familiarization sessions are intended for plant operators, supervisory management, and others who wish to attend. The training to take place at the Brantford WWTP (or another location that may be specified by the City of Brantford) with a maximum of 12 attendees at any session. The number and the duration of training sessions are tabulated in Table 1 below.

Table 1 Training Sessions

	Training
SCADA System	One (1) session for PLC/SCADA, HMI applications, Historian, Reporting, and alarming (1hr)

**END OF SECTION**

## **1 GENERAL**

### **1.1 Related Sections**

- 1.1.1 Section 01330 - Submittal Procedures
- 1.1.2 Section 01820 - Demonstration and Training
- 1.1.3 Section 13100 - Control & Instrumentation
- 1.1.4 Section 16010 - Electrical General Requirements

### **1.2 Scope**

- 1.2.1 This section covers the furnishing of all instrumentation equipment required for the Control & Instrumentation System as indicated on the P&ID drawings and the sections herein.
- 1.2.2 Principal components of the instrumentation systems shall be as indicated on the P&ID drawings. The contractor is required to provide all instruments including electronic/electrical and non-electronic/electrical instruments.
- 1.2.3 Provide product submittal data sheets for all instrumentation supplied under this project in the format identified in the sample forms included at the end of this section.
- 1.2.4 Section 13100 shall apply to all systems described in this section. All applicable requirements defined in Section 13100 shall apply to equipment and services provided under Section 13560.

### **1.3 General**

- 1.3.1 The Contractor shall select the equipment furnished under this section for its superior quality and the intended performance. The Contractor shall install all equipment in accordance with the manufacturer's instructions. Equipment and materials used shall be subject to review and shall comply with the following requirements.
- 1.3.2 Refer to Division 1 specifications for general equipment requirements which shall apply to all equipment furnished under this section.
- 1.3.3 Supplementing this section, the drawings indicate locations and arrangement of instruments and enclosures, provide mounting details, and may show device schedules and other information regarding the connection and interaction with other equipment.
- 1.3.4 Governing Standards for instruments shall be as indicated in Section 13100.
- 1.3.5 All parts, which are exposed to corrosive conditions, shall be made from corrosion resistant materials. Contractor shall submit certification that the instrument manufacturer approves the selection of materials of primary elements that are in contact with the specified process fluid to be inert to the effects of the process fluid.
- 1.3.6 Elevation and Temperature. All instruments shall be designed to operate within a range of elevation and temperature as required.

- 1.3.7 Power and Instrument Signals. Unless otherwise indicated, electric power supply to the instrumentation equipment will be unregulated 120VAC and emergency electrical power will be from a diesel generator. All line powered instruments suitable for use on these supplies shall be provided with appropriate CSA approval. Line voltage ac powered instrument not CSA certified must bear an Electrical Safety Authority Approvals Branch label.
- 1.3.8 Unless otherwise indicated, all transmitted electronic analog instrument signals shall be 4-20 mA DC and shall be linear with the measured variable.
- 1.3.9 Appurtenances. Signal converters, intrinsically safe relays, signal boosters, amplifiers, special power supplies, special cable, special grounding, and isolation devices shall be furnished as needed for proper performance of the equipment.
- 1.3.10 Interchangeability and Appearance. To the extent possible, instruments used for similar types of functions and services shall be of the same brand and model line. Similar components of different instruments shall be the products of the same manufacturer to facilitate maintenance and stocking of repair parts. Whenever possible, identical units shall be furnished.
- 1.3.11 Programming Devices. A programming or system-configuring device shall be provided for systems that contain equipment that requires such a device for routine calibration, maintenance, and troubleshooting.
- 1.3.12 Device Tag Numbering System. All devices shall be provided with permanent identification tags. The tag numbers shall agree with equipment drawings and shall be as close as practical to the tag numbers used on the project drawings and device schedules. All field-mounted transmitters and devices shall have stamped stainless steel identification tags. Panel, subpanel, and rack-mounted devices shall have laminated phenolic identification tags securely fastened to the device. Hand-lettered or tape labels will not be acceptable.
- 1.3.13 Indoor Installation. Unless otherwise shown or specified, enclosures for all instruments located indoors in dry hazardous areas shall be as a minimum EEMAC12.
- 1.3.14 Outdoor Installation. Unless otherwise shown or specified, instruments located outdoors shall be suitable for the surrounding climate and appropriately installed with:
- .1 A combined rain/ice/snow protection shield and sun shade for all electronic instruments which are already provided with sturdy EEMAC4 enclosures by the manufacturer. Supply tip-up type hoods for access for routine calibration and maintenance.
  - .2 Drawing submissions must clearly show the enclosures proposed for each instrument.
  - .3 Unless otherwise shown or specified, instruments located in areas subjected to flooding shall be provided submergence rated enclosures.
- 1.3.15 Hazardous Area Installation. Unless otherwise shown or specified, instruments located in hazardous areas shall be suitable for the classification area in which they are installed.
- 1.4 Submittals**
- 1.4.1 Submittals shall be as required in Section 13100 - Control and Instrumentation System and Section 01330 - Submittal.

- 1.4.2 Product Data Sheets. Provide completed product Data Sheets specifying instruments and equipment conforming to ISA specification sheet standards. Complete blank spaces on these sheets with the information noted below and other data pertinent to the equipment and the application.
- .1 Use the product data sheet for documenting installation and testing.
  - .2 Include the following upon initial submission (to accompany Shop Drawings):
    - .1 Project Name
    - .2 Tag number and description.
    - .3 Manufacturer, Model and Part Numbers.
    - .4 Identification Nameplate details.
    - .5 The product manufacturer and the supplier or representative.
    - .6 The complete model and catalogue numbers including special options.
    - .7 The available adjustment ranges and the project operating ranges.
    - .8 Web link for each product manufacturer.
    - .9 On each sheet, add the following information following field calibration:
      - .1 Serial numbers.
      - .2 Date of installation.
      - .3 Date, time and person who performed calibration.
      - .4 Calibration data.
      - .5 Input, output, and error at 0, 25, 50, 75, 100 per cent of span for analog instrument.
      - .6 Switch setting, contact action, and dead band, if applicable, for discreet elements.
      - .7 Certification by installer and acknowledgement by contractor.
      - .8 Special procedures and equipment required to duplicate calibration.
      - .9 Comments, including calibration changes, repair or replacement works performed.
  - .10 Add the following upon final submission (immediately following site acceptance):
    - .1 Signature by the Contractor and the Engineer indicating acceptance.
    - .2 Phone and fax numbers of contact person for product support/service.

- .3 Provide a completed Instrumentation Installation "Checklist" form for each instrument.

## **1.5 Delivery, Storage, And Shipping**

- 1.5.1 Delivery, storage and shipping shall be as required in Division 1 and Section 13100.

## **1.6 Spare Parts**

- 1.6.1 Spare parts shall be provided as following: duplicated full set of lamps for indicating lights, terminal blocks, fuses, breakers, relays and timers.
- 1.6.2 Supply spare parts required to commission instruments. Include five spare fuses of each type for each instrument panel.

# **2 PRODUCTS**

## **2.1 Individual Device Specifications**

- 2.1.1 Individual instruments and related devices shall be provided as specified in the following sections:
- 2.1.2 Section 11015 - Installation of Pre-purchased Equipment
- 2.1.3 Section 11290 - Valve and Gate Actuators

# **3 EXECUTION**

## **3.1 Instrumentation Installation Requirements**

- 3.1.1 Additional instrumentation installation requirements are specified in Section 13100.
- 3.1.2 Instrumentation field wiring shall be continuous, no splices.
- 3.1.3 Complete an Instrumentation Installation Checklist Form and Instrumentation Calibration Form for each instrument that is tested and commissioned. Testing and commissioning of the instruments will be considered incomplete unless the respective instrument is provided with an Instrumentation Calibration Form, with all fields completed. The contractor shall provide a typed version of all completed calibration forms to be included in the maintenance manual.
- 3.1.4 Field Calibration. After each instrument has been installed, a technical representative shall calibrate each instrument and shall provide a written calibration report for each instrument, indicating the results and final settings. The adjustments of calibrated instruments shall be sealed or marked, insofar as possible, to discourage tampering. Instrument calibration shall be done before checkout of the system operation. A typical instrument calibration form and Instrumentation Installation Checklist form is attached to the end of each section.
- 3.1.5 Systems Check. A technical representative shall participate in the checkout of instrumentation systems. Systems check requirements shall be as specified in Section 13100.

- 3.1.6 Installation Test Equipment. Unless specified otherwise, all test equipment for the calibration and checking of system components shall be provided by Contractor for the duration of the testing work and this test equipment will remain the property of the Contractor.
- 3.1.7 Mounting of Field Instruments. Instruments shall be mounted so that they can be easily read and serviced and so that all appurtenant devices can be easily operated. Installation details for some instruments are indicated on the drawings. Where installation details are not indicated, the installation performed shall conform to the manufacturer's instructions and/or API RP 550 recommendations.
- .1 Unless otherwise shown or specified, all required mounting hardware, enclosures, termination's, junction boxes, etc., shall be provided. Refer to the tender drawings and the manufacturer's documentation to confirm the necessary hardware and construction for specific mounting assemblies where such details are not specified herein.
  - .2 No instruments shall be mounted on vibrating structures (e.g. handrails), or on piping or near equipment that induces vibration. No instruments shall be mounted below or directly adjacent to lines conveying corrosive chemicals or near sources of leakage or spillage.
  - .3 Metal surfaces shall be prepared and supports or frames shall be painted the same color as the member of the complete assembly is mounted on.
  - .4 Unless otherwise shown or specified, instruments shall be mounted 1.4m above finished floors, grade or platforms. Allow for cabinet plinth/floor-pad heights when locating panel instruments. Instruments that are not easily accessible for operation or maintenance, or indicator that is not easily and readily visible must be relocated as directed by the Engineer at no cost to the contract.
  - .5 When drilling or installing conduit entry points in instruments, protect internally mounted equipment from vibration, shock and metal filings. Conduit entries must maintain the equipment or panel EEMAC rating.
  - .6 Lengths for transducer cables and similar items shall be field measured prior to ordering. Cables shall be mechanically protected and adequately secured in place without sagging.
  - .7 All instruments shall be provided with isolation valves.
  - .8 All instrument cables shall be protected with capillaries throughout their length without sagging by using painted/galvanized angle iron and clips. Avoid sharp bends in capillary and coil excess close to the sensor end. Protect the coiled capillary by clipping to a steel plate or other safe method.
  - .9 Sensing and sample lines shall be run in ½" stainless steel tubing with "Swagelok" compression type fittings.
  - .10 Install process sample piping and sensing lines to avoid accumulation of vapor or gas in liquid service and of liquid or condensate on vapor or gas service as appropriate.
  - .11 Instruments shall be positioned so that they do not block or obstruct walkways or access points and adequate space shall be provided around installation for removal of covers, etc.

- .12 Instrument support brackets shall not be welded to process piping or equipment, but should generally be pedestal or wall mounted.
- .13 Field cables for analogue signals shall be run in separate conduit from 120V AC/24VDC control or 120VAC power supply cables.
- .14 Field junction boxes suitable for the area classification to "marshal" groups of signals of the same type in an area and cable back to buildings and local control panel with multi-core cables shall be used.
- .15 Junction boxes may be FRP (fiberglass reinforced plastic) or similar material suitable for the area and rust and weather resistant. Terminals inside field junction boxes are to be DIN rail mounted.
- .16 Once an instrument has been inspected by the Engineer and initially calibrated, it is to remain powered up at all times unless servicing the instrument itself.
- .17 Instrument calibration, setpoints and other programmable parameters are to be confirmed with the Engineer during on-site inspection as soon as site conditions are sufficiently ready. Final calibration values may be adjusted to values different than the nominal values specified in the Product Data Sheets at no extra cost to the contract.
- .18 Standard instrument process connections of ½" NPT female are to be provided (pressure gauges normally ½ inch NPT male).
- .19 Provide the necessary mechanical shields, mounting plates to properly secure and protect transducers. Provide stilling wells wherever turbulence can adversely affect measurement.

### **3.2 Customer Training**

- 3.2.1 Provide Instrumentation training in accordance with Section 13100 and Section 01820 Demonstration and Training.

### **3.3 Forms**

- 3.3.1 Provide the calibration report from the vendor as a pre-SAT activity and have this available prior to commissioning.
- 3.3.2 Complete an Instrumentation Installation Checklist Form and Instrumentation Calibration Form for each instrument that is tested and commissioned.



### Instrumentation Installation Checklist

Project Name:	Project Number:	
Contractor:	Contract Number:	

<b>EQUIPMENT:</b>		<b>DATE INSTALLATION</b>	
		<b>COMPLETE:</b>	
<b>SERIAL NO.:</b>		<b>MAKE AND MODEL NO.:</b>	
<b>PRE-START-UP</b>	<b>CHECKED BY</b>	<b>DATE</b>	<b>REMARKS</b>
Installation/Mounting Sensor/Transmitter			
Wiring/Conduit Termination and Seals			
Check Fuse Ratings (Supply and Internal)			
Tagging/Nameplate			
Compliance Section 16			
Test (Ground Loop, Continuity, Installation)			
Power Supply			
Check Instrument Air/Adjust Filter/Regulator			
Check Temp. Control (Internal/Heat Tracing)			
Configure Calibration			
Tailback lights			
<u>START-UP</u>			

Verify Operation Under Max Process Conditions			
Correct Quantities of Expandable Material			
* Indicates (N/A) if not applicable			
Comments:			

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	
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\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Supplier

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Consultant

\_\_\_\_\_  
City/Operator

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date



### Instrumentation Calibration Form

Project Name:	Project Number:	
Contractor:	Contract Number:	

Equipment:			
Tag/Instrument Number:			
PLC:			
Input Point:			
Manufacturer:			
Model Number:			
Serial Number:			
Calibration Range:			
Service			
Temperature		Chlorine Residual	
Pressure		pH	
Differential Pressure		Density	
Flow		Dissolved Oxygen	
Level		Gas monitoring	
Weight		Others	
Type			
4-20 mA		0-100 VDC	
0-20 mA		Digital Input	
1-5 VDC			

Power Source			
120 VAC		Dry Contact	
24 VDC			
Alarms – Hardwired			
HIHI		LO	
HI		LOLO	
Failure			

[illegible]

Inspection Result	Passed Installation and Start-up checkout. Equipment certified ready for service		Failed – Contractor to schedule equipment re-inspection	
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\_\_\_\_\_  
Contractor

\_\_\_\_\_  
Supplier

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

\_\_\_\_\_  
Consultant

\_\_\_\_\_  
City/Operator

\_\_\_\_\_  
Date

\_\_\_\_\_  
Date

**END OF SECTION**



## MSBCB\_PAC01 I/O Check Spreadsheet

Date: 13-May-2024

Platform: ControlLogix

Processor: 1756-L73

Power Supply:

Notes: Consultant is to enter how many "Used" points per card (highlighted in RED). Provided the card points, type, and model are correct, the formulae will calculate the spare count %.

Rack	Slot	Points	Card Type	Card Model	Points	Used	Spare	Spare %	Final Spare Counts	
0	0		CPU	1756-L73						
	1		ETHERNET CARD	1756-EN2T					DI	64.84
	2	16	DIGITAL INPUT	1756-IA16I	16	11	5	31.25	DO	43.75
	3	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33	AI	34.88
	4	8	DIGITAL OUTPUT	1756-IX8I	8	6	2	25	AO	33.33
	5	16	DIGITAL INPUT	1756-IA16I	16	10	6	37.5		
1	6	16	DIGITAL OUTPUT	1756-IX8I	8	4	4	50		
	0		ETHERNET CARD	1756-EN2T				#DIV/0!		
	1	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	2	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	3	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	4	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	5	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	6	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	7	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	8	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	9	8	ANALOG INPUT	1756-IF8	8	4	4	50		
	10	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	11	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	12	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	13	6	ANALOG INPUT	1756-IF6I	6	4	2	33.33		
	14		SPARE	1756-N2	0		0	#DIV/0!		
2	15	8	DIGITAL OUTPUT	1756-IX8I	8	4	4	50		
	16	8	DIGITAL OUTPUT	1756-IX8I	8	4	4	50		
	0	N/A	ETHERNET CARD	1756-EN2T				#DIV/0!		
	1	6	ANALOG OUTPUT	1756-OF6CI	6	4	2	33.33		
	2	6	ANALOG OUTPUT	1756-OF6CI	6	4	2	33.33		
	3	6	ANALOG OUTPUT	1756-OF6CI	6	4	2	33.33		
	4	6	ANALOG OUTPUT	1756-OF6CI	6	4	2	33.33		
	5	6	ANALOG OUTPUT	1756-OF6CI	6	4	2	33.33		
	6		SPARE	1756-N2	0		0	#DIV/0!		
	7	16	DIGITAL INPUT	1756-IA16	16	4	12	75		
	8	16	DIGITAL INPUT	1756-IA16	16	4	12	75		
	9	16	DIGITAL INPUT	1756-IA16	16	4	12	75		
	10	16	DIGITAL INPUT	1756-IA16	16	4	12	75		
	11	16	DIGITAL INPUT	1756-IA16	16	4	12	75		
	12	16	DIGITAL INPUT	1756-IA16	16	4	12	75		
	13		SPARE	1756-N2	0		0	#DIV/0!		
	14		SPARE	1756-N2	0		0	#DIV/0!		
	15		SPARE	1756-N2	0		0	#DIV/0!		
	16		SPARE	1756-N2	0		0	#DIV/0!		

Rack	Slot	Point	SCADA TAG	Description	Wire Tag OK (Panel)	Wire Tag OK (Field)	Wire Colour OK	Point Jumped	Point Confirmed	Comments
0	0			Processor						
	1			Ethernet Card						
	2	0	MSBCB_BLD01_SSY01_DI_ARM	Blower Building Security Panel Armed Status						
	DI	1	MSSPB_SCL01_00000_DI_RN	Secondary Clarifier 1 Run Status						
		2	MSSPB_SCL01_00000_DI_GA	Secondary Clarifier 1 Fault Alarm						
		3	MSSPB_SCL01_00000_DI_HI	Secondary Clarifier 1 Torque Warning						
		4	MSSPB_SCL01_00000_DI_ES	Secondary Clarifier 1 E-Stop Status						
		5	MSSPB_SCL01_00000_DI_CM	Secondary Clarifier 1 Control Mode						



		5		Spare																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																
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[illegible]

		2		Spare										
		3		Spare										
		4	MSBCB_ABL04_ITV01_DI_CM	Blower 4 Intake Valve Control Mode										
		5		Spare										
		6	MSAER_ATK00_QIV01_DI_CM	PM1&PM2 Interconnect Valve Control Mode										
		7	MSAER_ATK00_QIV01_DA_GF	PM1&PM2 Interconnect Valve General Fault										
		8		Spare										
		9		Spare										
		10		Spare										
		11		Spare										
		12		Spare										
		13		Spare										
		14		Spare										
		15		Spare										
8 DI	0	MSAER_ATK1A_ARV01_DI_CM	PM1 Tank A Pass 1 Aeration Valve Control Mode											
	1	MSAER_ATK1A_ARV01_DA_GF	PM1 Tank A Pass 1 Aeration Valve General Fault											
	2	MSAER_ATK1A_ISV01_DI_CM	PM1 Tank A Pass 2&3 Isolation Valve Control Mode											
	3	MSAER_ATK1A_ISV01_DA_GF	PM1 Tank A Pass 2&3 Isolation Valve General Fault											
	4	MSAER_ATK1A_ISV01_DI_OP	PM1 Tank A Pass 2&3 Isolation Valve Opened Status											
	5	MSAER_ATK1A_ISV01_DI_CL	PM1 Tank A Pass 2&3 Isolation Valve Closed Status											
	6	MSAER_ATK1A_ARV02_DI_CM	PM1 Tank A Pass 2 Aeration Valve 1 Control Mode											
	7	MSAER_ATK1A_ARV02_DA_GF	PM1 Tank A Pass 2 Aeration Valve 1 General Fault											
	8	MSAER_ATK1A_ARV03_DI_CM	PM1 Tank A Pass 2 Aeration Valve 2 Control Mode											
	9	MSAER_ATK1A_ARV03_DA_GF	PM1 Tank A Pass 2 Aeration Valve 2 General Fault											
	10	MSAER_ATK1A_ARV04_DI_CM	PM1 Tank A Pass 3 Aeration Valve 1 Control Mode											
	11	MSAER_ATK1A_ARV04_DA_GF	PM1 Tank A Pass 3 Aeration Valve 1 General Fault											
	12	MSAER_ATK1A_ARV05_DI_CM	PM1 Tank A Pass 3 Aeration Valve 2 Control Mode											
	13	MSAER_ATK1A_ARV05_DA_GF	PM1 Tank A Pass 3 Aeration Valve 2 General Fault											

## MSSPB\_PAC01 I/O Check Spreadsheet

Date: 13-May-2024

Platform: ControlLogix

Processor: NA

Power Supply: 1756-L73

Notes: Consultant is to enter how many "Used" points per card  
(highlighted in RED). Provided the card points, type, and model are  
correct, the formulae will calculate the spare count %.

Rack	Slot	Points	Card Type	Card Model	Points	Used	Spare	Spare %	Final Spare Counts	
0	0	N/A	ETHERNET	1756-EN4TR						
	1	16	DIGITAL INPUT	1756-IA16I	16	9	7	56.25	DI	20.83
	2	16	DIGITAL INPUT	1756-IA16I	16	14	2	87.5	DO	37.5
	3	16	DIGITAL INPUT	1756-IA16I	16	15	1	93.75	AI	62.5
	4	16	DIGITAL OUTPUT	1756-OA16I	16	10	6	62.5	AO	#DIV/0!
	5						0	#DIV/0!		
	6	8	ANALOG INPUT	1756-IF8IH	8	3	5	37.5		
	7	8	ANALOG INPUT	1756-IF8IH	8	3	5	37.5		
	8						0	#DIV/0!		
	9						0	#DIV/0!		

Rack	Slot	Point	SCADA TAG	Description	Wire Tag OK (Panel)	Wire Tag OK (Field)	Wire Colour OK	Point Jumped	Point Confirmed	Comments
0	0			Ethernet Module						
	1	0	MSSPB_FCT01_LIT01_DA_LOE	Ferric Tank 1 Loss of Echo						
	DI	1	MSSPB_FCT02_LIT01_DA_LOE	Ferric Tank 2 Loss of Echo						
		2		Spare						
		3		Spare						
		4	MSSPB_SCL05_00000_DI_RN	Secondary Clarifier 5 Run Status						TO BE REMOVED
		5	MSSPB_SCL06_00000_DI_RN	Secondary Clarifier 6 Run Status						TO BE REMOVED
		6		Spare						
		7	MSSPB_SCL07_00000_DI_RN	Secondary Clarifier 7 Run Status						
		8	MSSPB_SCL08_00000_DI_RN	Secondary Clarifier 8 Run Status						
		9	MSSPB_RAP01_00000_DI_RN	RAS Pump 1 Run Status						TO BE REMOVED
		10	MSSPB_RAP02_00000_DI_RN	RAS Pump 2 Run Status						TO BE REMOVED
		11		Spare						
		12		Spare						
		13		Spare						
		14		Spare						
		15	MSSPB_SSV01_00000_DI_ARM	Screw Pump Building Security Panel System Armed						
	DI	0	MSSPB_SCL07_WAV01_DI_OP	Secondary Clarifier 7 Waste Valve 1 Open Status						
		1	MSSPB_SCL07_WAV01_DI_CL	Secondary Clarifier 7 Waste Valve 1 Closed Status						
		2	MSSPB_SCL07_WAV01_DI_AV	Secondary Clarifier 7 Waste Valve 1 Available Status						
		3	MSSPB_SCL07_WAV01_DI_CM	Secondary Clarifier 7 Waste Valve 1 Control Mode						
		4	MSSPB_SCL05_00000_DI_RN	Secondary Clarifier 5 Run Status						NEW
		5	MSSPB_SCL05_00000_DI_GF	Secondary Clarifier 5 Fault Alarm						NEW
		6	MSSPB_SCL05_00000_DI_HI	Secondary Clarifier 5 Torque Warning						NEW
		7	MSSPB_SCL05_00000_DI_ES	Secondary Clarifier 5 E-Stop Status						NEW
		8	MSSPB_SCL05_00000_DI_CM	Secondary Clarifier 5 Control Mode						NEW
		9	MSSPB_SCL06_00000_DI_RN	Secondary Clarifier 6 Run Status						NEW
		10	MSSPB_SCL06_00000_DI_GF	Secondary Clarifier 6 Fault Alarm						NEW
		11	MSSPB_SCL06_00000_DI_HI	Secondary Clarifier 6 Torque Warning						NEW
		12	MSSPB_SCL06_00000_DI_ES	Secondary Clarifier 6 E-Stop Status						NEW
		13	MSSPB_SCL06_00000_DI_CM	Secondary Clarifier 6 Control Mode						NEW
		14		Spare						
		15		Spare						
	DI	0	MSSPB_SCL08_WAV01_DI_OP	Secondary Clarifier 8 Waste Valve 1 Open Status						
		1	MSSPB_SCL08_WAV01_DI_CL	Secondary Clarifier 8 Waste Valve 1 Closed Status						
		2	MSSPB_SCL08_WAV01_DI_AV	Secondary Clarifier 8 Waste Valve 1 Available Status						
		3	MSSPB_SCL08_WAV01_DI_CM	Secondary Clarifier 8 Waste Valve 1 Control Mode						

	4	MSSPB_SCL07_TQS01_DA_HI	Secondary Clarifier 7 High Torque Switch						TO BE REMOVED
	5	MSSPB_SCL07_00000_DI_RN	Secondary Clarifier 7 Run Status						NEW
	6	MSSPB_SCL07_00000_DI_GF	Secondary Clarifier 7 Fault Alarm						NEW
	7	MSSPB_SCL07_00000_DI_HI	Secondary Clarifier 7 Torque Warning						NEW
	8	MSSPB_SCL07_00000_DI_ES	Secondary Clarifier 7 E-Stop Status						NEW
	9	MSSPB_SCL07_00000_DI_CM	Secondary Clarifier 7 Control Mode						NEW
	10	MSSPB_SCL08_00000_DI_RN	Secondary Clarifier 8 Run Status						NEW
	11	MSSPB_SCL08_00000_DI_GF	Secondary Clarifier 8 Fault Alarm						NEW
	12	MSSPB_SCL08_00000_DI_HI	Secondary Clarifier 8 Torque Warning						NEW
	13	MSSPB_SCL08_00000_DI_ES	Secondary Clarifier 8 E-Stop Status						NEW
	14	MSSPB_SCL08_00000_DI_CM	Secondary Clarifier 8 Control Mode						NEW
	15		Spare						
DO	0	MSSPB_SCL07_WAV07_DO_OP	Secondary Clarifier 7 Waste Valve 1 Open Command						
	1	MSSPB_SCL07_WAV07_DO_CL	Secondary Clarifier 7 Waste Valve 1 Close Command						
	2	MSSPB_PAC01_ALM00_DA_GA	Dialer Channel 0 - RAS/WAS Failure						
	3	MSSPB_PAC01_ALM01_DA_GA	Dialer Channel 1 - Secondary Clarifier Not Running						
	4		Spare						
	5		Spare						
	6		Spare						
	7		Spare						
	8	MSSPB_SCL08_WAV08_DO_OP	Secondary Clarifier 8 Waste Valve 1 Open Command						
	9	MSSPB_SCL08_WAV08_DO_CL	Secondary Clarifier 8 Waste Valve 1 Close Command						
	10		Spare						
	11		Spare						
	12	MSSPB_SCL05_00000_DO_ST	Secondary Clarifier 5 Start/Stop Command						NEW
	13	MSSPB_SCL06_00000_DO_ST	Secondary Clarifier 6 Start/Stop Command						NEW
	14	MSSPB_SCL07_00000_DO_ST	Secondary Clarifier 7 Start/Stop Command						NEW
	15	MSSPB_SCL08_00000_DO_ST	Secondary Clarifier 8 Start/Stop Command						NEW
5			Spare						
6 AI	0	MSSPB_FCP01_00000_AI_SI	Ferric Pump 1 Speed Feedback						
	1	MSSPB_FCP03_00000_AI_SI	Ferric Pump 3 Speed Feedback						
	2		Spare						
	3	MSSPB_FCT01_LIT01_AI_CV	Ferric Tank 1 Level						
	4		Spare						
	5		Spare						
	6		Spare						
7 AI	0	MSSPB_FCP02_00000_AI_SI	Ferric Pump 2 Speed Feedback						
	1	MSSPB_FCP04_00000_AI_SI	Ferric Pump 4 Speed Feedback						
	2		Spare						
	3	MSSPB_FCT02_LIT01_AI_CV	Ferric Tank 2 Level						
	4		Spare						
	5		Spare						
	6		Spare						
8	7		Spare						
			Spare						
			Spare						

## **DIVISION 16 – ELECTRICAL**



DIVISION 16 – ELECTRICAL

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Section No.	Title
16010	Electrical General Requirements
16015	Electrical Systems Analysis
16021	Demolition of Electrical Systems
16051	Installation of Cables in Ducts and Trenches
16062	Grounding – Secondary
16090	Equipment Identification
16122	Wires and Cables (0-100V)
16131	Splitters, Junction, Pull Boxes and Cabinets
16132	Outlet Boxes, Conduit Boxes and Fittings
16133	Conduits, Conduit Fittings and Fastenings
16223	Motor Starters to 600V
16225	Motor Control Centres
16400	Basic Electrical Equipment & Materials
16412	Moulded Case Circuit Breakers
16414	Disconnect Switches – Fused & Unfused

## **1 GENERAL**

### **1.1 Description**

1.1.1 This section describes the following:

- .1 General and common requirements for Division 16 (Electrical Work)
- .2 Overall scope of work for Division 16
- .3 General coordination between Division 16 and related work in other Divisions, particularly Division 13.

### **1.2 General**

- 1.2.1 Read and conform to the General Requirements (Division 1), which applies to and forms part of all sections of the work. The general instructions are intended to supplement and not to replace Division 1 requirements.
- 1.2.2 The specifications are divided into Divisions of work and a Division may consist of the work of more than one (1) subcontractor. The responsibility as to which subcontractor provides labour, materials, equipment and services required to complete the work rests solely with the Contractor.
- 1.2.3 Furnish, install, test and commission a complete operational electrical system as required by the drawings and as herein specified.
- 1.2.4 The Contractor shall provide all power and control conduit and wiring as required for all process equipment and for equipment supplied under other Divisions, as shown on the drawings and/or specified herein.
- 1.2.5 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. Install and connect all electrical and instrumentation equipment, controls and devices supplied under other sections.
- 1.2.6 Remove and dispose of existing equipment made obsolete by this project and also disconnect/reconnect existing equipment either relocated or serviced from new equipment.
- 1.2.7 Visually inspect the existing building and equipment conditions, including below grade areas, prior to the project award to suit the installation of the new power and controls distribution.
- 1.2.8 Furnish and install a complete operational instrumentation system as required by the drawings and as specified in Division 13.

### **1.3 Scope Of Work**

- 1.3.1 The WWTP will remain in service while the Clarifier upgrades are completed. Shutdowns of the Aeration Tanks shall occur as required to facilitate the concrete tank rehabilitation work. The drawings and specifications in Division 16 outline the Contractor's responsibilities regarding the electrical portion of the Work. However, the Contractor has additional electrical duties that are described in the documents of Division 1 and 13.

1.3.2 Utility Power

.1 Construction Power (Temporary Service)

- .1 The Contractor shall provide on a temporary basis, an electrical service, power distribution panels and cabling as necessary to supply power to the various mobile offices and structures used by the Contractor and Sub-Contractors to facilitate execution of the Work. Contractor shall coordinate this work with the local utility.
- .2 Contractor shall not assume temporary power will be provided from the plant. However, Contractor may negotiate with the Owner after award if use of existing plant power is acceptable.

1.3.3 Power Distribution

- .1 Existing MCC-4, located in the Blower Building, shall be upgraded to provide motor starters to control Secondary Clarifiers 2 to 4.
- .2 Motor starter for Secondary Clarifier 1, located in existing MCC-4, shall remain. All field wiring to this starter shall be replaced with new.
- .3 Existing MCC-10, located in the Screw Pump building, shall be upgraded to provide motor starters to control Secondary Clarifiers 5 to 8.
- .4 Existing Secondary Clarifiers 2-8 shall be upgraded with new mechanisms, wiring, local control panels and disconnect switches.
- .5 Existing Secondary Clarifier 1 shall be rehabilitated as directed in the contract drawings. The clarifier shall be outfitted with new raceways as required to connect to the existing local control panel and disconnect switch.
- .6 The Contractor shall provide all new power distribution equipment and raceways, including new MCC starter buckets as indicated on the contract drawings.
- .7 Existing Secondary Clarifier Wasting Valves 7 and 8 shall be replaced as directed in the contract drawings. The contractor shall provide new field-mounted disconnect switches on a new support stand adjacent to the switches. Their respective MCC buckets at MCC-10 shall be replaced with new. All new wiring from MCC-10 and from the PLC control panel shall be provided.
- .8 Existing MCC-4 supplies power to the motorized valves at the Aeration Tanks. The contractor shall lockout tag-out (LOTO) these power feeds before commencing the work described on the contract drawings. The existing power are to be disconnected at the devices and stored neatly and safely at the Aeration Header to allow for the concrete rehabilitation of the tanks to occur. All devices affixed to the tanks (e.g. disconnect switches, cable tray, etc.) are to be temporarily removed and reinstalled after the completion of the tank rehab work.
- .9 Standby/Emergency Power Generator
  - .1 The WWTP is equipped with an existing permanently installed standby generator. The generator shall not be used by the contractor for construction activities.

- .10 The Contractor shall provide feeders to the equipment's single point of power connection that shall be provided on all packaged process equipment. Respective of the clarifier mechanisms, each shall be fitted with a new disconnect switch to provide local power disconnection of the motor.
- .11 The Contractor shall install all branch circuits for and within process equipment systems that are directly controlled by the Brantford WWTP process control system (i.e. SCADA).
- .12 The Contractor shall install process control I/O cabling and conduit, as appropriate and necessary (refer to the contract drawings).

#### 1.3.4 Process Instrumentation and Controls

- .1 The Contractor is responsible for integrating all the new process control entities into the existing process control system for the WWTP.
- .2 The equipment vendors that are providing their own clarifier mechanism systems are responsible for the design, construction, installation, testing and commissioning of this apparatus. The Contractor shall provide all the materials (i.e. disconnect switches, local control panels, conduit, wire, process connections, brackets and supports, etc.), components and labour to complete the installation of vendor provided process equipment.
- .3 The Contractor shall provide process control entities and the related instrumentation as indicated on the contract drawings. The Contractor is responsible for the final design, construction, installation, testing and commissioning of its process control systems. The Contractor will provide all the materials (i.e. disconnect switches, local control panels, conduit, wire, process connections, brackets and supports, etc.), components and labour to complete the installation of the process equipment under the realm of its responsibility.
- .4 Power and control to the instruments at the Aeration Tanks is supplied from the existing Aeration Remote I/O CP BWPCP-CP-06. These power feeds are to be shut off at CP-06 to safely disconnect their power and control cables at the field devices. Typical of the other equipment around the Aeration Tanks, these power cables are to be temporarily disconnected, pulled back, and stored safely and neatly before reconnecting after the concrete rehab work is completed.
  - .1 Power and control wiring to the two (2) DO system analyzers located on the North-end of the Centre Walkway of the Aeration Tanks (identified on the contract drawings) are to be removed and replaced with new; all outdoor raceways to these devices shall be removed. Indoor raceways may be re-used; new raceways shall be installed outdoors along the perimeter of the tank, typical of the existing installation.

#### 1.3.5 SCADA

- .1 The Contractor shall work with the system integrator (Division 13) to provide an upgraded functional SCADA system which will include monitoring and control of process equipment, as shown on drawings and as detailed in Division 13.

- .2 The Contractor shall work with the system integrator and the City to test and re-commission all devices at the Aeration Tanks that were temporarily disconnected to facilitate the tank rehabilitation work.

#### 1.3.6 Demolition

- .1 Parts of the existing WWTP will be demolished and others will be modified for new duties.
  - .1 The Contractor shall effectively remove all sources of power to make the building/area/appurtenance safe for demolition or for modification as the case may be.
  - .2 The Contractor shall inspect the buildings, areas and appurtenances for the existence of hazardous substances (i.e. mercury, asbestos, PCB's, etc.) within the existing electrical power distribution, instrumentation and control equipment installations. The Contractor shall remove and dispose the substances in accordance with Ministry of the Environment, Conservation and Parks regulations, before demolition or modification commences.
  - .3 For those buildings, areas and appurtenances being modified for new duties, the Contractor shall completely remove all electrical apparatus such that there are no visible or identifiable components remaining from the existing electrical system. The electrical apparatus includes but is not limited to:
    - .1 Components, panels, pull/junction boxes, terminal boxes, conduits, wiring, brackets and supports for or that comprise the existing secondary clarifier systems.
    - .2 Affected motor starter buckets located within the respective MCCs, including all field wiring to be pulled back to the source terminals.

#### 1.3.7 Installation and Operation Certification

- .1 Installation Certification
  - .1 The Contractor shall certify that the installation of the electrical work is complete and complies with the contract specifications and contract drawings, for each motor, screen, each automated process valve and each analytical sensing instrument. Refer to the Process and Instrumentation Drawings (P&IDs) which illustrates the majority of all the field devices relevant to the work.
  - .2 The Installation Certification document shall include the following.
    - .1 Identification of the device
    - .2 Confirmation that the device or component is installed in the specified location and in the correct orientation.
    - .3 Confirmation that all wiring installation work related to the device (i.e. power, communication, instrumentation, control) is complete, connections are correct as per the drawings and manufacturer's specifications, and all connections are secure.

- .4 Confirmation that the tags and labels related to the device are in place and inscriptions match the data provided in the contract specifications and drawings.
  - .5 Confirmation that the device or component is clean and in good order (i.e. undamaged or if required, scratches painted).
  - .6 Confirmation that manuals, tools, spare parts and materials supplied with the device or component are stored in a safe location on site and accessible for retrieval.
  - .7 Confirmation that the feeder and branch circuit relevant to the device has been megger checked and that the check has passed.
  - .8 Confirmation that all installation deficiencies have been addressed.
- .2 Operation Certification
- .1 The Contractor shall certify the electrical function/operation of each secondary clarifier.
  - .2 The Operation Certification document shall include the following.
    - .1 Identification of the device
    - .2 Confirmation that all power phases and phase voltages are within specification.
    - .3 Confirmation that motor rotation is correct.
    - .4 Confirmation that the device or component is powered up and ready to operate.
    - .5 Confirmation that the device or component configuration and calibration is complete and as per specification.
    - .6 Confirmation that the device or component can be operated repeatedly and consistently throughout its specified operating range.
    - .7 Confirmation that all features and functions of the device or component operate as expected and as specified.
    - .8 Confirmation that all operational deficiencies have been addressed.
  - .3 The Contractor shall perform the operation certification for a device or component only after the device and component has successfully passed the installation certification. Perform the operation certification on the device or component as a system.
  - .4 Complete the operation certification and submit the operation certification documentation to the Contract Administrator prior to commencement of the site acceptance testing (SAT). The operation certification documentation shall be submitted to support progress payment claims for this part of the project.

- 1.3.8 Test and commission all new and modified equipment, power distribution and control systems.
- 1.3.9 Clean all electrical equipment.
- 1.3.10 Provide training for all equipment supplied under this Division.

#### **1.4 Related Sections**

- 1.4.1 Read and conform to all Sections of the specifications. References to specific sections of the specifications do not relieve the Contractor of the requirement to read and follow all sections as a complete document.
- 1.4.2 The general instructions are intended to supplement and not to replace Division 1 requirements. Where requirements conflict, apply the more strenuous requirement.
- 1.4.3 The drawings, specifications, and standards are complimentary to one another, meaning that, that which is called for on one is meant to be called for on all. Where conflict exists between the Sections, Standards and/or Drawings, obtain clarification from the Construction Manager before any material is purchased or work commences.
- 1.4.4 If it is not clear from the Drawings and Specifications, which Division is responsible for performing certain works, obtain clarification of the item and/or items in question from the Construction Manager.

#### **1.5 Codes And Standards**

- 1.5.1 All equipment and work shall meet or exceed the requirements of the Ontario Electrical Safety Code (OESC) and to all standards referenced therein.
  - .1 The OESC is CSA C22.1, Canadian Electrical Code, Part 1, and the Ontario Amendments to that Code
  - .2 All electrical equipment shall bear all required approval marks to demonstrate approval to all applicable codes and standards.
- 1.5.2 Perform overhead systems in accordance with CSA C22.3 No.1 except where specified otherwise.
- 1.5.3 Perform underground systems in accordance with CSA C22.3 No.7 except where specified otherwise.
- 1.5.4 Code requirements shall be considered a minimum standard. When materials shown on drawings as indicated in the specifications exceed code requirements, the plans and specifications shall govern.
- 1.5.5 All references to regulations, codes and standards shall be made to the latest edition.

#### **1.6 Definitions**

- 1.6.1 The following are definitions of terms and expressions used in the specification:
  - .1 "Indicated" is defined as shown on the drawings or noted in contract documents.

- .2 "Inspection Department/Authority" means an agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site. For this project the Inspection Authorities include:
  - .1 The Electrical Safety Authority (ESA)
  - .2 The Technical Safety and Standards Authority (TSSA)
  - .3 The local building inspector
  - .4 The local fire inspector
- .3 "OESC" is defined as CSA C22.1, Canadian Electrical Code, Part 1, and the Ontario Amendments to that Code.
- .4 "Provide" is defined as to supply install, verify, test and commission.
- .5 "Supply Authority" is defined as the local electrical distribution company.
- .6 "Wiring" means wiring of power and control conductors to lighting, receptacles, as well as any controlling or controlled devices associated with them.

## **1.7 Coordination With Other Trades**

- 1.7.1 The specification is divided into divisions of work and a division may consist of the work of more than one (1) subcontractor. The responsibility as to which subcontractor provides labour, materials, equipment and services required to complete the work rests solely with the Contractor.
- 1.7.2 The Contractor shall be responsible for all electrical wiring and terminations required for equipment supplied in other Divisions, irrespective whether or not it is shown or mentioned on the drawings and specifications respectively so as to supply a complete working system.
- 1.7.3 Where special wiring (cables supplied with instruments, etc.) is supplied by other Divisions, the Contractor will be responsible for the installation of this wiring in coordination with the Division supplying said wiring.
- 1.7.4 Where equipment is supplied by other Divisions and installed under this Division:
  - .1 The Contractor shall be responsible for the proper installation of all panels, enclosures, switches, fixtures, etc., as shown on the drawings.
  - .2 Provide all terminations, junction boxes, fittings and flex connectors, such that raceway is continuous for its intended application. The Contractor shall be responsible for coordination with other Divisions supplying equipment, as to the exact location for installation of said equipment.
  - .3 Raceway types are to conform with the space classification.
  - .4 The Contractor shall request from other Divisions supplying equipment for installation and/or wiring under this Division, all pertinent instruction manuals, diagrams, specifications sheets, etc., required for the proper installation of the equipment.



- .5 The Contractor shall be responsible for verifying that the equipment's electrical specifications are suitable for the intended application as per Division 1. Check all voltage ratings, wiring terminations, current ratings and other electrical characteristics so as to supply a complete working system.

## **1.8 Coordination With Power Supply Authority**

- 1.8.1 If required by local regulations, arrange for inspection of all work by the Authorities having jurisdiction over the work. On completion of the work, present to the Owner the final unconditional certificates of approval of the Inspection Authorities.
- 1.8.2 Pay associated fees, for all permits, inspections, and power outages to suit supply authority/utility requirements.
- 1.8.3 The Contractor shall provide the Construction Manager with copies of all ESA reports, inspections, etc.

## **1.9 Permits, Fees and Inspection**

- 1.9.1 Submit all necessary documentation to the ESA during the construction period including electrical distribution equipment shop drawings as requested by ESA. The Contractor shall abide by all comments and recommendations provided by the ESA based on the submitted information, at no additional cost.
- 1.9.2 Notify the Construction Manager of changes required by Electrical Safety Authority (ESA) prior to making changes.
- 1.9.3 Furnish Certificates of Acceptance from the ESA on completion of work to the Construction Manager.
- 1.9.4 Arrange for inspection of all work by the Authorities having jurisdiction over the work. On completion of the work, present to the Owner the final unconditional certificate of approval of the Inspection Authorities.
- 1.9.5 Before starting any work, submit the required number of copies of drawings and specifications to the Authorities for their approval and comments. Comply with any changes requested as part of the contract, but notify the Construction Manager immediately of such changes for proper processing of the requirements. Prepare and furnish any additional drawing details for information as may be required.

## **1.10 Contract Drawings and Specifications**

- 1.10.1 Follow the Contract Drawings to become familiar with all conditions affecting the work and verify spaces in which the work will be installed.
- 1.10.2 The drawings for electrical work are performance drawings, diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate location of apparatus, fixtures and approximate sizes and location of equipment and outlets. The drawings do not show complete architectural, process and structural details.
- 1.10.3 Do not scale the drawings to determine dimensions, but obtain information for accurate dimensions by referring to architectural and structural drawings, or by site measurements.

- 1.10.4 Review existing drawings as available during the tender period. Become familiar with the condition of the existing drawings and related equipment. Allow for errors and omissions in the existing drawings and ensure that the tender price includes the provisions to make the necessary field reviews, field verifications, field changes, and drawing changes to suit the intent of the modification required.
- 1.10.5 Work which is indicated, but not completely detailed shall be installed by common practice or as directed by the Construction Manager.
- 1.10.6 Make, at no additional cost, any changes or additions to materials, and/or equipment necessary to accommodate structural conditions (i.e. runs around beams, columns, etc.).
- 1.10.7 Alter, at no additional cost, the location of materials and/ or equipment as directed, provided that the changes are made before installation and do not necessitate additional material.
- 1.10.8 Arrange work neatly and in compact fashion to maximize space available to accommodate future materials and/or equipment as indicated and to accommodate equipment and/or material supplied by other trades as well as to accommodate unplanned future equipment. Verify spaces in which work is to be installed. Install conduit and cable runs to maintain headroom and clearances to conserve space.
- 1.10.9 Confirm onsite the exact location of outlets and fixtures. Confirm location of outlets for equipment supplied by other trades.
- 1.10.10 Provide all minor items and work not shown or specified but which are reasonably necessary to complete the Work.
- 1.10.11 If discrepancies or omissions in the drawings or specifications are found, or if the intent or meaning is not clear, advise the Construction Manager for clarification before submitting tender.
- 1.10.12 Responsibility to determine which Division provides various products and work rests with the Contractor. Additional compensation will not be considered because of differences in interpretation of specifications.
- 1.11 Construction/Shop Drawings**
  - 1.11.1 Submit shop drawings in accordance with Section 01330 - Submittals.
  - 1.11.2 Submit data (drawings) for review prior to commencement of manufacturing or installing with the exception of conduit, standard conduit fittings and low voltage wiring.
  - 1.11.3 Prior to submitting the shop drawings, the Contractor shall review the shop drawings to determine that the equipment complies with the requirements of the specifications and drawings.
  - 1.11.4 Assume responsibility for accuracy of equipment dimensions related to available space and accessibility for maintenance and service, and compliance with codes and inspection authorities.
  - 1.11.5 Show all details of construction, dimensions, capacities, weights, and electrical performance characteristics of equipment or material.

- 1.11.6 Obtain manufacturer's installation directions to aid in properly executing the work. Submit two copies of such directions to the Construction Manager prior to installation, for use in inspecting the work.
- 1.11.7 Prepare composite construction drawings, fully dimensioned of cables, conduit, cable tray, sleeves, clearances, pipes, ducts, etc., and equipment in mechanical and electrical equipment rooms, ceiling spaces and all other critical locations to avoid a conflict of trades. Base drawings on manufacturer's shop drawings. Drawings should be developed from consultation with and agreement of all trades involved.
- 1.11.8 Prepare drawings of equipment bases, anchors, slabs, floor and roof curbs, if needed, for the electrical work.
- 1.11.9 In addition to the requirements of Section 01330, provide working drawings with, but not necessarily limited to, the following additional information:
  - .1 Manufacturer's and Supplier's name.
  - .2 Manufacturer's bulletins, leaflets and specifications of major electrical equipment.
  - .3 Catalogue model number.
  - .4 Number identifying item on the drawings and/or in the specifications such as equipment, item number, panel identification letters, etc.
  - .5 Indicate details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
  - .6 Where applicable, include wiring, single line and schematic diagrams.
  - .7 Include wiring diagrams or diagrams showing interconnections with work of other sections.
- 1.11.10 Contractor is responsible for providing shop drawings showing the integration between supplied control panels and control panels supplied with equipment. These drawings are to be a single drawing for each specific device, showing interconnection between the device and all associated panels and terminal blocks. Construction Manager reserves the right to request more detailed drawings if those provided are deemed insufficient.
- 1.11.11 Submit samples of material and equipment where specified or as may reasonably be requested by the Construction Manager for review before ordering same in accordance with Division 1. The Construction Manager may retain the samples until the completion of the contract.
- 1.11.12 Complete all work in accordance with reviewed shop drawings.
- 1.11.13 Where conduits, cable trays and lay-in ducts are not detailed, submit conduit, cable tray and wiring layout drawings. Show conduit/tray and cable sizes including number of cables/conductors in each conduit/tray. Drawings shall be on the same size sheets as the contract drawings.
- 1.11.14 Update single line electrical diagrams to include any modifications to the electrical distribution system.

1.11.15 Indicate the number, letter or equipment tag used on the drawings/specifications as an identification symbol on product data for equipment submitted.

1.11.16 Bind one complete set of construction/shop drawings showing "as built" conditions in each operating and maintenance instruction manual.

## **1.12 Record Drawings**

1.12.1 Comply with requirements for record drawings stated in 01330 - Submittals.

1.12.2 Before commencing work, obtain two sets of electrical drawings for showing "As Built" conditions. As job progresses, mark on field set of prints to indicate accurately all installed work. At completion stage, transfer all information onto master set of drawings and indicate "Contractors Certified Approval of Accuracy" before submitting to Construction Manager for review and record use.

1.12.3 Indicate on record drawings "As Built" stamp.

1.12.4 Show on the record drawings as-built, all outlets and equipment such as runs of conduit, locations of pull boxes, equipment, outlets, motors, panels, etc., as well as all services entering the building and on the property.

1.12.5 Dimension underground services and concealed main and sub-feeder conduits at key points of every run in relation to structure and building. Record all elevations for underground services in relation to the ground floor level of the building. Indicate on record drawings, location of all buried services. This information is to be certified correct by Construction Manager before backfilling commences.

1.12.6 Indicate exact location of all services left for future work.

## **1.13 Operations And Maintenance Manuals**

1.13.1 Comply with requirements for operating and maintenance manuals stated in 01330 - Submittals.

1.13.2 In addition to the requirements of 01330 - Submittals, include in the Operations and Maintenance Manuals:

- .1 Details of design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
- .2 Technical data, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items and parts lists. Advertising or sales literature are not acceptable.
- .3 Wiring and schematic diagrams and performance curves.
- .4 Names and addresses of local suppliers for items included in Maintenance Manuals.
- .5 Copy of test data.

- .6 List of spare parts of all electrical equipment complete with names and addresses of sales, service representatives and suppliers.
- .7 A motor list showing each motor number, name, horsepower, full load amps, overload settings, nameplate, current rating, heater size and type, and current being drawn, etc.
- .8 Copy of final inspection certificate.
- .9 Copy of the purchase order, showing equipment make and model numbers issued to the manufacturer complete with all addenda. All cost details may be hidden.
- .10 Copy of all warranty certificates.
- .11 Set of final reviewed Shop Drawings.

#### **1.14 Voltage Ratings**

- 1.14.1 Operating voltages: CAN2-C235-83
- 1.14.2 Control and distribution devices and equipment to operate satisfactorily under the extreme operating conditions established in the above standard without mis-operation or damage to equipment.

#### **1.15 Site Conditions**

- 1.15.1 Voltage Supply (MCC-4 & MCC-10), 600 V: 3-phase, 3-wire, solidly grounded.
- 1.15.2 Voltage Supply, other: as shown on drawings.
- 1.15.3 Temperature range:
  - .1 Indoor: 10°C to 40°C
  - .2 Outdoor: -35°C to +40°C
- 1.15.4 Altitude: <1000 m ASL
- 1.15.5 Contaminants: Hydrogen sulfide
- 1.15.6 The project contains classified areas as shown on the drawings.

## **2 PRODUCTS**

### **2.1 Materials And Equipment**

- 2.1.1 All equipment shall be new, of first quality, and wherever possible shall be of a manufacturer's standard design.
- 2.1.2 Equipment and material must be certified to a recognized Canadian standard (CSA, CUL, etc.).
  - .1 Where listed equipment is not available, obtain special approval acceptable to the ESA and pay all associated fees.

- 2.1.3 Unless otherwise indicated all equipment shall conform to customary North American standards (e.g. NEMA, ANSI, ASTM, CSA, etc.).
- 2.1.4 Factory-assemble control panels and component assemblies.
- 2.1.5 All new electrical wiring, equipment, and new local control panels are to be supplied to meet the electrical and environmental classifications of area in which they are to be installed.
- 2.1.6 Equipment and material must be CSA certified. Where there is no alternative to supplying equipment that is CSA certified, obtain special approval from ESA Electrical Inspection Department. Pay all associated fees and perform all required retrofits to obtain special inspection certification.
- 2.1.7 CSA labels shall be visible and legible after equipment is installed.

## **2.2 Finishes**

- 2.2.1 Unless otherwise noted in the equipment sections or drawings, finish all equipment as follows.
- 2.2.2 All shop finishes for steel enclosures shall include cleaning, iron phosphate wash, rinsing, rust resistant primer inside and outside, and at least two coats of finish enamel with appropriate baking to cure each paint application.
- 2.2.3 Colours:
  - .1 Paint outdoor electrical equipment "equipment green" finish to ANSI C57.12.28.
  - .2 Paint indoor switchgear and distribution enclosures ANSI- 61 light grey (Munsell 8.3G 6.1/05) to EEMAC 2Y-1-1958.
  - .3 Paint the interior of control compartments semi-gloss white.
- 2.2.4 Stainless steel enclosures shall not be painted.
- 2.2.5 Paint and primer application shall be power coat unless otherwise specified or approved in writing by the Engineer.
- 2.2.6 On site, clean and touch up any scratched or marred surfaces of on shop painted equipment scratched or marred during shipment or installation, to match original paint.
- 2.2.7 Break and deburr all edges.
- 2.2.8 Clean and prime exposed non galvanized and non-stainless hangers, racks and fastenings to prevent rusting.

## **2.3 Enclosure Ratings**

- 2.3.1 Enclosure ratings to be as follows unless indicated otherwise in the contract documents:
- 2.3.2 Indoor and dry locations: NEMA 12, sprinkler proof.
- 2.3.3 Below grade, damp or outdoor locations: NEMA 4X, or as noted on drawings.

2.3.4 Classified areas (indoors and outdoors): to suit area classification.

## **2.4 Equipment Identification**

2.4.1 All equipment, wiring and conduits shall be identified as described in Section 16090 and in the contract documents.

## **2.5 Warning Signs**

2.5.1 As specified and to meet requirements of Electrical Inspection Department and Construction Manager.

2.5.2 Decal signs, minimum sized 175 x 250mm.

2.5.3 Protect exposed live equipment during construction for personnel safety.

2.5.4 Shield and mark live parts with appropriate voltage values in English.

## **2.6 Single Line Electrical Diagrams**

2.6.1 Provide updated single line electrical diagrams under Plexiglas as follows:

- .1 Electrical distribution system: Locate one in the MCC room contain (MCC-4 and 10). Coordinate location with the construction manager and Owner.
- .2 Single line shall include 600V distribution complete with all protection equipment settings, cable sizes, raceways, and distribution equipment specifications.
- .3 Single line diagram shall include the as as-built ratios for all CTs. For multi-tap CTs, indicate the as-left tap settings.

2.6.2 Drawings: 600 x 600mm minimum size.

2.6.3 Drawings shall meet the requirements of the power supply authority and local inspection authority's single line diagram requirements, and as a minimum shall include transformer ratings and connections, breaker ratings, relays, CT ratios, PTs, and main cable sizing information. Drawing is to be reviewed by Engineer for accuracy and completeness.

## **2.7 Insert, Sleeves, Fastenings and Supports**

2.7.1 Provide all necessary inserts, hangers, fastenings, sleeves and curbs for electrical equipment, suspended from or passing through structural walls or floors, to suit the specific location, and as approved by the Construction Manager.

2.7.2 Sleeves: allow 12 mm clearance over the O.D. of all cables and conduits, 25 mm horizontally and vertically for rectangular openings.

## **3 EXECUTION**

3.1.1 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section. Install and connect all electrical and instrumentation equipment, controls and devices supplied under other sections. The word "provide" shall be defined to mean supply and install.

### **3.2 General**

- 3.2.1 The use of permanent electrical system for temporary construction service shall be only with written permission of the Construction Manager.
- 3.2.2 Maintain at the job site, at all times, qualified personnel and supporting staff, with proven experience in erecting, supervising testing projects of comparable nature and complexity.
- 3.2.3 Expedite the work as follows:
  - .1 Continuously check and expedite delivery of equipment and materials.
  - .2 If necessary, inspect at the source of manufacture.
  - .3 Continuously check and expedite the flow of necessary information to and from all parties involved.
  - .4 Inform the Construction Manager promptly where information is required.
- 3.2.4 The work of this division shall be coordinated with other divisions in such a manner as not to interfere with other work. In areas where the ducts, pipes, wiring and equipment for other sections will be installed in proximity to pipes, wiring and equipment pertaining to this division, cooperate to ensure that all pipes, ducts, wiring and equipment are installed to the best advantage.
- 3.2.5 Equipment, conduit, etc., installed but not coordinated with the work of other trades shall be relocated as directed by the Construction Manager without extra cost to the Owner.
- 3.2.6 Install equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly to the satisfaction of the Construction Manager. Install exposed conduit runs parallel and perpendicular to building planes. Install conduit concealed in chases, behind furring, or above ceiling, except in unfinished areas. Install exposed systems neatly and group to present a neat appearance.
- 3.2.7 The Contractor is required to remove all power distribution, conduit and control wiring for all items that are identified for demolition on the contract drawings. The Contractor shall correlate the demolition requirements on the electrical drawings with all other drawings and disciplines to ensure that all power and control wiring distribution is removed for any equipment identified for demolition. The contractor is required to remove all wiring and raceways that are rendered redundant as a result of the demolition and/or equipment removals.
- 3.2.8 Remove and return all field instrumentation to the owner in good condition.

### **3.3 Workmanship**

- 3.3.1 Install all equipment, conduit and cables in a workmanlike manner to present a neat appearance and to function properly.
- 3.3.2 Install exposed systems and equipment neatly and grouped to present a neat appearance, without conflict to other services.



- 3.3.3 Install equipment and apparatus requiring maintenance, adjustment or eventual replacement with due allowance therefore, in terms of space and accessibility.
- 3.3.4 Include in the work all requirements of manufacturers shown on the shop drawings or manufacturers' installation instructions and make provision for future and equipment as shown.
- 3.3.5 Replace without extra cost work unsatisfactory to the Construction Manager.
- 3.3.6 Protect all equipment from damage during delivery to the site and during installation. Make good any damage or deterioration whatsoever and have it covered by replacement guarantee.
- 3.4 Pre-Construction Inspection**
  - 3.4.1 The contractor is required to coordinate the installation of the new power/control infrastructure with the existing conditions and services. The Contractor shall verify all existing conditions including building services that are in close proximity to the proposed cable installation as shown on the drawings.
- 3.5 Temporary Power**
  - 3.5.1 The Contractor shall be responsible for all costs associated with servicing the site with temporary power (i.e. Electricity) for the purpose of construction as well as maintaining a site office.
  - 3.5.2 The Brantford WWTP is required to remain in continuous service for the duration of this contract with a normal and emergency power source continuously available. Provide temporary power as required to accommodate the construction works and staging requirements. The facilities comprise of multiple 600 V and 208/120 V feeds.
  - 3.5.3 The Contractor shall be responsible for all costs associated with providing temporary power generation on site to ensure that all systems remain in full and un-interrupted operation for the duration of the project.
- 3.6 Excavation And Backfill**
  - 3.6.1 Ensure that route and depth of excavation for underground electrical services are as indicated. Provide protective materials around and over services and be present at all times during excavation and backfilling to supervise work.
- 3.7 Cutting, Patching and Welding**
  - 3.7.1 Conform to the requirements of Division 1 in respect to cutting, patching, and fitting electrical equipment.
  - 3.7.2 Where installation of equipment by this section requires cutting or patching of new or existing work, the work shall be performed by, and under direction and supervision of, this section. Make good surface finishes to satisfaction of the Construction Manager.
  - 3.7.3 Locate and provide holes and sleeves required for electrical work. Relocate improperly located holes and sleeves at no cost.

- 3.7.4 Finish sleeves flush with wall finish (each side) or the ceiling to curb top.
- 3.7.5 No cutting or welding of beams, columns or structural surfaces is permitted without approval of the Construction Manager and all damage to finished or unfinished surfaces shall be made good to the satisfaction of the Construction Manager.
- 3.7.6 Pay all costs for cutting and patching resulting from failure to co-ordinate timely installation of electrical inserts, sleeves, etc., into masonry structures.

### **3.8 Securing Of Equipment**

- 3.8.1 Secure equipment to poured concrete with expandable inserts, properly sized for the load to be carried.
- 3.8.2 Secure equipment to hollow masonry walls or suspended ceilings with factory made threaded or toggle type inserts, properly sized for the load to be carried.
- 3.8.3 Secure equipment to solid masonry, tile and plaster surfaces with lead anchors or nylon shields, properly sized for the load to be carried.

### **3.9 Mounting Heights**

- 3.9.1 Mounting height of equipment is from finished floor to centreline of equipment.
- 3.9.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- 3.9.3 Install electrical equipment at following heights unless indicated otherwise.
  - .1 Local switches: 1220mm.
  - .2 Wall receptacles
    - .1 General: 300mm.
    - .2 Above top of continuous baseboard heater: 200mm.
    - .3 Above top of counters or counter splash backs: 175mm.
    - .4 In mechanical rooms: 1220mm.
  - .3 Panelboards: as required by Code or as indicated.
  - .4 Disconnect switches: 1220mm.
- 3.9.4 No controls shall be mounted at greater than 1800 mm above finished floor or grade.

### **3.10 Conduit And Cable Installation**

- 3.10.1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be plastic, sized for free passage of conduit, and protruding 50mm either side.
- 3.10.2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

- 3.10.3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

### **3.11 Wiring - General**

- 3.11.1 Unless otherwise indicated on the drawings all power and control wiring shall be installed in surface-mounted conduit.

.1 Conduit types shall be as indicated in Section 16133.

- 3.11.2 Provide spare conductors as follows:

- .1 10% or minimum three (3) spare conductors in each 120 V power conduit.
- .2 20% spare control wiring or minimum four (4) spare conductors in each control-wiring discrete control signal conduit.
- .3 20% or minimum one (1) analog twisted shielded pair which ever quantity is greater.
- .4 20% spare control conductors in each multi-conductor armoured discrete control cable.

- 3.11.3 Provide space for 20% additional conductors in each low voltage power and control conduit and box.

- 3.11.4 All conductors are to be continuous with no splices for each application.

.1 Marrettes are only permitted for lighting and receptacle circuits.

- 3.11.5 All conductors shall be stranded copper unless otherwise indicated.

- 3.11.6 All wiring shall be identified in accordance with Section 16090.

- 3.11.7 Provide a dedicated green jacket bond conductor in all raceways including PVC and metallic conduits.

- 3.11.8 Provide a ground/bond conductor to suit all power distribution wiring applications. Unless otherwise indicated on the drawings the ground conductors are to be sized in accordance with the Ontario Electrical Safety Code - Latest Edition.

### **3.12 Wiring Terminations**

- 3.12.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

- 3.12.2 Where stranded conductors terminate on a screw terminal, the conductor will be terminated with a full ring terminal.

- 3.12.3 Under no circumstances will more than one (1) conductor or ground be installed in a screw type connector, lug or terminal block.

**3.13 Demolition**

- 3.13.1 Removals shall include all equipment, distribution, raceways, wiring that is redundant as a result of the equipment removals.
- 3.13.2 Restore all surfaces and fill all voids that are left as a result of the removals. Items identified for removal and redundant infrastructure are to be disposed of from the site by the contractor.
- 3.13.3 Remove all unused surface-mounted raceway. Cap and tag all abandoned, embedded raceway.
- 3.13.4 Do not remove or demolish existing systems until the replacement systems are installed, commissioned and accepted by the Contract Administrator.
- 3.13.5 Coordinate demolition work with other divisions. It remains the Contractor's responsibility to coordinate the demolition work.

**3.14 Cleaning**

- 3.14.1 Comply with Section 01000 - General Requirements.
- 3.14.2 Before energizing any system, inspect and clean the inside of switchgear, MCC, panels, etc. to ensure that they are free from dust, shavings and debris.
- 3.14.3 At time of final cleaning, clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt.
- 3.14.4 Clean all polished, painted and plated work brightly.
- 3.14.5 Remove all debris, surplus material and all tools.

**3.15 Field Quality Control (Testing)**

- 3.15.1 Prior to the Owner's acceptance, all electrical equipment, materials and systems installed shall be subject to an inspection and applicable performance tests supervised by the Construction Manager to ensure that the operation of the system and components satisfy the requirements of the Contract Documents.
- 3.15.2 Comply with requirements of:
  - .1 Section 01810 - Testing and Commissioning
  - .2 Section 01820 - Demonstration and Training
- 3.15.3 Refer to specific equipment sections for additional details and requirements.
- 3.15.4 All equipment and electrical systems which are provided under this Division shall be performance tested for electrical and mechanical defects and all defects and adjustments made, prior to requesting inspection by the Construction Manager.
- 3.15.5 Tests requiring initial power-up of a system shall not be made without notification of the Construction Manager.

- 3.15.6 Carry out tests in presence of Construction Manager.
- 3.15.7 Furnish labour, materials, instruments and bear all costs for tests as requested by the Construction Manager.
- 3.15.8 Conduct all testing by fully qualified personnel only.
- 3.15.9 In addition to tests on purely electrical systems, supply the necessary labour and equipment for operational tests required by other Divisions where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Construction Manager.
- 3.15.10 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.
- 3.15.11 Clean all equipment prior to testing.
- 3.15.12 Ensure that the system and its components are ready prior to the inspection and test for acceptance.
- 3.15.13 All testing shall be scheduled and coordinated through the Construction Manager. No testing of any kind shall be done without this clearance. Give three (3) working days' notice of proposed tests.
- 3.15.14 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.
- 3.15.15 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.
- 3.15.16 Document all testing. Record test procedures, acceptable results, actual results, remedial work performed and final outcome.
- 3.15.17 Submit original copies of letters from the manufacturers of auxiliary systems indicating that their technical representatives have inspected and tested the respective systems and are satisfied with the methods of installation, wiring and operation.
- 3.15.18 Submit two (2) copies of test results for Construction Manager's review in addition to copies included in maintenance data.
- 3.15.19 Replace at no additional cost all fuses, relays, or other devices destroyed during field quality control testing.
- 3.16 Care, Operation, And Start Up**
- 3.16.1 Instruct Engineer and operating personnel in the operation (testing), care and maintenance of equipment.
- 3.16.2 Arrange and pay for services of manufacturer's factory service engineer to supervise start up of installation, check, adjust, balance and calibrate components.

- 3.16.3 Provide these services for such period, and for as many visits as necessary to put equipment in operation and ensure that operating personnel are conversant with all aspects of its care and operation.

**3.17 Trial Usage**

- 3.17.1 The Owner and Owner's representatives shall have the privilege of trial usage of the electrical system or parts thereof for the purpose of testing and verifying operational procedures.
- 3.17.2 Trial usage by the Owner shall not waive the Contractor/Sub-Contractor of any responsibility because of trial usage.
- 3.17.3 Trial usage shall not be construed as acceptance by the Owner.

**3.18 Demonstration And Training**

- 3.18.1 Instruct Owner's personnel in the operation, care and maintenance of equipment. Perform demonstration and training in accordance with Section 01800 - Start-up, Commissioning & Training.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Purpose**

1.1.1 The specification describes the requirements for the following studies:

- .1 Short circuit analysis, device evaluation and coordination study (SCCS)
- .2 Arc flash hazard analysis study (AFHS)

1.1.2 The specification describes the requirements for:

- .1 Setting and verifying the operation of protective devices
- .2 Arc flash hazard labelling

1.1.3 Contractor is responsible to confirm and request for the latest most up to date study for reference if required prior to providing a new complete study.

### **1.2 Scope of Work**

1.2.1 The Contractor and/or their supplier of analysis services shall, as defined in this section:

- .1 Investigate the existing system to gather data for the analysis.
- .2 Obtain the necessary characteristics of equipment supplied under the contract
- .3 Obtain utility fault data from the Supply Authority
- .4 Prepare a short circuit analysis
- .5 Verify all equipment duties and make recommendations where equipment is underrated
- .6 Prepare a coordination study
- .7 Prepare an arc flash hazard analysis and prepare recommendations to reduce arc flash hazards
- .8 Set all protective devices
- .9 Apply Arc Hazard labels
- .10 Field test, inspect and verify all protective devices

1.2.2 The Short Circuit Analysis, Protection Coordination Study and Arc Flash Hazard Analysis shall include all new 600V power distribution system equipment under this project as well as all upstream equipment affected by the project including:

- .1 New equipment and power distribution system
- .2 Retrofitted existing MCCs

.3 Existing Distribution panels

### **1.3 General Requirements**

- 1.3.1 The Contractor shall provide all labour, supervision, tools, equipment, materials, services and miscellaneous expenses necessary to complete the work as outlined in this Section.
- 1.3.2 Equipment and component titles used in the studies shall be identical to the equipment and component titles shown on the drawings.
- 1.3.3 The Contractor is responsible for providing all services in accordance with the Ontario Electrical Safety Code - Latest Addition and ESA latest bulletins. The Contractor shall provide licensed and appropriately trained electricians where required for data gathering and device settings.
- 1.3.4 The Contractor is responsible for providing appropriate arc flash safety equipment and procedures when opening live equipment.
- 1.3.5 The analysis shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.
- 1.3.6 This Section covers items common to Sections of Division 16. This section supplements requirements of Division 1.

### **1.4 Definitions**

- 1.4.1 The following are definitions of terms and expressions used in the specification:
  - .1 "Inspection Department/Authority" means an agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site. For this project the Inspection Authority is the Electrical Safety Authority (ESA).
  - .2 "Provide" means to supply, implement, test, verify and implementation of recommendations related to analysis works.
  - .3 "Electrical Code" means Ontario Electrical Safety Code, latest edition.
  - .4 "Indicated" means as shown on contract drawings or noted in contract documents.
  - .5 "Supply Authority" means the local electrical distribution company. For this project the Supply Authority is Wellington North Power Inc.

### **1.5 Codes and Standards**

- 1.5.1 Perform work and supply equipment in compliance with the latest editions of the Ontario Electrical Safety Code and all local codes and requirements, which govern the installation.
- 1.5.2 Perform SCCS in accordance with IEEE 242
- 1.5.3 Perform arc flash analysis and prepare labels in accordance with CSA Z462.
- 1.5.4 Perform harmonic analysis in accordance with IEEE 519.



## **1.6 References**

- 1.6.1 Read and conform to the General Requirements (Division 1), which applies to and forms part of all sections of the work. The general instructions are intended to supplement and not to replace Division 1 requirements.
- 1.6.2 The following is a list of standards which may be referenced in this section:
  - .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
    - .1 IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
    - .2 IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
    - .3 IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
    - .4 IEEE 241 - Recommended Practice for Electric Power Systems in Commercial Buildings
    - .5 IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems.
  - .2 Canadian Standards Association (CSA)
    - .1 CSA C22.2 No.0 for "Definitions and General Requirements".
    - .2 CSA Z85 for abbreviations for electrical terms:

## **1.7 Coordination - Supply Authority**

- 1.7.1 Co-ordinate with the power supply authority to obtain utility fault contribution data.
- 1.7.2 Obtain specific fault contribution data for each utility feeder circuit that supplies power to the Wastewater Treatment Plant. Where feeders can be fed from multiple stations, obtain the fault current from each station
- 1.7.3 Obtain the design short circuit level from the supply authority for the device evaluation.
- 1.7.4 Arrange for access to equipment controlled by the supply authority as required to suit the analysis works.
- 1.7.5 Pay all costs levied by the supply authority for site assistance or access to equipment that is under the care and control of the supply authority. Pay for, schedule and obtain station guarantees from the supply authority as required to suit data gathering.

## **1.8 Coordination - Electrical Safety Authority**

- 1.8.1 Provide copies of the approved studies to ESA as required.

1.8.2 Make all changes required by ESA and resubmit the study to the Owner and the ESA. All changes required to satisfy ESA shall be made at no cost to the owner.

1.8.3 Arrange for and pay for any ESA Inspections that are required to re-energize equipment.

**1.9 Coordination - General**

1.9.1 Coordinate with the owner's staff for access to fenced areas, buildings, and rooms for the purpose of data gathering and verification.

1.9.2 The Contractor shall provide a schedule to the owner indicating the locations that will require access by the contractor's staff. The contractor shall provide a schedule 5 business days in advance of the proposed location access for review and approval by the owner.

1.9.3 In case of a discrepancy between statement(s) or value(s) between the specifications, contract drawings, codes and referenced standards, the more stringent statement or value shall take precedence and shall govern.

1.9.4 The shop drawings for electrical equipment operating at 600 V and above shall not be reviewed without the device evaluation study.

**1.10 Quality Assurance**

1.10.1 One firm shall be employed to perform the data gathering, analysis and verification.

1.10.2 The study agent shall not perform device settings. All device settings shall be performed by the manufacturer or their designated representative.

.1 The Contractor may perform device settings where properly trained and when authorized by the manufacturer.

.2 Where existing device settings are modified, the study agent shall make the changes and the Contract Administrator shall verify the changes.

1.10.3 The firm should be currently involved in the preparation of high and low voltage power system studies of the type required herein.

1.10.4 The firm performing the study shall demonstrate experience and training in the following:

.1 The relevant analysis procedures

.2 Use of the required analysis software

.3 Operation of the required testing instruments

.4 Operation, setting and verification of the protective devices covered by the studies

1.10.5 All studies and verification reports shall be supervised, stamped and signed by a Professional Engineer registered in the Province of Ontario.

.1 The stamping Engineer shall have a minimum of five (5) years of experience in power system analysis.

1.10.6 All testing devices shall be calibrated in accordance with the manufacturer's requirements and, where applicable, to a NIST recognized standard.

.1 All equipment shall have up-to-date calibration marks.

.2 Any testing done with uncalibrated equipment shall be repeated at no cost to the Owner.

#### 1.11 Submittals

1.11.1 Provide the following submissions to the Contract Administrator:

.1 Preliminary information

.2 Short Circuit Study and Protective Device Evaluation

.3 Protection Coordination Study

.4 Arc Flash Hazard Analysis

.5 Protective device setting sheets

.6 Settings and device verification report

.7 As-set device files

1.11.2 The purpose and format of the submissions shall be as follows:

Submission	Purpose		Format		
	Review & Approval	Info	Electronic (pdf)	Electronic (native)	Paper
Preliminary information	x		x		
Short Circuit Study and Protective Device Evaluation	x		x		x
Protection Coordination Study	x		x		x
Arc Flash Hazard Analysis	x		x		x
Protective device setting sheets	x		x		x
Settings and device verification report		x	x		x
As-set device files		x		x	

#### .1 Paper Submissions Requirements

.1 The studies shall be separately bound in individual binders.

.2 Pages that contain colour, including charts, graphs, warning labels, shall be printed in colour.

.3 All diagrams, tables and charts shall be printed on a suitable size to allow clear reading.

**1.12 Submittals - Preliminary Information**

1.12.1 Provide the following information:

- .1 Credentials of the firm and stamping Engineer
- .2 Proposed distribution system arrangements for the SCCS and AFHS
- .3 The software used for the analysis

1.12.2 Submit for approval prior to commencing any work under the section.

**1.13 Submissions - Short Circuit Study and Protective Device Evaluation**

1.13.1 Provide a report containing the following:

- .1 Descriptions, purpose, basis and scope of the study
- .2 Calculation methods and assumptions, the base per unit quantities selected, source impedance data including power company system characteristics
- .3 Fault current calculations including a definition of terms and guide for interpretation of computer printout
- .4 Input data tables showing:
  - .1 Short circuit reactance of rotating machines
  - .2 Cable and conduit material data
  - .3 Bus data
  - .4 Transformer data
  - .5 Circuit resistance and reactance values
- .5 Calculation tables showing:
  - .1 Symmetric and asymmetric fault current for 3 phase faults and ground faults
  - .2 Fault contribution from all motors greater than or equal to 100hp at all voltages.
  - .3 Fault contribution from all generators and utility sources
  - .4 Maximum available fault currents, 3 phase and phase-to-ground for all busses
  - .5 Maximum available fault current RMS symmetrical at each protective device.
  - .6 Fault impedances.
  - .7 X to R ratios.
  - .8 Asymmetry factors.

- .6 Evaluation tables showing:
    - .1 Interrupt ratings of all existing distribution equipment showing protective devices ratings versus calculated short circuit duties, and commentary, and commentary regarding same.
    - .2 Equipment "Pass" or "Fail" given available fault levels
    - .3 The name, description, locations and voltage level of the respective equipment in the summary table.
    - .4 Fault impedance, X to R ratios, asymmetry factors, motor contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.
  - .7 Establish settings to all protective devices in the distribution system, including devices with fixed protection characteristics.
  - .8 A Single Line Diagram from the analysis software showing the parameters for all new and existing electrical distribution system devices used in the analysis and the names and/or tags of all distribution equipment
  - .9 Single Line Diagrams from the analysis software showing the worst case interrupting and withstand short circuit current levels at each bus.
- 1.13.2 Provide a copy of the analysis model in its native format.
- 1.14 Submissions - Protection Coordination Study**
- 1.14.1 Provide a report containing the following:
- .1 Descriptions, purpose, basis and scope of the study
  - .2 The approved Short Circuit Study and Protective Device Evaluation
  - .3 Time-current curves (TCC) graphically indicating the coordination proposed for the system, centred on conventional, full-size, log-log forms.
  - .4 Include with each TCC sheet complete title and one-line diagram with legend identifying the specific portion of the system covered by that particular curve sheet.
  - .5 Tabulations of all protection and configuration settings for each microprocessor based protection relays including multifunction protection relays for branch feeders and motor protection relays.
- 1.14.2 Include a detailed description of each protective device identifying its type, function, manufacturer, and time-current characteristics.
- 1.14.3 Tabulate recommended device tap, time dial, pickup, instantaneous, and time delay settings.
- 1.14.4 Include on the curve sheets power company relay and fuse characteristics, system medium voltage equipment relay and fuse characteristics, low voltage equipment circuit breaker trip device characteristics, pertinent transformer characteristics, pertinent motor and generator characteristics, and characteristics of other system load protective devices. Include at least

all devices down to largest branch circuit and largest feeder circuit breaker in each motor control centre, and main breaker in branch panel-boards. Include all adjustable settings for ground fault protective devices. Include manufacturing tolerance and damage bands in plotted fuse characteristics. Show transformer full load and 150, 400 or 600% currents, transformer magnetizing inrush, ANSI transformer withstand parameters, and significant symmetrical and asymmetrical fault current to which the device is exposed.

- .1 Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip settings, fuse selection, and commentary regarding same.

- .1 Fault contribution from the Emergency Generator System.
- .2 Feeder cables thermal short circuit damage curve.
- .3 Primary fusing for protection of the transformers.
- .4 Power transformer thermal short circuit damage curve, 3 phase, phase to ground.
- .5 Largest 600V moulded case distribution breaker and characteristics.
- .6 Largest distribution transformer thermal short circuit damage curve.
- .7 Main 120/208V distribution breaker and characteristics.

- 1.14.5 Provide a copy of the analysis model in its native format.

#### **1.15 Submissions - Arc Flash Hazard Analysis**

- 1.15.1 Provide a report containing the following:

- .1 Descriptions, purpose, basis and scope of the study.
- .2 The approved Short Circuit Study and Protective Device Evaluation
- .3 The approved Protection Coordination Study
- .4 Tabulations of the arc flash hazard data and incident energy for each bus and distribution point.
- .5 Recommendations to reduce arc flash hazard levels.
- .6 Colour printouts on paper of the application specific Arc Flash Hazard warning labels that will be applied in the field.
- .7 A sample arc hazard label for approval
- .8 A Single Line Diagram from the analysis software showing the Incident energy levels at each bus, distribution point

- 1.15.2 Provide a copy of the analysis model in its native format.

**1.16 Submissions - Protective Device Setting Sheets**

1.16.1 Provide detailed data sheets for all relays and monitors within the scope of this study, including all multifunction relays, feeder protection relays, motor protection relays showing:

- .1 Protective device setting parameters
- .2 Allowable parameter ranges
- .3 Parameter setpoints
- .4 Output relay functions
- .5 Parameters for input devices
- .6 Internal logic settings
- .7 Communications parameters and addresses

**1.17 Submissions - Settings and Device Verification Report**

1.17.1 Provide a report for each tested device that shows the following:

- .1 The operator and equipment used including equipment make, model, serial number and calibration information.
- .2 Environmental conditions at time of testing
- .3 Test procedure
- .4 Expected and/or acceptable test result
- .5 Actual test results
- .6 Remedial action taken to achieve compliance with the test goals
- .7 Outstanding deficiencies and recommended remedial action required.

**1.18 Submissions - As-set device files**

1.18.1 Provide all as-built multifunction solid state relay files in their original format on compact disk.

1.18.2 Provide a pdf of the as-left device setting sheets on the same compact disk.

**1.19 Software Products**

1.19.1 The Contractor shall utilize a reputable software product to produce the respective analysis works, including the Short Circuit Study and Protective Device Evaluation, Protection Coordination, and Arc Flash Hazard Analyses

1.19.2 The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in

the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

1.19.3 The Contractor shall gather all required data prior to commencing analysis.

**1.20 Short Circuit and Protective Device Evaluation and Coordination Study**

1.20.1 Calculate the short circuit interruption and momentary (when applicable) duties for an assumed 3-phase bolted fault at each:

- .1 Supply Authority point of common coupling
- .2 Primary voltage equipment including aerial fused interrupters, underground distribution switchgear, unit substation primary and secondary terminals, etc
- .3 Secondary equipment including switchgear, switchboards, motor control centres, distribution panel-boards, generators, motors or loads, etc. operating at greater than 300 V L-L
- .4 Pertinent branch circuit panel-board operating at less than 300 V L-L.
- .5 Other significant locations throughout the system

1.20.2 Calculate the ground fault current study for the same system areas, including the associated zero sequence impedance data.

1.20.3 Include complete fault calculations as specified herein for each proposed and ultimate source combination. Note that source combinations may include present and future supply circuits, large motors, or generators as noted on drawing one-lines.

1.20.4 Source combination may include present and future power company supply circuits, large motors, or generators.

1.20.5 Include fault contribution of all motors in the study. Notify the Construction Manager in writing of circuit protective devices not properly rated for fault conditions.

1.20.6 Utilize equipment load data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

.1 Verify:

- .1 Equipment and protective devices are applied within their ratings.
- .2 Adequacy of switchgear and motor control centres bus bars to withstand short circuit stresses.
- .3 Adequacy of transformer windings to withstand short circuit stresses.
- .4 Cable and busway sizes for ability to withstand short circuit heating, besides normal load currents.

1.20.7 When an emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along



with the operating characteristic of the protective devices. Obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

## **1.21 Coordination Study**

1.21.1 Select each primary protective device required for a delta-wye connected transformer so that its characteristic or operating band is within the transformer characteristics; including a point equal to 58% of the ANSI withstand point to provide secondary line-to-ground fault protection.

.1 Where the primary device characteristic is not within the transformer characteristics, show a transformer damage curve.

.2 Separate transformer primary protective device characteristic curves from associated secondary device characteristics by a 16% current margin to provide proper coordination and protection in the event of secondary line-to-line faults.

1.21.2 Separate medium voltage relay characteristic curves from curves for other devices by at least 0.4 second time margin.

1.21.3 Ratios of all Current Transformers (CT's), utilized in the electrical distribution system, are to be verified by the protection coordination study to ensure compatibility of the proposed protection coordination settings. The contractor is required to coordinate all ratios identified on the respective electrical distribution equipment shop drawings with the protection coordination study

1.21.4 Evaluate proper operation of the ground relays in 4-wire distributions with more than one (1) main service circuit breaker, or when generators are provided, and discuss the neutral grounds and ground fault current flows during a neutral to ground fault.

1.21.5 The study shall provide analysis and coordination to suit all possible operational configurations of the 600V distribution systems that will supply the new 600V loads.

## **1.22 Arc Flash Hazard Analysis**

1.22.1 Provide an Arc Flash Hazard Analyses to suit the new electrical distribution systems. The analysis shall include all new distribution systems and existing distribution equipment that will supply the new electrical installations.

1.22.2 The Arc Flash Hazard analysis shall be an Incident Energy Analysis per CSA Z462 and the calculations shall be performed according to IEEE 1584.

1.22.3 When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model. Alternative methods shall be presented for approval.

1.22.4 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centres, panelboards, busway and splitters and motors) where work could be performed on energized parts.

1.22.5 The Arc-Flash Hazard Analysis shall include all significant locations in 600V and 208V systems fed from transformers equal to or greater than 125 kVA.

- 1.22.6 Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.
- 1.22.7 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering incident energy of 1.2 Cal/cm<sup>2</sup>.
- 1.22.8 Where the Hazard/Risk Category exceeds 2 (8 cal/cm<sup>2</sup>), make recommendations to reduce the incident energy.
- 1.22.9 The Arc Flash Hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude. The minimum calculation shall assume that the utility contribution is at a minimum and shall assume a minimum motor load. Conversely, the maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.
- 1.22.10 Arc flash computation shall be performed for both line and load side of main breakers for all MCCs, Switchboards and Switchgear.

**1.23 Arc Flash Warning Labels**

- 1.23.1 The Contractor shall provide 90mm x 130mm thermal transfer type label of high adhesion polyester for each work location analysed.
- 1.23.2 The label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD", and shall include the following information:
  - .1 Location designation
  - .2 Nominal voltage
  - .3 Flash protection boundary
  - .4 Hazard risk category (PPE level)
  - .5 Incident energy
  - .6 Working distance
  - .7 Engineering report number, revision number and issue date.
- 1.23.3 Labels shall be machine printed in colour, with no field markings.
- 1.23.4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
  - .1 For each 600V, and applicable 208V and 240V panelboards, one arc flash label shall be provided.
  - .2 For each motor control centre, one arc flash label shall be provided.
  - .3 For each low voltage switchboard, one arc flash label shall be provided.
  - .4 For each switchgear, one flash label shall be provided.

.5 For medium voltage switches\breakers one arc flash label shall be provided

.6 For medium voltage starters one arc flash label shall be provided.

#### **1.24 Approved Coordination Study and Arc Flash Hazard Analysis Providers**

1.24.1 Eaton Cutler Hammer Engineering Service

1.24.2 Or approved equivalent

### **2 PRODUCTS**

#### **2.1 Test Reports**

2.1.1 Provide all tests results with typed test reports and signed field test sheets.

2.1.2 All test sheets to include equipment nameplate data, customer identification, time and date of tests, environmental conditions during tests, and test results.

### **3 EXECUTION**

#### **3.1 Data Gathering**

3.1.1 Prior to analysis, the examine the existing electrical distribution system and obtain and/or verify all background information required by the analysis services including:

.1 New and existing distribution equipment ratings

.2 All distribution system loads

.3 All distribution cable ratings & lengths

.4 Locations of all distribution equipment and related loads

.5 Location, nameplate data and settings of all overcurrent protection devices, including breakers, electromechanical relays, fuses, and solid state multifunction relays.

3.1.2 Verify the accuracy of any information and/or documentation that is obtained from the owner or other sources in the course of data collection to suit the analysis works.

3.1.3 Provide a licensed electrician to gain access to any existing distribution equipment to suit verification of existing electrical name plate data as required.

#### **3.2 Protective Relay Settings**

3.2.1 The Contractor shall adjust existing relay and protective device settings according to values established by the approved coordination study.

3.2.2 The equipment manufacturer and/or their representative shall adjust all new relay and protective device settings according to values established by the approved coordination study.

- 3.2.3 Provide all necessary equipment and/or software to setup new and existing Electronic, Solid-state Multifunction Protection Relays.

### **3.3 Protective Relay Verification**

- 3.3.1 Perform functional testing for the following types of protective device:

- .1 Protective relays with adjustable settings, new and existing.
- .2 Devices with fixed protection settings (e.g. Thermal-Magnetic breakers) with ratings in excess of 200A
- .3 All ground-fault alarm or trip devices
- .4 Ancillary protective devices including transformer overcurrent devices, temperature sensors, etc.

- 3.3.2 Perform visual inspection for all protective devices supplied under the contract and for existing devices including within the coordination and/or arc flash hazard studies.

#### **3.3.3 General Procedure**

- .1 Carry out tests in the presence of the Construction Manager and a representative of the owner
- .2 Notify the Construction Manager of the protection system testing. Provide 5 business days advanced notice prior to scheduling testing.
- .3 Carry out the work with trained personnel, experienced in the particular type of testing and procedures required for each protection application.
- .4 Ensure suitable power supply is available for test equipment.
- .5 Record make, model and calibration date of test instrument.
- .6 Conduct inspection and tests and compile test results on approved relay test sheets.
- .7 Make minor modifications (relay setting changes, fuse changes) to equipment as required to accomplish conformance with the short circuit and protective device coordination studies.

#### **3.3.4 Deviations and Defects:**

- .1 Ensure that any defects discovered are noted and corrected before continuing work.
- .2 Mark any deviations found, initially on one set of the report analysis documents. Revise the protection coordination study report as required to suit as-left conditions.
- .3 Revisions, further test results and clarifications of comments shall be incorporated into the test reports.
- .4 Notify Construction Manager in writing of any required major equipment modifications.

### 3.3.5 Functional Testing

- .1 Ensure all protective and metering devices are set-up as per the coordination study settings. These settings include relay protective settings, output and input relay assignments.
- .2 Conduct tests on all protective relays including relays, auxiliary voltage and current relays, overloads, speciality protection relays, trip supervisory relays and trip relays.
- .3 Tests to include all protective features, verification of current transformer, voltage/potential transformer settings, relay input and output functions, communication acceptance.
- .4 Use special test set and test methods as available from relay manufacturer. Take all recommended manufacturer's precautions.
- .5 Provide all necessary equipment and/or software to test existing Electronic, Solid-state Multifunction Protection Relays.
- .6 Simulate all inputs to test for correction output operation.
- .7 Verify all interlocks.
- .8 Prove all logic, both hardwired and internal.
- .9 Perform secondary current and/or voltage injection testing for all over current protection devices, including breakers and/or relays to simulate all fault conditions to demonstrate the coordination study settings.
  - .1 Use three-phase test sets where required.

### 3.3.6 Visual Inspection

- .1 Inspect all devices not covered by the functional testing requirements.
  - .1 Verify the presence of the device and that the rating and type matches the approved coordination study.
  - .2 Verify the condition of all devices and ensure that wiring is correct and check for conditions that would impair operation.
  - .3 Verify that identification tags match the approved study and/or single line diagram.
- .2 Record results in a log book or worksheet and submit with record drawings.

## 3.4 Arc Flash Hazard Labels

### 3.4.1 The Contractor shall install the arc Flash Hazard Labels.

- .1 Clean all surfaces prior to installing labels.
- .2 Labels shall be neatly installed with their edges parallel to the equipment.

- .3 Labels shall not mask other labels or operating controls.
  - .4 Labels that are installed in a manner deemed unsuitable by the Contractor Administrator shall be replaced at no cost to the Owner.
- 3.4.2 The supplier of analysis services shall verify that the labels are installed on the correct equipment and shall provide a verification report stating same.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section describes the procedures for electrical demolition work.

### **1.2 General Conditions**

- 1.2.1 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.
- 1.2.2 Treat the demolishing equipment containing designated substances (e.g. PCBs, asbestos, etc.) in accordance with all applicable regulations and codes. Certificates for destruction of equipment containing such substances are required for performing the work.

### **1.3 Scope**

- 1.3.1 Furnish all labour, materials, equipment, transportation, services, facilities and supervision necessary to demolish and/or dispose all equipment, systems and materials specified herein and on the drawings.
- 1.3.2 Furnish all labour, equipment and supervision necessary to surrender (hand over) to the Owner all equipment, systems and materials specified herein and on the drawings.
- 1.3.3 In general, the demolition of the electrical systems comprises, but is not limited to:
- .1 Removal of existing 600V and/or 120V power distribution equipment from the existing water treatment facility as required to suit the installation of the new process equipment, electrical distribution and control system. Demolish infrastructure that is rendered redundant as a result of the new electrical and process works.
  - .2 Electrical cables and raceways to devices at the Aeration Tanks are to be temporarily removed, as described in the contract drawings.
  - .3 Electrical wiring and raceways to the DO System located at the North-end of the Aeration Tanks are to be removed and replaced with new.
  - .4 Four (4) welding receptacles, with respective disconnect switches and support stands, are to be removed. Their connecting wiring and raceways are to be removed back to their source.
  - .5 One (1) 120V receptacle at the Aeration Tanks is to be removed. Its connecting wiring is to be removed back to its source. Its connecting raceway is embedded in the concrete wall of the Aeration Tank and is to be abandoned in place.
  - .6 One (1) junction box located at the North end of the Aeration Tanks, including its connecting raceways and any present wiring, is to be removed. The existing wall-mounted tray and bracket adjacent to the junction box are to be removed.

#### **1.4 Coordination**

- 1.4.1 Coordinate demolition work with the Construction Manager and Owner to ensure no disruption of station operation.
- 1.4.2 Refer to Section 16010 of this specification for coordination with all other trades.

#### **1.5 Submittals**

- 1.5.1 Prepare drawings, stamped and signed by a licensed professional engineer, indicating temporary bracing and/or supporting structures required during the demolition as described herein.
- 1.5.2 Provide a written procedure for all lifting operations involving the existing facility cranes. Include weights and dimensions of items to be lifted and details of slings or other lifting tackle required.

#### **1.6 Procedures And Stages**

- 1.6.1 Demolition and removal of the existing electrical equipment will not begin prior to the installation and commissioning and satisfactory operation of all new and temporary equipment.
- 1.6.2 Demolition and/or removal of equipment must follow the approved sequencing schedules. Refer to Section 01120 Sequence of Construction.
- 1.6.3 Perform the demolition of electrical systems such that availability and continuity of supply, monitoring and control of the common systems and auxiliaries are kept and secured.
- 1.6.4 Demolition procedures outlined herein are suggestions only. The contractor is to take full responsibility for all procedures employed.

### **2 PRODUCTS**

#### **2.1 General**

- 2.1.1 Supply and install the necessary temporary bracing, supporting structures, guards, warning signs, lock out/tag out locks, etc. necessary to complete the project safely and in accordance with all regulations and/or codes.

### **3 EXECUTION**

#### **3.1 General**

- 3.1.1 Organize the work and provided sufficient labour and equipment to ensure safety at all times.
- 3.1.2 All workers shall be competent in, and trained to perform, the tasks that they perform. Where applicable, workers shall be licensed or otherwise qualified for the tasks that they perform.
- 3.1.3 Prior to starting demolition, the Contractor shall inspect with the Owner all facilities described to ascertain the limits of the works.



- 3.1.4 Do not commence any demolition work until a complete survey is performed on the equipment to be removed.
- 3.1.5 All the demolition work shall be done in a systematic fashion and in such a manner as not to damage other services and equipment and not to affect the use and function of any process equipment and any services (electrical power, lighting, communication, and heating) for the rest of the facility.
- 3.1.6 There shall be no additional compensation for carrying out any condition embodied by the requirements stipulated under this section.
- 3.1.7 Abandoned conductors and raceways to removed equipment must be removed. This also applies to all abandoned conductors that exist within the construction zones identified in the contract drawings.
- 3.1.8 The contractor is responsible for lock-out/tag-out procedures during demolition and for ensuring that all equipment is deenergized.
- 3.1.9 Demolition and disposal
  - .1 Contractor shall inspect all the existing equipment designated for removal and plan the demolition of existing equipment in stages consistent with the requirements of Section 01120 - Sequence of Activities. Contractor shall identify all equipment to be demolished in the proposed sequence of construction and project plan prior to construction. Project plan shall be submitted to the Engineer for approval prior to construction.
  - .2 The Contractor shall correlate the demolition requirements on the electrical drawings with all other discipline drawings and contractors to ensure that all power and control wiring distribution is removed for any equipment identified for demolition.
  - .3 Remove all power distribution and/or control wiring and related infrastructure that are rendered redundant as a result of the required equipment removals. Remove power distribution and make safe up to the first over current protection device that is to remain in service.
  - .4 Remove the equipment or material from site and dispose in accordance with all applicable regulations and codes. The contractor is to pay all associated fees for disposal.
  - .5 The Contractor shall take all reasonable steps to ensure that equipment removed from site is reused or recycled.
  - .6 Remove surface-mounted conduits made obsolete by this project and remove from site. Tag, seal and cap unused embedded conduits.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 The section describes the installation requirements for installing cables in outdoor underground ducts and trenches.
- 1.1.2 These requirements apply to ducts and trenches for power, communications and control cables.
- 1.1.3 Installation of cables in indoor conduits and raceways is described in Section 16133.

### **1.2 Related Sections**

- 1.2.1 The General Requirements (Division 1) applies to and forms part of all sections of the work.
- 1.2.2 Section 02315 - Excavating, Trenching and Backfilling.
- 1.2.3 Section 16010 - Electrical General Requirements.

### **1.3 Submittals**

- 1.3.1 Cable and Duct Log Book:
  - .1 Maintain a cable and duct log book on site.
  - .2 Record results of duct testing, cable pull tensions.
  - .3 Submit one (1) copy to the Contract Administrator on conclusion of job.

## **2 PRODUCTS**

### **2.1 Markers**

- 2.1.1 Concrete type cable markers: 600 x 600 x 100mm with words: cable, joint or conduit impressed in top surface, with arrows to indicate change in direction of cable and duct runs.

### **2.2 Warning/Tracer Tape**

- 2.2.1 Metal-detectable, heavy-duty polyethylene warning tape.
- 2.2.2 Width: 75 mm minimum
- 2.2.3 Tapes shall be the specified colour and shall contain approximately the following message:
  - .1 Power & composite ductbanks: red tape with the warning "Caution - Electric Line"
  - .2 Communications ductbanks: orange tape with the warning "Caution - Telephone" or "Caution - Fibre Optic"

### **2.3 Materials For Direct-Buried Ductbanks**

- 2.3.1 Ducts shall be PVC Electrical Conduit, Schedule 40.

### **2.4 Materials For Concrete-Encased Ductbanks**

- 2.4.1 Reinforcing steel to CSA G30.18 billet steel grade 400 deformed bars. All reinforcing rods shall have a minimum length of 1800mm and be overlapped by a minimum of 610mm.
- 2.4.2 Wire ties to CSA G30.0-M1983 plain, cold drawn annealed steel, to be used on rebar only.
- 2.4.3 Concrete to be 25.0 MPa, shall have a minimum slump of 100mm to 150mm and be of pea gravel aggregate.
- 2.4.4 Ducts to be joined together with an approved coupling.
- 2.4.5 Ducts shall be PVC Electrical Duct, Type DB2/ES2, to CSA C22.2 No. 211.1.
- 2.4.6 Duct spacers shall be plastic, with dimensions as shown on the drawings or in accordance with OESC table B4-4.
- .1 Approved product: IPEX Monobloc or equivalent.
- .2 Wood spacers are not permitted.

### **2.5 Cable Pulling Equipment**

- 2.5.1 All cable pullers capable of exerting a force in excess of 1500 kg shall have a force readout.

### **2.6 Pulling Lubricant**

- 2.6.1 Use CSA approved pulling lubricant for all cable pulls into duct.
- 2.6.2 Lubricant shall be approved by the cable manufacturer and suitable to the specific installation.
- 2.6.3 Approved Manufacturer: American Polywater

### **2.7 Splice Kits**

- 2.7.1 Use cold-shrink splice kits for medium voltage cables.

## **3 EXECUTION**

### **3.1 Excavation - General**

- 3.1.1 Refer to Section 02315.

### **3.2 Direct Buried Ducts**

- 3.2.1 The duct lengths shall be joined together with an approved coupling and solvent to provide a sound and watertight joint. The joints in adjacent ducts shall be staggered by at least 200mm.
- 3.2.2 Deburr all ends prior to assembling joints.
- 3.2.3 When complete, the ducts shall be clean, waterproof and free from obstructions and the ends plugged with standard plastic duct plugs to prevent the ingress of moisture and dirt.
- 3.2.4 A non-metallic, non-deteriorating rope with a minimum five hundred (500) pounds breaking strength shall be installed in each duct.
- 3.2.5 All ducts to be terminated at both ends with a "Bell End" coupling.
- 3.2.6 The duct shall have an even slope in one (1) direction of not less than 75mm in 30.5 meters to provide drainage. The slope should be toward the street where possible.
- 3.2.7 Backfill the remaining trench with selected excavated materials per section 02315 except:
  - .1 Backfill with sand to 100 mm above the top of the ductbank.
  - .2 Compact the next 300 mm of backfill material by hand.

### **3.3 Concrete Encased Ducts**

- 3.3.1 Concrete encased ducts to be installed with a minimum of 1000mm cover (below finished grade) unless otherwise noted.
- 3.3.2 Concrete encased duct bank shall be constructed on undisturbed soil or on well compacted granular 'A' material not less than 150mm thick, compacted to 95% of corrected maximum dry density.
- 3.3.3 Install spacers in accordance with manufacturer's instructions.
- 3.3.4 Adjacent couplings shall be staggered by at least 200mm.
- 3.3.5 Deburr all ends prior to assembling joints.
- 3.3.6 When complete, the ducts shall be clean, waterproof and free from obstructions and the ends plugged with standard plastic duct plugs to prevent the ingress of moisture and dirt.
- 3.3.7 The duct run shall be reinforced. Reinforcing steel bars 16mm diameter shall be laid longitudinally along the trench with 100mm lateral spacing and 50mm above the base of the concrete.
  - .1 An overlap of 610mm on the reinforcing bars shall be provided where necessary. The duct runs shall also be reinforced at all building and manhole entries with the bars being embedded in the walls.

- .2 50mm inside the perimeter of the bank at 100mm centres along the sides and bottom of the bank. The rods shall project 900mm from the centre to anchor firmly into the concrete of the extension when the latter is poured.

3.3.8 Where concrete formwork is required, construct in accordance with CAN3-A23.1-M77.

- .1 Formwork lumber materials to CAN3-A23.1-M77.

3.3.9 Do not pour concrete directly onto the ductbank structure. Concrete shall be deflected down alongside the ducts to the bottom and up through the duct assembly.

3.3.10 Where shown on the drawings, lay a bare copper conductor in the ductbank with 50 mm of concrete cover. Bring either end of conductor out and terminate.

3.3.11 The concrete shall be worked below and between pipes to produce a homogeneous mass.

3.3.12 Clearances:

- .1 At crossings with other utilities, maintain a minimum 300mm vertical clearance.
- .2 When running parallel to another utility the duct bank, maintain a minimum horizontal clearance of 1.5m.

3.3.13 The Contractor shall notify the Contract Administrator at least twenty-four (24) hours before concrete is poured to permit inspection of duct installation.

3.3.14 Backfilling of trenches shall not commence until concrete has attained 50% of its strength.

#### **3.4 Cable Installation in Ducts**

3.4.1 Install cables as indicated in ducts.

3.4.2 Do not pull spliced cables inside ducts.

3.4.3 Install multiple cables in duct simultaneously.

3.4.4 Submit to the Engineer prior to cable installation calculations that indicate the maximum pulling tension of the cable will not be exceeded. Do not exceed cable pulling tensions and bending radius recommended by manufacturer.

3.4.5 Preparation

- .1 Inform the Contract Administrator three (3) days prior to the inspection. Conduct tests in the presence of the Contract Administrator.
- .2 Pull a rubber swab and wire brush through the conduit prior to pulling in the pulling cable.
- .3 Pull a slug with diameter of 80% of the conduit ID through the entire length of duct that the cable will be installed in.
- .4 Record the date and time of inspection and the condition of the mandrel in a log book.

- .5 Submit copies of the logbook to the Contract Administrator upon completion of cable pulling.
- .6 Pull cables immediately upon successful testing.
- 3.4.6 For cable pulls exceeding 1200 kg and/or 75% of the allowable cable pulling tension or sidewall bearing pressure, use cable puller with a force gauge.
  - .1 Record the maximum pulling force in a log book.
  - .2 Record dynamometer correction factors as applicable.
- 3.4.7 Take all measures to reduce pulling tension and damage to the cables, including but not limited to: lubricants, sheaves, shoes, etc.
- 3.4.8 Cables shall be guided into ducts and shall not rub the edge of the conduit opening.
- 3.4.9 Cables showing signs of jacket damage shall be removed and replaced.
- 3.4.10 To facilitate matching of colour coded multi-conductor control cables reel off in same direction during installation.
- 3.4.11 Before pulling cable into ducts and until cables are properly terminated, seal cables end with moisture seal tape or cold-shrink caps.
  - .1 Cold shrink caps shall be the only sealing method for medium-voltage cables.
- 3.4.12 After installation of cables, seal duct ends with approved, water tight duct sealing compound.
- 3.5 Splicing Of Cables**
  - 3.5.1 Splices are permitted only in pits, vaults or chambers.
    - .1 Underground cable splices not acceptable.
  - 3.5.2 Make termination and splice only as indicated leaving 0.6m of surplus cable in each direction.
    - .1 Make splices and terminations in accordance with manufacturer's instructions using approved splicing kits.
- 3.6 Restoration**
  - 3.6.1 All landscaping to be restored to its original condition.
  - 3.6.2 Install detectable warning tape within 150 mm of the final grade.
  - 3.6.3 Provide all required asphalt and/or concrete cutting for installation of the proposed high voltage duct bank. All surfaces to be restored to new conditions once work complete.
  - 3.6.4 Install cable markers in asphalt or concrete surfaces.
    - .1 Mark cable every 50m along cable runs and changes in direction.

.2 Use concrete type markers.

3.6.5 Where markers are removed to permit installation of additional cables, reinstall existing markers.

**3.7 Field Quality Control**

3.7.1 Test cables in accordance with the requirements of the relevant cable specification section.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section describes the requirements for general grounding and bonding requirements.

### **1.2 Scope**

- 1.2.1 Provide bonding conductors for all electrical equipment. Unless otherwise indicated provide a dedicated bond conductor for each piece of equipment, sized in accordance with Table 16 of the Ontario Electrical Safety Code.
- 1.2.2 Bond all non-current carrying metallic equipment including metallic piping, raceways and tray and building steel to ground.
- 1.2.3 Provide a dedicated ground/bond conductor to suit each directly buried cable, and/or metallic raceway power distribution application sized in accordance with Table 16 of the Ontario Electrical Safety Code. Ground conductor to be buried adjacent to the current carrying conductors.

### **1.3 References**

- 1.3.1 ANSI/IEEE 837-2014, Qualifying Permanent Connections used in Substation Grounding.
- 1.3.2 IEEE Standard 142™-2007 IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
- 1.3.3 IEEE 81.2-1991 IEEE Guide for Measurement of Impedance and Safety Characteristics of Large, Extended or Interconnected Grounding Systems.

## **2 PRODUCTS**

### **2.1 Equipment**

- 2.1.1 Clamps for grounding of conductor: size as required.
- 2.1.2 Copper conductor: minimum 3 m long for each concrete encased electrode, bare, stranded, tinned, soft annealed, size as indicated.
- 2.1.3 Rod electrodes: copper clad steel 19mm diameter, by 3m long.
- 2.1.4 Grounding conductors: bare stranded copper, tinned, soft annealed size as indicated.
- 2.1.5 Insulated grounding conductors: green, size: as indicated on the drawings or required by code.
- 2.1.6 Ground bus: copper bus with insulated supports complete with fastenings, connectors.



- 2.1.7 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 Compression-type conductor connectors.
  - .5 Bonding jumpers, straps.
  - .6 Pressure wire connectors.

### **3 EXECUTION**

#### **3.1 Installation General**

- 3.1.1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, accessories. Where a metal duct, conduit or raceway is used, run a dedicated ground wire in conduit.
- 3.1.2 Install connectors in accordance with manufacturer's instructions.
- 3.1.3 Provide a dedicated bonding conductor in all metallic and non-metallic raceways.
- 3.1.4 Protect exposed grounding conductors from mechanical injury.
- 3.1.5 Make buried connections, and connections to conductive water main, electrodes, using permanent mechanical connectors or inspectable wrought copper compression connectors to ANSI/IEEE 837.
- 3.1.6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- 3.1.7 Soldered joints not permitted to suit ground connections.
- 3.1.8 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.
- 3.1.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.
- 3.1.10 Bond single conductor, metallic armoured cables to cabinet at supply end, and provide non-metallic entry plate at load end.
- 3.1.11 Ground secondary service pedestals.

#### **3.2 Electrodes**

- 3.2.1 Install rod and/or plate electrodes and make grounding connections.

3.2.2 Bond separate, multiple electrodes together.

3.2.3 Use size AWG copper conductors for connections to electrodes.

### **3.3 System And Circuit Grounding**

3.3.1 Install system and circuit grounding connections to neutral of primary 600V system and secondary 120/240V system.

### **3.4 Equipment Bonding**

3.4.1 Install grounding connections to new equipment installed.

3.4.2 Install bonding connections between distribution components and equipment in accordance with code requirements including but not limited to, MCC, distribution panel boards, transformers, packaged equipment, motor frames/housing, and control panels.

### **3.5 Field Quality Control**

3.5.1 Perform tests in accordance with Section 16010 - Electrical General Requirements.

3.5.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of the Contract Administrator and the local authority having jurisdiction over installation.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 The section describes the identification requirements for electrical equipment including distribution equipment, wire and conduit and loads.
- 1.1.2 Process equipment identification requirements and requirements for client asset management tagging are found elsewhere.

### **1.2 Scope**

- 1.2.1 Provide identification nameplates for all new electrical apparatus including motor starters, disconnect switches, conduit, wiring, junction boxes, breakers, contactors, system control panels, etc.
- 1.2.2 All power and systems wiring shall be colour coded in accordance with this Section and be provided with appropriate wire markers identifying panel circuits.

### **1.3 General**

- 1.3.1 Nameplates for outdoor locations shall be UV resistant.
- 1.3.2 Nameplates shall be oil and water resistant.
- 1.3.3 All materials shall be suitable for the temperatures and contaminants present in the area the equipment is located in.
  - .1 Refer to the equipment specifications and drawings for the environmental conditions for each piece of equipment.
- 1.3.4 All adhesives shall be designed to adhere permanently to the equipment.
- 1.3.5 Unless otherwise indicated, allow for average of 25 letters per nameplate.
- 1.3.6 Identification to be English.

### **1.4 Submittals**

- 1.4.1 Provide samples of all nameplate materials.
- 1.4.2 Provide data sheets for all adhesive labels indicating the following:
  - .1 Dimensions and colours
  - .2 Suitable substrates
  - .3 Resistance to contaminants and environmental conditions
  - .4 Application requirements

1.4.3 Issue nameplates lists for review prior to manufacture.

.1 The final wording of all nameplates shall be reviewed and approved by the Owner and Consultant prior to fabrication.

## **2 PRODUCTS**

### **2.1 Lamicoid Nameplates**

2.1.1 All identification nameplates and nametags unless otherwise specified shall be engraved black letters on white lamicoid stock with bevelled edges. The lamicoid stock shall be 3 mm minimum thickness.

2.1.2 For equipment in dry, indoor areas, lamicoid nameplates shall be drilled for mechanical attachment.

2.1.3 In wet, outdoor and/or classified locations, provide lamicoid nameplates with pressure-sensitive adhesive suitable for the material and environment.

2.1.4 Where equipment surfaces prevent mechanical or adhesive fastening, mount lamicoid nameplates with stainless steel chains.

.1 In classified areas, provide non-sparking chains.

### **2.2 Adhesive Tape Nameplates**

2.2.1 Where tape nameplates are specified or indicated, provide oil and water-resistant nameplates with an adhesive suitable for the equipment surface and the environmental conditions.

### **2.3 Conduit Markers**

2.3.1 Provide pressure-sensitive, coloured, vinyl pipe banding tape, min 25 mm wide.

	<b>Prime</b>	<b>Auxiliary</b>
Up to 250 V	Yellow	
Up to 600 V	Yellow	Green
Other communication systems	Green	Blue
Other security systems	Red	Yellow

### **2.4 Wire Markers**

2.4.1 Provide pre-printed, permanent, heat-shrink, labels for wires less than #1 AWG.

.1 Colour: Black letters on white body unless otherwise indicated.

2.4.2 Provide cable markers for all wires #1 AWG and larger.

2.4.3 All wire markers shall be fire retardant.

2.4.4 Acceptable Products:

- .1 Brady Perma-sleeve
- .2 Panduit Military Grade Heat Shrink Labels
- .3 Approved equivalent

**2.5 Cable Markers**

2.5.1 Provide pre-printed, plastic, clip-on wire markers.

- .1 Colour: Black letters on white body

2.5.2 Acceptable products:

- .1 Thomas & Betts type SM markers
- .2 Approved equivalent

**2.6 Phasing Tape**

2.6.1 Coloured polyvinyl chloride (PVC) electrical tape with pressure-sensitive adhesive.

2.6.2 The tape shall be 7 mils thick (min).

2.6.3 The tape shall meet CSA C22.2 No.197 and shall be marked as "Flame-Retardant."

2.6.4 The tape shall be compatible with synthetic cable insulations, jackets and splicing compounds.

2.6.5 Continuous operating temperature: 105 °C (min)

2.6.6 Voltage Rating: 600 V (min)

**2.7 Distribution Equipment - General**

2.7.1 Engrave nameplates for MCC's and other distribution equipment as follows:

- .1 First line: Equipment name per single line in 25 mm high lettering
- .2 Second line: Voltage in 13 mm high letters
- .3 Example:
  - .1 SWG-0100
  - .2 4160 V

## **2.8 Lighting Panels and Splitters**

2.8.1 Engrave nameplates for lighting panels and splitters as follows:

- .1 First line: Equipment name per single line in 13mm high lettering
- .2 Second line: Voltage in 8 mm high letters
- .3 Third Line: Source in 8 mm high letters
- .4 Example:
  - .1 LP-A
  - .2 120/240V
  - .3 TX-A

## **2.9 Disconnect Switches, Combination Starters and Field-Mounted VFDS**

2.9.1 Engrave nameplates for disconnect switches, combination starters, field-mounted VFDs as follows:

- .1 Equipment description per the single line diagram in 13 mm high letters
- .2 Equipment number per the single line diagram in 13 mm high letters
- .3 Example:
  - .1 Sanitary Lift Pump
  - .2 SLP No. 1

## **2.10 Loads**

2.10.1 Engrave nameplates for all loads as follows:

- .1 Equipment description per the single line diagram in 13 mm high letters
- .2 Equipment number per the single line diagram in 13 mm high letters
- .3 Voltage in 8 mm high letters
- .4 Example:
  - .1 Sanitary Lift Pump
  - .2 SLP No. 1
  - .3 600 V

2.10.2 Comply with the owner's equipment identification requirements.

**2.11 Junction Boxes, Terminal Cabinets, Pull Boxes, Etc.**

- 2.11.1 Terminal cabinets and pull boxes: indicate equipment being controlled and its voltage.
- 2.11.2 Nameplates for junction boxes, terminal boxes, pull boxes, etc. larger than a 100mm square to indicate system voltage characteristics.
- 2.11.3 Engrave nameplates for all loads as follows:
  - .1 Equipment description per the single line diagram in 13 mm high letters
  - .2 Equipment number per the single line diagram in 13 mm high letters
  - .3 Voltage in 8 mm high letters
  - .4 Example:
    - .1 High Lift Pump
    - .2 HLP-01
    - .3 600 V
  - .5 Comply with the owner's equipment identification requirements.

**2.12 Control Stations**

- 2.12.1 Panel Label:
  - .1 Provide Lamicoid nameplate indicating panel name and number in 13 mm high letters.
- 2.12.2 Pilot devices:
  - .1 Provide Lamicoid plates indicating the device function.
  - .2 Lettering shall be 6 mm high
  - .3 Colour: White plate with black lettering
- 2.12.3 Interior Components:
  - .1 Provide self-adhesive labels adjacent to all devices including relays, fuses, etc. to indicate the specific device reference number.
  - .2 Label devices according to the manufacturer's drawings.
  - .3 Mark the fuse rating on all fuse labels.
  - .4 Mark the transformer primary and secondary voltages and kVA rating for all transformers.

## **2.13 Warning Signs**

- 2.13.1 Provide warning signs as specified or to meet requirements of the Electrical Safety Authority (ESA) and Engineer.
- 2.13.2 Unless otherwise specified, signs shall comply with CAN/CSA-Z321-96 Signs and Symbols for the workplace.
- 2.13.3 Decal signs, minimum sized 175x50mm.
- 2.13.4 Protect exposed live equipment during construction for personnel safety.
- 2.13.5 Shield and mark live parts "LIVE 600 VOLTS", or with appropriate voltage in English.

## **3 EXECUTION**

### **3.1 General**

- 3.1.1 Plates shall be installed after all painting has been completed.

### **3.2 Lamicoid Nameplates**

- 3.2.1 Lamicoid nameplates shall be mounted behind the panel door, mechanically fastened or secured with contact cement.
- 3.2.2 Attach mechanically-fastened lamicoid nametags with self-tapping screws.
- 3.2.3 Use rivets and nut & bolts where access may conflict with a protruding screw point.

### **3.3 Adhesive Labels**

- 3.3.1 Clean all surfaces in accordance with manufacturer's recommended procedure prior to applying adhesive nameplates.
- 3.3.2 Do not apply adhesive labels when the temperature is outside the manufacturer's recommended range.
- 3.3.3 Feeder cables shall be colour coded in each terminal panel and junction box with phasing tape.

### **3.4 Wiring Identification**

- 3.4.1 Identify wiring at both ends and at all points where the conductors are accessible (i.e. distribution panels, MCC, junction boxes, elbows, etc.).
- 3.4.2 Identify each control conductor in accordance with the City's standards or as otherwise directed.
- 3.4.3 Identify all power conductors according to the application and/or circuit number.
- 3.4.4 Identify spare wiring with unique tag number and record on record drawings.
- 3.4.5 Wiring identification shall match the drawings.



3.4.6 Apply phasing tape where the wire jacket does not indicate phase.

**3.5 Conduit And Armoured Cable Identification**

3.5.1 Apply conduit marking tape at points where conduit or cable enters equipment, walls, ceilings, or floors, and at 10m intervals.

**3.6 Manufacturers And CSA Labels**

3.6.1 Visible and legible after equipment is installed.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section describes the requirements for wire and cable up to 1000V for power, control and communications circuits.
- 1.1.2 This section does not apply to special-application wiring such as festoon cables, wiring provided by manufacturers to run between parts of packaged systems, or to wiring inside equipment and panels. Refer to the individual equipment specifications.
- 1.1.3 Refer to Division 13 for wiring associated with SCADA systems and for communications wiring.

### **1.2 General**

- 1.2.1 All necessary power and control wiring to all equipment shall be supplied and installed to suit the power and control requirements noted on the drawings. It shall be noted that the drawings do not necessarily indicate the locations of each individual feeder, but these shall be located to best suit the site conditions.
- 1.2.2 Where cable constructions are shown on drawings, the drawings shall take precedence.
- 1.2.3 All cables to be sized and installed in accordance with the OESC.
- 1.2.4 All conductors shall be stranded copper unless otherwise noted.
- 1.2.5 All exposed wiring should have flame test rating FT4 unless otherwise indicated.
  - .1 All wiring in plenums including areas above drop ceilings acting as plenums shall have flame test rating FT6.
- 1.2.6 Wire and cable for all applications shall meet the equipment supplier's requirements and the OESC. Where this section does not contain specific requirements, refer to the manufacturer's instructions and the OESC.

### **1.3 Related Sections**

- 1.3.1 Section 13010 - Process Control - General

### **1.4 References**

- 1.4.1 CSA C22.2 No.0.3-92, Test Methods for Electrical Wires and Cables.
- 1.4.2 CSA - 600 V AWM I/II A/B - For VFD Applications
- 1.4.3 CSA C22.2 No. 131 Type TECK 90 Cables.
- 1.4.4 CSA C22.2 No. 38 Thermoset Insulated Wires and Cables.
- 1.4.5 CSA C22.2 No. 174 Cables and Cable Glands for use in Hazardous Locations.

1.4.6 CSA C22.2 #239 Control and Instrumentation Cable

1.4.7 ICEA S-66-524.

## **1.5 Submittals**

1.5.1 Submit product data in accordance with Section 01330-Submittals.

1.5.2 Provide data sheets indicating the following:

- .1 Manufacturer's name
- .2 Cable type and ratings
- .3 Approval listings
- .4 Conductor, insulation, shield and jacket materials (as applicable)
- .5 Temperature ratings for conductors and installation
- .6 Weight/unit length
- .7 Allowable pulling tension and sidewall bearing pressure
- .8 Minimum bend radius
- .9 Manufacturer's handling and installation requirements.

## **2 PRODUCTS**

### **2.1 Colours**

2.1.1 Colour Coding, three phase systems:

- .1 Phase A - Red
- .2 Phase B - Black
- .3 Phase C - Blue

2.1.2 Colour Coding, single phase systems:

- .1 Live - Black
- .2 Neutral - White

2.1.3 Insulated ground wires: green.

## **2.2 Minimum Conductor Sizing**

2.2.1 The minimum conductor sizing shall be as follows:

- .1 Motor or branch circuit feeders: #12 AWG
- .2 Digital control wiring, 24 to 120 VAC/VDC: #14 AWG
- .3 Minimum current transformer wiring conductor: #10 AWG
- .4 Use #10 AWG minimum for home runs to lighting panels exceeding 25 m.

## **2.3 Identification**

- 2.3.1 Identify all wiring with wire markers at both ends.
- 2.3.2 All branch circuit wiring and all systems wiring shall be identified at all panels and terminal boxes.
- 2.3.3 All wiring shall be identified at junction boxes and termination points.

## **2.4 Terminations**

- 2.4.1 All wiring connections shall be made with T & B StaKon crimp connector, or approved equal, applied with a pressure tool.
- 2.4.2 Wiring connections, where required, shall be made with CSA approved compression tool with a nylon cap equal to Buchanan "Pres Sure".
- 2.4.3 All wiring shall be sized so that voltage drop between the panel board and the furthest outlet shall not exceed 2% when the circuit has a full load.

## **2.5 Unarmoured Power Wire**

- 2.5.1 System Description: 600 V solidly grounded, 120/208 and/or 120/240 solidly grounded power conductors.
- 2.5.2 Allowable Construction:
  - .1 Wire in conduits, above grade: 1/C, RW90
  - .2 Wire in conduit, underground and/or wet locations: 1/C, RWU90
  - .3 Wire to suspended lighting fixtures: 3/C, SWT90 or SWT105 to suit luminaire.
  - .4 Insulated ground wires for cable tray and above-ground, dry area conduit: 1/C, RW90
  - .5 Insulated ground wires, below grade conduits and wet areas: 1/C, RWU90
  - .6 All conductors copper unless otherwise noted.
- 2.5.3 Insulation: XLPE, 1000V, 90°C or 105°C as required.

- 2.5.4 Shielding: Non-shielded
- 2.5.5 Jacket: Abrasion, oil and acid resistant.
- 2.5.6 cUL Flame test: FT4
- 2.5.7 Type RW90 and RWU90 construction shall meet CSA C22.2 No. 38.
- 2.5.8 Acceptable Manufacturers: Prysmian, Nexans, Southwire, United Wire of Canada.

## **2.6 Armoured Power Wire and Cable**

- 2.6.1 System Description: 600 V solidly grounded, 120/208 and/or 120/240 solidly grounded power conductors.
- 2.6.2 Environmental Conditions: damp indoor areas with temperatures ranging between -10 C and 40 C.
- 2.6.3 Shielding: Non-shielded cable unless otherwise noted.
- 2.6.4 Allowable Construction:
  - .1 Wire in tray in dry, damp or wet areas: TECK90, FT4
  - .2 Wire in classified areas: TECK90, HL, FT4
  - .3 Direct buried wiring: TECK 90, -40°C
  - .4 Concealed wiring in office areas: AC90
- 2.6.5 Insulation: XLPE, 1000 V, 90°C (wet)
- 2.6.6 Shielding; none
- 2.6.7 Inner and outer jacket: moisture and oil resistant, low-acid gas, sunlight resistant,
  - .1 Outer jacket colour: black
- 2.6.8 Flame Spread Rating: FT4.

## **2.7 VFD Cables**

- 2.7.1 VFD cables shall have continuous copper or aluminium sheaths.
- 2.7.2 Acceptable cable type
  - .1 Belden VFD Cable Series 295 CSA-1000 V AWM I/II A/B, installed in a dedicated conduit
  - .2 Approved, CSA C22.2 No. 123-96 equal
- 2.7.3 Provide product shop drawing submissions that confirm the cable is rated to suit VFD applications.

## **2.8 Digital Control Wire**

- 2.8.1 Conform to the requirements of Division 13.
- 2.8.2 System Description: field wiring, 24 to 120 V digital signals for control circuits when run in conduit
- 2.8.3 Allowable Construction
  - .1 Wire in conduits, above grade: 1/C RW90
  - .2 Wire in conduit, underground and/or wet locations: 1/C RWU90
- 2.8.4 Insulation: XLPE, 600V, 90°C
- 2.8.5 Shielding: Non-shielded
- 2.8.6 Jacket: Abrasion, oil and acid resistant.
- 2.8.7 cUL Flame test: FT4
- 2.8.8 Type RW90 and RWU90 construction shall meet CSA C22.2 No. 38.
- 2.8.9 Acceptable manufacturers: Prysmian, Nexans, Southwire, United Wire of Canada.

## **2.9 Analog Control Wire**

- 2.9.1 Conform to the requirements of Division 13.
- 2.9.2 System description: 0-10 V and 4-20 mA signal wiring for control setpoints and feedback. Does not apply to speciality signal conductors such as flow meters.
- 2.9.3 Allowable Construction:
  - .1 Cables in conduit: CIC
- 2.9.4 Conductor: #18 AWG, 7x26 stranded, copper or to match required cable impedance.
- 2.9.5 Cable: individual wires formed into pairs or triads as required by the application. Provide multi-pair/multi-triad cables where indicated.
- 2.9.6 Insulation: PVC, 300 V, 90°C (dry and wet)
- 2.9.7 Shielding:
  - .1 Inner Shield: Aluminium/polyester tape shield over individual pairs or triads.
  - .2 Inner Drain Wire: 7-strand tinned copper drain wire.
  - .3 Outer Shield: Aluminium/polyester tape shield over cable.
  - .4 Outer Drain Wire: 7-strand tinned copper drain wire.

- 2.9.8 All cables to have a ripcord.
- 2.9.9 Jacket: 90°C (-40°C) PVC
- 2.9.10 cUL Flame test: FT4
- 2.9.11 Control cables shall meet CSA, C22.2 No. 239.
- 2.9.12 Acceptable manufacturers: Shawflex, Belden.

## **2.10 Thermocouple/RTD Wire**

- 2.10.1 Conform to the requirements of Division 13.
- 2.10.2 System description: field wiring for thermocouples between thermocouple junction box on equipment to monitoring instrument.
- 2.10.3 Allowable Construction:
  - .1 CIC
- 2.10.4 Conductor: #18 AWG, 7x26 stranded, copper or to match required cable impedance.
- 2.10.5 Cable: individual wires formed into pairs or triads as required by the application.
- 2.10.6 Insulation: PVC, 300 V, 105°C
- 2.10.7 Shielding:
  - .1 Outer Shield: Aluminium/polyester tape shield over cable.
  - .2 Outer Drain Wire: 7-strand tinned copper drain wire.
- 2.10.8 Jacket: 105°C (-40°C) PVC, Low-Acid Gas
- 2.10.9 cUL Flame test: FT4
- 2.10.10 Control cables shall meet CSA, C22.2 No. 239,
- 2.10.11 Acceptable manufacturers: Shawflex, Belden.

## **3 EXECUTION**

### **3.1 Shipping And Storage**

- 3.1.1 Wire and cable shall be maintained in dry environment with ends sealed at all times.
- 3.1.2 Protect reels from damage.
- 3.1.3 Damaged reels shall be removed from site. Prior to removal from site reels shall be marked by the Contract Administrator to prevent reuse.

### **3.2 Power Wiring - General**

#### **3.2.1 Install wiring as follows:**

- .1 In conduit systems in accordance with Section 16133
- .2 In underground ducts in accordance with Section 16051

#### **3.2.2 All feeders shall run in continuous length between power supply point and the load. No splices will be allowed in feeder cable.**

#### **3.2.3 Only circuits of the same voltage shall be installed in a common conduit or duct or share the same ground return line. Do not mix voltage in the same duct or conduit.**

#### **3.2.4 Install 20% spare control wiring capacity in each controls conduit.**

### **3.3 Armoured Cables**

#### **3.3.1 Group cables wherever possible in channels.**

#### **3.3.2 Use sheaves/shoes or other guides to ensure smooth changes in direction and to minimize cable tension.**

#### **3.3.3 Install cable in trenches in accordance with Section 16051.**

#### **3.3.4 Group cables wherever possible.**

### **3.4 VFD Cables**

#### **3.4.1 Supply and install all VFD motor cables in dedicated metal conduits, including underground and aboveground applications.**

#### **3.4.2 VFD Cable terminations are to be inspected by the VFD manufacturer's representative prior to energizing the VFD starter.**

### **3.5 Control Wiring**

#### **3.5.1 Conform to the requirements of Division 13.**

#### **3.5.2 All cables and wires to be continuous runs.**

#### **3.5.3 Run all wiring in conduit or duct (underground wire) unless otherwise specified. Refer to this division and to the drawings for additional information, requirements and details.**

#### **3.5.4 Provide minimum 20% spare wiring or two (2) conductors (1 pair) whichever is greater for each run.**

#### **3.5.5 All wires must be tagged with pre-numbered slip-on markers. Allow for up to ten (10) characters per individual wire. No wrap around markers will be accepted.**



**3.5.6 Communication and Special Wire and Cable (Field):**

- .1 The Contractor shall provide all wiring and cable, including connectors, plugs and termination devices required for the wiring of the systems and equipment shown on the drawings, unless otherwise specified.
- .2 Provide quantities and lengths of cable and wire type as recommended by the system equipment manufacturers. Do not de-rate any cabling and wire. No wire/cable to be sized less than 18 AWG unless approved by the Contract Administrator or unless a specific requirement of the equipment manufacturer.
- .3 Provide, as part of shop drawing submittal, cable and wire specifications and data for each system. Include written proof that cable and wire meet requirements of equipment supplier.
- .4 Coordinate with the manufacturer and other sections of these specifications to ensure proper conduit type (i.e.: metal) and sizes are provided.
- .5 Any wire and cable installed that does not meet the wiring specifications of the equipment manufacturer shall be removed and replaced (including conduits, if necessary), at the Contractor's expense.

**3.6 Communications Cables**

- 3.6.1 Supply and install all communications cables to suit the communications system connection requirements.
- 3.6.2 All communications cables located outdoors or in classified areas are to be installed in dedicated rigid aluminum conduit unless otherwise indicated.

**3.7 Testing**

**3.7.1 General**

- .1 Test all wire and cables prior to energization.
- .2 Clean and dry ends of wire and cable prior to test.
- .3 Provide a written (typed) report to suit the test results for each cable indicating:
  - .1 Equipment make/model and calibration data
  - .2 Operator name or employee number and initials
  - .3 Environmental conditions including temperature and approximate humidity (e.g. dry/damp/wet)
  - .4 Cable tag number, description (e.g. #10AWG, 3/C, TECK90) and length under test
  - .5 Results in MΩ/unit length
  - .6 Reports may be handwritten in logbook or typed.

- .4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.
- .5 Disconnect sensing and protection equipment from the respective circuits to be megger tested including PT's and Surge Protectors.
- .6 Do not perform megger tests on control circuits containing transistorized or solid-state components.
- .7 Conduct tests in accordance to NETA standards.
- .8 The Contractor shall repeat the test in the presence of the Contract Administrator for any cable listed in the test report, at the request of the Contract Administrator.

3.7.2 Power cables (types TECK, RW, RWU, STJ, AC90, etc.)

- .1 Perform 1000V DC insulation resistance test.
- .2 Test each circuit with equipment disconnected.
- .3 Test phase-to-phase and phase-to-ground.
- .4 Take test results after one (1) minute at full voltage.
- .5 Cables with an insulation resistance > 50 M $\Omega$  shall be considered acceptable.
- .6 Cables with an insulation resistance of less than 50 M $\Omega$  shall be reported to the Contract Administrator for investigation and remedial action shall be taken by the Contractor after discussion with the Contract Administrator.
- .7 Cables with an insulation resistance <2 M $\Omega$  shall be removed and replaced.

3.7.3 Control cables

- .1 Perform 500V DC insulation resistance test.
- .2 Test each control circuit to ground only.
- .3 Take test results after one (1) minute at full voltage
- .4 Cables with an insulation resistance > 50 M $\Omega$  shall be considered acceptable.
- .5 Cables with an insulation resistance of less than 50 M $\Omega$  shall be reported to the Contract Administrator for investigation and remedial action shall be taken by the Contractor after discussion with the Contract Administrator.
- .6 Cables with an insulation resistance <2 M $\Omega$  shall be removed and replaced.
- .7 Submit the testing results as a formal shop drawing submission

3.7.4 Instrumentation and Thermocouple Wiring

- .1 Check continuity of each wire using ohm meter or DC buzzer. Megger or 120 V filament lamp testing is not acceptable.
- .2 Test thermocouple wiring for continuity and polarity in accordance with manufacturer's recommendations.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 Provide splitters, junction boxes, pull boxes and wiring cabinets for the power, control and communications wiring systems as shown on the drawing and as required to complete the wiring systems described in the drawings.

### **1.2 Shop Drawings and Product Data**

- 1.2.1 Submit shop drawings and product data for junction and pull boxes in accordance with Section 01330 - Submittal Procedures.

### **1.3 General Requirements**

- 1.3.1 All mounting hardware shall be of non-corrosive type material including:
  - .1 Stainless steel
  - .2 Aluminium
  - .3 PVC encapsulated metal
- 1.3.2 Splitter, Junction Boxes, Pull Boxes and Cabinets installed indoors or outdoors shall be ULC & UL listed.

### **1.4 Enclosure Ratings**

- 1.4.1 Dry, non-corrosive areas: NEMA 12, sprinklerproof
- 1.4.2 Wet, damp and/or corrosive areas: NEMA 4X
- 1.4.3 Splitter, Junction Boxes, Pull Boxes and Cabinets installed indoors in classified areas shall be rated NEMA 7 to suit hazardous environments.

## **2 PRODUCTS**

### **2.1 PVC Pull and Junction Boxes**

- 2.1.1 Provide cast PVC boxes with external mounting lugs.
- 2.1.2 Provide PVC Cover with retaining screws and seamless gasket all around.
- 2.1.3 Acceptable manufacturer: same as conduit system.

### **2.2 Aluminum Pull and Junction Boxes**

- 2.2.1 Provide welded or die-cast aluminium boxes with
- 2.2.2 Covers shall be hinged covers with minimum two (2) retained screw fasteners and a seamless gasket all around.

2.2.3 Acceptable manufacturer: same as conduit system.

### **2.3 Cabinets**

2.3.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

2.3.2 Type T: sheet steel cabinet, with hinged door, latch, lock, two (2) keys, containing Unistrut backing flush mounted.

2.3.3 Cabinets to be rated NEMA 4X unless indicated otherwise on the drawings.

## **3 EXECUTION**

### **3.1 Junction, Pull Boxes and Cabinets Installation**

3.1.1 Boxes shall be surface mounted in unfinished areas and flush mounted in finished (e.g. office) areas.

3.1.2 Install pull boxes in inconspicuous but accessible locations.

3.1.3 Mount cabinets with top not higher than 2m above finished floor.

3.1.4 Install terminal block as indicated in Type T cabinets.

### **3.2 Identification**

3.2.1 Provide equipment identification in accordance with Section 16090 - Equipment Identification.

**END OF SECTION**

## **1 GENERAL**

### **1.1 References**

- 1.1.1 Ontario Electrical Safety Code and ESA latest bulletins.

### **1.2 General Requirements**

- 1.2.1 All mounting hardware shall be of non-corrosive type material including:
- .1 Stainless steel
  - .2 Aluminium
  - .3 PVC encapsulated rigid steel
- 1.2.2 All outlet boxes, conduit boxes and fittings installed indoors or outdoors shall be PVC encapsulated rigid metal type to match PVC encapsulated rigid steel conduit applications.
- 1.2.3 All junction boxes, pull boxes and cabinets installed outdoors shall be of the same manufacturers as the conduit application and rated NEMA 4X.
- 1.2.4 Outlet and Conduit Boxes must be of the same material as the conduit application.
- 1.2.5 Outlet boxes, conduit boxes and fittings installed in classified areas shall be rated NEMA 7 to suit hazardous environments.

## **2 PRODUCTS**

### **2.1 Outlet And Conduit Boxes General**

- 2.1.1 Size boxes in accordance with code requirements.
- 2.1.2 102mm square or larger outlet boxes as required for special devices.
- 2.1.3 Gang boxes where wiring devices are grouped.
- 2.1.4 Blank cover plates for boxes without wiring devices.
- 2.1.5 Combination boxes with barriers where outlets for more than one (1) system are grouped.
- 2.1.6 All boxes used with exposed conduits to be galvanized rigid metal. Boxes to be as manufactured by Appleton or equal.
- 2.1.7 Each light, switch, receptacle and/or outlet shall be provided with suitable outlet box, each approved for the particular area which it is to be installed.
- 2.1.8 One outlet box shall be installed per switch, receptacle, light, etc.
- 2.1.9 Provide PVC encapsulated outlet and conduit boxes to suit all PVC encapsulated conduit applications. Acceptable product: Plasti-Bond.

## **2.2 Sheet Steel Outlet Boxes**

- 2.2.1 Electro-galvanized steel single and multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38mm or as indicated. 102mm square outlet boxes when more than one (1) conduit enters one (1) side with extension and plaster rings as required.
- 2.2.2 Electro-galvanized steel utility boxes for outlets connected to surface mounted EMT conduit, minimum size 102 x 54 x 48mm.
- 2.2.3 102mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

## **2.3 Masonry Boxes**

- 2.3.1 Electro-galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

## **2.4 Concrete Boxes**

- 2.4.1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

## **2.5 Conduit Boxes**

- 2.5.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle.

## **2.6 Outlet Boxes for Non-Metallic Sheathed Cable**

- 2.6.1 Electro-galvanized, sectional, screw ganging steel boxes, minimum size 76 x 50 x 63mm with two (2) double clamps to take non-metallic sheathed cables.

## **2.7 Fittings - General**

- 2.7.1 Bushing and connectors with nylon insulated throats.
- 2.7.2 Knock-out fillers to prevent entry of debris.
- 2.7.3 Conduit outlet bodies for conduit up to 32m and pull boxes for larger conduits.
- 2.7.4 Double locknuts and insulated bushings on sheet metal boxes.

## **2.8 While-In-Use Outlet Covers**

- 2.8.1 Provide while-in-use outlet covers for all receptacles in outdoor areas or where indicated on the contract documents. Cover shall be extra duty rated with clear polycarbonate cover as manufactured by Leviton, Red Dot or approved equal.

# **3 EXECUTION**

## **3.1 Installation**

- 3.1.1 Support boxes independently of connecting conduits.

- 3.1.2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- 3.1.3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6mm of opening.
- 3.1.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

**END OF SECTION**



## 1 GENERAL

### 1.1 Description

1.1.1 This section describes the requirements for conduits and associated fittings.

### 1.2 Scope

1.2.1 Provide a complete conduit system to in accordance with the drawings and specifications.

1.2.2 Seal conduits against propagation of water, corrosive gases, fire and/or smoke.

### 1.3 General Requirements

1.3.1 The requirements of this section are generic, and details and/or requirements shown on the drawings shall take precedence.

1.3.2 Provide conduits per the following:

Location	Area Classification	Application	Conduit Material
Indoors: Offices, Meeting Rooms, Washrooms, Laundry Rooms, Kitchens, Control Rooms, Office Hallways, Laboratories Surface mount and embedded	Unclassified Ordinary non-corrosive and dry locations	Power, control, and communication wiring, fibre optic cables.	PVC
Indoors: Process Areas Electrical Rooms	Unclassified	Power & control wiring, fibre optic cables.	PVC
Indoors: Process Areas Electrical Rooms	Unclassified	Copper communications cables, VFD cables to motors, Ultrasonic Level Transmitter, Level Element wiring.	Aluminum
All except buried	Class I, Div 1 or 2	All	PVC Coated RGS
Outdoors, Above Grade	Unclassified	All	PVC
Underground	Unclassified	All	PVC
Concrete Encased	Unclassified	All	PVC

1.3.3 The conduit sizes shown on the drawing are a minimum and are for a single feed. Size all conduits for multiple feeders in accordance with the Electrical Code and the spare space requirements of Section 16010.

1.3.4 Minimum conduit size for lighting and power circuits: 19mm.

## **1.4 References**

1.4.1 Canadian Standards Association (CSA)

- .1 CAN/CSA C22.2 No. 18-98, Outlet Boxes, Conduits Boxes, and Fittings.
- .2 CSA C22.2 No. 45-M1981 (R2003), Rigid Metal Conduit.
- .3 CSA C22.2 No. 56-2017, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
- .4 CSA C22.2 No. 83-M1985 (R2017), Electrical Metallic Tubing.
- .5 CSA C22.2 No. 211.2-M1984 (R2003), Rigid PVC (Un-plasticized) Conduit.
- .6 CAN/CSA C22.2 No. 227.3-[M91] (R2003), Flexible Non-metallic Tubing.

## **2 PRODUCTS**

### **2.1 General**

2.1.1 Fittings: manufactured for use with conduit specified. The fitting material and coating shall be the same as conduit used in the application.

### **2.2 Expansion/Deflection Fittings**

- 2.2.1 Provide at all structural expansion joints.
- 2.2.2 Provide on all interior conduits where required to suit a 14°C maximum temperature variation.
- 2.2.3 Provide on all exterior, above-grade conduits. Design for temperature range of 75°C. Each straight run shall have a minimum of one (1) fitting.
- 2.2.4 Install in accordance with manufacturer's instructions.

### **2.3 Rigid Aluminium Conduit**

- 2.3.1 Meet requirements of CSA C22.2 No. 45.2.
- 2.3.2 Rigid Aluminium Conduit to be manufactured of 6063 alloy in temper designation T-1 listed by U.L.6 "Standard for Rigid Metal Conduit" and manufactured to ANSI C80.5.
- 2.3.3 Fittings:
  - .1 Type: Threaded, copper free - Set screw and fittings not permitted.

- .2 Insulated Bushing
  - .1 Material: Cast aluminium with integral insulated throat, rated for 150°C.
  - .2 Manufacturers and Products: O-Z/Gedney: Type AB
- .3 Grounding Bushing
  - .1 Material: Cast aluminium with integral insulated throat rated for 150°C, with solder-less lugs.
  - .2 Manufacturers and Products: O-Z/Gedney: Type ABLG
- .4 Conduit Hub
  - .1 Material: Cast aluminum with integral insulated throat.
  - .2 UL listed for use in wet locations.
  - .3 Manufacturers and Products:
    - .1 O-Z/Gedney: Type CHA
    - .2 Thomas & Betts: Series 370AL
    - .3 Meyers: Series SA
- .5 Conduit Bodies
  - .1 Manufacturers and Products (for normal conditions)
    - .1 Appleton: Form 85 threaded unilets
    - .2 Crouse-Hinds: Mark 9 or Form 7-SA threaded condulets
    - .3 Killark: Series O electrolets
  - .2 Manufacturers (For hazardous Locations)
    - .1 Appleton
    - .2 Crouse-Hinds
    - .3 Killark
- .6 Couplings: As supplied by conduit manufacturer
- .7 Conduit Sealing Fitting Manufacturers and Products:
  - .1 Appleton: Type EYF-AL or EYM-AL
  - .2 Crouse-Hinds: Type EYS-SA or EZS-SA

- .3 Killark: Type EY or EYS
- .8 Drain Seal Manufacturers and Products
  - .1 Appleton: Type EYDM-A
  - .2 Crouse-Hinds: Type EYD-SA or EZD-SA
- .9 Drain/Breather Fittings Manufacturers and Products
  - .1 Appleton: Type ECDB
  - .2 Crouse-Hinds: ECD
- .10 Expansion Fittings Manufacturers and Products
  - .1 Deflection/Expansion Movement: Steel City: Type DF-A
  - .2 Expansion Movement Only: Steel City: Type AF-A
- .11 Cable Sealing Fittings: To form watertight nonslip cord or cable connection to conduit.
  - .1 Bushing: Neoprene at connector entry
  - .2 Manufacturer: Appleton: CG-S

## **2.4 PVC Conduit**

- 2.4.1 Meet requirements of CSA C22.2 No. 211.2 and NRMA TC 2.
- 2.4.2 Suitable for areas NOT exposed to physical damage, underground direct burial, concealed or direct sunlight exposure and 90°C insulated conductors.
- 2.4.3 Unless shown otherwise on drawings or required by code, provide schedule 80 under equipment pads and schedule 40 conduit elsewhere.
- 2.4.4 PVC Conduit and Tubing
  - .1 Meet requirements of NEMA TC-3.
  - .2 Type: PVC, slip-on

## **2.5 PVC Coated Rigid Galvanized Steel Conduit**

- 2.5.1 Meet requirements of NEMA RN 1.
- 2.5.2 Material
  - .1 Meet requirements of CSA C22.2 No. 45.
  - .2 Exterior finish: PVC coated, 40 mils nominal thickness, bond to metal shall have tensile strength greater than PVC.

- .3 Interior finish: Urethane coating, 2 mils nominal thickness.
- 2.5.3 Threads: Hot-dipped galvanized and factory coated with urethane.
- 2.5.4 Bendable without damage to either interior or exterior coating.
- 2.5.5 Acceptable Manufacturer: "Plasti-Bond Red" by Robroy Industries.
- 2.5.6 Fittings:
  - .1 Meet requirements of NEMA RN 1.
  - .2 Fittings: Rigid galvanized steel type, PVC coated by conduit manufacturer.
  - .3 Conduit Bodies: Cast metal hot-dipped galvanized or urethane finish. Cover shall be of same material as conduit body. PVC coated by conduit manufacturer.
  - .4 Overlapping pressure sealing sleeves.
  - .5 Conduit Hangers, Attachments, and Accessories: PVC-coated
  - .6 Manufacturers:
    - .1 Robroy Industries
    - .2 Ocal
- 2.5.7 Expansion Fitting Manufacturer and Product: Ocal; OCAL-BLUE XJG

## **2.6 Conduit Fastenings**

- 2.6.1 One (1) hole steel straps to secure surface conduits NPS 2 50mm and smaller. Two (2) hole steel straps for conduits larger than NPS 2 50mm.
- 2.6.2 Beam clamps to secure conduits to exposed steel work.
- 2.6.3 Channel type supports for two (2) or more conduits at 15m oc.
- 2.6.4 Threaded rods, 6mm dia., to support suspended channels.
- 2.6.5 All mounting hardware used outdoors and in corrosive areas shall be of non-corrosive type material compatible with the conduit material including:
  - .1 Stainless steel
  - .2 Aluminium
  - .3 PVC encapsulated steel

## **2.7 Flexible, Nonmetallic, Liquid-Tight Conduit**

- 2.7.1 Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.

2.7.2 Body/compression nut (gland) design to assure high mechanical pull-out strength and watertight seal.

2.7.3 Manufacturers and Products

.1 Carlon: Type LT

.2 O-Z/Gedney: Type 4Q-P

.3 Thomas & Betts: Series 6300

## **2.8 Flexible METALLIC CONDUIT**

2.8.1 Meet requirements of CSA C22.2 No. 56, liquid-tight flexible metal.

## **2.9 Watertight Entrance Seal Device**

2.9.1 New construction

.1 Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.

.2 Manufacturer and Product: O-Z/Gedney; Type FSK or WSK, as required

2.9.2 Cored-Hole Application

.1 Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.

.2 Manufacturer and Product: O-Z/Gedney: Series CSM.

## **2.10 Expansion Fittings for Rigid Conduits**

2.10.1 Weatherproof expansion fittings with internal bonding assembly suitable for 200mm linear expansion.

2.10.2 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19mm deflection in all directions.

2.10.3 Weatherproof expansion fittings for linear expansion at entry to panel.

## **2.11 Fish Cord**

2.11.1 6mm polypropylene in all empty conduits.

## **2.12 Electrical Metallic Tubing**

2.12.1 Electrical Metallic Tubing shall be hot galvanized steel O.D. with an organic corrosion resistant I.D. coating, and shall be listed to UL Safety Standard 797 and manufactured in accordance with ANSI C80.3.

### **3 EXECUTION**

#### **3.1 Installation, General**

- 3.1.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- 3.1.2 Conceal all conduits in finished rooms that are equipped with suspended ceilings.
- 3.1.3 Install sleeves where conduits pass through slab or wall.
- 3.1.4 Do not pass conduits through structural members except as indicated.
- 3.1.5 Install conduit sealing fittings in hazardous areas in accordance with the Electrical Code. Fill with compound.
- 3.1.6 Install fish cord in empty conduits.
- 3.1.7 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- 3.1.8 Dry conduits out before installing wire.
- 3.1.9 Install conduits with minimum clearances as follows:
  - .1 To parallel steam or hot water line: 75mm
  - .2 To steam or hot water line crossover: 25mm
  - .3 To infrared or gas fired heaters: 1.5m
  - .4 To any building surface in Damp/Wet and/or Corrosive areas: 12 mm
  - .5 Between conduits containing copper communication lines and any power circuit rated at more than 600 V or 1000 A: 600 mm

#### **3.2 Surface Conduits**

- 3.2.1 Run parallel or perpendicular to building lines.
- 3.2.2 Run conduits in flanged portion of structural steel.
- 3.2.3 Group conduits in parallel runs.

#### **3.3 Bends, General**

- 3.3.1 Install concealed raceways with a minimum of bends in the shortest practical distance.
- 3.3.2 Make bends and offsets of longest practical radius.
- 3.3.3 Bends in conduits and ducts for fiber optic cables shall be not less than 20 times cable diameter, 375mm minimum.

- 3.3.4 Make bends and kicks in parallel or banked runs from same center or centerline with same radius so that bends and kicks are parallel.

### **3.4 Support**

- 3.4.1 Support from structural members only, at intervals not exceeding Canadian Electrical Code requirements and in any case not exceeding 2.5 metres. Do not support from piping, pipe supports or other raceways.

- 3.4.2 Provide supports that are impervious to galvanic reaction between dissimilar metals.

- 3.4.3 Support aluminum conduit on concrete surfaces with spacers or framing channel constructed of stainless steel, aluminum or non-metallic material.

- 3.4.4 Do not overtighten supports against conduit. Allow for conduit expansion and contraction.

- 3.4.5 Multiple Adjacent Raceways: Provide ceiling trapeze. For trapeze-supported conduit allow 25 percent extra spaces for future conduit.

- 3.4.6 Application/Type of Conduit Strap

- .1 Rigid Steel or EMT Conduit: Zinc coated steel, pre-galvanized steel or malleable iron.
- .2 PVC Coated Rigid Steel Conduit: PVC coated metal.
- .3 Non-metallic Conduit: Non-metallic or PVC coated metal.

- 3.4.7 Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

- .1 Wood: wood screws
- .2 Hollow Masonry Units: toggle bolts
- .3 Concrete or Brick: expansion shields or threaded studs driven in by powder charge with lock washers and nuts
- .4 Steelwork: machine screws
- .5 Location/Type of Hardware
  - .1 Dry, noncorrosive areas: galvanized
  - .2 Wet, noncorrosive areas: stainless steel
  - .3 Corrosive areas: stainless steel

- 3.4.8 Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

### **3.5 Penetrations**

- 3.5.1 Make penetrations at right angles, unless otherwise shown.



- 3.5.2 Notching or penetration of structural members, including footings and beams, is not permitted.
- 3.5.3 Fire-Rated walls, floors, or ceilings: fire stop openings around penetrations to maintain fire-resistance rating.
- 3.5.4 Apply single layer of wraparound duct band to all metallic conduit protruding through concrete floor slabs to a point 50mm above and 50mm below concrete surface.
- 3.5.5 Where conduits protrude through floor slabs in areas subject to mechanical damage, provide heavy steel guards around conduits from grade to a height of 1200 mm above grade.
  - .1 Leave drainage holes at base of guards.
- 3.5.6 Concrete walls, floors, or ceilings (aboveground): provide non-shrink grout dry-pack or use watertight seal device.
- 3.5.7 Entering Structures
  - .1 General: Seal raceway at the first box or outlet with listed water-stopping sealant to prevent the entrance of gases or liquids from one area to another.
  - .2 Arrange conduits to allow water to drain away from seals.
  - .3 Concrete roof or Membrane Waterproofed Wall or Floor:
    - .1 Provide a watertight seal.
    - .2 Without concrete encasement: Install watertight entrance seal device on each side.
    - .3 With concrete encasement: Install watertight entrance seal device on the accessible side.
    - .4 Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
    - .5 Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
  - .4 Heating, Ventilating, and Air Conditioning Equipment
    - .1 Penetrate equipment in area established by manufacturer.
    - .2 Terminate conduit with flexible PVC encapsulated metallic conduit at junction box or conduit attached to exterior surface of equipment prior to penetrating equipment.
    - .3 Seal penetration with Type 5 sealant, as specified in Section 07900 - Joint Sealants.
  - .5 Corrosive-Sensitive Areas
    - .1 Seal all conduits passing through chlorine/chemical room walls.

- .2 Seal conduit entering equipment panel boards and field panels containing electronic equipment.
- .3 Seal penetration with Type 5 sealant, as specified in Section 07900 - Joint Sealants.
- .6 Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.
- .7 Non waterproofed Wall or Floor (Underground without Concrete Encasement)
  - .1 Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
  - .2 Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint on each side.
- .8 Maintenance holes and Hand holes
  - .1 Metallic Raceways: Provide insulated grounding bushings.
  - .2 Non-metallic Raceway: Provide bell ends flush with wall.
  - .3 Install such that raceways enter as near as possible to one end of wall unless otherwise shown.

### **3.6 Conduits In Cast-In-Place Concrete**

- 3.6.1 All cast in place conduit installations not specified on the drawings must be approved by the Contract Administrator.
- 3.6.2 Locate to suit reinforcing steel. Install in centre third of slab.
- 3.6.3 Protect conduits from damage where they stub out of concrete.
- 3.6.4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.
- 3.6.5 Do not place conduits in slabs in which slab thickness is less than four (4) times conduit diameter.
- 3.6.6 Encase conduits completely in concrete with minimum 25mm concrete cover.
- 3.6.7 Organize conduits in slab to minimize crossovers.

### **3.7 Conduits In Cast-In-Place Slabs on Grade**

- 3.7.1 All cast in place conduit installations not specified on the drawings must be approved by the Contract Administrator.
- 3.7.2 Run conduits 25mm and larger below slab and encased in 75mm concrete envelope. Provide 50mm of sand over concrete envelope below floor slab.

### **3.8 Conduits Underground**

- 3.8.1 Slope conduits to provide drainage.
- 3.8.2 Waterproof joints (except PVC) with heavy coat of bituminous paint.
- 3.8.3 Provide horizontal expansion joints at building foundations and vertical expansion joints where conduits rise out of ground.

### **3.9 Connections To Equipment, Unclassified Areas**

- 3.9.1 Make rigid connection to equipment
- 3.9.2 In unclassified areas and where the conduit size is 103mm or less use flexible, liquid-tight conduit for other connections to equipment containing motors or subject to vibration or other motion.
- 3.9.3 Conduit size over 103mm: nonflexible.
- 3.9.4 Wet or Corrosive areas: flexible, non-metallic, liquid-tight.
- 3.9.5 Dry Areas: flexible, metallic liquid-tight.

### **3.10 Connections To Equipment, Classified Areas**

- 3.10.1 Use TECK-HL cable for power connection between disconnect switches and explosion proof motors
- 3.10.2 Use explosion proof flexible, liquid-tight conduit for other connections to equipment containing motors or subject to vibration or other motion.

### **3.11 PVC Conduit**

- 3.11.1 Debur all ends prior to making joints.
- 3.11.2 Solvent Weld all joints using manufacturer's recommended solvent.
- 3.11.3 Install such that joint is watertight.
- 3.11.4 Adapters:
  - .1 PVC to metallic fittings: PVC terminal type
  - .2 PVC to rigid metal conduit: PVC female adapter
- 3.11.5 Belled End Conduit: Bevel the unbelled end of the joint prior to joining.
- 3.11.6 PVC Conduit:
  - .1 Bends 30° and larger: provide factory-made elbows.
  - .2 Use manufacturer's recommended method for forming smaller bends and kicks.

3.11.7 Do not install conduit with scorch marks.

### **3.12 Aluminum Conduit**

3.12.1 Bend conduit cold.

3.12.2 Do not install kinked or flattened conduit.

3.12.3 Protect aluminum conduits in contact with concrete with:

- .1 Apply bituminous Paint, shrink wrap or other protective coating acceptable to the Engineer and AHJ.
- .2 Apply protective coatings in accordance with the manufacturer's recommendations
- .3 Extend protection to 100 mm minimum from concrete.

3.12.4 Field threads must be of sufficient length to draw conduits up tight.

### **3.13 PVC Coated Rigid Galvanized Steel Conduit**

3.13.1 Do not install conduit with major scratches or damage to the coating.

3.13.2 Repair minor scratches coating using manufacturer's touch-up paint.

### **3.14 Liquid-Tight Flex**

3.14.1 Control wiring terminations to be in Liquid tight, PVC encapsulated steel armoured flex to suit the transition from conduit or junction box to the respective process equipment and instrumentation.

3.14.2 Liquid tight flex shall not exceed 2m in length.

3.14.3 Bends shall exceed the minimum allowable conductor bending radius and shall allow conduit flexibility.

3.14.4 Length: 450mm minimum, 1500mm maximum.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 The section describes the requirements for motor starters supplied under the contract as stand-alone devices or as part of an MCC or other equipment.
- 1.1.2 This section shall apply to starters supplied with or as part of equipment supplied by all divisions.

### **1.2 Related Sections**

- 1.2.1 Section 16010 - Electrical General Requirements
- 1.2.2 Section 16225 - Motor Control Centres

### **1.3 References**

- 1.3.1 International Electro-technical Commission (IEC)
  - .1 IEC 947-4-1, Part 4: Contactors and motor starters.

### **1.4 Product Data**

- 1.4.1 Submit shop drawings in accordance with Section 01330 - Submittals.
- 1.4.2 Shop drawings to indicate:
  - .1 Mounting method and dimensions.
  - .2 Starter size and type.
  - .3 Layout of identified internal and front panel components.
  - .4 Enclosure types.
  - .5 Wiring diagram for each type of starter.
  - .6 Interconnection diagrams.

### **1.5 Operation And Maintenance Data**

- 1.5.1 Provide operation and maintenance data for motor starters for incorporation into manual, specified in Section 01800 - Start-up and Commissioning.
- 1.5.2 Include operation and maintenance data for each type and style of starter.

### **1.6 Maintenance Materials**

- 1.6.1 Provide maintenance materials in accordance with Section 01800 - Start-up and Commissioning.

1.6.2 Provide listed spare parts for each different size and type of starter:

- .1 Contacts, stationary.
- .2 Contacts, movable.
  - .1 1 contact, auxiliary.
  - .2 1 control transformer.
  - .3 1 operating coil.
  - .4 2 fuses.
- .3 10% LED push to test type bulbs.

## **2 PRODUCTS**

### **2.1 Materials**

2.1.1 Starters: to IEC 947-4 with AC4 utilization category.

### **2.2 Enclosure**

- 2.2.1 Supply and install the respective motor starters in the respective MCC's and/or in dedicated motor starter enclosures as indicated on the drawings.
- 2.2.2 Dedicated Motor Starter enclosures shall have a minimum rating of NEMA 12 unless otherwise indicated on the drawings. All dedicated motor starter enclosures shall include a front door complete with a full piano door hinge and external operating handle that is interlocked with the door to prevent live access to the motor starter interior components.

### **2.3 Full Voltage Starters**

- 2.3.1 Provide starters of the Full Voltage (FV) type as specified and shown on the drawings. Provide EEMAC starter size to suit the electrical name plate data of the respective motor application.
- 2.3.2 Each starter shall be provided with a control transformer, 600V, fused, primary connections phase to phase and 115V secondary shall be grounded on X2 secondary side and a suitable control circuit fuse provided on the other side. Control power transformers shall be adequately rated to carry continuously the control circuit burdens and intermittently, the inrush currents imposed by the contactor coil. One (1) side of coil shall be connected to the grounded side of the C.P.T. secondary. Each starter in addition to its holding contact shall be provided with two (2) normally open and two (2) normally closed auxiliary contacts for control and interlocking.
- 2.3.3 All starters shall be closed transition type and designed for front access. Each starter shall be provided with a cover mounted green indicating light which is visible with the door closed to indicate when the motor is running, and a red indicating light when motor is not running. Provide heavy duty oil tight pushbutton, or selector stations in the covers of those starters as indicated on the drawings. Each motor starter and unit compartment shall be provided with flange formed doors with concealed hinges, and large captive screws for fastening in closed

position. Starters shall be capable of being removed from a section for maintenance without the need of disconnecting power to any or complete MCC. Motor starters of EEMAC size No. 5 and smaller shall be connected to vertical bus by means of "stab-on" connectors providing a positive tin-plated contacts with both sides of the bus at all times and shall be easily removable from the unit compartment and readily interchangeable with other starters of same size. Means shall be provided in the stationary structure for supporting and aligning starter units during their removal or replacement.

- 2.3.4 Provide all control wiring, interlocking, auxiliary contacts, timers, double voltage relays or Ontario Electrical Safety Code approved Mylar barriers called for on the drawings or required for proper operation. Each terminal block shall be isolated to permit working on any section with MCC with the remainder of MCC energized. Terminal blocks and terminals shall be numbered and clearly identified.

## **2.4 Control Transformer**

- 2.4.1 Single phase, dry type, control transformer with primary voltage as indicated and 120V secondary, complete with secondary fuse, installed in with starter as indicated.
- 2.4.2 Size control transformer for control circuit load plus 50% spare capacity.

## **2.5 Motor Management Relays**

- 2.5.1 Provide motor management relays and remote RTD modules as shown on the drawings.

## **2.6 Finishes**

- 2.6.1 Apply finishes to enclosure in accordance with Section 16010 - Electrical General Requirements.

## **2.7 Equipment Identification**

- 2.7.1 Provide equipment identification in accordance with Section 16090 - Equipment Identification.
- 2.7.2 Magnetic starter designation label, white plate, black letters, size 2, engraved as indicated.

# **3 EXECUTION**

## **3.1 Installation**

- 3.1.1 Install starters, connect power and control as indicated.
- 3.1.2 Ensure correct fuses and overload devices elements installed.

## **3.2 Field Quality Control**

- 3.2.1 Perform tests in accordance with Section 16010 - Electrical General Requirements and manufacturer's instructions.
- 3.2.2 Operate switches, contactors to verify correct functioning.
- 3.2.3 Perform starting and stopping sequences of contactors and relays.

- 3.2.4 Check that sequence controls, interlocking with other separate related starters, equipment, control devices, operate as indicated.
- 3.2.5 Provide a detailed documentation of all Soft Starter and/or VFD configuration settings to the Contract Administrator prior to commissioning.

**END OF SECTION**



## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section covers the modifications to existing MCCs.

### **1.2 Scope**

- 1.2.1 Provide modifications to existing MCC-4 as per the drawings.
- 1.2.2 Provide modifications to existing MCC-10 as per the drawings.

### **1.3 General**

- 1.3.1 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for General Electrical requirements related to this work.
- 1.3.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.

### **1.4 Related Sections**

- 1.4.1 Section 16010 - Electrical General Requirements
- 1.4.2 Section 16090 - Equipment Identification
- 1.4.3 Section 16223 - Motor Starters to 600V
- 1.4.4 Section 16412 - Moulded Case Circuit Breakers

### **1.5 Applicable Codes and Standards**

- 1.5.1 All equipment furnished under this section shall be designed, constructed and tested in accordance with current versions of the applicable standards of ANSI, CSA, EEMAC, IEEE, NEMA, and the OESC including, but not limited to NEMA ICS 2-322.
- 1.5.2 Reference to standards and organizations in the Specifications shall be by the following abbreviated letter designations:
- |    |       |   |
|----|-------|---|
| .1 | CEA   | Canadian Electricity Association                              |
| .2 | CSA   | Canadian Standard Association                                 |
| .3 | IEEE  | Institute of Electrical and Electronic Engineers              |
| .4 | IEC   | International Electro Technical Commission                    |
| .5 | NEMA  | National Electrical Manufacturers Association                 |
| .6 | EEMAC | Electrical and Electronic Manufacturers Association of Canada |

- |    |      |  |
|----|------|--|
| .7 | ISO  | International Organization for Standardization |
| .8 | NFPA | National Fire Prevention Association           |
| .9 | ULC  | Underwriters Laboratory Canada                 |

## **1.6 General**

- 1.6.1 Equipment furnished under this section shall be fabricated, assembled, tested, and shipped to the job site in full conformity with the instructions and recommendations of the equipment manufacturer, unless Engineer notes exceptions.
- 1.6.2 Dimensional Restrictions: Layout dimensions will vary between manufacturers. The supplier shall coordinate with the Contractor to facilitate a proper installation, subject to acceptance by Engineer.
- 1.6.3 Nameplates: Each hinged door shall be provided with a nameplate giving the units description. Each control or indicating device mounted on the face of each door shall be provided with a nameplate giving its designation. Each control device and each control wire terminal block connection inside each unit shall be identified with nameplates or painted legends to match the identification on the manufacturer's wiring diagrams. Unit nameplates for circuit breakers, motor starters and contactors shall indicate the equipment being controlled and the operating voltage and phase. Nameplates shall be attached with self-tapping screws. Adhesive backed nameplates are not acceptable. Nameplates shall be white and black laminated phenolic material of suitable size, and shall be engraved with 10 mm high letters for compartment identity and 5 mm letters for other information. The engraving shall extend through the white exterior lamination to the black center.

## **1.7 Quality Assurance**

- 1.7.1 The equipment supplier shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective workmanship or materials, and leakage, breakage, or other failure. Materials shall be suitable for service conditions.
- 1.7.2 All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practice. Individual parts shall be manufactured to standard sizes and thicknesses so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable.
- 1.7.3 Equipment shall not have been in service at any time prior to delivery, except when required by tests.
- 1.7.4 Manufacturer to provide standard factory testing of complete motor control centre including operation of switches, circuit breakers, starters and controls.
- 1.7.5 Submit certified written test results to Engineer prior to shipment.
- 1.7.6 The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.
- 1.7.7 For the equipment specified herein, the manufacturer shall be ISO certified.

- 1.7.8 Provide manufacturer's type test certificates including short circuit fault damage certification up to short circuit values specified under bus bracing.

**1.8 Submittals**

- 1.8.1 Complete assembly, foundation and installation drawings, together with complete engineering data covering the materials used, parts, devices, and accessories forming a part of the motor control centre shall be submitted in accordance with the submittals section. The drawings and data shall include, but shall not be limited to, the following:

- .1 Master Drawing Index
- .2 Front View Elevation of modified MCC Assembly
- .3 Single Line Wiring Diagram showing MCC power distribution.
- .4 Unit Wiring Diagrams for modified buckets showing devices, connections and terminal designations
- .5 Starter wiring schematics customized to project specific requirements
- .6 Interconnection wiring schematics
- .7 Nameplate Schedule
- .8 Starter and Component Schedule c/w individual component technical data sheets for each modified bucket
- .9 Assembly Ratings including:
  - .1 Short-circuit rating
  - .2 Voltage
  - .3 Continuous current
- .10 Major Component Ratings including:
  - .1 Voltage
  - .2 Continuous current
  - .3 Interrupting Ratings
- .11 Cable terminal sizes.
- .12 Shipping and handling instructions.

- 1.8.2 Where applicable the following information shall be submitted to the Engineer:

- .1 Busway connection.

1.8.3 Provide the following product information:

- .1 Descriptive bulletins.
- .2 Product sheets.

**1.9 Operation And Maintenance Data**

1.9.1 Operation and maintenance manuals shall be submitted in accordance with the submittals section.

1.9.2 Operation and Maintenance manuals shall include the following:

- .1 Assembly, installation, alignment, adjustment and checking instructions.
- .2 Lubrication and maintenance instructions.
- .3 Guide to troubleshooting.
- .4 Parts lists and predicted life of parts subject to wear.
- .5 Outline, cross section, and assembly drawings, engineering data; and wiring diagrams.
- .6 Test data and performance curves, where applicable.

1.9.3 The operation and maintenance manuals shall be in addition to any instructions or parts lists packed with or attached to the equipment when delivered.

**1.10 Delivery, Storage and Handling**

1.10.1 Shipping, handling, and storage shall be in accordance with Division 1 requirements.

1.10.2 Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10.3 Ship the equipment in as few sub-assemblies as is practical and in accordance with overall erection schedule.

**1.11 Packaging And Shipping**

1.11.1 Pack, crate or otherwise protect each item so that it is not damaged in transit and arrives in serviceable condition at the site. Ensure accumulation of water in equipment is prevented.

1.11.2 Include with the shipment one copy of erection drawings, instructions and maintenance manuals in English.

1.11.3 Clearly mark all crates, boxes and cartons to indicate the purchase order number and the name of the equipment.

1.11.4 Shipping invoice shall show the crate, box or carton number.

## **1.12 Field Measurements**

- 1.12.1 The installing Contractor to verify equipment proposed shall fit into the available space. Coordinate installation with other trades and notify the approval authorities of any interferences or conflicts in the MCC system power and control wing.

## **2 PRODUCTS**

### **2.1 General**

- 2.1.1 Motor control centres shall be modified as indicated on the drawings and as specified herein.
- 2.1.2 Withstand rating: 42 kA
- 2.1.3 Interrupt rating: 42 kA (series-rating not allowed)
- 2.1.4 Each motor control centre and all of its components shall be rated for the interrupting capacity (IC) indicated on the drawings.
- 2.1.5 Provide connection to SCADA as required and indicated on drawings.

### **2.2 Starter Unit Compartments**

- 2.2.1 Units EEMAC size 5 and smaller, circuit breaker units 225A and smaller, plug-in type with self-disconnect. Guide rail supports for units to ensure that stabs make positive contact with vertical bus. Provision for units to be installed or removed, off load, while buses energized.
- 2.2.2 Unit mounting
- .1 Engaged position - unit stabbed into vertical bus.
  - .2 Withdrawn position - unit isolated from vertical bus but supported by structure. Terminal block accessible for electrical testing of starter.
  - .3 Provision for positive latching in either engaged or withdrawn position and padlocking in withdrawn position.
  - .4 Stab-on connectors free floating tin plated clips, self-aligning, backed up with steel springs.
- 2.2.3 External operating handle of circuit switch interlocked with door to prevent door opening with switch in "on" position. Provision for 3 padlocks to lock operating handle in "off" position and lock door closed.
- 2.2.4 Hinge unit doors on same side.
- 2.2.5 Overload relays manually reset from front with door closed.
- 2.2.6 Pushbuttons and indicating lights mounted on door front.
- 2.2.7 Devices and components by one (1) manufacturer to facilitate maintenance.

- 2.2.8 Pull-apart terminal blocks for power and control to allow removal of starter units without removal of field wiring.

### **2.3 Finishes**

- 2.3.1 Shop finish metal enclosure surfaces by application of rust-resistant primer inside and outside, and at least two coats of finish enamel.
- 2.3.2 Paint motor control centre buckets exterior to match existing with and interiors white.
- 2.3.3 Provide a 100 mL container of finish enamel for touch-up of scratches during installation.

### **2.4 Circuit Breakers**

- 2.4.1 Motor Control centre disconnects shall be three pole, single-throw, 600 volt, moulded-case air circuit breakers. Circuit breakers of combination starters shall be magnetic motor circuit protector type. Feeder circuit breakers shall be thermal-magnetic type and shall be manually operated, with quick-make, quick-break, trip-free toggle mechanism. Bimetallic thermal elements shall withstand sustained overloads and short-circuit currents without injury and without affecting calibration. Thermal elements shall trip the breaker at 125 percent of trip rating. The instantaneous elements of 225 ampere frame and larger breakers shall be adjustable and shall be set at 800 percent of trip rating.

### **2.5 Starters/Contactors**

- 2.5.1 Contactors for control of bus voltage loads other than motors shall be the same as contactors for combination magnetic starters, except overloads will not be required. Mechanically held contactors shall have 120 volts AC coils with disconnecting contacts. Other contactors shall have 120 volt continuous duty coils and contacts where indicated on the drawings.
- 2.5.2 Refer to Section 16223 - Motor Starters to 600 V.

### **2.6 Controls Devices and Wiring**

- 2.6.1 Wiring Labels and Terminal Blocks: All internal wires shall be labelled at each termination. Terminals shall also be identified with labels showing the terminal block and terminal number.
- .1 All starter units shall be provided with side-mounted, latching, pull-apart terminal blocks for control wiring.
- .2 Terminal blocks shall be pull-apart type rated 20 amperes. All current carrying parts shall be tin-plated. The removable portion of the terminal blocks shall be used for factory installed wiring.
- 2.6.2 NEMA MCC wiring class shall be as shown on the data sheet.
- 2.6.3 Control wiring shall be 105 °C Type SIS, min #14 AWG.
- 2.6.4 All wires shall be identified with heat-shrink, oil-resistant wire markers.
- 2.6.5 Identify wires in accordance with the control schematics and Section 16010 - Electrical General Requirements.

- 2.6.6 Provide spade wire terminals for all control circuit wiring.
- 2.6.7 Each section requiring control power shall have a dedicated control power transformer.
- 2.6.8 Relays and Timers: Auxiliary relays and timers shall have 120 volt, 60 Hz coils for continuous duty in 40°C ambient, and 10 ampere, 120 volts ac contacts. Auxiliary relays shall be NEMA rated.
- 2.6.9 Control Switches and Pilot Lights: Control switches and pilot lights shall be heavy-duty, oil tight construction. Pilot lights shall be transformer type with LED lamps.
- 2.6.10 Pilot/Indicator Light
  - .1 All pilot/indicator lights to be LED type.
  - .2 All lights to be push to test type.
- 2.6.11 Where MCCs have multiple incoming feeders, provide mechanical and/or electrical interlocks as shown on the drawings.

## **2.7 Equipment Identification**

- 2.7.1 Provide equipment identification in accordance with Section 16090 - Equipment Identification.
  - .1 Motor control centre main nameplate: size No. 7.
  - .2 Individual compartment nameplates: size No. 5, engraved as indicated on drawings.

## **2.8 Acceptable MCC Suppliers**

- 2.8.1 The existing MCC-4 is a Eaton Cutler-Hammer Freedom Series 2100 Control Centre with the following info:
  - .1 S.O.: 37B642801
  - .2 BUS: 600A
  - .3 600V, 3 phase, 3 wire, 60 Hz
  - .4 Date of Manufacturer: 08/2007
- 2.8.2 The existing MCC-10 is to be modified in two sections of different ages; the original MCC, and an addition to the left-most side of the MCC. Both are Klockner-Moeller Series 200 Control Centre with the following info:
  - .1 Original Section:
    - .1 S.O.: 670-16-0135, Cust. Order No. DW78-58-12
    - .2 BUS: 600A
    - .3 600V, 3 phase, 3 wire, 60 Hz

.4 Date of Manufacturer: Unknown

.2 Added Section:

.1 S.O.: W + S 65711, No. 16/94-5453-A

.2 BUS: 600A

.3 600V, 3 phase, 3 wire, 60 Hz

.4 Date of Manufacturer: Unknown

2.8.3 The new equipment shall be compatible with the above listed descriptions. The contractor shall verify existing MCC information before purchasing new equipment.

### **3 EXECUTION**

#### **3.1 Examination**

3.1.1 Overload relay heater ratings must be properly sized and coordinated for each motor starter unit.

3.1.2 Installing Contractor to verify ESA clearances prior to installation. Verify CSA labelling of the assembly prior to installation.

#### **3.2 Factory Testing**

3.2.1 The motor control centres buckets shall have been type-tested in a high-power laboratory to prove adequate mechanical and electrical capabilities.

3.2.2 All factory tests required by the latest ANSI, NEMA and CSA standards shall be performed.

3.2.3 The manufacturer shall provide three (3) certified copies of factory test reports.

3.2.4 Factory tests as outlined above shall be witnessed by the Owner's representative.

.1 The manufacturer shall notify the Owner two (2) weeks prior to the date the tests are to be performed.

#### **3.3 Installation**

3.3.1 Contractor to follow the installation instructions supplied by the manufacturer.

3.3.2 Control wiring shall be as shown on the contract drawings except as modified by the approval and submittal process. Interface all local and remote devices into the control wiring and operational systems for each load.

3.3.3 Coordinate terminal connections with installation of secondary feeders.

3.3.4 Retighten current-carrying bolted connections and enclosure support framing and panels to manufacturer's recommendations.

3.3.5 Remove foreign material, including dust before energizing equipment.



- 3.3.6 Connect power, control and grounding wiring.
- 3.3.7 Prior to energization, confirm in writing that solid state devices have been activated, programmed, calibrated, and set.
- 3.3.8 Make grounding connections between equipment ground busses and building grounding system.
- 3.3.9 Check all factory made connections for mechanical security, electrical continuity and current phasing.
- 3.4 Manufacturer's Commissioning Services**
  - 3.4.1 Provide the services of a qualified factory-trained manufacturer's representative to assist the contractor in installation and start-up of the equipment specified under this section for a period of one (1) working day. The manufacturer's representative shall provide technical direction and assistance to the Contractor in general assembly of the equipment, connections and adjustments, and testing of the assembly and components contained therein.
  - 3.4.2 The following minimum work shall be performed by the Contractor under the technical direction of the manufacturer's service representative:
    - .1 Check all removable cells and starter units for easy removal and insertion.
    - .2 Perform insulation tests on each phase and verify low-resistance ground connection on ground bus.
    - .3 Connect all power wiring and control wiring and verify basic operation of each starter from control power source.
    - .4 Torque all bolted connections made in the field and apply witness marks.
    - .5 Verify all factory bolted connections.
    - .6 Calibrate any solid state metering or control relays for their intended purpose and make written notations of adjustments on record drawings. Perform start-up of any solid state starters and adjustable frequency drives.
    - .7 Operate all equipment under load.
  - 3.4.3 Follow the manufacturer's instructions and the contract documents concerning any short circuit device settings, heater selection, timing relays, or start-up of components.
  - 3.4.4 Generate a field report on tests performed, test values experienced, etc., and make available to Owner upon request.
  - 3.4.5 The Contractor shall provide three (3) copies of the manufacturer's field start-up report.
  - 3.4.6 Provide a hard copy typed printout of all set up parameters to the Engineer for review prior to field commissioning.
  - 3.4.7 Measure and record Full Load Amp (FLA) for all starters and feeder breakers.

**3.5 Field Testing**

- 3.5.1 Follow the minimum requirements as stipulated in the manufacturer testing procedure for this type of motor control centre assembly.

**3.6 Manufacturer's Certification**

- 3.6.1 A qualified factory trained manufacturer's representative shall certify in writing that the equipment has been installed, adjusted and tested in accordance with the manufacturer's recommendations. Equipment shall be inspected prior to the generation of any reports.
- 3.6.2 The Contractor shall provide three (3) copies of the manufacturer's representatives certification.

**3.7 Training**

- 3.7.1 The Contractor shall provide a training session for up to five (5) Owner's representatives for one (1) normal work day (this can coincide with the installation and start-up field visit) at the job site or other office location chosen by the Owner.
- 3.7.2 The training session shall be conducted by a manufacturer's qualified representative.
- 3.7.3 The training program shall consist of the following:
- .1 Review of the MCC one-line drawings and schedules.
  - .2 Review of the factory record shop drawings and placement of the various cells.
  - .3 Review of each type of starter cell, components within, control, and power wiring.
  - .4 Review common maintenance procedures including bus inspection, cable termination inspection, contactor coil replacement and contact replacement procedures.
  - .5 Review the operation of equipment including wrapper removal and proper lock-out procedure.
  - .6 Discuss the maintenance timetable and procedures to be followed in an on going maintenance program.
  - .7 Provide three-ring binders to participants complete with copies of drawings and other course material covered.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 This section describes miscellaneous electrical equipment and materials not covered by other sections.

### **1.2 General**

- 1.2.1 All sections of Division 1 form a part of this Specification.
- 1.2.2 Refer to all other Divisions of the Specifications and these documents to determine their effect upon the work of this section.
- 1.2.3 All sections of Divisions 1 to 16 inclusive form part of the Contract Documents. Refer to Section 16010 for General Electrical Requirements related to this work.

### **1.3 Scope**

- 1.3.1 Furnish all labour, materials, supervision, equipment and services specified, indicated or requested to install all equipment and materials specified herein and on the drawings.
- 1.3.2 All (local) control panels and pushbutton stations indicated on the Electrical Drawings - Elementary (Schematic) Control Diagrams will be supplied, installed and tested under this section.

### **1.4 Definitions**

- 1.4.1 The following are definitions of terms and expressions used in the specification:
- .1 "Inspection Department/Authority" means an agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site. For this project the Inspection Authority is the Electrical Safety Authority (ESA).
  - .2 "Electrical Code" is defined as the Ontario Electrical Safety Code, latest edition.
  - .3 "Indicated" is defined as shown on the drawings or noted in contract documents.
  - .4 "Provide" is defined as to supply install, verify, test and commission.
- 1.4.2 Refer to CSA C22.2 No.0 for "Definitions and General Requirements".

### **1.5 Related Sections**

- 1.5.1 Division 1 - General Requirements
- 1.5.2 Division 13 - Process Control
- 1.5.3 Division 11 - Equipment

## **1.6 Codes And Standards**

- 1.6.1 Abbreviations for electrical terms: Refer to CSA Z85.
- 1.6.2 Ontario Electrical Safety Code latest edition and latest Bulletins of Electrical Safety Authority (ESA)
- 1.6.3 Building Code of Ontario, O.Reg. 413, Latest Revision.
- 1.6.4 Local applicable codes and regulations.

## **2 PRODUCTS**

### **2.1 Materials And Equipment**

- 2.1.1 Equipment and material must be CSA certified. Where there is no alternative to supplying equipment that is CSA certified, obtain special approval from Electrical Inspection Department. Pay all associated fees and perform all required retrofits to obtain special inspection certification.
- 2.1.2 Factory-assemble control panels and component assemblies.

### **2.2 Control Panel - General**

- 2.2.1 General dimensions and arrangements are indicated on the drawings. System Supplier shall be responsible for coordinating the console and enclosure sizes and arrangements to accommodate the equipment provided.
- 2.2.2 Provide industrial type control panels to suit model and dimensions shown on the drawings. Dimension identified on the drawings are to be considered minimum. It is the responsibility of the system supplier to increase the dimensions of the control panel, as required to accommodate all components to be installed within the respective control panel. All control panel designs that require additional control sections shall include a full size door to suit each additional section.
- 2.2.3 All panels furnished by the Contractor shall carry CSA/ULC label to suit the custom fabricated application or be special inspected by the Electrical Safety Authority.
- 2.2.4 All panels and cabinets shall be provided with interior back and side sub panels for mounting equipment, a minimum of 300mm print pocket, a cable base, and a drip shield across the top of the panel.
- 2.2.5 Self regenerating desiccant with vapour corrosion inhibitors for moisture and corrosion protection shall be provided for two years operation. The installed date shall be marked on the package.
- 2.2.6 Compression type bulkhead fittings shall be provided near the bottom or the top of the panel for all field connections. Compression nuts and sleeves shall be provided for the field connections.
- 2.2.7 Provide wall mounted or free standing control panels to suit the respective applications as shown on the design drawings.

- 2.2.8 Control Panel wiring or instrument connections and all internal items to be identified with tag number or service with nameplates affixed with double-sided tape.
- 2.2.9 Control Panel terminal block shall be arranged such that a minimum of 50mm of clear space is left for outgoing wiring termination. If two terminal blocks are side by side, then minimum of 75mm shall be left between terminal blocks.
- 2.2.10 Low voltage control wiring shall be copper, colour coded, twisted pairs sized and installed in 80 per cent full lay-in plastic panduit ducts. All outgoing wiring to field devices shall be terminated in terminal blocks, 20 per cent spare terminals shall be provided. All terminals and wires shall be numbered. The numbering system will be agreed upon during the shop drawing review stage and is intended to agree with corresponding numbers on the design drawings. All wires terminating under screws as opposed to clamp type terminals shall have spaded lugs installed.
- 2.2.11 Sub-panels and mounting plates to be 12 gauge CRS finished with white baked on enamel and have suitable breaks and stiffeners to provide a motion free mounting plate when installed.
- 2.2.12 All panel wiring shall be neatly dressed and run in plastic duct with AC and DC conductors in separate ducts.
- 2.2.13 Wire/conductor colour coding to be:
  - .1 Current carrying neutral conductors shall be coloured white.
  - .2 Line and load AC Power conductors shall be coloured black.
  - .3 Ground conductors shall be coloured green.
  - .4 DC signal ground shall be coloured green with white stripes.
  - .5 DC voltage conductors shall be coloured blue.
  - .6 Intrinsically safe circuits: Light Blue
  - .7 Foreign source interlock control circuits - yellow
  - .8 AC control wiring conductors shall be coloured red.
  - .9 Signal (4-20 mA) cabling to have PVC outer jacket coloured grey.
- 2.2.14 Two separate grounds are to be supplied, one for instrument grounding and one for control circuit grounding. Install grounding so as to keep two grounds isolated (separate). Ground conductors are to be coloured green, with light green used for control circuit ground and dark green for instrument ground. Provide a dedicated ground connection to the building primary ground electrode.
- 2.2.15 All panel wiring and testing shall be done in CSA certified control panel shop.
- 2.2.16 All panel mounted equipment including switches, relays, timers, analog equipment power suppliers, circuit breakers etc., shall be identified with individual lamacoid nameplates. Provide Engineer with nameplate data for review.

- 2.2.17 The Contractor shall provide the Engineer in writing with a proposed system of terminal wire numbering for approval prior to submitting shop drawings.
- 2.2.18 All wiring shall be identified with pre-numbered slip-on markers as manufactured by Brady. Slip-on markers shall be sized to suit wire size and type. Where signal cable identification is required, provide each cable with cable number and each wire with individual wire markers. The Contractor shall allow for up to 10 characters and numbers per wire being terminated at the JC.
- 2.2.19 The low voltage wiring terminal blocks shall be separated with barriers from 120V control and power wiring terminal blocks.
- 2.2.20 120V control and power wiring shall be stranded copper and colour coded. This control wiring shall be segregated from low voltage control wiring and be installed in separate lay-in plastic panduit ducts, terminated in terminal blocks with 20 per cent of spare terminals. Panel wiring shall be neatly dressed and run in Panduit duct with AC, DC, analog, and communications conductors in separate ducts. Allow a minimum of 150mm wide x 100mm deep for incoming field wiring, and minimum 100mm wide x 100mm deep for internal wiring.
- 2.2.21 All wire and cable shall be run in continuous lengths between supply point and the load and/or device termination points. No splices will be allowed.
- 2.2.22 Adequate slack shall be provided on cable harnesses to permit easy removal of I/O and other printed circuit cards and/or modules and instruments during service or repair.
- 2.2.23 All wiring to instruments mounted on doors shall be twisted into one bundle and shall cross from the cabinet to the door at a shallow angle using expandable sleeving.
- 2.2.24 All wiring for signal systems (analog loops) shall be identified as to loop/circuit numbers with approved markers on the cables at all termination points. Signal (analog) wires shall be PVC insulated tinned copper stranded 18 AWG, rated at 300 volts. Conductors shall be in individual pairs with overall shield and drain wire. Signal wiring shall be Belden #9318 (one pair) and Belden #9368 (two pair).
- 2.2.25 The shields shall be continuous through terminal strips and shall be individually isolated from other shields.
- 2.2.26 All wiring, including spares, to be terminated and tagged slip-on wire marker at terminal blocks. No termination to marrettes will be accepted.
- 2.2.27 Employ plastic wire ways, a minimum of 100mm wide x 75mm deep complete with fine fingers, must be suitable size for field and internal wiring. Provide wire way dimensions and layouts to suit the specific requirements of each control panel application.
- 2.2.28 Segregate signal wiring from control power wiring according to the following categories: Power 12- VAC, Analog 24 VDC, Digital 120VAC and Communication wiring.
- 2.2.29 Provide Velcro tie wraps (Hubbell or Panduit) for bundling and securing all wiring.
- 2.2.30 Internal wiring not less than #16 AWG 600V single conductor stranded copper with TEW insulation.
- 2.2.31 Provide Belden type 1118A, #16 AWG shielded twisted pair of analog signals.

- 2.2.32 For 120VAC power wiring provide RW 90 #12 AWG with insulation rated at 600VAC.
- 2.2.33 600VAC wiring shall be protected from finger touch with lexan covers.
- 2.2.34 Provide control panel ventilation and/or dedicated cooling units as required to dissipate heat generated by internal components such that the internal panel temperature is limited to 24 degrees Celsius.
- 2.2.35 Approved Panel Manufacturers
  - .1 Eurobex
  - .2 Hammond
  - .3 Hoffman

### **2.3 Terminal Blocks**

- 2.3.1 Supply and install terminal blocks and mounting rails as shown on drawings complete with slip on marking strips (No hand written markers).
- 2.3.2 Terminal blocks for external connections shall be suitable for 12 AWG wire and shall be rated 30 amperes at not less than 300 volts. Terminal blocks shall be fabricated complete with marking strip, covers, and pressure connectors. Terminals shall be labelled to agree with identification shown on the supplier's submittal drawings. A terminal shall be provided for each conductor of external circuits, plus one ground for each shielded cable. Not less than 200mm of clearance shall be provided between the terminal strips and the base of vertical panels for conduit and wiring space
- 2.3.3 Supply and install 30 per cent spare terminals or minimum of 10 spare terminals whichever is greater, evenly distributed in pairs across terminal blocks in the junction cabinets (JC). Spare wires to be terminated on spare terminals.
- 2.3.4 All terminals are to be easily accessible with ample room for termination of field and panel wiring. Supply terminal block partitions for separating instrument analog loops (4-20mA, etc.) from 120VAC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and grounding points are partitioned by terminal block barriers.
- 2.3.5 Terminal blocks to be as manufactured by Phoenix Contact Ltd. or Wiedmuller or ENTRELEC Terminal Block Ltd. Field & PLC/RTU /JC terminals to be of the disconnect type UK5-MTK-P P or M6/8 SN and, USLKGIO or M6/8P or W series type for ground termination.
- 2.3.6 All terminal block groupings to be complete with printed sequentially numbered type marking strips (black on white for field term. and black on yellow for PLC/RIO/RTU /JC term.), partition plates, end covers and end clamps. Mounting rail to be DIN 1 type as supplied by polyamide.
- 2.3.7 All terminals shall be easily accessible with ample room for termination of field and panel wiring. Terminal block partitions shall be supplied for separating instrument loop (4-20mA, etc.) from 120 VAC terminals. Arrange terminal strips so that power, control wiring, instrument wiring and ground points are partitioned by terminal block barriers. In panels with large numbers of terminals, separate rails shall be provided for 120VAC blocks.
- 2.3.8 Common connection of wires at terminal blocks to be generally connected by jumper bar.

- 2.3.9 Group markers shall be used for major group, e.g. all signals from an MCC starter.
- 2.3.10 Knife-switch field terminal blocks shall be provided on all analog 4-20 mA loops to permit easy electrical isolation of loop and connection of ammeter into loop.
- 2.3.11 Fused terminal blocks with neon "fuse blown" indicator on a knife switch shall be provided for all digital loops to electrically isolate the loop. One spare fuse shall be provided per each 10 digital connection. All fuses or circuit breakers shall be clearly labelled and located for easy maintenance.
- 2.3.12 One side of each terminal strip shall be reserved for field incoming conductors. No common connections and jumpers required for internal wiring shall be allowed on the field side of the terminal.
- 2.3.13 250ohm precision resistors shall be provided at terminal blocks where required.
- 2.3.14 Acceptable Terminal Block Manufacturers:
  - .1 Weidmuller
  - .2 Phoenix Contacts
  - .3 Entrelec

## **2.4 Control Panel Grounding and Power Distribution**

- 2.4.1 Power shall be supplied to the all field devices and instruments from the respective control panels as indicated on the drawings. Each instrument power circuit shall be protected with a panel mounted terminal block type circuit breaker sized to suit the application. Two 120VAC /24VDC (two Amp minimum) power supplies with power distributor block shall be supplied. The power supplies shall be sized such that one can handle the total 24V DC load. Fused terminal blocks shall be provided to distribute the 24VDC power.
- 2.4.2 Panel lighting, service outlets, and heater shall be put on a separate 120VAC circuit supplied by a separate power feeder to the panel. Internal panel circuits or loads must not be mixed.
- 2.4.3 Two separate grounds, one for instrument grounding (i.e. 4-20mA cable shields etc.) and one for control circuit grounding (i.e. case grounds, control circuits, etc.) shall be provided. Install grounding so as to keep two grounds isolated. Ground conductors shall be #6 AWG, coloured green, with white stripes used for instrument grounds and dark green for control circuit grounds.
- 2.4.4 Vinyl insulated ring type crimp connectors shall be provided for all ground connections.
- 2.4.5 Supply and install terminal blocks and mounting rails to suit power distribution with slip on marking strips (No hand written markers).

## **2.5 Local Control Stations**

- 2.5.1 Control stations shall be provided as indicated on the one line diagrams or schematics or as required by the equipment furnished.



- 2.5.2 Pilot devices shall be heavy duty, oil tight (NEMA 13) and shall perform the functions indicated.
- 2.5.3 Control stations shall have the following NEMA enclosure ratings:
  - .1 Indoor, ordinary areas: 12
  - .2 Indoor, hazardous areas: 7
  - .3 Indoor, wet, damp or corrosive areas: 4X
  - .4 Outdoor, non-hazardous areas: 4X
- 2.5.4 Outdoor, hazardous areas: 8
- 2.5.5 Control stations outdoors or indicated to be weatherproof shall have protective caps on the control devices.
- 2.6 Control Relays (Instantaneous)**
- 2.6.1 General purpose plug-in type relays, low coil current, heavy duty contacts with multi-contact poles as indicated.
  - .1 Coil rating (Vac systems): 120 V, 60 Hz.
  - .2 Coil rating (Vdc systems): 125 V.
  - .3 Contact rating (Vac systems): 120 V, 10A.
  - .4 Contact rating (Vdc systems): 125 V, 2A.
- 2.6.2 Provide overlap contact cartridges where indicated or required by the control logic. Supply in pairs having NO contact that closes before NC contact opens (early make -late break).
- 2.6.3 Mounting strips: indexed strips easily cut to required length and bolted in place. Relays are installed in rows on strip with captive mounting screws. Rows of relays on mounting strip form their own wiring trough.
- 2.6.4 Label all relays with the identifier shown on the respective control drawings. Label the relay and the panel location corresponding to the relay.
- 2.6.5 Acceptable Manufacturers.
  - .1 Omron
  - .2 Eaton
  - .3 Potter-Bromfield
  - .4 Allen-Bradley

## **2.7 Timing Relays**

- 2.7.1 General purpose electronic plug-in type relays, low coil current heavy duty contacts with multi-contact poles as indicated. Coil rating: 120 V, 60 Hz. Contact rating: 120 V, 10A.
- 2.7.2 Potentiometer: self-contained to provide time interval adjustment. Timing range as indicated.
- 2.7.3 Where timed elements shown on drawing are not possible with a single relay, provide multiple timing relays to suit.
- 2.7.4 Acceptable manufacturers:
  - .1 Omron
  - .2 Eaton
  - .3 Potter-Bromfield
  - .4 Allen-Bradley

## **2.8 Pushbuttons**

- 2.8.1 Momentary contact type: Heavy duty - oil tight, operator flush type, colour as indicated, 1-NO and 1-NC contacts rated 5A at 120V AC, labels as indicated.
- 2.8.2 Push-pull contact type: Heavy duty - oil tight, operator mushroom head type, red colour, provision for padlocking in "OFF" position, 2-NO and 2-NC contacts rated 5A at 120V AC, labels as indicated.
- 2.8.3 Pushbutton ratings:
  - .1 NEMA type 13 for indoor control panels
  - .2 NEMA type 4X/13 for outdoor control panels
  - .3 NEMA 7 for hazardous area control panels
- 2.8.4 Acceptable Manufacturers
  - .1 Allen-Bradley
  - .2 Schneider
  - .3 Cutler Hammer

## **2.9 Selector Switches**

- 2.9.1 Maintained contact type, 2 or 3 positions (as indicated), heavy duty - oil tight, operators standard knob, contact arrangement as indicated rated 5A at 120V AC, labels as indicated.
- 2.9.2 Switch ratings:
  - .1 NEMA type 13 for indoor control panels

.2 NEMA type 4X/13 for outdoor control panels

.3 NEMA 7 for hazardous area control panels

2.9.3 Acceptable Manufacturers

.1 Allen-Bradley

.2 Square D

.3 Cutler Hammer

**2.10 Indicating Lights**

2.10.1 Heavy duty - oil tight, LED cluster Push-To-Test type, lens colour: as indicated, supply voltage: 120 V, labels as indicated.

2.10.2 Indicating light ratings

.1 NEMA type 13 for indoor control panels

.2 NEMA type 4X/13 for outdoor control panels

.3 NEMA 7 for hazardous area control panels

2.10.3 Acceptable manufacturers

.1 Allen-Bradley

.2 Square D (Schneider)

.3 Cutler Hammer

**2.11 Control Power Transformers**

2.11.1 Single phase, dry type

2.11.2 Primary: as indicated, 60 Hz AC.

2.11.3 Secondary: 120V or 24V AC as indicated.

2.11.4 Rating: as indicated plus 20% spare capacity.

2.11.5 Provide secondary fuses kit (terminal block type clips) and fuse, size as indicated.

2.11.6 Transformers shall provide voltage regulation as required by magnet coils and solenoid valves.

**2.12 Fire Transits**

2.12.1 All cable trays, conduit etc. that transitioning through building walls, floors, ceilings to be sealed with a two (2) hour fire rated caulking or fire transit.

- 2.12.2 Provide shop drawing package for fire transits with data sheets and drawings indicating where each product will be used.
- 2.12.3 Fire transit to be ULC listed.
- 2.12.4 Approved Manufacturer: HILTI

### **3 EXECUTION**

#### **3.1 Fire Transits**

- 3.1.1 Install per manufacturer's approved drawings.
- 3.1.2 Inform contract administrator prior to installation. Contract Administrator reserves the right to witness installation.
- 3.1.3 Provide manufacturer's letter of proper installation for all fire transits.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description**

- 1.1.1 The section describes the requirements for moulded case breakers supplied under the contract as stand-alone devices in enclosures or as part of a panelboards, MCC or other equipment.
- 1.1.2 This section shall apply to starters supplied with or as part of equipment supplied by all divisions except that:
  - .1 This section does not apply to breakers in SCADA panels supplied under Division 13.

### **1.2 Related Sections**

- 1.2.1 Section 16010 - Electrical General Requirements
- 1.2.2 Section 16441 - Panelboards Breaker Type
- 1.2.3 Section 16225 - Motor Control Centre
- 1.2.4 Section 16426 - Service Entrance Switchboard

### **1.3 References**

- 1.3.1 CSA C22.2 No.5-02 Moulded Case Circuit Breakers.

### **1.4 Product Data**

- 1.4.1 Submit product data in accordance with Section 01330 - Submittals.
- 1.4.2 Include time current characteristic curves for breakers with interrupting capacity of 22,000 A symmetrical (RMS) and over at system voltage.

## **2 PRODUCTS**

### **2.1 Breakers General**

- 2.1.1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- 2.1.2 Plug-in moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- 2.1.3 Common-trip breakers: with single handle for multi-pole applications.
- 2.1.4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3-10 times current rating.
- 2.1.5 Circuit breakers with interchangeable trips as indicated.
- 2.1.6 EEMAC/NEMA equipment only.

- 2.1.7 Protective devices shall be moulded case circuit breakers with inverse time and instantaneous tripping characteristics.
- 2.1.8 Circuit breakers shall be operated by a toggle type handle and shall have a quick make, quick break over centre switching mechanism that is mechanically trip free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be non-welding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
- 2.1.9 Circuit breakers shall have a minimum symmetrical interrupting capacity of 42,000A or as indicated on the drawings whichever is greater.
- 2.1.10 Circuit breakers 600 ampere frame and below shall be equipped with thermal magnetic trip units and inverse time current characteristics.

## **2.2 Thermal Magnetic Breakers**

- 2.2.1 Moulded 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.

## **2.3 Magnetic Breaker**

- 2.3.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.
- 2.3.2 Provide a solid state electronic tripping module for timed and instantaneous overcurrent protection as indicated on the drawings.
- 2.3.3 Include a solid state electronic tripping module for timed and instantaneous overcurrent and ground overcurrent protection for all breakers rated 1000A or greater.

## **2.4 Solid State Trip Breakers**

- 2.4.1 Moulded case circuit breaker to operate by means of a solid state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous tripping for phase, ground fault short circuit protection.

## **2.5 Enclosure**

- 2.5.1 Individual wall mounted breakers to be installed in a NEMA 12 enclosure (or as otherwise indicated on the drawings) complete with a hinged door and a lockable external breaker handle.

# **3 EXECUTION**

## **3.1 Installation**

- 3.1.1 Install circuit breakers as indicated.

**END OF SECTION**

## **1 GENERAL**

### **1.1 Description of Work**

- 1.1.1 Provide circuit and equipment disconnect switches as indicated on the drawings and as required by code.

### **1.2 Product Data**

- 1.2.1 Submit product data in accordance with Section 01330 - Submittals.
- 1.2.2 Submit manufacturer's data for all disconnect switches.
- 1.2.3 Identify motor or equipment served by each switch; indicate nameplate inscription.

## **2 PRODUCTS**

### **2.1 Disconnect Switches**

- 2.1.1 Supply and install heavy duty safety switches, fused or unfused, as required complete with fuses as shown or required by code. Safety switches shall be quick make and quick break construction with safety interlock and HP ratings as indicated.
- 2.1.2 Switches located in process areas shall at minimum be enclosed in a NEMA Type 4X housing. Where switches are installed in Class 1, Division 1 or Division 2 environments, the switches shall be certified for such areas. Where switches are installed outdoors, the switches shall be in UV resistant enclosures.
- 2.1.3 Provision for padlocking in off switch position by one (1) lock.
- 2.1.4 Mechanically interlocked door to prevent opening when handle in ON position.
- 2.1.5 Provide Fuse performance, rating and type as recommended by the protection coordination study.
- 2.1.6 Fuse holders: re-locatable and suitable without adaptors, for type and size of fuse indicated.
- 2.1.7 Quick-make, quick-break action.
- 2.1.8 ON-OFF switch position indication on switch enclosure cover.
- 2.1.9 Switches shall be fitted with a label to indicate switch voltage (e.g. 120V, 600V, etc.) in accordance with ESA requirements.
- 2.1.10 Disconnect switches to be equipped with auxiliary status position contacts to suit switch position. Auxiliary contacts shall be suitable for use with VFD applications. Contacts shall be late make, early break type.

### **2.2 Equipment Identification**

- 2.2.1 Provide equipment identification in accordance with Section 16090 - Equipment Identification.

**2.3 Acceptable Manufacturer**

- 2.3.1 Cutler Hammer
- 2.3.2 Hubbell
- 2.3.3 Cooper Crouse - Hinds
- 2.3.4 Square 'D'

**3 EXECUTION**

**3.1 Installation**

- 3.1.1 Install disconnect switches complete with fuses if applicable.
- 3.1.2 Provide corrosion resistant mount hardware, and stands for free standing disconnect installations.
- 3.1.3 Wire all disconnect switch auxiliary status contacts into the respective motor starters as required.

**END OF SECTION**



# **2025-55 - Wastewater Treatment Plant Secondary Clarifier and Aeration Tank Rehabilitation**

Opening Date: July 10, 2025 8:30 AM

Closing Date: August 7, 2025 3:00 PM

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Schedule of Prices

Instructions on How to Complete Pricing Form(a) Rates shall be provided in Canadian funds, inclusive of all applicable duties and taxes except for HST.

(b) Rates quoted by the bidder shall be all-inclusive and shall include all labour and material costs, all travel and disbursement costs, all insurance costs, and all other overhead, including any fees or other charges required by law.

The Summary Table provides your Sub-Total for each pricing table and also indicates whether or not the table is mandatory. Asterisks within the table denote a "MANDATORY" line item.

If the line item and/or table is "NON-MANDATORY" and you are not bidding on it, leave the table and/or line item blank. Do not enter a \$0.00 dollar value unless you are prepared to provide the line item at zero dollars to the City.

If a table is "NON-MANDATORY" and you are bidding on it, you must bid on all line items with an asterisk.

If there are multiple tables, you must click the "EDIT PRICING" button inside the Summary Table to display the applicable Pricing Table that you wish to bid on.

Pricing Form

The bidder having the lowest contract amount will be recommended for the award of the project.

Line Item	Description	Quantity	Unit of Measure	Unit Price *	Extended Price
1	Division 1 - General	1	lump sum		
2	Division 2 - Site Works	1	lump sum		
3	Division 3&5 - Concrete and Metals	1	lump sum		
4	Division 6 - Wood and Plastics	1	lump sum		
5	Division 7 - Thermal and Moisture Protection	1	lump sum		
6	Division 11 - Process Mechanical	1	lump sum		
7	Division 13 - Instrumentation & Control	1	lump sum		
8	Division 16 - Electrical	1	lump sum		
Subtotal:					

Provisional Items

The total contract amount shall include a price for the provisional item(s) as identified in the Pricing Form. The City intends to award all provisional items at the time of award however the Contractor must have prior written approval from the City Project Lead prior to proceeding with any provisional item(s) throughout the term of the contract. Approval to proceed with a provisional item(s) is contingent on a continued requirement and budget approval.

Line Item	Description	Estimated Quantity	Unit of Measure	Unit Price *	Extended Price
1	Miscellaneous Metal Repairs (Welding)	32	hour		
2	Secondary Clarifiers Crack Injection	74	m		
3	Secondary Clarifiers Spall Repairs (600mmx600mmx75mm deep)	19	each		
4	Effluent Channel Crack Injection	45	m		
5	Effluent Channel Spall Repairs (300x300x75mm deep)	2	each		
6	Effluent Channel Expansion Joint Sealant	9	m		
7	Aeration Tank Temporary Works	7	each		
8	Aeration Tank 1 Demolition and Disposal for Wall Recast	430	m		
9	Aeration Tank 1 Crack Injection	17	m		
10	Aeration Tank 1 Concrete Repairs	1	lump sum		
11	Aeration Tank 1 Spall Repairs (300mmx229mmx75mm deep)	13	each		
12	Aeration Tank 1 Expansion Joint Sealant	18	m		
13	Aeration Tank 1 Grating Angle Replacement	487	m		
14	Aeration Tank 1 Grating Replacement	310	m2		
15	Aeration Tank 1 Grating Beam and Stair Angle	54	kg		
16	Aeration Tank 1 FRP Guardrails	452	m		
17	Aeration Tank 2 Demolition and Disposal for Wall Recast	460	m		
18	Aeration Tank 2 Crack Injection	12	m		
19	Aeration Tank 2 Concrete Repairs	1	lump sum		
20	Aeration Tank 2 Spall Repairs (300mmx229mmx75mm deep)	9	each		
21	Aeration Tank 2 Expansion Joint Sealant	18	m		
22	Aeration Tank 2 Grating Angle Replacement	474	m		
23	Aeration Tank 2 Grating Replacement	300	m2		
24	Aeration Tank 2 Grating Beam	36	kg		
25	Aeration Tank 2 FRP Guardrails	474	m		
26	Aeration Tank all other items not noted above to perform a complete upgrade as per the contract drawings and specifications	1	lump sum		
27	Temporary pumping Phase 2A or 2B	1	week		
Subtotal:					

Summary Table

Bid Form	Amount
Pricing Form	
Provisional Items	
Subtotal Contract Amount:	

The bidder confirms that the pricing information provided is accurate. The bidder acknowledges that any inaccurate, misleading or incomplete information, including withdrawn or altered pricing, could adversely impact the acceptance of its bid or its eligibility for future work.

References

Provide current references, not to include the City of Brantford, for work of a similar nature (i.e. size and scope) to this project. The City of Brantford may verify references and a negative or poor reference or job completion may, at the City’s sole discretion, be sufficient reasons for not negotiating a contract with the bidder.

References

Business Name	Description of Project/Work	Date Work Completed	Project Value	Reference Contact Name & Number	Email Address	
						*
						*
						*

Subcontractors

The bidder shall state all Subcontractor(s) and type of work proposed to be used for this project. Bidders shall not indicate "TBD" (To Be Determined) or "TBA" (To Be Announced) or similar wording and shall not indicate multiple choices of Subcontractor names for any Subcontractor category in their list of Subcontractors. One Subcontractor name shall be indicated for each Subcontractor category.

The bidder shall state only one (1) Subcontractor for each type of work.

Subcontractors

☐ By clicking here I confirm that there are no Subcontractor(s) and the bidder shall perform the project with their "OWN FORCES".

Trade	Business Name & Address	Contact Name & Number

Documents

Ensure your bid submission document(s) conforms to the following:

1. Documents should be in PDF format. Documents should NOT be provided in any other format.
2. Documents should NOT have a security password, as the City may not be able to open the file. It is the bidder's sole responsibility to ensure that their uploaded document(s) are not either defective, corrupted or blank and that the documents can be opened and viewed by the City.
3. The City may reject any submission where any document(s) cannot be opened and viewed by the City.
4. Multiple file responses, if applicable, (e.g. Corporate Profile, Project Lead Experience, Project Examples;) should be merged into one PDF file in the order and format listed in the competitive document and named accordingly. E.g. "Technical Responses"

The respondent shall upload:

- WISR Report from within the last 90 days
- A copy of a valid Occupational Health & Safety Management System Certification (ISO 45001 or COR Certification)
- Workplace Injury Summary Report (WISR) \* (mandatory)
- Occupational Health & Safety Management System Certificate (ISO 45001 or COR Certification) \* (mandatory)

Addenda, Terms and Conditions

Submission Form

1. Acknowledgement of Terms of Reference and Governing Law

The bidder acknowledges that this competitive process will be governed by the terms and conditions of the competitive document.

2. Ability to Provide Deliverables

The bidder has carefully examined this competitive document and has a clear and comprehensive knowledge of the Deliverables required. The bidder represents and warrants its ability to provide the Deliverables in accordance with the requirements of the competitive document for the rates set out in the completed Pricing Form

3. Prohibited Conduct

The bidder declares that it has not engaged in any conduct prohibited by this competitive process.

4. Confidential Information of Bidder

A bidder should identify any confidential information in its response or any accompanying documentation. The City will make reasonable efforts to safeguard confidential information of bidders, subject to its disclosure requirements under the Municipal Freedom of Information and Protection of Privacy Act or any other disclosure requirements imposed by order of a court or tribunal. The bidder agrees that their bid will, as necessary, be disclosed on a confidential basis to the City's advisers retained to advise or assist with this competitive process, including the review of bids. In addition, the bidder consents to the disclosure of contractual information, including pricing information, which may be disclosed to City Council and, accordingly, may become part of the public record. If a bidder has any questions about the collection and use of information pursuant to this competitive document, questions are to be submitted to the Purchasing Contact.

☐

I/WE agree to be bound by the terms and conditions contained in the bid document and any applicable Addenda, and the person named below has the authority to submit this bid on behalf of the bidder.

Conflict of Interest

For the purposes of this section, the term "Conflict of Interest" includes, but is not limited to, any situation or circumstance where:

- (a) in relation to the bidding process, the bidder has an unfair advantage or engages in conduct, directly or indirectly, that may give it an unfair advantage, including but not limited to (i) having, or having access to, confidential information of the City in the preparation of its bid that is not available to other bidders; (ii) communicating with any person with a view to influencing preferred treatment in the competitive bidding process (including but not limited to the lobbying of decision makers involved in the competitive process); or (iii) engaging in conduct that compromises, or could be seen to compromise, the integrity of the open and competitive process or render that process non-competitive or unfair; or
- (b) in relation to the performance of its contractual obligations under a contract for the Deliverables, the bidder's other commitments, relationships or financial interests (i) could, or could be seen to, exercise an improper influence over the objective, unbiased and impartial exercise of its independent judgement, or (ii) could, or could be seen to, compromise, impair or be incompatible with the effective performance of its contractual obligations.

Bidders must declare all potential Conflicts of Interests which includes disclosing the names and all pertinent details of all individuals (employees, advisers, or individuals acting in any other capacity) who (a) participated in the preparation of the bid; AND (b) were employees of the City within twelve (12) months prior to the Submission Deadline.

If you declare a Conflict of Interest select 'YES' and provide the required details. If no Conflict of Interest exists select 'NO'.

☒ Yes ☐ No

Addenda

The bidder is deemed to have read and accepted all addenda issued by the City prior to the Submission Deadline. The onus is on bidders to make any necessary amendments to their bids based on the addenda.

Please check the box in the column "I have reviewed this addendum" below to acknowledge each of the addenda.

File Name	I have reviewed the below addendum and attachments (if applicable)	Pages
There have not been any addenda issued for this bid.		

