Kingston Health Sciences Centre

KHSC-Emergency Power System Capacity & Infrastructure Remediation

Construction Documents
Project Manual

Issued 100% IFT

2026/07/15

HDR Project No. / Client PLO Number 10434805 / PLO 301360

Electrical / Mechanical
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INSTRUCTIONS TO BIDDERS

1.1 COMPLIANCE

A. The bidder acknowledges that by submitting a compliant bid, it has accepted an offer by the *Owner* to enter into a "bid contract" for the evaluation of bids and the award of the *Contract*, if an award is made. The bidder acknowledges that the terms of the "bid contract" are represented by the Bid Documents.

B. A bid which fails to comply with the requirements of these Instructions to Bidders may cause a bid to be declared non-compliant.

1.2 INTENT

A. The intent of this Bid call is to obtain an offer to perform work to complete the *Kingston Health Sciences Centre - KHSC-Emergency Power System Capacity & Infrastructure Remediation* for a Stipulated Price contract, in accordance with the *Contract Documents*.

B. Initiate work within 2 weeks of receipt of notice of *Contract* award.

C. The intent of the bid is to acquire Prime Contractor services for coordination and receipt of equipment; installation, integration, and provision of all electrical, mechanical, and controls systems to provide Kingston General Hospital an additional 2 MW capacity in a complete and seamlessly integrated Emergency Power System.

D. Achieve *Ready-for-Takeover* and *Total Completion of the Work* by the *Scheduled Ready-for-Takeover Date* and *Scheduled Total-Completion Date* as defined by Supplementary Conditions 2.2 H. and 2.2 I.

1.3 CONTRACT DOCUMENTS IDENTIFICATION

A. *Contract Documents* are identified as *Kingston Health Sciences Centre - KHSC-Emergency Power System Capacity & Infrastructure Remediation, HDR Architecture Associates, Inc., Contract* number / Owner's project number *10434805 / PLO 301360* as prepared by *HDR Architecture Associates, Inc.,* Prime Consultant; Structural Consultant; and *H.H. Angus & Associates Ltd.*, Mechanical & Electrical Consultant.

B. The form of *Contract* for this project will be the CCDC 2-2020 and Supplementary Conditions included in section 00 73 00.

C. The following documents form the basis of this bid process (the "Bid Documents"):
1. Instructions to Bidders
2. Bid Forms
3. Agreement, Definitions and General Conditions of the CCDC 2-2020
4. Supplementary Conditions
5. *Specifications* (per List of Contents)
6. *Drawings* (per List of Drawings)
7. Addenda issued during bidding period

D. Check Bid Documents for completeness upon receipt. Inform *Consultant* immediately should any documents be missing or incomplete or upon finding any discrepancies or omissions.

E. Documents obtained from sources other than the Prime Consultant may be incomplete or otherwise deficient. Bidders assume all risks associated with the use of such documents.

F. Unauthorized reproduction of Bid Documents is prohibited without written consent of the *Consultant*.

G. The Bid Documents are made available only for the purpose of submitting bids for the *Project*. Availability and/or use of the Bid Documents do not confer a license or grant for any other purpose.

H. Except as otherwise defined in these Instructions to Bidders, the defined terms in these Bid Documents are taken from the *Contract*. The term *Contract* is defined in the Agreement.

1.4 CONDITIONS OF THE PLACE OF THE WORK

A. The *Place of the Work* is located at the *Kingston General Hospital Site*, *76 Stuart St., Kingston, Ontario.*

B. Before submitting a bid, investigate the *Place of the Work* to fully ascertain existing conditions, circumstances and limitations affecting the *Work*. No allowances will be made for additional costs and no claims will be entertained in connection with conditions which could reasonably have been ascertained by such investigation or other due diligence prior to submitting a bid.

1.5 MANDATORY SITE MEETING

A. A mandatory site meeting has been scheduled to take place on ***July 22, 2026 @ 10:00 h*** and is to commence from the 76 Stuart Street Kingston General Hospital **Connell 0 – King Street Staff Entrance.** All prequalified general contract bidders and electrical subcontractor bidders must attend and will be required to sign the "Site Meeting Log" to confirm their attendance.

B. Bidders not in attendance at the mandatory site visit, as determined by the "Site Meeting Log" will not be permitted to submit a bid for this project. Bids received by the *Owner*, submitted by general contract bidders not in attendance will be returned unopened.

1.6 PREQUALIFICATION

A. The following bidders have been prequalified:
1. Bradf ord Construction Ltd.
2. David J. Cupido Construction Ltd.
3. Emmons & Mitchell Construction (2000) Ltd.
4. Frecon Construction Ltd.
5. Gen-eer Construction Ltd.
6. Harbridge & Cross Ltd.
7. 12491401 Canada Ltd. o/a HEIN
8. Jumec Construction Inc.
9. Ledcor Projects Eastern Ltd.
10. M. Sullivan & Son Ltd.
11. PCL Constructors Canada Inc.
12. Quinan Construction Ltd.

B. Bidders must use *Subcontractors* from the following prequalified list:
1. Mechanical Subcontract Bidders:
   a. E.S. Fox Ltd.
   b. Kelson Mechanical Eastern Inc.
   c. Modern Niagara Kingston
2. Electrical Subcontract Bidders:
   a. E.S. Fox Ltd.
   b. Modern Niagara Kingston
   c. Parallel Electric Ltd.
3. BAS / Fire Alarm
   a. Siemens

C. Bids received from bidders which have not been prequalified shall be returned unopened.

1.7 BID AND PERFORMANCE SECURITY

A. Each bid submitted shall be accompanied by bid security in the form of a Bid Bond in an amount of not less than 10% of Bid price submitted, naming the *Owner* as obligee and issued by a surety licensed to conduct surety and insurance business in Ontario. The bid security is for the benefit of the *Owner* and stands as security that the bidder, if awarded the *Contract*, will deliver the performance security and evidence of insurance and other documents required by these Instructions to Bidders or by the *Contract*, and will execute the *Contract*. The bid security shall remain valid for a period of ninety (90) days from the date of bid submission. No other form of bid security is acceptable.

B. The bid security of the bidder whose bid is accepted will be retained by the *Owner* to compensate the *Owner* for the damages it will suffer should the successful bidder fail to execute the *Contract* and/or fail to provide the specified performance security and/or evidence of insurance and other documents required by these Instructions to Bidders or by the *Contract*.

C. The bid security of the bidder whose bid is accepted will be returned after the delivery of the specified performance security and evidence of insurance and other documents required by these Instructions to Bidders or by the *Contract*, and after the execution of the *Contract*. The bid security of all other bidders will be returned after the execution of the *Contract* or after the expiry of this bid process without an award of *Contract* or after the rejection of all bids.

D. Each bid shall be accompanied by an agreement to bond issued by the same surety company that provides the bid bond, undertaking to provide a fifty percent (50%) Performance Bond and a fifty percent (50%) Labour and Material Payment Bond, both to be delivered to the *Owner* if the bidder is awarded the *Contract*.

E. Bids not accompanied by the required bid security, the required agreement to bond and declaration of insurance may be declared non-compliant and be disqualified at the discretion of the *Owner*.

F. Include the cost of all bonds in the bid price.

G. All forms shall be latest CCDC approved bonding forms.

1.8 UNDERTAKING OF INSURANCE

A. Provide signed "Undertaking of Insurance" on standard form provided by insurance company stating intention to provide insurance to Bidder in accordance with insurance requirements of *Contract Documents*. Include this form with Bid submission.

1.9 AMENDMENTS TO BID DOCUMENTS

A. Direct questions arising during the bidding period to:

Rekha Kyathanahalli Suresh
HDR Architecture Associates, Inc.
Email: Rekha.KyathanahalliSuresh@hdrinc.com

B. The Bid Calling Authority shall be the sole contact for bidding inquiries on this *Project*.

C. Neither the *Owner* nor the *Consultant* will be responsible for instructions, clarifications or amendments communicated orally. Instructions, clarifications or amendments which affect the Bid Documents may only be made in writing by written addendum.

D. If bidders find discrepancies, omissions, errors, departures from building by-laws, codes or good practice, and points considered to be ambiguous or conflicting, they shall bring them to the attention of the Bid Calling Authority in writing, and not less than seven (7) *Working Days* before the bid closing date, so that the *Consultant* may, if the *Consultant* deems it necessary, issue instructions, clarifications or amendments by addendum to all bidders prior to the bid closing date. The *Consultant* will endeavor to issue such addenda at least forty-eight (48) hours prior to bid closing.

E. Addenda issued during the bidding period shall become part of the Bid Documents and their receipt shall be acknowledged in the space provided on the Bid Form. Addenda will be sent to all bidders. Associated costs shall be included in the Base Bid.

1.10 REQUESTS FOR CLARIFICATION

A. The *Consultant* may contact any one or more bidders to request clarification without any obligation to contact other bidders. Such additional clarification shall be provided promptly by the bidder to the *Consultant*.

B. Requests for information shall not be construed as acceptance of a bid.

1.11 PRODUCT/SYSTEM OPTIONS

A. Where Bid Documents stipulate a particular product, consideration for *Consultant* approved equivalents will be considered by *Consultant* up to ten (10) days before receipt of Bids.

B. Bidders shall supply the *Consultant* with all pertinent data required to carry out a detailed review of the proposed equivalent.

C. When a request to substitute a product is made, *Consultant* may approve equivalents and will issue an Addendum to known bidders.

D. In submission of equivalents to products specified, Bidders shall include in their Bid, any changes required in work to accommodate such substitutions. A later claim by Bidder for an addition to contract price because of changes in work necessitated by use of substitutions shall not be considered.

E. Unless equivalents are submitted in this manner and subsequently accepted, provide products as specified.

1.12 VALUE ADDED TAXES

A. The bid price shall not include any *Value Added Taxes*. All other eligible taxes shall be included in the bid price. Any taxes or increases to taxes announced prior to the date of the issuance of the Bid Documents and scheduled to come into effect subsequent to it shall be taken to be included in the bid price.

1.13 BID COMPLETION

A. Fill in all blank spaces on the Bid Forms in ink, or typewritten, providing all information requested, and ensure an authorized person or persons sign all forms where indicated. Failure to provide all requested information on the Bid Form and failure to fill in all blank spaces may result in a bid being declared non-compliant at the *Owner*'s discretion.

B. Use only the Bid Form issued as part of the Bid Documents for this Project. If any or all pages of the Bid Forms are amended by addendum, the Bid Form will be reissued in its entirety. The latest Bid Form shall be used when submitting as bid. Failure to comply with this paragraph may result in the bid being declared non-compliant at the *Owner*'s discretion.

C. Information provided by bidders on the Bid Forms may be amended prior to bid closing, provided corrections are initialed by an authorized representative of the bidder. Other modifications, erasures, additions, conditions, qualifications or un- initialed pre-closing amendments may result in the bid being declared non-compliant at the *Owner*'s discretion.

D. Bids that are not originals, are unsigned, improperly signed, un- initialed, incomplete, conditional or illegible, may be declared non-compliant at the *Owner*'s discretion.

E. Bid Price
1. The Bid Form provides that the bid price shall be provided in numbers and expanded written text.

2. Where the Bid Forms require the bidder to provide a breakdown of the bid price, the bid price shall govern in the case of conflict or ambiguity between the bid price and the sum of the breakdown of the bid price.
3. In the case of a conflict or ambiguity between the numeric and written bid price, the numeric price shall govern.

F. Listing of *Subcontractors*
1. Where required by the Bid Documents, a bidder shall complete and submit a Supplementary Bid Form – List of *Subcontractors*, naming the *Subcontractors* and *Suppliers* which the bidder will employ to perform an item of the *Work* called for by the *Contract*. Failure of the bidder to list *Subcontractors* and *Suppliers*, where required, or the listing by a bidder of more than one *Subcontractor* and *Supplier* to perform or supply an item of work listed, may result in the bid being declared non-compliant.
2. Where a bidder lists "own forces" in lieu of a *Subcontractor*, the bidder shall carry out such item of the *Work* with its own forces. Where "own forces" have been listed by a bidder, the *Owner* reserves the right to obtain information from the bidder and from third parties respecting the qualifications and experience of the bidder's "own forces" for such item of the *Work*. If the *Owner*, acting reasonably, determines that the bidder's "own forces" are not sufficiently qualified or sufficiently experienced to undertake such item of the *Work*, it may reject the bid.

G. Itemized Prices: Where required by the Bid Document, a bidder shall complete and submit a Supplementary Bid Form – Itemized Prices. The costs associated with Itemized Prices shall be included in the base bid and are provided to the *Owner* for informational purposes. The *Owner* reserves the right to use such pricing to delete scope from the project for budgetary reasons, at their discretion.

H. Identified Prices: Where required by the Bid Document, a bidder shall complete and identify on their submitted bid form. The costs associated with Identified Prices shall be included in the base bid and are provided to the *Owner* for informational purposes.

I. Alternative Prices: Where required by the Bid Documents, a bidder shall complete and submit a Supplementary Bid Form – Alternative Prices. Alternative prices shall show the net difference in cost of supplying and installing the alternative constructions or materials in lieu of the constructions or materials indicated on the drawings and/or described in the specifications. The *Owner* reserves the right to accept or reject any or all alternative prices, at their discretion.

J. Unit Prices: Where required by the Bid Documents, a bidder shall complete and submit a Supplementary Bid Form – Unit Prices. Submit Unit Prices for the items of work listed. Unit Prices shall show the total cost of supplying and installing work listed. Unit Prices shall include all overhead and profit for the *Contractor* and *Subcontractor* and shall follow the intent and conditions for each part of the work indicated on the drawings and/or described in the specifications.

K. Separate Prices: Provide separate prices for items of work as listed on the Bid Form. Separate Prices ARE NOT included in the Base Bid submitted. The *Owner* reserves the right to accept of reject any or all alternative prices, at their discretion.

1.14 BID ELIGIBILITY

A. Bid eligibility will be determined by and at the discretion of the *Owner* and Bid Calling Authority based on the requirements set by the Bid Documents.

B. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations, or irregularities of any kind, may be declared informal at the discretion of the *Owner*.

C. The *Owner* reserves the right to obtain additional information from the bidders following receipt of the bids and prior to the selection of a successful bidder, as required to aide in the review and selection of a successful bidder, including, but not limited to the correction of irregularities.

1.15 BID SUBMISSION

A. Submit one (1) completed original of the Base Bid Form, and any required Supplementary Bid Forms, accompanied by the bid enclosures, in a sealed opaque envelope. Ensure that the outside of the envelope bears the bidder's return address and a label clearly identifying the *Project* Name and *Contract* Number for which the bid is submitted.

B. Bids shall be signed under seal, executed, and dated and will be addressed to and received by:

Mr. Scott Garrett
Director, Redevelopment
Kingston Health Sciences Centre
Planning Office
24 Barrie Street,
Kingston ON K7L 3J6

C. Bids must be received before ***15:00 h local time on August 10, 2026***. The term "local time" shall mean the time as measured by the identified clock at the recipient's location.

D. Bids will be date and time stamped at the place receiving the bids.

E. Bids which are submitted by facsimile transmission or by electronic means will not be considered.

F. Bidders are solely responsible for the method and timing of delivery of their bids.

1.16 BID EXPIRY PERIOD

A. Bids shall be irrevocable for a period of ninety (90) days from the date of submission, after which period the bid expires.

1.17 BID OPENING AND EVALUATION

A. Bids will be opened in public at the office of the *Owner*, located at *24 Barrie Street, Kingston, Ontario*, *Room 17-205* immediately following the close of bids.

B. To gain access to the building, please call:
Scott Garrett
Kingston Health Sciences Centre
Phone: 613-549-6666 ext. 3629

C. In the event that more than one envelope is received from the same bidder, only the last envelope received will be considered.

D. The Bids will be reviewed by the Bid Calling Authority and the *Owner*.

E. CCDC 23-2005 "A Guide to Calling Bids and Awarding Contracts" and CCA 29-1995 "A Guide on Standard Contracting and Bidding Procedures" will be used as guidelines in reviewing the bids.

1.18 AWARD OF CONTRACT, EXECUTION OF THE CONTRACT AND DOCUMENTS TO BE DELIVERED

A. Bidders shall not issue or make any statements or news release concerning their bid, the bid process, the *Owner*'s evaluation of the bids, or the *Owner*'s award or cancellation of the bid process without the express written consent of the *Owner*.

B. If the *Owner* decides to award the *Contract* to a bidder, the *Consultant* will issue a Letter of Intent on behalf of the *Owner*.

C. Prior to commencing the *Work*, the *Contractor* shall deliver to the *Owner* the following:
1. Performance Bond and the Labour and Material Payment Bond described in the Bid Documents, the form of such bonds to comply with the requirements of the *Contract*;

2. Certificate of Insurance. Certified true copies of the insurance policies required by the Bid Documents shall be provided within 90 days of notice of award of contract; and
3. Current Clearance Certificate issued by the Workplace Safety and Insurance Board.
4. Schedule "A" – Key Personnel as outlined in 01 11 00 paragraph 1.2.

D. The *Contractor* shall execute the *Contract* and deliver the executed original to the *Owner* within ten (10) *Working Days* of receipt from the *Consultant*.

E. The *Owner* will be recognized as *"Kingston Health Sciences Centre".*

1.19 LIMIT OF LIABILITY

A. The liability of the bidder to the *Owner* for loss and damage arising out of the bidder's breach of the "bid contract" shall be limited to the lesser of the actual loss suffered by the *Owner* and the amount indicated on the Bid Bond.

B. The liability of the *Owner* to any bidder for loss and damage arising in tort or for the breach by the *Owner* of the "bid contract" shall be limited to the lesser of the sum of the Bid Bond and the reasonable cost to the bidder of preparing its bid.

1.20 DISPUTES

A. In the event of a dispute arising in connection with this bid process including, without limitation, a dispute concerning the existence of the "bid contract" or a breach of the "bid contract", or a dispute as to whether the bid of any bidder was submitted on time or whether a bid is compliant, the *Owner* may refer the dispute to a confidential binding arbitration pursuant to the Arbitration Act, 1991, as amended, before a single arbitrator with knowledge of procurement/bidding law. In the event that the *Owner* refers the dispute to arbitration, the bidder agrees that it is bound to arbitrate such dispute with the *Owner*. Unless the *Owner* shall refer such dispute to binding arbitration, there shall be no arbitration of such dispute.

B. In the event the *Owner* refers a dispute to binding arbitration, the *Owner* may give notice of the dispute to one or more of the other bidders who submitted bids, whether or not they may be compliant, each of who m shall be a party to and shall be entitled to participate in the binding arbitration, and each of whom shall be bound by the arbitrator's award, whether or not they participated in the binding arbitration.

C. In the event the *Owner* refers a dispute to binding arbitration, the parties to the arbitration shall exchange brief statements of their respective positions on the dispute, together with the relevant documents, and submit to a binding arbitration hearing which shall last no longer than two days, subject to the discretion of the arbitrator to increase such time. The parties further agree that there shall be no appeal from the arbitrator's award.

D. This Article is not intended to form part of any "bid contract" that may come into being between a bidder and any prospective *Subcontractor* or *Supplier* of that bidder.

END OF INSTRUCTIONS TO BIDDERS

SECTION 00 41 00
BID FORM

Name of *Contractor*: ……

Bid For: Kingston Health Sciences Centre
KHSC-Emergency Power System Capacity & Infrastructure Remediation
Kingston, Ontario.

To: Scott Garrett
Director, Redevelopment
Kingston Health Sciences Centre
Planning Office
24 Barrie Street,
Kingston ON K7L 3J6

We, the undersigned, having carefully examined the Bid Documents, visited the site, and taken into account all conditions affecting the *Work*, hereby offer to furnish all necessary labour, *Products* and *Construction Equipment* required to perform expeditiously, and complete in a satisfactory manner, the above mentioned *Project* in accordance with the Bid Documents, for the Stipulated Sum of

……

…….dollars ($ ……)

We confirm that the above sum includes all applicable taxes, royalties, custom duties, overhead and profit, insurance premiums, permits, and all other charges at the date of this Bid, and is not subject to revisions due to changes in the cost of labour, materials or other items, but does not include any *Value Added Taxes*.

1.1 VALUE ADDED TAXES

The Stipulated Sum does not include *Value Added Taxes*.

1.2 ITEMIZED PRICES

We list hereunder the requested breakdown of items of *Work* included in our bid price. It is understood that these itemized prices are provided for information purposes only and will not be used to modify the scope of the *Work* and adjust our bid price.

Item of Work	**Itemized Price**
2 MW Diesel Generator	$ 1,562,338.00 from Total Power……..
Master Control Upgrades	$ 67,500 from Total Power……
Removal of SAN and STM and provision of new SAN and STM	$.....
Allowances	$.....
Inspection and Testing	$15,000
Independent Verification Services	$30,000

Fire Alarm Verification Services $10,000

1.3 ALTERNATIVE PRICES

We list hereunder the requested alternative prices. The amount to be added to, or deducted from, our base bide price is entered for each requested alternative. All alternative prices exclude *Value Added Taxes*. If there is no change to the base bid price for an alternative, we have so indicated. It is understood that:

a) the *Owner* may accept any of the alternatives and corresponding alternative prices in any order or combination, including all or none,

b) the lowest bidder will be determined solely from the base bid, without considering any alternative prices,

c) [reserved]

d) alternatives and alternative prices are open for acceptance by the *Owner* for the same period of time as the base bid price,

e) the *Work* of the *Contract* and the *Contract Price* will reflect the alternatives and alternative prices, if any, accepted by the *Owner* at the time of *Contract* award, and

f) acceptance of any alternatives will not affect the base bid *Contract Time*, unless we have specifically indicated an increase or decrease in time, in number of days, on account of a particular alterative.

	Effect on Base Bid Price	
Description of Alternative	**Add**	**Deduct**
Alternative No. 1:		
[…]:	$…….	$....…….
Alternative No. 2:		
[…]:	$…….	$....…….

1.4 SUBCONTRACTS

We list hereunder the names of the *Subcontractors* whose bids we have used in our Bid and with whom we intend to award subcontracts, if awarded the *Contract*. We acknowledge that no changes to the list will be made without the *Consultant*'s approval.

1.5 TRADE NAME

Demolition ……

Structural Steel ……

Formwork and Foundations ……

Metal Panel Systems ……

Sprinklers & Fire Suppression ……

Concrete/Structural Reinforcing ……

Mechanical Prime .....

Electrical Prime .....

1.6 VALIDITY OF THE BID

Our bid will remain in good standing for a period of ninety (90) days after the closing date of general contract bids.

1.7 COMPLETION OF THE WORK

We understand the sequence of work as outlined in the Project Manual and undertake to complete the work within _____ weeks.

Date to Commence Work _____ Date of Ready-for-Takeover _____

1.8 ACCEPTANCE OF THE BID

We recognize the right of the *Owner* not to accept the lowest or any other bid received.

1.9 ALTERNATIVES

We hereby submit for your consideration the following alternatives and understand that the *Owner* may reject any or all of these proposals:

SPEC SECTION	ADD TO STIPULATED SUM	DEDUCT FROM STIPULATED SUM

1.10 ENCLOSURES

We enclose herewith the following:

A. Letter of Consent from the Surety Company.

B. A Bid Bond made out in favour of the *Owner* in the amount of 10% of the Bid Price.

C. Undertaking of Insurance.

1.11 ADDENDA

We acknowledge receipt of the following addenda issued during the bidding period.

Addendum No. _____ dated _____.

Addendum No. _____ dated _____.

Addendum No. _____ dated _____.

Addendum No. _____ dated _____.

Addendum No. _____ dated _____.

1.12 BID EVALUATION

We understand that the Bid will be evaluated based on the Base Bid.

Dated at _____

This _____ Day of _____ 2026.

Seal (If a Corporation) …….
Signature of Bidder

END OF BID FORM

SECTION 00 73 00
SUPPLEMENTARY CONDITIONS

AMENDMENTS TO THE STIPULATED PRICE CONTRACT, CCDC2-2020

The Standard Construction Document for Stipulated *Price the Contract*, English version, consisting of the Agreement Between *the Owner* and the *Contractor*, Definitions, and General Conditions of the Stipulated *Price the Contract*, Parts 1 to 13 inclusive, governing same is hereby made part of these *the Contract Documents*, with the following amendments, additions and modifications:

PART 1 - AGREEMENT BETWEEN OWNER AND CONTRACTOR

1.1 ARTICLE A-1 THE WORK

A. Delete paragraph 1.3 and replace it with the following:
"1.3 commence the *Work* by the _____ day of _____ in the year _____ and, subject to adjustment in the *Contract Time* as provided for in the *Contract Documents* attain *Ready-for Takeover,* by the *Scheduled Ready-to-Takeover Date;* and attain the *Total Completion of the Work* by the *Scheduled Total Completion Date. (Refer to Section 00 21 13, Instruction to Bidders Item 1.2 B)*

1.2 ARTICLE A-5 – PAYMENT

A. Amend paragraph 5.1.3, in the first line, by deleting the words "the issuance of the" and replacing them with "receipt of the *Consultant*'s".

B. Delete paragraph 5.2.1 and replace it with the following:
"Should either party fail to make payments as they become due under the terms of the *Contract* or in an award by arbitration or a court, interest shall also become due and payable on such unpaid amounts at 1% above the prime rate. Such interest shall be compounded on a monthly basis. The prime rate shall be the rate of interest quoted by Bank of Canada for prime business loans as it may change from time to time."

C. Amend paragraph 5.2.1(1) by deleting "for the first 60 days".

D. Delete paragraph 5.2.1(2) and replace it with "Intentionally deleted".

1.3 ARTICLE A-6 – RECEIPT AND ADDRESSES FOR NOTICES IN WRITING

A. Delete paragraph 6.1 and replace it with the following:
"*Notices in Writing* between the parties or between them and the *Consultant* shall be considered to have been received by the addressee on the date of receipt if delivered by hand or by commercial courier or if sent during normal business hours by fax and addressed as set out below. Such *Notices in Writing* will be deemed to be received by the addressee on the next business day if sent by fax after normal business hours or if sent by overnight commercial courier. Such *Notices in Writing* will be deemed to be received by the addressee on the fifth *Working Day* following the date of mailing, if sent by pre-paid registered post, when addressed as set out below. An address for a party may be changed by *Notice in Writing* to the other party setting out the new address in accordance with this Article."

1.4 ARTICLE A-8 – SUCCESSION

A. Amend paragraph 8.1 by inserting "permitted" before "assigns".

1.5 ARTICLE A-9 TIME OF THE ESSENCE

A. Add new Article A-9 as follows:

"9.1 The *Contractor* acknowledges and agrees that one of the reasons the *Contractor* was selected for the *Work* is the *Contractor's* representation and warranty that it will attain *Ready-for-Takeover* and the *Total Completion of the Work* by the dates set out in Article A-1, paragraph 1.3, and the *Contractor* acknowledges and agrees that they have been advised by the *Owner* that it is critical to the *Owner* that *Ready-for-Takeover* be achieved by the prescribed dates and that time is of the essence of this *Contract.*

9.2 No approval or consent of, or certification, inspection, review, comment, verification, confirmation, acknowledgement or audit by, any governmental authority, the *Owner*, or the *Consultant*, or anyone on their behalf, shall relieve the *Contractor* from performing or fulfilling any of its obligations under the *Contract*. Without limitation, whenever any drawings, plans, procedures, programs or other work product of the *Contractor* requires any review, inspection, comment or approval by any governmental authority, the *Owner*, or the *Consultant*, or anyone on their behalf, any such review, inspection, comment or approval shall not, in any way, reduce or modify any of the *Contractor's* obligations under the *Contract*.

9.3 If any part of the *Contract* or the application of such part to any party, person or circumstance shall, to any extent, be invalid or unenforceable, the remainder of the *Contract*, or the application of such part to any other party, person or circumstance, shall not be affected thereby and each provision of the *Contract* shall be valid and enforceable to the fullest extent permitted by law.

9.4 The terms of the *Contract,* which by their nature are continuing, shall survive the termination or other expiration of the *Contract*.

9.5 This Agreement, including the *Contract Documents* described herein and the attachments, documents and other agreements to be furnished or executed in connection herewith, supersede all prior negotiations, representations or agreements, either written or oral, with respect to the subject matter hereof. No modification to the *Contract* shall be effective unless made in writing signed by both the *Owner* and the *Contractor*, unless otherwise provided for herein.

9.6 This Agreement may be executed at different times and in counterparts, each of which when executed and delivered, including any counterpart executed by a Party and transmitted by email by way of pdf attachment or facsimile transmission, shall be deemed an original, but all of which together will constitute one and the same instrument binding upon the parties hereto, notwithstanding that all such parties may not have executed the same counterpart. Signature and delivery by any party of signature pages by an electronic signature service shall be as binding an execution and delivery of this Agreement by such party as if the party had delivered an actual physical original of this Agreement with an ink signature from such party."

PART 2 - DEFINITIONS

2.1 AMEND DEFINITION OF, "*CONSULTANT*", BY ADDING THE FOLLOWING TO THE END OF THAT DEFINITION:

A. "For purposes of the *Contract*, the terms "*Consultant*", "Architect" and "Engineer" shall be considered synonymous."

2.2 ADD THE FOLLOWING NEW DEFINITIONS:

A. "'*Act*' means the *Construction Act* (Ontario), RSO 1990, c C.30."

B. *"'Commissioning'* means the process of putting the *Work* or any part thereof into operation and includes Start-Up, Verification and Performance Testing as described in the *Contract* Documents."

C. *"'COVID-19'* means the novel coronavirus infectious disease SARS-CoV-2 as referenced by the World Health Organization, including all related viruses, diseases, or variants, and any subsequent waves."

D. *"'Dispute'* has the meaning ascribed in GC 8.1.1."

E. "'*Environmental Programs*' means the environmental plans, programs, procedures and requirements of the *Owner*. The *Environmental Programs* incorporate *the Owner's* infection control program including measures to suppress dust and noise and to avoid conditions likely to propagate mould or fungus of any kind."

F. "'*Key Personnel'* means the project managers, superintendents, coordinators or other personnel of the *Contractor,* if any, identified in Schedule "A" – Key Personnel to the *Contract.* Reference project manual section 01 11 00 and Schedule "A" submittal.

G. "'*OHSA*' means the *Occupational Health and Safety Act* (Ontario), RSO 1990, c O.1, as amended, and all regulations passed thereunder."

H. "'*Scheduled Ready-for-Takeover Date'* means ***TBD***."

I. "'*Scheduled Total Completion Date*' means ***TBD***."

J. "'*Submittals*' are documents, items or other forms of information required by the *Contract Documents* to be provided by the *Contractor to* the *Owner or the Consultant*, and include, without limitation: (a) *Shop Drawings*, samples, models, mock-ups to indicate details or characteristics, before the portion of the *Work* that they represent can be fabricated and incorporated into the *Work*; and (b) *Record Drawings*, manuals and other close-out documentation to provide instructions for the operation and maintenance of the *Work*".

K. "'*Total Completion of the Work'* means the date that the *Work* is fully complete as prescribed by the *Contract Documents,* including, without limitation, the rectification of all defects and deficiencies."

L. "'*WSIB*' means the *Work*place Safety & Insurance Board."

PART 3 - GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT

Where a General Condition or paragraph of the General Conditions of the Stipulated Price Contract is deleted by these Supplementary Conditions, the numbering of the remaining General Conditions or paragraphs shall remain unchanged, and the numbering of the deleted item will be retained, unused.

3.1 GC 1.1 - CONTRACT DOCUMENTS

A. Amend paragraph 1.1.3 by inserting "Applying the standard of care described in paragraph 1.5.1.1 of GC 1.5 – PROJECT REQUIREMENTS," at the beginning of the first sentence.

B. Amend paragraph 1.1.4 by inserting "Except for its obligations to review under GC 1.1.3 and to report under this GC 1.1.4," at the beginning of the first sentence and by adding "Neither the *Owner* nor the *Consultant* will be responsible for oral instructions." after the second sentence.

C. Amend paragraph 1.1.5.1 by moving the reference to "Supplementary Conditions" to the top of the order of priority.

D. Delete subparagraph 1.1.5.5 in its entirety and substitute new subparagraph 1.1.5.5 as follows:
"In case of discrepancies, noted materials and annotations shall take precedence over graphic indications in the *Contract Documents.*"

E. Add the following as paragraph 1.1.6.3:
"The S*pecifications* are divided into divisions and sections for convenience but shall be read as a whole and neither such division nor anything else contained in the *Contract Documents* will be construed to place responsibility on the *Consultant* to settle disputes among the *Subcontractors* and *Suppliers* in respect to such divisions. The *Drawings* are, in part, diagrammatic and are intended to convey the scope of the *Work* and indicate general and appropriate locations, arrangement and sizes of fixtures, equipment and outlets. The *Contractor* shall obtain more accurate information about the locations, arrangement and sizes 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 in 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*. The *Contractor* shall arrange and install fixtures and equipment in such a way as to conserve as much headroom and space as possible. The schedules are that portion of the *Contract Documents* wherever located and whenever issued, compiling information of similar content and may consist of *Drawings*, tables and/or lists."

F. Delete paragraph 1.1.8 in its entirety and substitute new paragraph 1.1.8:
"1.1.8 The *Owner* shall provide the *Contractor*, without charge, up to six copies of the *Contract Documents* if requested in writing."

G. Amend paragraph 1.1.9 by adding the following to the end of the paragraph:

"The *Specifications* may be divided into Divisions and the Divisions into Sections for the purpose of convenience, but a Section may consist of work of more than one *Subcontractor* or *Supplier*. The *Specifications* are intended to be read as a whole."

H. Delete paragraph 1.1.10 in its entirety and substitute new paragraph 1.1.10 as follows:

"1.1.10 The design information furnished to the *Contractor* as part of the *Contract Documents*, including the *Drawings* and *Specifications*, are the property of the *Owner* and/or the *Consultant*, and are to be used by the *Contractor* only for the purposes of performing the *Work*. The *Contractor* shall not copy, alter or utilize the aforesaid design information for any purpose unrelated to the *Work* without written authorization from the *Owner* and the *Consultant*."

I. Add new paragraph 1.1.12 as follows:

"1.1.12 The table of contents, titles, section headings, running headlines and marginal notes contained in the *Contract Documents* are solely to facilitate reference to various provisions of the *Contract Documents* and in no way affect or limit the interpretation or construction of the provisions to which they refer."

3.2 GC 1.4 ASSIGNMENT

A. Delete paragraph 1.4.1 in its entirety and substitute new paragraph 1.4.1 as follows:

"1.4.1 The *Contractor* shall not assign the *Contract* or any of its rights or interest in the *Contract*, nor shall the *Contractor* assign or subcontract all or substantially all of the *Work* or the *Contractor's* responsibilities under the *Contract* to a single *Subcontractor* or any other person, without the prior written consent of the *Owner*, which consent may not be unreasonably withheld. The *Owner* may assign the *Contract* without the consent of the *Contractor* upon providing *Notice in Writing* to the *Contractor*. "

3.3 GC 1.5 PROJECT REQUIREMENTS

A. Add new paragraph 1.5.1 as follows:

"1.5.1 The *Contractor* represents, covenants and warrants to the *Owner* that:

.1 it has the necessary high degree of experience and expertise required to perform the *Work* and it will in the performance of the *Work* exercise a standard of care, skill and diligence that would normally be provided by an experienced and prudent contractor providing similar services for hospital projects of a similar nature, and the *Contractor* shall exercise the same standard of due care and diligence in respect of any *Products*, personnel, or procedures which it may recommend to the *Owner*;

.2 the personnel it assigns to the *Project* are experienced and it has a sufficient staff of qualified and competent personnel to replace its designated *the Contract* personnel referred to in GC 3.5, subject to the *Owner's* approval, in the event of death, incapacity, termination or resignation;

.3 there are no pending, threatened or anticipated claims or litigation involving the *Contractor* that would have a material adverse effect on the financial ability of the *Contractor* to perform the *Work*, and

.4 it will achieve *Ready-for-Takeover* and the *Total Completion Date* by the date set out in Article A-1, paragraph 1.3."

3.4 GC 2.2 - ROLE OF THE CONSULTANT

A. Amend paragraph 2.2.3 by adding the following to the end of that paragraph:

"The presence of such project representatives at the *Place of the Work* or the *Work* shall not relieve the *Contractor* from any responsibility to perform the *Work* as required by the *Contract* Documents."

B. Amend paragraph 2.2.5 by: (a) adding the word ", schedules" after the word "techniques"; (b) adding the words "to the *Contractor*" after the words "the *Consultant* will not be responsible" in the first sentence, (c) adding to the following to the end of the second sentence "or to adhere to the construction schedule", and (d) adding the following sentence to the end of the paragraph: "the *Consultant* will not have control over, charge of or be responsible for the acts or omissions of the *Contractor*, *Subcontractors*, *Suppliers*, or their agents, employees, or any other person performing any portion of the *Work.*

C. Amend paragraph 2.2.6 by deleting the words "Except with respect to GC 5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER" and capitalizing "the".

D. Amend paragraph 2.2.7 by adding "the *Contractor* or *the Owner* on its own behalf or on behalf of" after the word "by" in the second line.

E. Amend paragraph 2.2.12 by: (a) deleting the word "will" and replacing it with the word "may"; and (b) adding the following to the end of that paragraph:
"The *Contractor* shall be responsible for requesting any additional instructions or clarifications that may be required from the *Consultant* which are needed for the performance of the *Work,* and shall request such instructions or clarifications in time to avoid any delay or additional cost of the *Work*. If, in the opinion of the *Contractor*, the *Supplemental Instruction* involves an adjustment in the *Contract Price* or the *Contract Time*, the *Contractor* shall, within ten (10) *Working Day*s of receipt of a *Supplemental Instruction* provide the *Consultant* with a written notice to that effect. In the event that the *Contractor* needs additional information to determine whether a *Supplemental Instruction* involves an adjustment of the *Contract Price* or the *Contract Time*, the *Contractor* may issue a written request to the *Consultant* seeking such additional information. The *Contractor* shall, within ten (10) *Working Day*s of receipt of such additional information, provide the *Consultant* with a written notice if, in the opinion of the *Contractor*, the *Supplemental Instruction* involves an adjustment in the *Contract Price* or the *Contract Time*. Failure to provide written notification within the time stipulated in this paragraph 2.2.12 shall be deemed an acceptance of the *Supplemental Instruction* by the *Contractor* without adjustment in the *Contract Price* or the *Contract Time*."

F. Amend paragraph 2.2.13 by deleting the word "submittals" and replacing it with "*Submittals*".

G. Amend paragraph 2.2.18 by deleting the words "immediately engage a *Consultant* against whom the *Contractor* makes no reasonable objection and" and replace it with "engage a *Consultant"*.

H. Add new paragraph 2.2.19 as follows:
"2.2.19 Neither the *Contractor* nor any *Subcontractor*, *Supplier* or other third party shall have any claim against the *Consultant* as a result of the performance or non-performance of the *Consultant*'s services. The *Contractor* shall include this provision in any contracts it makes with its *Subcontractor*s, *Suppliers* and others and shall require such *Subcontractor*s, *Suppliers* and others to include the same term in their contracts with sub-subcontractors, sub-suppliers and others."

3.5 GC 2.3 – REVIEW AND INSPECTION OF THE WORK

A. Amend paragraph 2.3.2 by inserting in line 1 ", *Commissioning*" after "inspections," and inserting in line 3 "and *Commissioning*" after "inspection".

B. Amend paragraph 2.3.3 by inserting in line 1 ", *Commissioning*" after "certificates".

C. Amend paragraph 2.3.4 by inserting in line 2 "*Commissioning*" after "inspections," and inserting in line 3 "or *Commissioning*" after "tests".

D. Amend paragraph 2.3.5 by inserting "Subject to paragraph 2.3.4" at the beginning of the third sentence.

E. Amend paragraph 2.3.6 and paragraph 2.3.7 by inserting "or *Commissioning*" after "inspection" in all instances.

3.6 GC 2.4 - DEFECTIVE WORK

A. Amend paragraph 2.4.1 by: (a) adding the words "or the *Owner*" after "the *Consultant"* in the first line; and (b) by adding the following to the end of the paragraph:

"The *Contractor* shall rectify, in a manner acceptable to the *Owner* and the *Consultant*, all defective work and deficiencies throughout the *Work*, whether or not they are specifically identified by the *Consultant*."

B. Amend paragraph 2.4.3 by deleting the words "the difference in value between the work as performed and that called for by the *Contract Documents*" and inserting the words "the value of such work as is necessary to correct any non-compliance with the *Contract Documents*."

C. Add new paragraphs 2.4.4, 2.4.5, and 2.4.6 as follows:

"2.4.4 The *Contractor* shall prioritize the correction of any defective work which, in the sole discretion of the *Owner*, adversely affects the day to day operation of the *Owner*.

2.4.5 Upon notification of a defect in the *Work,* the *Contractor* shall promptly, and no later than five (5) *Working Days*, provide a written statement outlining the proposed remedial measures and a schedule for implementation. Once approved by the *Consultant*, the *Contractor* shall proceed with the remedial measures without adversely affecting the construction schedule.

2.4.6 Notwithstanding any rejection of the *Work* by the *Consultant* or *the Owner*, or the deduction of an amount otherwise due to the *Contractor* by the *Owner* as a result of defective work, the *Contractor* is required to continue the *Work* in accordance with the *Contract Documents*."

3.7 GC 3.1 - CONTROL OF THE WORK

A. Amend paragraph 3.1.1 by inserting the words "schedule, coordinate and" after the word "effectively".

B. Amend paragraph 3.1.2 by adding the word ", schedules" after the word "techniques" and by adding the following to the end of the sentence: "and shall coordinate the *Work* so as not to interfere with, interrupt, obstruct, delay, or otherwise affect, the work of others".

C. Add new paragraph 3.1.3:
"3.1.3 Prior to commencing individual procurement, fabrication and construction activities, the *Contractor* shall verify, at the *Place of the Work*, 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, the *Contractor* shall immediately notify the *Consultant* in writing and obtain written instructions from the *Consultant* before proceeding with any part of the affected *Work*."

3.8 GC 3.2 - CONSTRUCTION BY THE OWNER OR OTHER CONTRACTORS

A. Delete subparagraphs 3.2.2.1 and 3.2.2.2 in their entirety.

B. Amend paragraph 3.2.3.2 by adding the following to the end of that paragraph:
", and for *Other Contractors* or the *Owner's* own forces, the *Contractor* shall assume overall responsibility for compliance with *OHSA* and all other aspects of the applicable health and safety legislation of the *Place of the Work*, including the responsibilities of the "constructor" under *OHSA*."

C. Amend paragraph 3.2.3.4 by adding the following to the end of that paragraph:
"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 the *Owner's* own forces except for those deficiencies not then reasonably discoverable;"

D. Add new subparagraph 3.2.3.5:
"Subject to GC 9.4 CONSTRUCTION SAFETY, for the *Owner's* own forces and for the *Other Contractors*, assume overall responsibility for compliance with all aspects of the applicable health and safety legislation in the *Place of the Work*, including all of the responsibilities of the constructor under the *OHSA."*

E. Delete the last sentence of paragraph 3.2.5.

F. Delete paragraph 3.2.6 in its entirety and substitute the following:

"3.2.6 Entry by the *Owner*, the *Owner's* forces and/or by *Other Contractors* does not indicate acceptance of the *Work* and does not relieve the *Contractor* of any responsibility under the *Contract* including the responsibility to complete the *Work*."

G. Add new paragraph 3.2.7 as follows:

"3.2.7 Placing, installing, application and connection of work by the *Owner, the Owner's* own forces, and/or by *Other Contractors*, on and to the *Work* will not relieve the *Contractor's* responsibility to provide and maintain the specified warranties unless a defect has been created by the *Owner*, *the Owner's* own forces or *Other Contractors.*"

3.9 **GC 3.3 - TEMPORARY WORK**

A. Add new paragraph 3.3.4 as follows:

"3.3.4 Temporary or trial usage of any mechanical device, machinery, apparatus, equipment or materials shall not be construed as evidence of acceptance of the same and no claim for damage shall be made by the *Contractor* for damage to or breaking of any part of such work which may be used."

3.10 **GC 3.4 - CONSTRUCTION SCHEDULE**

A. Delete paragraph 3.4.1 and replace it with the following new paragraph 3.4.1 as follows:

"3.4.1 The *Contractor* shall:

.1 unless it is required to be submitted earlier in accordance with the *Specifications*, then prior to site mobilization, submit to the *Owner* and the *Consultant* for their review and acceptance a construction schedule, indicating the critical milestone dates for the *Project* using a scheduling program which is approved by the *Consultant,* acting reasonably, to demonstrate that the *Work* will be performed in conformity with the *Contract Time* and the *Contract Documents*. The *Contractor* shall provide the schedule information required by this paragraph 3.5.1.1 in both electronic format and hard copy. Once accepted by the *Owner* and the *Consultant,* the construction schedule submitted by the *Contractor* shall become the baseline construction schedule;

.2 provide the necessary expertise and resources, including, without limitation, manpower and *Construction Equipment*, as are necessary to maintain progress under the accepted baseline construction schedule referred to in paragraph 3.4.1.1 or any successor or revised schedule accepted by the *Owner*;

.3 monitor the progress of the *Work* on a weekly basis relative to the construction schedule, reviewed and accepted pursuant to paragraph 3.4.1.1, or any successor or revised schedule accepted in writing by the *Owner* pursuant to GC 3.4, update the construction schedule on a monthly basis, and advise the *Consultant* and the *Owner* by *Notice in Writing* of any variation from or slippage in the baseline construction schedule or any other schedule; and

.4 if after applying the expertise and resources required under paragraph 3.4.1.2, the *Contractor* forms the opinion that the slippage in the construction schedule or any other schedule, reported in paragraph 3.4.1.3, cannot be recovered by the *Contractor*, it shall, in the same notice provided under paragraph 3.4.1.3, indicate to the *Consultant* if the *Contractor* intends to apply for an extension of the *Contract Time*."

B. Add a new paragraph 3.4.2 as follows:

"3.4.2 Without limiting the other obligations of the *Contractor* under GC 3.4, the *Contractor* shall not amend the construction schedule without the prior written consent of the *Owner*. In addition, at each site construction meeting, the *Contractor* shall provide to the *Owner* and the *Consultant* a two (2) week look-ahead schedule indicating the major activities to be undertaken or constructed in such two (2) week period."

C. Add new paragraph 3.4.3:

"3.4.3 If at any time it should appear to the *Owner* or the *Consultant* that the actual progress of the *Work* is behind schedule or is likely to become behind schedule, based on critical path methodology, or if the *Contractor* has given notice of such to the *Owner* or the *Consultant* pursuant to 3.4.1.3, the *Contractor* shall take appropriate steps to cause the actual progress of the *Work* to conform to the schedule and shall produce and present to the *Owner* and the *Consultant* a recovery plan demonstrating how the *Contractor* will achieve the recovery of the schedule. The *Owner* may instruct the *Contractor*, at the *Contractor*'s expense, to employ additional labour and equipment or work overtime or employ any other reasonable procedures, at no expense to the *Owner*, to bring the *Work* back to conform with the schedule."

3.11 GC 3.5 - SUPERVISION

A. Delete paragraph 3.5.1 in its entirety and substitute new paragraph 3.5.1:

"3.5.1 The *Contractor* shall provide all necessary supervision and appoint competent representatives who shall be in attendance at the *Place of the Work* while *Work* is being performed. The appointed

representatives shall not be changed except for valid reasons, and upon the *Contractor* obtaining the *Owner's* written consent, which consent shall not be unreasonably withheld."

B. Add new paragraphs 3.5.3, 3.5.4, 3.5.5, and 3.5.6 as follows:

"3.5.3 The *Contractor* shall employ competent *Key Personnel* who will not be removed or replaced during the course of the *Work* without the prior written consent of the *Owner,* which approval shall not be unreasonably withheld.

3.5.4 The *Contractor*'s site supervisor for the *Contract* shall devote their full time during working hours to the *Project* and remain at the *Place of the Work* until a final certificate of payment has been issued by the *Consultant* and all deficiencies in the *Work* have been rectified to the satisfaction of the *Owner*. The full-time site supervisor for the *Contract* shall be named in the Schedule "A" – Key Personnel and any acceptable replacement shall represent the *Contractor* at the *Place of the Work* and notices and instructions given to the site supervisor for the *Contract* by the *Consultant* shall be held to have been received by the *Contractor*.

3.5.5 The *Owner* acting reasonably, shall have the right to give written notice to the *Contractor* who shall, within seven (7) days of receipt of the written notice, at the *Contractor's* sole expense, remove from the *Project* any representative or employee of the *Contractor, Subcontractors* or *Suppliers* who, in the opinion of the *Owner* are unacceptable or a detriment to the *Project*. The *Contractor* shall not be entitled to receive any compensation or extension of the *Contract Time* in connection with such removal.

3.5.6 The supervisor appointed by the *Contractor* shall demonstrate competency in both spoken and written English."

3.12 GC 3.6 - SUBCONTRACTORS AND SUPPLIERS

A. Delete paragraph 3.6.2 in its entirety and substitute new paragraph 3.6.2:

"3.6.2 The *Contractor* agrees not to change *Subcontractors* without prior written approval of the *Owner*, which approval will not be unreasonably withheld. Where the *Contractor* wishes to change any identified *Subcontractors* or *Suppliers*, the *Contractor* shall set out in writing to the *Owner* sufficient reasons for the desired change. The *Owner* or *Consultant* shall advise the *Contractor* if the *Owner* agrees to the proposed change. If the *Owner* is not satisfied with the *Contractor's* reason for wanting to change an identified *Subcontractor* or *Supplier,* the *Contractor* shall be required to proceed with the identified *Subcontractor* or *Supplier."*

B. Amend 3.6.4 by inserting the following at the end of the paragraph:

"unless the request to change a proposed *Subcontractor* or *Supplier* is a result of issues with the ability of the *Subcontractor* or *Supplier* to complete the *Work* in a proper manner, in which case the *Contractor* will not be entitled to any change in the *Contract Price* or *the Contract Time*".

C. Add a new paragraph 3.6.7 as follows:

"3.6.7 The *Owner* may assign to the *Contractor*, and the *Contractor* agrees to accept, any contract procured by the *Owner* for work or services or *Products* required on the *Project* that has been pre-tendered or pre-negotiated by the *Owner*, where the *Owner* has identified, before bid close, the contract or contracts that are to be assigned to the *Contractor.*"

3.13 GC 3.7 - LABOUR AND PRODUCTS

A. Amend paragraph 3.7.1 by: (a) adding the words "agents, *Subcontractor*s and *Supplier*s" after the word "employees"; and (b) adding the following three new sentences to the end of that paragraph:

"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 *Owner*. Any such job site rules prepared by the *Contractor* shall be consistent with the *Contractor*'s duties and obligations under the *OHSA* and shall also include provisions making smoking and the consumption of alcohol or non-prescription drugs on the *Project* site the subject of discipline proceedings and/or termination of employment."

B. Amend paragraph 3.7.2 by adding the following sentence at the end of that paragraph:

"The *Contractor* represents and warrants that the *Products* provided in accordance with the *Contract Documents* are not subject to any conditional sales contracts and are not subject to any security rights

claimed or obtained by any third party which may subject any of the *Products* to seizure and/or removal from the *Place of the Work*."

C. Delete paragraph 3.7.3 and replace it with the following:
"3.7.3 *Products* provided shall be new and shall conform to all current applicable specifications of the Canadian Standards Association, Canadian Standards Board or General Standards Board, ASTM, National Building Code, Ontario Building Code and all governmental authorities having jurisdiction at the *Place of the Work*, unless otherwise specified. *Products* which are not specified shall be of a quality consistent with those specified and their use acceptable to the *Consultant*. *Products* brought on to the *Place of the Work* by the *Contractor* shall be deemed to be the property of the *Owner*, but the *Owner* shall be under no liability for loss thereof or damage thereto arising from any cause whatsoever, and such *Products* shall be at the sole risk of the *Contractor*."

D. Add new paragraphs 3.7.4, 3.7.5 and 3.7.6 as follows:
"3.74 The *Contractor* is responsible for the safe on-site storage of *Products* and their protection (including *Products* supplied by the *Owner* and *Other Contractors* to be installed under the *Contract*) in such ways as to avoid dangerous conditions or contamination to the *Products* or other persons or property and in locations at the *Place of the Work* to the satisfaction of the *Owner* and the *Consultant*. The *Owner* shall provide all relevant information on the *Products* to be supplied by the *Owner*.
3.7.5 The *Contractor* shall not employ any persons on the *Work* whose labour affiliation, or lack thereof, is incompatible with other labour employed in connection with the *Work*. Any costs arising from labour disputes as a result of the employment of any such person by the *Contractor*, its *Subcontractor*s or *Suppliers*, shall be the sole expense of the *Contractor*.
"3.7.6 The *Contractor* shall cooperate with the *Owner* and its representatives and shall take all reasonable and necessary actions to maintain stable and harmonious labour relations with respect to the work at the *Place of the Work*, including cooperation to attempt to avoid work stoppages, trade union jurisdictional disputes, and other labour disputes."

3.14 GC 3.8 - SHOP DRAWINGS

A. Add the words "AND OTHER SUBMITTALS" to the title of GC 3.8 after "SHOP DRAWINGS".

B. Add "and *Submittals*" after the words "*Shop Drawings*" in clauses 3.8.1, 3.8.2, 3.8.3, 3.8.3.2, 3.8.5, and 3.8.6.

C. Delete paragraph 3.8.3 in its entirety and substitute new paragraph 3.8.3:
"3.8.3 Prior to the first application for payment, the *Contractor* and the *Consultant* shall jointly prepare a schedule of the dates for submission and return of *Shop Drawings* and any *Submittals*, and that:"

D. Delete subparagraph 3.8.3.1 in its entirety and substitute new subparagraph 3.8.3.1:
"the *Contractor* has determined and correlated the field measurements with the *Shop Drawings* and any *Submittals* and field construction conditions, *Product* requirements, catalogue numbers and similar data, or will do so if not possible at that time, and"

E. Delete paragraph 3.8.7 in its entirety and substitute new paragraph 3.8.7:
"3.8.7 The *Consultant* will review and return *Shop Drawings* and *Submittals* in accordance with the schedule agreed upon in paragraph 3.8.2, or, in the absence of such schedule, within fifteen (15) *Working Days*. If, for any reason, the *Consultant* cannot process the *Shop Drawings* and *Submittals* within the agreed-upon schedule or with reasonable promptness, the *Consultant* shall notify the *Contractor* and they shall meet to review and arrive at an acceptable revised schedule for processing. The *Contractor* shall update the *Shop Drawings* and *Submittals* schedule to correspond to changes in the construction schedule. Changes in the *Contract Price* or *the Contract Time* may be made only as provided in the *Contract*."

3.15 **GC 3.9 - DOCUMENTS AT THE SITE**

A. Add a new GC 3.9 DOCUMENTS AT THE PLACE OF THE WORK as follows:

"GC 3.9 DOCUMENTS AT THE PLACE OF THE WORK

3.9 The *Contractor* shall keep one copy of the current the *Contract Documents, Supplemental Instructions, Contemplated Change Orders, Change Orders, Change Directives*, reviewed *Shop*

Drawings, Submittals, reports and records of meetings at the *Place of the Work*, in good order and available to the *Owner* and the *Consultant*."

3.16 **GC 3.10 - CLEAN UP**

A. Add a new GC 3.10 CLEAN UP as follows:

"GC 3.10 CLEAN UP

3.10.1 The *Contractor* shall maintain the *Work* and *Place of the Work* in a safe and tidy condition and free from the accumulation of waste products and debris, other than that caused by the *Owner, Other Contractors*, or their employees.

3.10.2 Before applying for *Substantial Performance of the Work* as provided in GC 5.4 – SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK, the *Contractor* shall remove waste products and debris, other than that resulting from the work of the *Owner*, *Other Contractors*, or their employees, and shall leave the *Place of the Work* clean and suitable for use or occupancy by the *Owner*. The *Contractor* shall remove products, tools, *Construction Equipment*, and *Temporary Work* not required for the performance of the remaining work.

3.10.3 Prior to application for the final payment, the *Contractor* shall remove any remaining products, tools, *Construction Equipment*, *Temporary Work*, and waste products and debris, other than those resulting from the work of the *Owner, Other Contractors,* or their employees."

3.17 GC 3.11 - USE OF THE WORK

A. Add new GC 3.11 USE OF THE WORK as follows:

"GC 3.11 USE OF THE WORK

3.11.1 The *Contractor* shall confine *Construction Equipment, Temporary Work*, storage of *Products,* waste products and debris, and operations of employees and *Subcontractors* to limits indicated by laws, ordinances, permits, or the *Contract Documents* and shall not unreasonably encumber the *Place of the Work*.

3.11.2 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*.

3.11.3 Except for those normally used during the performance of the *Work*, such as elevator, mechanical, electrical, hydro, the *Contractor* shall not use any service plant or equipment installed as part of the *Work* without prior written consent from *the Owner*. On receipt of such consent, the *Contractor* shall be subject to any conditions set out as part of such consent and shall be responsible for all costs, damage and compensation for wear and tear.

3.11.4 If storage or other areas are required for the *Work* in addition to the *Work Site*, the *Contractor* shall be responsible for making arrangements to obtain the additional areas and obtaining any necessary permits, permission or authorization and, if required, for making permit, rental or other payments that may be required for such purpose."

3.18 GC 3.12 – CONTRACTOR'S USE OF PERMANENT EQUIPMENT OR SYSTEMS

A. Add a new GC 3.12 as follows:

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

3.12.1 With the prior written approval of the *Owner*, the *Contractor* may make use of elements of the mechanical and electrical systems or equipment comprising a permanent part of the *Work* for the purpose of providing heat or power to the *Project* during the final stages of construction. In such event, and before the issuance of the certificate of *Substantial Performance of the Work*, the *Contractor* shall clean and make good, to the satisfaction of the *Consultant*, such systems and equipment as it had been permitted to use. The *Contractor* shall pay any and all costs associated with such use, cleaning and making good.

3.12.2 Where the *Contractor* has made use of elements of the mechanical and electrical systems or equipment comprising a permanent part of the *Work*, as described in paragraph 3.12.1 above, the *Contractor* shall obtain, from the manufacturer or *Supplier* of the systems or equipment used, a

confirmation from such manufacturer or *Supplier* that the warranty on such systems or equipment begins on the date of *Substantial Performance of the Work* and is not impaired in scope or reduced in time by virtue of the *Contractor*'s use of such systems or equipment."

3.19 GC 4.1 - CASH ALLOWANCES

A. Delete paragraph 4.1.4 in its entirety and substitute new paragraph 4.1.4:

"4.1.4 Any surpluses in one or more cash allowance may at the election of the *Owner* be expended pursuant to paragraph 4.1.3 in respect of other cash allowances or to fund changes in the *Work* by way of *Change Order* or *Change Directive*, as the case may be, but without the imposition of Overhead or profit in respect *Work* pertaining to such other cash allowances or changes."

B. Delete paragraph 4.1.5 in its entirety and substitute new paragraph 4.1.5:
"4.1.5 Where the value of the *Work* under cash allowances exceeds the aggregate amount of all the cash allowances stated in the *Contract Documents,* the *Contractor* shall be compensated for the approved amount of such excess and for *Overhead* and profit on such approved amount, with the *Contract Price* being adjusted to reflect such excess, all pursuant to and only to the extent permitted under, GC 6.1 – CHANGES, 6.2 – CHANGE ORDER and GC 6.3 – CHANGE DIRECTIVE."

C. Delete paragraph 4.1.7 in its entirety and substitute new paragraph 4.1.7:

"4.1.7 The *Contractor* shall provide a schedule prior to the first application for progress payment that shows when the items called for under cash allowances must be ordered to avoid delaying the progress of the *Work.*"

D. Add new paragraph 4.1.8:
"4.1.8 The *Owner* reserves the right to call, or to have the *Contractor* call, competitive bids for portions of the *Work*, to be paid for from cash allowances. If the *Owner* determines to proceed with competitive bids, the *Contractor* shall comply with the directions of the *Owner*."

3.20 GC 5.1 - FINANCING INFORMATION REQUIRED OF THE OWNER

A. Amend the heading, "GC 5.1 FINANCING INFORMATION REQUIRED OF THE OWNER" to read, "GC 5.1 FINANCING INFORMATION REQUIRED".

B. Delete paragraph 5.1.1 in its entirety and substitute new paragraph 5.1.1:

"5.1.1 The *Contractor* shall provide the *Owner* with timely *Notice in Writing* of any material change in its financial ability to (a) properly complete the *Work* in accordance with the *Contract Documents* or (b) fulfil its obligations under the *Contract*."

C. Delete paragraph 5.1.2 in its entirety and substitute the following: "Intentionally deleted".

3.21 GC 5.2 - APPLICATIONS FOR PAYMENT

A. Amend paragraph 5.2.2 by adding the following sentence to the end of that paragraph:
"Applications for payment shall be made in a form that is mutually acceptable to the *Owner* and the *Contractor*, and shall include, as a separate line item, the applicable *Value Added Taxes* payable on that application."

B. Amend paragraph 5.2.3 by: adding the following to the end of that paragraph:
"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."

C. Add to the end of paragraph 5.2.8 the following new sentence:
"Any *Products* delivered to the *Place of the Work* but not yet incorporated into the *Work* shall remain at the risk of the *Contractor* until *Ready-for-Takeover* notwithstanding that title has passed to the *Owner* pursuant to GC 13.1 OWNERSHIP OF MATERIALS."

D. Add new paragraph 5.2.9:
"5.2.9 The *Contractor* shall submit, with each application for payment, as true conditions precedent to the *Contractor's* right to payment under this *Contract*:

.1 after the first payment, a Statutory Declaration, on an original form of CCDC Document 9A-2001, stating that payments in connection with the *Work*, as noted in the Statutory Declaration, have been made to the end of the period immediately preceding that covered by the current application."

.2 evidence of compliance with workers' compensation legislation at the *Place of the Work,* including a WSIB Clearance Certificate, with each application for progress payment.

.3 if the application is for payment of the lien holdback amount, a written request for release of holdback including a declaration that no written notices of lien have been received by the *Contractor*."

E. Add new paragraph 5.2. 10:

"5.2.10 The *Contractor* shall prepare and maintain current as-built Drawings which shall consist of the Drawings and Specifications revised by the *Contractor* during the *Work*, showing changes to the Drawings and Specifications, which current as-built Drawings shall be maintained by the *Contractor* and made available to the *Consultant* for review with each application for progress payment. The *Consultant* reserves the right to retain a reasonable amount for the value of the as-built *Drawings* not presented for review."

3.22 GC 5.3 - PAYMENT

A. Add a new paragraph 5.3.2 as follows:

"5.3.2 If the *Contractor* fails to provide a statutory declaration as required by paragraph 5.2.8, or if the *Contractor* fails to demonstrate compliance with GC 10.4 – WORKERS' COMPENSATION, the *Owner* shall be entitled to deduct from amounts otherwise payable to the *Contractor* an amount sufficient to cover any liability which it might incur as a result of the *Contractor*'s failure to provide a statutory declaration or to demonstrate compliance with GC 10.4."

3.23 GC 5.4 - SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK

A. Amend paragraph 5.4.1 by deleting the words "20 calendar days" in the second line and substituting the words "fifteen (15) *Work*ing Days" therefor, and by adding the following at the beginning of the paragraph:

"5.4.1 When the *Contractor* considers that the *Work* is substantially performed, or if permitted by the lien legislation applicable to the *Place of the Work* a designated portion thereof which the *Owner* agrees to accept separately is substantially performed, the *Contractor* shall, within one (1) *Working Day*, deliver to the *Consultant* and the *Owner* a written application for payment of the lien holdback amount, in accordance with GC 5.3, for review by the *Consultant* to establish *Substantial Performance of the Work* or substantial performance of the designated portion of the *Work*."

B. Delete paragraph 5.4.2 in its entirety and substitute the following: "Intentionally deleted".

C. Delete paragraph 5.4.3 in its entirety and substitute new paragraph 5.4.3:

"5.4.3 Subject to the terms and conditions of the *Contract,* the requirements of any *Payment Legislation,* and any Notice of Non-Payment of Holdback, the holdback amount authorized by the certificate for payment of the holdback shall be due and payable on the first (1st) *Working Day* following the expiration of the holdback period stipulated in the *Payment Legislation* applicable to the *Place of the Work*. The *Owner* may retain out of the holdback amount any sums required by law to satisfy any liens against the *Work* or, if permitted by the lien legislation applicable to the *Place of the Work*, other third party monetary claims against the *Contractor* which are enforceable against the *Owner*."

D. Amend paragraph 5.4.5 by deleting "hereby agrees to release, and shall release," and substituting "may agree to release".

E. Add new paragraph 5.4.7 as follows:

"5.4.4 The *Contractor* shall publish a copy of the Certificate of *Substantial Performance of the Work* within seven (7) days of receiving a copy of the Certificate of *Substantial Performance of the Work* signed by the *Consultant*, and the *Contractor* shall provide suitable evidence of the publication to the *Consultant* and *the Owner*. If the *Contractor* fails to publish such notice, the *Owner* shall be at liberty to publish and back charge the *Contractor* its reasonable costs for doing so."

3.24 GC 5.5 – FINAL PAYMENT

A. Delete paragraph 5.5.1 in its entirety and substitute new paragraph 5.5.1:

"5.5.1 When the *Contractor* considers that the *Work* is completed and satisfies the requirements of *Total Completion of the Work* and *Completion of Commissioning*, the *Contractor* shall submit an application for final payment. The *Contractor's* application for final payment shall be accompanied by any documents or materials not yet delivered as agreed to in writing by the *Owner* pursuant to paragraph 12.1.2 of GC 12.1 - READY-FOR-TAKEOVER together with fully complete as-built *Drawings.* Should the *Contractor* fail to deliver any of the said documents, or other documents required to be delivered pursuant to the *Contract Documents*, the *Owner* shall be at liberty to withhold from amounts otherwise payable to the *Contractor,* an amount, in the discretion of the *Owner,* up to the full amount otherwise payable to the *Contractor* as security for the obligation of the *Contractor* to deliver the undelivered documents."

B. Delete from the first line of paragraph 5.5.2 the words, "calendar days" and substitute the words "*Working Days*".

C. Delete paragraph 5.5.4 in its entirety and substitute new paragraph 5.5.4:

"5.5.4 Subject to the other requirements of the *Contract*, the unpaid balance of the *Contract Price* shall become payable to the *Contractor* on the tenth (10th) *Working Day* following the issuance of the *Consultant's* final certificate for payment, subject to the *Owner's* right to withhold payment from the unpaid balance of the *Contract Price* for any amounts required pursuant to GC 5.6 DEFERRED WORK, and any sums required to satisfy any lien or trust claims arising from the *Work*".

D. Add new paragraph 5.5.5:

"5.5.5 As additional preconditions for release of the final payment, the *Contractor* shall submit the following documentation:

.1 the *Contractor's* written request for release of final payment, including a declaration that no written notices of lien have been received by it.;

.2 the *Contractor's* Statutory Declaration CCDC 9A-2001.; and

.3 the *Contractor's* WSIB Clearance Certificate."

3.25 GC 5.6 - DEFERRED WORK

A. Add new paragraph GC 5.6.2:

"5.6.2 Notwithstanding the provisions of GC 5.3 PAYMENT, GC 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK and GC 5.5 FINAL PAYMENT, the *Owner* may withhold payment of any amounts otherwise due under the *Contract* on account of any costs or damages the *Owner* has incurred or, is likely to incur, by reason of:

.1 defective or incomplete portions of the *Work* or damage to the work of *Other Contractors* not rectified in accordance with the *Contract*;

.2 failure of the *Contractor* to indemnify the *Owner* in accordance with the terms of the *Contract*;

.3 failure of the *Contractor* to fulfil its obligations in respect of construction liens in accordance with GC 14.2 CONSTRUCTION LIENS;

.4 evidence of the *Contractor*'s failure to make payments to *Subcontractors* or *Suppliers*;

.5 unsatisfactory prosecution of the *Work* by the *Contractor* or any *Subcontractor*, and

.6 failure to attain the *Contract Time*. "

B. Add new paragraph GC 5.6.3:

"5.6.3 Where the *Owner* has withheld payment of any portion of the *Contract Price* pursuant to the provision of paragraphs 5.6.1 or 5.6.2, the *Owner* shall be entitled to apply such withheld portion towards any costs or damages suffered by the *Owner*."

3.26 GC 6.1 – OWNER'S RIGHT TO MAKE CHANGES

A. Amend paragraph 6.1.2 by adding the following to the end of that paragraph:
"This requirement 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 *the Contract Time* shall be barred unless there has been strict compliance with PART 6 – CHANGES IN THE WORK. No course of conduct or dealing between the parties, no express or implied acceptance of alterations or additions to the *Work*, and no claims that the *Owner* has been unjustly enriched by any alteration or addition to the *Work*, whether in fact there has been any such unjust enrichment or not, shall be the basis of a claim for additional payment under this *Contract* or a claim for any extension of the *Contract Time*."

B. Add new paragraphs 6.1.3, 6.1.4, 6.1.5, 6.1.6, and 6.1.7, 6.1.8, 6.1.9, 6.1.10, 6.1.11, and 6.1.12 as follows:
"6.1.3 The *Contractor* shall not be entitled to receive any compensation or extension of *the Contract Time,* and the *Owner* shall have no obligation or liability to pay compensation to the *Contractor*, unless a *Change Order* or *Change Directive* has been issued to the *Contractor*, in writing, and before the *Contractor* commences with any work in respect of such *Change Order* or *Change Directive*.

6.1.4 There shall be no adjustment to the *Contract Time* should the *Contractor* fail to present a request for a specific adjustment to the *Contract Time*, if any:
.1 at the time of first presenting a request for adjustment to the *Contract Pri*ce in response to a *Contemplated Change Order*; or
.2 within ten (10) *Working Days* of receipt of a *Change Directive*.

6.1.5 There shall be no adjustments to the *Contract Time* or *the Contract Price* or compensation or payment of any kind whatsoever relating to a *Contractor* claim unless notice in writing of the claim is given to *the Owner*, through *Consultant* not later than twenty (20) *Working Days* after the *Contractor* becomes aware of the claim.

6.1.6 Any *Change Order* or *Change Directive* shall clearly set out what, if any, extension of the *Contract Time* is anticipated as a result thereof and failing the inclusion of the same, the *Contractor* shall be barred in making a claim for extension of the *Contract Time* in respect thereof.

6.1.7 The following fee percentage and overhead charges shall be applied to additional work directed by the *Consultant* through a *Change Directive* or *Change Order*:
.1 for changes to the *Work* with a value of less than or equal to $50,000, the *Contractor* shall be entitled to mark-ups for overhead and profit of ten percent (10%) on work performed by the *Contractor*'s own forces plus five percent (5%) on work performed by *Subcontractor*s; and
.2 for changes to the *Work* with a value greater than $50,000, the *Contractor* shall be entitled to mark-ups for overhead and profit of seven and a half percent (7.5%) on work performed by the *Contractor*'s own forces plus five percent (5%) on work performed by *Subcontractor*s.
.3 Where a change is made in work to be carried out by the *Contractor*'s own forces, and for which no *the Contract* unit prices are scheduled, the value of the additional work shall be determined by adding to the reasonable cost of materials and labour (as assessed by the *Consultant*), an allowance for the *Contractor*'s combined overhead and profit of not more than ten percent.
.4 Where such a change is made in work to be carried out by a *Subcontractor*, the value of the additional work shall be determined in a similar manner; the allowances for *Subcontractor*'s overhead and profit, being not more than ten percent for overhead and five percent for profit. In such cases, the *Contractor* shall be permitted to add an allowance in

respect of combined overhead and profit of not more than ten percent on the total of the *Subcontractor*'s quotation.

.5 Additional charges for bonds and insurance relating to the increased value of the *Work* as a result of changes in the *Work*, shall be included in the *Contractor*'s and *Subcontractor*'s overhead relating to the change in the *Work*.

.6 *Work* performed by *Subcontractor* to a *Subcontractor* (sub-subcontractor): Cost of sub-contactor's work plus 5% for the *Contractor*'s overhead and profit. *Subcontractor*'s mark-up shall consist of cost of sub-sub-contactor's work plus 5% for overhead and profit. Sub-subcontractor's mark-up shall consist of the actual cost of the work plus 10% for overhead and profit.

.7 Rates for labour shall be based on standard normal time prevailing rate in the area of work. Rates used in determination of additional work value shall be mutually agreed upon by the *Owner*, *Consultant* and the *Contractor* prior to the commencement of additional work."

6.1.8 Overtime labour costs and labour burdens are the lesser of either the basic or approved overtime hourly wages actually paid for labour in the direct employ of the *Contractor*, *Subcontractor* and Supplier or, those hourly wages established in the community under collective bargaining agreements in effect at the time of the changed *Work* being performed, plus a labour burden mark-up of 50% for every hour the worker consumes in the interests of the changed *Work* on the *Project*. Labour burden covers the full cost of labour in addition to actual wages paid, and includes, but is not necessarily limited to, the cost of workers compensation, employment insurance, holiday pay, travelling time (related to the change) consumed at all times other than actually performing *Work* onsite, sick time, travelling expenses and subsistence allowances, welfare, union dues, industrial training, Canada or Quebec Pension plans, or other pension funds, rest periods, small tools allowances, uniforms, safety equipment and protection, insurance against property damage and personal injury, medical and dental insurance, and all other items reasonably expected to be provided as part of the cost of labour for the provision of the changed *Work*.

6.1.9 There shall be no adjustments to the *Contract Time* or *the Contract Price* or compensation or payment of any kind whatsoever including potential or contingent costs for matters such as loss of profit, loss of productivity, loss of opportunity or any other such losses based on the quantity, scope or cumulative value or number of changes in the *Work* whether resulting from one or more *Change Orders* or *Change Directives*, unless agreed in writing by the parties in a *Change Order*.

6.1.10 Superintendent costs means the overhead costs associated with the provision of superintendence of the *Work* of the *Contractor*, *Subcontractor* or Supplier. Where a Superintendent actually performs *Work* on the improvement, then such costs are payable at the appropriate labour cost as defined in Item 2 above. The additional costs associated with the overhead portion of the superintendent *Work* are to be included in the appropriate the *Contractor*'s, *Subcontractor*'s and Supplier's overhead costs.

6.1.11 Overhead and profit costs means all costs relating to the changed *Work* by the *Contractor*s, *Subcontractors* and Suppliers. Overhead and profit costs include, but are not necessarily limited to, the following: profit, superintendence (other than the actual labour cost and labour burden for a working superintendent) head office costs, site security, temporary facilities, parking, travel and subsistence (including meals and accommodation), site office and communication, disposal (including waste and debris storage transportation and disposal), and small tools (other than those covered by labour burden) estimating, drafting and engineering (including cost associated with any required additional drafting, detailing and modifications to shop or engineering drawings resulting from the change and the distribution and processing of the same), time sensitive costs, schedule acceleration costs, impact costs, financing costs, quality assurance, code compliance inspection and testing services, royalties, patent fees, damages for infringement of patents and costs of defending suits thereof, adjustments in premiums for all bonds and insurance, and adjustments in taxes and duties, the charges for all long distance telephone, facsimile and other communications, courier services, as-built and record drawings, and petty cash items and other

such items reasonably expected to be provided as part of the overhead costs relating to the provision of the changed *Work*.

6.1.12 The *Owner*, through the *Consultant*, reserves the right to authorize payment for a change in the *Work* by means of the *Cash Allowance*."

3.27 **GC 6.2 - CHANGE ORDER**

A. Delete paragraph 6.2.1 inserting new paragraph 6.2.1 as follows:

"6.2.1 When a change in the *Work* is proposed or required, *Consultant* or *the Owner* shall provide a notice describing the proposed change in the *Work* to the *Contractor*. The *Contractor* shall provide:

.1 a quotation from the *Contractor*, on the *Contractor's* letterhead and with the *Contractor's* signature;

.2 quotations from all *Subcontractors,* each on *Subcontractor's* respective letterhead and with *Subcontractor's* respective signature; and

.3 the following information in quotations from *Subcontractors* and the *Contractor:*

(1) a complete breakdown for all items of material;

(2) a total number of hours for labour;

(3) a dollar rate applied against individual material items and labour quantities;

(4) stipulated adjustment in the *Contract Time*, if any, for the proposed change in the *Work;*

(5) percentage values for overhead and profit by the *Contractor* and *Subcontractors*; and

(6) all mathematical calculations, which shall be complete.

Quotations submitted with any of the above items or information in this paragraph 6.2.1 missing or incorrect will be returned for revision."

3.28 GC 6.3 - CHANGE DIRECTIVE

A. Delete paragraphs 6.3.7.1(1), (2), (3) and (4) and replace them with the following:

"(1) carrying out the *Work*, including necessary supervisory services;"

"(2) intentionally left blank;"

"(3) engaged in the preparation of *Shop Drawings*, fabrication drawings, coordination drawings and *Project* record drawings: or…"

"(4) including clerical staff engaged in processing changes in the *Work*."

B. Delete paragraphs 6.3.7.5, 6.3.7.11, 6.3.7.15 and 6.3.7.19.

C. Add new paragraph 6.3.14 as follows:

"6.3.14 For purposes of calculating the cost of performing the work attributable to a Change Directive, the *Contractor* shall not be entitled to charge the following:

.1 head office salaries and benefits and all other overhead or general expenses, except only for the salaries, wages and benefits of personnel described in paragraph 6.3.7.1 and the contributions, assessments or taxes referred to in paragraphs 6.3.7.2;

.2 capital expenses and interest on capital;

.3 general clean-up, except where the performance of the work in the *Change Directive* causes specific additional clean-up requirements;

.4 wages paid for field supervision of *Subcontractors*;

.5 wages, salaries, rentals, or other expenses that exceed the rates that are standard in the locality of the *Place of the Work* that are otherwise deemed unreasonable by the *Consultant*;

.6 any costs or expenses attributable to the negligence, improper work, deficiencies, or breaches of *the Contract* by the *Contractor* or *Subcontractor*; and

.7 any cost of quality assurance, such as inspection and testing services, charges levied by authorities, and any legal fees unless any such costs or fees are pre-approved in writing by the *Owner*."

3.29 GC 6.4 - CONCEALED OR UNKNOWN CONDITIONS

A. Amend paragraph 6.4.2 by adding a new first sentence which reads as follows:

"Having regard to paragraph 6.4.1, if the *Contractor* believes that the conditions of the *Place of the Work* differ materially from those reasonably anticipated, or differ materially from those indicated in the *Contract* Documents, or were concealed from discovery notwithstanding the conduct of the investigation described in paragraph 6.4.1, it shall notify the *Owner* and *Consultant* in writing no later than five (5) *Work*ing Days after the first observation of such conditions."

B. Amend the existing second sentence of paragraph 6.4.2 so that, as amended, it reads as follows:
"If the finding is that the conditions differ materially, or were concealed from discovery not withstanding the conduct of the investigation described in paragraph 6.4.1, and this would cause an increase or decrease in the *Contractor*'s cost or time to perform the *Work*, the *Consultant*, with the *Owner*'s approval, will issue appropriate instructions for a change in the *Work* as provided in GC6.2 – CHANGE ORDER or GC6.3 – CHANGE DIRECTIVE."

C. Delete paragraph 6.4.3 and substitute the following:
"6.4.3 If the *Consultant* makes a finding pursuant to paragraph 6.4.2 that no change in the *Contract Price* or *the Contract Time* is justified, the *Consultant* shall report in writing the reasons for this finding to the *Owner* and the *Contractor*."

D. Add new paragraphs 6.4.5 and 6.4.6:

"6.4.5 The *Contractor* confirms that, prior to entering into the *Contract*, applying the standard of care described in paragraph 1.5.1.1 of GC 1.5 - PROJECT REQUIREMENTS, it carefully investigated the *Place of the Work*. Notwithstanding any other provision in the *Contract,* the *Contractor* is not entitled to compensation or to an extension of the *Contract Time* for conditions which could reasonably have been ascertained by the *Contractor* by such investigation undertaken prior to the submission of the bid.

6.4.6 The *Contractor* shall not be entitled to claim, and waives its rights to make a claim, for any additional compensation or any increase to the *Contract Time* or *the Contract Price*, if the *Contractor* fails to provide notice to the *Owner* as required in paragraph 6.4.1."

3.30 GC 6.5 - DELAYS

A. Delete the period at the end of paragraphs 6.5.1 and 6.5.2 and substitute the following words in each case, "but excluding any any consequential, indirect or special losses or damages, including but not limited to loss of use, loss of productivity, loss of revenue, loss of opportunity, overhead and/or profit."

B. Amend paragraph 6.5.3 by adding the following to the end of that paragraph:
", in which case the *Contractor* shall be reimbursed by the *Owner* for reasonable direct costs directly flowing from the delay but excluding any consequential, indirect or special losses or damages, including but not limited to loss of use, loss of productivity, loss of revenue, loss of opportunity, overhead and/or profit."

C. Amend paragraph 6.5.3.3 by adding "epidemics or pandemics (except for *COVID-19*)," after the word "conditions,"

6.5.7 The *Contractor* shall at all times perform the services required to perform the *Work* in accordance with the *Contract Documents* diligently and expeditiously, to maintain an orderly progress of the *Work*, and in conformity with the *Contract Time* and any revisions made thereto in accordance with the *Contract Documents*. The *Contractor* shall at all times provide sufficient personnel to accomplish its services within the *Contract Time*.

6.5.8 If the *Contractor* is delayed in the performance of the *Work* by an act or omission of the *Contractor* or anyone employed or engaged by the *Contractor* directly or indirectly, or by any cause within the *Contractor*'s control, then the *Contractor* shall take appropriate steps, in accordance with paragraph 3.4.2 of GC 3.4 – CONSTRUCTION SCHEDULE to recover any lost time, and the costs of such recovery efforts shall be to the *Contractor's* account. The *Owner* shall be reimbursed by the *Contractor* for all reasonable costs incurred by the *Owner* as the result of such delay, including all services required by the *Owner* from the *Consultant* as a result of such delay by the *Contractor* and, in particular, the cost of the *Consultant*'s services during the period between the date of *Ready-for-Takeover* stated in Article A-1 herein as the same may be extended through the

provisions of these General Conditions and any later, actual date of *Ready-for-Takeover* achieved by the *Contractor*.

6.5.9 The *Contractor* shall be responsible for the care, maintenance and protection of the *Work* in the event of any suspension of construction as a result of the delay described in paragraphs 6.5.1, 6.5.2 or 6.5.3. In the event of such suspension, the *Contractor* shall be reimbursed by the *Owner* for the reasonable costs incurred by the *Contractor* for such care, maintenance and protection, but excluding the costs of the *Contractor*'s head office personnel. The *Contractor*'s entitlement to costs pursuant to this paragraph 6.5.9, if any, shall be in addition to amounts, if any, to which the *Contractor* is entitled pursuant to paragraphs 6.5.1, 6.5.2 or 6.5.3.

6.5.10 Without limiting the obligations of the *Contractor* described in GC 3.2 – CONSTRUCTION BY OWNER OR OTHER CONTRACTORS and GC 9.4 – CONSTRUCTION SAFETY, the *Owner* may, by Notice in Writing, direct the *Contractor* to stop the *Work* where the *Owner* determines that there is an imminent risk to the safety of persons or property at the *Place of the Work*. In the event that the *Contractor* receives such notice, it shall immediately stop the *Work* and secure the Project site. The *Contractor* shall not be entitled to an extension of the *Contract Time* or to an increase in the *Contract Price* unless the resulting delay, if any, would entitle the *Contractor* to an extension of the *Contract Time* or the reimbursement of the *Contractor*'s costs as provided in paragraphs 6.5.1, 6.5.2 or 6.5.3.

6.5.11 If the *Contractor* is delayed in the performance of the *Work* by a labour dispute, civil disobedience, riot, sabotage, acts of God or any of the events described in paragraphs 6.5.3.1 through 6.5.3.4 for a period of thirty calendar days or longer, the *Owner* may terminate the *Contract* by giving Notice in Writing to that effect. In such event, the *Owner* shall pay for the *Work* performed up to the effective date of termination, including mobilization and demobilization costs, and for such additional costs, if any, directly flowing from such termination which are a reasonable consequence of the termination, but excluding any consequential, indirect or special losses or damages, including but not limited to loss of use, loss of productivity, loss of revenue, loss of opportunity, overhead and/or profit. The *Owner* shall not be liable to the *Contractor* for any other claims, costs or damages whatsoever arising from such termination of the *Contract*.

6.5.12 The *Contractor* shall provide the *Consultant* with prompt written notice of any actual or anticipated labour dispute which may reasonably be expected to affect the *Contractor*'s performance of the *Work*."

GC 6.6 CLAIMS FOR A CHANGE IN CONTRACT PRICE

A. In paragraph 6.6.5, delete "claim" in the second line and substitute "necessary claim information".

B. Add new paragraphs 6.6.7 and 6.6.8 as follows:

"6.6.7 The *Owner* may make claims arising out of the costs incurred for additional services provided by *Consultant* resulting from the *Contractor's* failure to perform the *Work* in accordance with the terms and conditions of the *Contract*, including the *Contractor's* issuance of unnecessary requests for information. *Consultant* will notify *the Owner* and the *Contractor* where it has been determined that additional services will be required or have been provided in order not to cause a delay. The *Owner* shall make claims against the *Contractor* based on *Consultant's* invoices.

6.6.8 The *Contractor* shall not make claims arising out of any *COVID-19* conditions known at the time of the execution of this *Contract*."

3.31 GC 7.1 - OWNER'S RIGHT TO PERFORM THE WORK, TERMINATE THE CONTRACTOR'S RIGHT TO CONTINUE WITH THE WORK, OR TERMINATE THE CONTRACT

A. Amend paragraph 7.1.2 by (a) adding the words "or fails or neglects to maintain the latest construction schedule" immediately following the word "properly" in the first line; (b) adding the words "or *the Owner* determines that sufficient cause exists to justify such action," in line three after the words

"substantial degree"; and (c) deleting the words "including references to applicable provisions of the *Contract*".

B. Delete paragraph 7.1.5.2 and insert new paragraph 7.1.5.2 as follows:
"withhold further payment to the *Contractor* until the *Owner* has completed all *Work* required by the *Contract Documents* and satisfied any of its costs or damages resulting from the *Contractor's* default,"

C. Amend paragraph 7.1.5.3 by deleting the words "as certified by the *Consultant*".

3.32 GC 7.2 - CONTRACTOR'S RIGHT TO SUSPEND THE WORK OR TERMINATE THE CONTRACT

A. Amend paragraph 7.2.2, by: (a) in line 1, by deleting "20" and replacing it with "35"; (b) adding the words "or related to *COVID-19*" after the first instance of the word "the *Contractor*" in the third line; and (c) adding the following second sentence at the end of the paragraph: "If the *Work* is suspended or otherwise delayed as a result of *COVID-19* for a period of ninety (90) *Working Days,* the *Contractor* may, upon giving *the Owner* twenty (20) days *Notice in Writing*, terminate the *Contract*."

B. Delete subparagraph 7.2.3.1 in its entirety and substitute the words "Intentionally deleted."

C. Delete subparagraph 7.2.3.3 in its entirety and substitute new subparagraph 7.2.3.3:
"the *Owner* fails to pay the *Contractor* when due the amount certified by the *Consultant* or awarded by adjudication, arbitration or a court, except where the *Owner* has a bona fide claim for set off, or"

D. Delete from line 2 of subparagraph 7.2.3.4, the words, "except for GC5.1 – FINANCING INFORMATION REQUIRED OF THE OWNER,".

E. Delete paragraph 7.2.5 and replace it with the following:
"7.2.5 If the default cannot be corrected within the five (5) *Work*ing 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 an acceptable schedule for such correction; and
.3 completes the correction in accordance with such schedule."

F. Add new paragraphs 7.2.6 and 7.2.7:
"7.2.6 If the *Contractor* terminates the *Contract* under the conditions described in this GC 7.2, the *Contractor* shall be entitled to be paid for all *Work* performed to the date of termination. The *Contractor* shall also be entitled to recover the direct and demonstrable costs and expenses associated with termination, including the costs of demobilization, losses sustained on Products and construction machinery and equipment. The *Contractor* shall not be entitled to any recovery for any consequential, indirect or special losses or damages, including but not limited to loss of use, loss of productivity, loss of revenue, loss of opportunity, overhead and/or profit.

7.2.7 The *Owner*'s withholding of progress payments, holdback payment and/or final payments pursuant to GC 5.6 shall not constitute a default under paragraph 7.2.3 permitting the *Contractor* to stop the *Work* or terminate the *Contract*."

3.33 GC 8.1 AUTHORITY OF THE CONSULTANT

A. Delete paragraphs 8.1.1, 8.1.2 and 8.1.3 and substitute the following:
"8.1.1 Differences between *the Owner* and the *Contractor* as to the interpretation, application, or administration of this *Contract*, or any failure to agree where agreement between the parties is called for in the *Contract* (the "Dispute") which are not resolved in the first instance by finding of *Consultant* pursuant to the provisions of GC - 2.2 ROLE OF THE CONSULTANT, paragraphs 2.2.6 and 2.2.7 shall be settled in accordance with the requirements of this GC 8.1.

8.1.2 The claimant shall give written notice of the Dispute ("Notice of Dispute") to the other party no later than seven (7) days after the receipt of *Consultant*'s finding given under paragraphs 2.2.7 or 2.2.8 of GC 2.2 ROLE OF THE CONSULTANT. The Notice of Dispute shall set forth particulars of the matters in dispute, the probable extent and value of the damage, and the relevant provisions of the *Contract* Documents. The other party shall reply within seven (7) days of receipt of the Notice of Dispute, or such longer period as mutually agreed by the parties in writing, setting out the response and any relevant provisions of the *Contract* Documents.

8.1.3 The parties shall make all reasonable efforts to resolve the Dispute by amicable negotiations and agree to provide, without prejudice, full, frank, candid, and timely disclosure of relevant facts, information and documents to facilitate the negotiations.

8.1.4 If the *Dispute* is not resolved promptly by amicable negotiations in accordance with GC 8.1.3, *Consultant* may provide instructions that, in *Consultant*'s opinion, are necessary for the proper performance of the *Work* and to prevent delays pending settlement of the *Dispute.* The parties shall act immediately according to such instructions, it being understood that by so doing neither party will jeopardize any claim they may have. If it is subsequently determined that such instructions were in error or at variance with the *Contract Documents*, *the Owner* shall pay the *Contractor* verifiable costs incurred by the *Contractor* in carrying out such instructions, which the *Contractor* was required to do beyond what the *Contract Documents* correctly understood and interpreted would have required the *Contractor* to do including costs resulting from interruption of the *Work*.

8.1.5 It is agreed that no act by either party shall be construed as a renunciation or waiver of any of their rights or recourses, provided the party has given the notices in accordance with paragraph 8.1.2 and has carried out the instructions as provided in paragraph 8.1.4, if any.

8.1.6 If the parties have not been able to resolve the Dispute in accordance with paragraph 8.1.3, the parties may agree to submit the *Dispute* to be finally resolved by arbitration under the rules of arbitration as provided in CCDC 40 in effect at the time of the execution of the *Contract*.

8.1.7 If no agreement is made for arbitration, then either party may submit the *Dispute* to such judicial tribunal as the circumstances may required."

3.34 GC 8.3 NEGOTIATION, MEDIATION AND ARBITRATION

A. Delete 8.3 in its entirety and substitute the following: "Intentionally deleted".

3.35 GC 8.4 - RETENTION OF RIGHTS

A. Amend paragraph 8.4.2 by deleting "paragraph 8.3.6 of GC 8.3 – NEGOTIATION, MEDIATION AND ARBITRATION" and substituting "GC 8.1 – AUTHORITY OF THE CONSULTANT".

B. Add new subparagraph 8.4.3:
"8.4.3 If the either party give a *Notice in Writing* described in paragraph 8.3.6 to have a *Dispute* resolved by arbitration, the *Contractor* agrees that this paragraph 8.4.3 shall be construed as a formal consent to the stay of any lien proceedings until an award is rendered in the arbitration or such *Dispute* is otherwise resolved between the parties. In no event shall the *Contractor* be deprived of its right to enforce its lien against the *Project* should the *Owner* fail to satisfy any arbitral award against it in full on the dispute in respect of which the lien proceedings were commenced. Provided nothing in this paragraph 8.4.3 shall prevent the *Contractor* from taking the steps required by the *Act* to preserve and/or perfect a lien to which it may be entitled."

3.36 GC 9.1 - PROTECTION OF WORK AND PROPERTY

A. Delete subparagraph 9.1.1.1 in its entirety and substitute new subparagraph 9.1.1.1:
"errors or omissions in the *Contract* Documents which the *Contractor* could not have reasonably discovered applying the standard of care described in paragraph 1.5.1.1 of GC 15 – PROJECT REQUIREMENTS; or"

B. Delete paragraph 9.1.2 in its entirety and substitute the following new paragraph 9.1.2:
"9.1.2 Before commencing any *Work*, the *Contractor* shall determine the locations of all underground utilities and structures indicated in or reasonably apparent or determinable from the *Contract* Documents or that are reasonably discoverable by applying to an inspection of the *Place of the Work* the degree of care and skill described in paragraph 1.5.1.1 of GC 1.5 – PROJECT REQUIREMENTS."

C. Add a new paragraphs 9.1.5, 9.1.6 and 9.1.7 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 trees or other plantings, whether owned by the *Owner* or third parties, the *Contractor* shall be liable for the replacement cost of the 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*."

"9.1.6 The *Contractor* shall neither undertake to repair and/or replace any damage whatsoever to the *Work* of *Other Contractors*, or to adjoining property, nor acknowledge the same was caused or occasioned by the *Contractor*, without first consulting the *Owner* and receiving written instructions as to the course of action to be followed from either the *Owner* or the *Consultant*. However, where there is danger to life or public safety, the *Contractor* shall take such emergency action as it deems necessary to remove the danger."

"9.1.7 The *Contractor* shall be responsible for keeping the *Work* free from trespassers and for protection of the *Work* and the public from any loss or injury directly or indirectly caused by the *Work* from the commencement of construction until *Substantial Performance of the Work*."

3.37 GC 9.2 - TOXIC AND HAZARDOUS SUBSTANCES

A. Amend paragraph 9.2.5.3 by asserting the following words after the words "place of the work" in line two of that paragraph:
"and no property is injured or destroyed as a result of exposure to or the presence of the toxic or hazardous substances,"

B. Delete the word "and" at the end of paragraph 9.2.5.3.

C. Add the word "and" at the end of paragraph 9.2.5.4.

D. Add a new paragraph 9.2.5.5 as follows:
"take any further steps it deems necessary to mitigate or stabilize any conditions resulting from encountering toxic or hazardous substances.

E. Add to paragraph 9.2.6 after the word "responsible", the following new words:
"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,".

F. Amend paragraph 9.2.7.3 by inserting the following words after the word "delay" in line two of that paragraph:
", but excluding any consequential, indirect or special losses or damages, including but not limited to loss of use, loss of productivity, loss of revenue, loss of opportunity, overhead and/or profit."

G. Add to paragraph 9.2.8 after the word "responsible", the following new words:
"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,".

H. Add "and the *Consultant*" after the word "*the Owner*" in subparagraph 9.2.8.4.

I. Add a new paragraph 9.2.10 as follows:
"9.2.10 Without limiting its other obligations under this GC 9.2, the *Contractor* acknowledges that its obligations under the *Contract* include compliance with the *Environmental Programs.* The *Contractor* acknowledges that the *Owner* may suffer loss and damage should the *Contractor* fail to comply with the *Environmental Programs* and agrees to indemnify and hold harmless the *Owner* with respect to any loss or damage to which the *Owner* is exposed by the *Contractor*'s failure to comply. The *Contractor* expressly agrees that such loss and damage shall be included within the scope of the *Contractor*'s indemnity described in paragraph 12.1.1. The *Contractor* acknowledges that should it fail to comply with the *Environmental Programs*, such failure will

constitute a failure to comply with the *Contract* to a substantial degree within the meaning of paragraph 7.1.2."

3.38 GC 9.4 - CONSTRUCTION SAFETY

A. Delete paragraph 9.4.1 in its entirety and substitute new paragraph 9.4.1:

"9.4.1 The *Contractor* shall be solely responsible for construction safety at the *Place of the Work,* and for compliance with the rules, regulations and practices required by the applicable construction health and safety legislation, the *Owner*'s health and safety regulations, guidelines, and instructions for contractors, and the *Owner's* vaccination and/or *COVID-19* policies*,* as may be amended. The *Contractor* shall be responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the performance of the *Work*. The *Contractor* shall be deemed to be and accepts the designation of "constructor" as defined in the *OHSA* for the Project, and responsibility for the obligations and liabilities associated therewith. Prior to the commencement of the *Work*, the *Contractor* shall submit to the *Owner* a copy of the Notice of Project filed with the Ministry of Labour in respect of the *Work*."

B. Add new paragraphs 9.4.6, 9.4.7, 9.4.8, 9.4.9, 9.4.10, and 9.4.11:

"9.4.6 Prior to the commencement of the *Work*, the *Contractor* shall submit to the *Owner*:

.1 a current WSIB clearance certificate;

.2 copies of the *Contractor*'s insurance policies having application to the Project or certificates of insurance, at the option of the *Owner*;

.3 documentation of the *Contractor*'s in-house safety-related programs;

.4 a copy of the Notice of Project filed with the Ministry of Labour naming itself as "constructor" under OHSA.

9.4.7 The *Contractor* hereby represents and warrants to the *Owner* that appropriate health and safety instruction and training have been provided and will be provided to the *Contractor*'s employees, *Subcontractors* and Suppliers, before the *Work* is commenced. The *Contractor* also undertakes to provide such health and safety instruction and training to the *Owner*'s representatives, the *Owner*'s own forces and other contractors, should they fall under the jurisdiction of the *Contractor* as more particularly described in paragraph 9.4.1 above.

9.4.8 The *Contractor* shall indemnify and save harmless the *Owner*, the *Consultant* and their respective agents, officers, directors, employees, consultants, subconsultants, successors and assigns from and against any and all liability, cost, damage or loss, including legal fees and fines, related to or arising out of any and all acts or omissions of the *Contractor*, its *Subcontractors*, *Suppliers,* employees, agents or representatives which contravene the *Contractor*'s duties and obligations, as constructor, pursuant to the *OHSA* (including, without limitation, the consequences of any and all safety infractions committed by the *Contractor* under the *OHSA*), including the payment of legal fees and disbursements on a solicitor and client basis. Such indemnity shall apply to the extent to which the *Owner* is not covered by insurance, provided that the indemnity contained in this paragraph shall be limited to costs and damages resulting directly from such infractions and shall not extend to any consequential, indirect or special damages.

9.4.9 Without limiting the generality of paragraph 9.4.7, the *Contractor*,

.1 agrees to waive and release *the Owner* and its agents, officers, directors, employees, successors and assigns from any and all claims, demands, losses, costs, damages, actions, suits, or proceedings as against; and

.2 shall indemnify and save harmless *the Owner*, *Consultant* and their respective agents, officers, directors, employees, successors and assigns, from and against any and all claims, demands, losses, costs, damages, actions, suits, or proceedings by any the *Contractor*'s employees, *Subcontractors*, Suppliers, and/or third parties,

that arise out of, are caused or contributed by, or are attributable to *COVID-19*, including and without limiting the generality of the foregoing, any claims, demands, losses, costs, damages, actions, suits or proceedings arising from, caused or contributed by, or attributable to *COVID-19* outbreaks originating from or on *the Owner*'s premises.

9.4.10 In the event that the *Owner* engages *Other Contractors* at the *Place of the Work* or performs work with its own forces, the *Owner* undertakes to include in its contracts with *Other Contractors* and/or in its instructions to its own forces the requirement that the *Other Contractors* or own forces, as the case may be, will comply with directions and instructions from the *Contractor*, as "constructor", with respect to occupational health and safety and related matters. The text of such instruction is attached to these Supplementary Conditions as Appendix 1 to these Supplementary Conditions.

9.4.11 All of the safety measures outlined in this agreement, or reasonably requested by the *Owner*, or implemented in order to comply with applicable law shall be at the sole expense of the *Contractor*."

3.39 GC 9.5 - MOULD

A. Delete paragraph 9.5.3.3 in its entirety and substitute new paragraph 9.5.3.3:

"extend the *Contract Time* for such reasonable time as the *Consultant* may recommend in consultation with the *Contractor*. If, in the opinion of the *Consultant*, the *Contractor* has been delayed in performing the *Work* and / or has incurred additional costs under paragraph 9.5.1.2, the *Owner* shall reimburse the *Contractor* for reasonable costs incurred as a result of the delay and as a result of taking those steps, but excluding any consequential, indirect or special losses or damages, including but not limited to loss of use, loss of productivity, loss of revenue, loss of opportunity, overhead and/or profit, and"

3.40 GC 10.1 - TAXES AND DUTIES

A. Amend paragraph 10.1.2 by adding the following sentences at the end of that paragraph:

"Except where the Specifications require otherwise, this increase in costs shall not apply where taxes and duties known before bid submission, become effective after bid submission. The *Contract Price* shall be deemed to include such increased duties and taxes. 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 and the *Owner* shall not be entitled to any credit relating to mark-up for overhead or profit on any decrease in such taxes."

B. Add new paragraphs 10.1.3, 10.1.4, 10.1.5 and 10.1.6 as follows:

"10.1.3 Where 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* or the *Owner*'s representative, assist with 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 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 obtain from all *Subcontractors* and Suppliers cooperation 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 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."

3.41 GC 10.2 - LAWS, NOTICES, PERMITS, AND FEES

A. Delete paragraph 10.2.2 in its entirety and replace it with the following:
"10.2.2 The *Owner* shall obtain and pay for permanent easements and rights of servitude. The building permit will be obtained and paid for by the *Contractor*. The *Contractor* shall be responsible to obtain and pay for all other permits, licenses or certificates necessary for the performance of the *Work* which were in force at the date of bid closing. The *Owner* shall pay any plan inspection fee charged by the Ministry of Labour."

B. Add to the end of paragraph 10.2.4, the following words:
"The *Contractor* shall notify the Chief Building Official or the registered code agency where applicable, of the readiness, substantial completion, and completion of the stages of construction set out in the Ontario Building Code. The *Contractor* shall be present at each site inspection by an inspector or registered code agency as applicable under the Ontario Building Code. The *Contractor* shall be present at each site inspection by an inspector or registered code agency as applicable under the Ontario Building Code"

C. Delete from the first line of paragraph 10.2.5 the word, "The" and substitute the words:
"Subject to paragraph 1.1.3 and 1.1.4 of GC 1.1 – GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT, the".

D. Amend paragraph 10.2.7 by (a) deleting "bid closing" and substituting "execution of the *Contract*", and (b) adding the following to the end of the paragraph: ", save and except for changes related to COVID-19 which are provided for under paragraph 6.5.6 of GC 6.5 - DELAYS."

3.42 GC12.1 – READY-FOR-TAKEOVER

A. Amend paragraph 12.1.1.1 by adding ", and all prerequisites for substantial performance under the Construction Act, RSO 1990, c C.30 have been satisfied." after the word "*Work*".

B. Amend paragraph 12.1.1.4 by (a) adding "spare parts, maintenance materials, warranties, data manuals, and specifications" after the words "maintenance documents" and (b) deleting the word "immediate".

C. Add new paragraphs 12.1.1.9, 12.1.1.10, and 12.1.1.11:

"12.1.1.9 Local fire authority has inspected and confirmed that life safety systems are acceptable, if required by the *Contract Documents.*

12.1.1.10 Elevator inspection and approval by governing authority received by *Consultant*, if required by the *Contract Documents.*

12.1.1.11 Any other prerequisites required by the *Contract Documents*."

D. Amend paragraph 12.1.2 by deleting "to 12.1.1.6" and substituting ", 12.1.1.5, and 12.1.1.8".

E. Amend paragraph 12.1.4 by deleting "10 calendar days" and substituting "fifteen (15) *Work*ing Days, or such longer period as may be reasonably required in the circumstances".

F. Amend paragraph 12.1.6 by adding "RIGHT OF ENTRY AND " after "GC 12.2 – ".\

3.43 GC 12.2 RIGHT OF ENTRY AND EARLY OCCUPANCY BY THE OWNER

A. Delete GC 12.2 EARLY OCCUPANCY BY THE OWNER in its entirety and substitute the following:

"GC 12.2 RIGHT OF ENTRY AND EARLY OCCUPANCY BY THE OWNER

12.2.1 *the Owner* shall have the right to enter or occupy the *Work* in whole or in part for the purpose of placing fittings and equipment or for other uses before Ready-for-Takeover, if, in the opinion of *Consultant* and *the Owner*, such entry or occupation does not prevent or substantially interfere with the *Contractor* in completion of the *Contract* within the *Contract Time*. Such entry or occupation shall not be considered as acceptance of the *Work* or in any way relieve the *Contractor* from responsibility to complete the *Contract* or its obligations under the *Contract*.

3.44 GC 12.3 WARRANTY

A. Amend paragraph 12.3.1 by adding the following sentence to the end of the paragraph:

"Where the Project is phased and the Specifications instruct the *Contractor* that the *Work* will be completed in stages or phases and turned over to the *Owner* for permanent use and occupancy prior to the *Substantial Performance of the Work*, the warranty for such stage or phase shall commence, for the particular phase or stage only, on the date the *Owner* takes possession of the phase or stage for permanent use or occupancy and issues a Notice in Writing to that effect."

B. Delete from the first line of paragraph 12.3.2 the word, "The" and substitute the words "Subject to paragraphs 1.1.3 and 1.1.4 of GC 1.1 – GENERAL CONDITIONS OF THE STIPULATED PRICE CONTRACT, the".

C. Amend paragraph 12.3.6 by adding the words ", unless otherwise required by the *Contract* Documents" to the end of the third sentence.

D. Add new paragraphs 12.3.7 and 12.3.8 as follows:

"12.3.7 Any items which are replaced under warranty or extended warranty shall be warranted from the time of such replacement for an additional period equalling the original warranty under which they were repaired or replaced.

12.3.8 During the month prior to the end of the warranty period, the *Owner*, the *Consultant* and the *Contractor* shall conduct an inspection of the *Work* and the *Contractor* shall promptly remedy any defects to faulty materials or workmanship."

3.45 GC13.1 - INDEMNIFICATION

A. Delete paragraphs 13.1.1 through 13.1.6 and replace them with the following:

"13.1.1 Without restricting the parties obligations to indemnify respecting toxic and hazardous substances, patent fees, and health and safety:

.1 the *Contractor* shall indemnify and hold harmless the *Owner* and the *Consultant*, their agents and employees from and against all claims, demands, losses, costs, damages, actions, suits, or proceedings (hereinafter called "claims"), by third parties that arise out of, or are attributable to, the *Contractor*'s performance of the *Contract* provided such claims are:

(1) attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property, and

(2) caused by negligent acts or omissions of the *Contractor* or anyone for whose acts the *Contractor* may be liable, and

(3) made in writing within a period of 6 years from the date of *Substantial Performance of the Work* as set out in the certificate of *Substantial Performance of the Work*, or within such shorter period as may be prescribed by any limitation statute of the province or territory of the Place of *Work*.

(4) Except as otherwise provided in this *Contract*, the *Owner* expressly waives the right to indemnity for claims other than those stated above.

The obligation of the *Contractor* to indemnify hereunder shall be limited to $5,000,000 per occurrence from the commencement of the *Work* until *Substantial Performance of the Work* and thereafter to an aggregate limit of $5,000,000.

.2 The *Owner* shall indemnify and hold harmless the *Contractor*, the *Contractor*'s agents and employees from and against claims, demands, losses, costs, damages, actions, suits, or proceedings arising out of the *Contractor*'s performance of the *Contract* which are attributable to a lack of or defect in title or an alleged lack of or defect in title to the Place of *Work*."

3.46 GC 13.2 - WAIVER OF CLAIMS

A. Delete paragraphs 13.2.1 through 13.2.10 and replace them with the following:

"13.2.1 As of the date of final payment, the *Owner* expressly waives and releases the *Contractor* from all claims against the *Contractor* including without limitation those that might arise from negligence or breach of contract by the *Contractor* except for one or more of the following:

.1 those made in writing prior to the date of final payment and still unsettled;

.2 those arising from the provisions of GC13.1 – INDEMNIFICATION or GC13.3 – WARRANTY;

.3 those arising from GC9.2 – TOXIC AND HAZARDOUS SUBSTANCES and arising from the *Contractor* bringing or introducing any toxic or hazardous substances and materials to the *Place of the Work* after the *Contractor* commences the *Work*;

.4 those made by Notice in Writing within a period of six years from the date of *Substantial Performance of the Work* as set out in the certificate of substantial performance, or within such shorter period as may be prescribed in any limitation statute of the province or territory of the *Place of the Work* and arising from any liability of the *Contractor* for damages resulting from the *Contractor*'s performance of the *Contract* with respect to substantial defects or deficiencies in the *Work* for which the *Contractor* is proven responsible. As used herein, "substantial defects or deficiencies" means any defect or deficiency in the *Work* where the reasonable cost of repair of such defect or deficiency exceeds:

.1 for a *Contract Price* of $2,000,000 or less, the sum of $50,000, before GST;

.2 for a *Contract Price* of $2,000,000 or more, the sum of $100,000, before GST.

13.2.2 As of the date of certificate of *Substantial Performance of the Work*, the *Contractor* expressly waives and releases the *Owner* from all claims which it has or reasonably ought to have knowledge of that could be advanced against the *Owner* including without limitation those that might arise from the negligence or breach of contract by the *Owner* except:

.1 those for which *Notice in Writing* was given prior to the *Contractor*'s application for final payment and still unsettled; and

.2 those arising from the provisions of GC9.2 – TOXIC AND HAZARDOUS SUBSTANCES or GC10.3 – PATENT FEES."

3.47 PART 14 - OTHER PROVISIONS

A. Add new **PART 14 – OTHER PROVISIONS** as follows:

GC 14.1 - OWNERSHIP OF MATERIALS

14.1.1 Unless otherwise specified, all materials existing at the *Place of the Work* at the time of execution of the *Contract* shall remain the property of the *Owner*. All *Work* and Products delivered to the *Place of the Work* by the *Contractor* shall be the property of the *Owner*. The *Contractor* shall remove all surplus or rejected materials as its property when notified in writing to do so by the *Consultant*.

GC 14.2 - CONSTRUCTION LIENS

14.2.1 In the event that a construction lien is registered against the Project by or through a *Subcontractor* or Supplier, and provided that the liens did not arise as a direct result of the failure by the *Owner* to pay the *Contractor* in accordance with the *Contract*, the *Contractor* shall, at its own expense:

.1 within ten (10) days, ensure that any and all construction liens and certificates of action are discharged, released or vacated by the posting of security in accordance with the *Act*; and

.2 in the case of written notices of lien, ensure that such notices are withdrawn, in writing.

14.2.2 In the event that the *Contractor* fails to comply with GC 14.2, the *Owner* may see to the removal of the construction lien or certificate of action or the withdrawal of the written notice of lien, and in that event, the *Contractor* shall be liable to *the Owner* for any and all costs and expenses, including legal costs on a full indemnity basis, associated therewith. the *Owner* shall be at liberty to set off such costs and expenses against any amount otherwise due to the *Contractor* under this *Contract*. If there is no amount owing by the *Owner* to the *Contractor*, then the *Contractor* shall reimburse the *Owner* for all of the said costs and associated expenses."

GC 14.3 - CONTRACTOR DISCHARGE OF LIABILITIES

14.3.1 In addition to the obligations assumed by the *Contractor* pursuant to GC 3.6, the *Contractor* agrees to discharge all liabilities incurred by it for labour, materials, services, *Subcontractors* and Products, used or reasonably required for use in the performance of the *Work*, except for amounts withheld by reason of legitimate dispute and which have been identified to the party or parties, from whom payment has been withheld.

GC 14.4 - AS-BUILT DRAWINGS

14.4.1 Unless otherwise provided in the *Contract Documents*, the *Contractor* shall prepare as-built drawings and provide them to the *Consultant* for review in accordance with paragraph 12.1.1.5.

GC 14.5 - DAILY REPORTS/DAILY LOGS

14.5.1 The *Contractor* shall cause its supervisor, or such competent person as it may delegate, to prepare a daily log or diary reporting on weather conditions, work force of the *Contractor*, *Subcontractors*, Suppliers and any other forces on site and also record the general nature of Project activities. Such log or diary shall also include any extraordinary or emergency events which may occur and also the identities of any persons who visit the site who are not part of the day-to-day work force.

14.5.2 The *Contractor* shall also maintain records, either at its head office or at the job site, recording manpower and material resourcing on the Project, including records which document the activities of the *Contractor* in connection with GC 3.4, and comparing that resourcing to the resourcing anticipated when the most recent version of the schedule was prepared pursuant to GC 3.4.

GC 14.6 - NEUTRAL APPOINTING AUTHORITY

14.6.1 For purposes of the Rules the term “neutral appointing authority”, shall mean the “Appointing Committee” at ADR Chambers presiding at the time notice of the dispute is given pursuant to the *Contract*.”

GC 14.7 - PUBLIC STATEMENTS

14.7.1 The *Contractor* shall not publish, issue or make any statements or news release, electronic or otherwise, concerning the *Contract*, the *Work*, or the *Project,* without the express written consent of the *Owner*.

GC 14.9 - HOSPITAL RELATED PROVISIONS

14.9.1 The *Contractor* acknowledges that the security and safety of the patients, employees and other occupants of the existing hospital is paramount. If any of the employees of the *Contractor* or the *Subcontractors* is determined by the *Owner* to be a concern for the security or safety of such patients, employees or occupants, the *Owner* may require that the *Contractor* replace such employee.

14.9.2 The *Contractor* recognizes that part of the *Work* may consists of the renovation of existing buildings and structures or the addition of a structure to an existing building. The *Contractor*:

.1 recognizes that that the provision of patient care during construction is a priority for the *Owner.* The *Contractor* shall comply with the reasonable instructions provided by the *Owner* (including, without limitation, the *Owner*’s infection control practitioner) in regard to patient care and the operation and use of the hospital during the performance of the *Work*. Any costs incurred by the *Contractor* in complying with the said instructions shall be part of the *Contract Price*.

.2 without in any way limiting its responsibilities under this *Contract,* the *Contractor* shall take all reasonable steps to avoid interference with fire exits, building 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 all other steps reasonably necessary to promote and maintain the safety and comfort of the users and occupants of such structures or adjacent structures. Without *the*

Owner's prior approval, the *Contractor* shall not permit any *Work*er or *Subcontractor*s to use any existing facilities including, without limitation, lavatories, toilets, entrances and parking areas other than those designated by the *Owner*.

14.9.3 Notwithstanding any other provision in the *Contract*, paramountcy of access must be given to emergency vehicles and no claim may be made by the *Contractor* for any delay in the performance of the *Work* as a result of any temporary lack of access to the Place of *Work* resulting from this paramountcy of access by emergency vehicles, provided that the *Owner* will use commercially reasonable efforts to avoid and to limit the duration of any temporary lack of access for this reason.

14.9.4 The *Owner* has the authority, but without the obligation, to stop the *Work* in any circumstance affecting the safety of life or property or otherwise may cause an unsafe condition for the operation of the existing hospital. The *Contractor* shall abide by the *Owner*'s instructions to stop the *Work* and to any related instructions pertaining to the circumstance without any increase in the *Contract Price* and extension in the *Contract Time* if such circumstance was caused by the *Contractor*, *Subcontractors* or Suppliers.

14.9.5 The *Contractor* shall, and shall cause the *Subcontractors* and Suppliers to, comply with hospital policies and procedures including, without limitation, environmental requirements, infection control measures and safety and emergency preparedness guidelines which are or come into force (including, without limitation, those forming part of the *Contract* Documents) as such documents are amended by the *Owner* from time to time, provided that a material amendment to the hospital policies and procedures by the *Owner* after the date of the Agreement which gives rise to a significant change in the *Work* shall be dealt with in accordance PART 6 - CHANGES IN THE WORK."

END OF SUPPLEMENTARY CONDITIONS

APPENDIX 1

LANGUAGE FOR OWNER PERSONNEL OR FOR THIRD PARTY CONTRACTORS ENTERING A PROJECT SITE WHERE THE CONTRACTOR HAS ASSUMED OVERALL RESPONSIBILITY – IN CONTRACT – FOR OCCUPATIONAL HEALTH AND SAFETY

"The (trade or employee) acknowledges that the work it will perform on behalf of Kingston General Hospital (the "*the Owner*") requires it to enter a job site which is under the total control of a [name of contractor] (the "the *Contractor*").

The (trade or employee) acknowledges that the *Contractor* has assumed overall responsibility for compliance with all aspects of the health and safety legislation of Ontario, including all the responsibilities of the "constructor" under the Occupational Health and Safety Act (Ontario). Further, (trade or employee) acknowledges that the *Contractor* is also responsible to the *Owner* to co-ordinate and schedule the activities of our work with the work of the *Contractor*.

We agree to comply with the *Contractor* directions and instructions with respect to occupational health and safety and coordination. We acknowledge that it will be cause for termination under our contract with the *Owner* should (I/we) fail or refuse to accept the direction and instruction of the *Contractor* with respect to matters of occupational health and safety or matters related to coordination of work.

We agree to have the *Contractor* named as an additional insured on our comprehensive liability policy."

APPENDIX 2

AMENDMENT TO RULES FOR MEDIATION AND ARBITRATION OF CONSTRUCTION INDUSTRY DISPUTES

(CCDC-40, 2018) (THE "RULES")

This Amendment supersedes, replaces or amends the Rules, as the case may be, as outlined below.

RULES FOR MEDIATION OF CCDC 2 CONSTRUCTION INDUSTRY DISPUTES

A. By Agreement. Delete clause 5.1 and replace it with the following:

B. "5.1 By Agreement . Where a party desires the appointment of a Project Mediator and gives a Notice in Writing to that effect, such notice shall include the names of two qualified individuals who are prepared to act as mediator, ranked in order of preference. Within five Working Days of receiving such a notice, the other party shall deliver a responding notice including the names of two qualified individuals who are prepared to act as mediator, ranked in order of preference. From the names submitted by the parties, the parties shall unanimously appoint a mediator."

C. Appointment of Project Mediator. Add a new clause 5.5 which reads as follows:

D. "5.5 Formal Agreement. When the Project Mediator has been appointed, whether pursuant to clause 5.1 or clause 5.2, the parties and the mediator shall enter into an agreement in writing pursuant to which the terms and conditions of the engagement of the Project Mediator shall be set out. Such agreement shall include an undertaking by the Project Mediator to carry out the mediation pursuant to these Rules and such agreement shall specifically set out the undertaking of the Project Mediator and the parties as to "Costs of the Mediation" (Section 12) and "Privileged Process" (Section 14)."

Representation. Amend clause 8.1 by deleting the last six words of that clause.

RULES FOR ARBITRATION OF CCDC 2 CONSTRUCTIONS INDUSTRY DISPUTES

1) Location of Arbitration. Add the following as a second sentence to clause 6.1: "Failing agreement by the parties, the arbitrator may select a location for the arbitration within the jurisdiction of the Place of Work, which is convenient to both parties".

2) Single Arbitrator. Delete clause 9.1 and replace it with the following:

"9.1 The arbitration shall be conducted before a single arbitrator who possesses the qualifications specified in Clause 9.5."

3) Appointment Of Arbitrator. Delete Clause 9.2 in its entirety and replace it with the words, "intentionally left blank".

4) Appointment of 3 Arbitrators. Delete Clause 9.4 in its entirety and replace it with, "intentionally left blank".

E. Appointment of Arbitrator. Add a new clause 9.13 which reads as follows:

"9.13 Where the arbitrator has been appointed pursuant to the Section 9, the parties and the arbitrator shall enter an agreement in writing setting out, at minimum, the name of the arbitrator, the undertaking of the arbitrator and the parties to conduct the arbitration pursuant to these Rules and the terms and conditions of engagement of the arbitrator including the fees to be paid and expenses to be reimbursed and any arrangements required to provide for interim payment of fees and/or expenses to the arbitrator."

F. Procedural Meeting. Add the following new sentence to clause 10.2:
"Such written record shall be deemed to be the procedural code for the conduct of the arbitration, subject to any further orders of the arbitrator or of the Court of competent jurisdiction."

G. Powers of the Arbitrator. Delete clause 11.1 and substitute the following:
"Subject to these Rules and subject to the written record described in clause 10.3, the arbitrator may conduct the arbitration in such manner as the arbitrator, acting reasonably, considers appropriate provided that in all events each party shall be treated fairly and given a full opportunity to present its case and respond to the case presented by the other party."

H. Exchange of Statements. Delete clause 13.1(a) and replace it with the following:
"(a) which are relevant to the issues in dispute, and..".

I. Disclosure. Delete clause 13.2 and replace it with the following:
"13.2 The arbitrator may order one or both parties to prepare an affidavit, within a specified time, in which such party deposes under oath that it has made a full and complete listing of documents pursuant to clause 13.1(a) where the arbitrator has reason to believe that one or both parties may not have made full and complete disclosure of the documents relevant to the issues in the arbitration."

J. Add a new clause 16.7 as follows:
"16.7 In the event that a party provides the statement or report of an expert witness pursuant to clause 16.1, the provisions of clauses 16.4 and 16.5 shall apply, with necessary modifications."

K. Hearings and Meetings. Amend clause 13.3 by adding the following language to that clause:
"..unless otherwise agreed by both parties or directed by the arbitrator."

L. Arbitrator Retained Experts. Add clause 16.2(c) as follows:
"(c) provide the party with a written summary of any other information, beyond that described in clauses 16.2(a) and (b), upon which the expert relied in preparing the expert's report."

M. Consolidation, Conducting Together or Consecutively, or Stay of Arbitrations. Amend clause 24.1(a) by adding the following wording to that clause:
"...on the same Project,..".

END OF SUPPLEMENTARY CONDITIONS

SECTION 01 11 00
SUMMARY OF WORK

PART 1 - GENERAL

1.1 WORK OF THIS CONTRACT

A. *Work* of this *Contract* comprises the following:
Kingston Health Sciences Centre - KHSC-Emergency Power System Capacity & Infrastructure Remediation

B. Municipal Address:
76 Stuart Street, Kingston, Ontario, K7L 2V7

C. Legal Description:
All and singular that certain parcel or tract of land and premises, situate lying and being in the Province of Ontario and in the City of Kingston, comprising all of Abstract Block "D" in said City as laid out on Farm Lot 24 in Concession 1 (formerly Kingston Township) SAVE AND EXCEPT PART 1 on REFERENCE PLAN No. 13 R 6751 by David T. Humphries, Ontario Land Surveyor, dated the 18th April 1986, and SAVE AND EXCEPT PART 1 on REFERENCE PLAN No. 13 R 6752 by David T. Humphries, Ontario Land Surveyor, dated the 16th April 1986, which said Plans were deposited in the Land Registry Division of Frontenac (No. 13) on the 24th April 1986, which said plans form a part of this legal description.
Part Park Lot 1, Selma Block, Part Lots 294 & 295, Original Survey, City of Kingston.

D. The work for *Kingston Health Sciences Centre - KHSC-Emergency Power System Capacity & Infrastructure Remediation* includes but is not limited to work to provide a new emergency generator for Kingston General Hospital.

E. A list of the *Contract Documents* can be found in Article A-3 CONTRACT DOCUMENTS of the Agreement between *Owner* and *Contractor*.

F. *Consultant* may furnish additional drawings to assist proper execution of the *Work*. These drawings will be issued for clarification only. Such drawings shall have same meaning and intent as if they were included with plans referred to in *Contract Documents*.

G. The *Drawings* and *Specifications* shall be carefully read by the *Contractor* so that the extent and nature of the work of all trades is understood. All trades shall co-operate and work together, so that the *Work* will fit together and make a complete and satisfactory job in every detail. All work shall be done and materials supplied to complete such work in every detail to the true intent and meaning of the *Drawings*, *Specifications* and any additional details furnished as the *Work* progresses.

1.2 SCHEDULE "A" – KEY PERSONNEL

A. Prior to commencement of *Work*, prepare and submit 'Schedule "A" – Key Personnel' identifying *Contractor*'s personnel mentioned below, who will be employed/engaged in performance of the *Work:*
1. Project Manager(s)
2. Superintendent(s)
3. Coordinator(s)
4. Site Supervisor(s)

B. Make submittal in accordance with Section 01 33 00.

1.3 DIVISION OF WORK

A. Division of the *Work* among *Subcontractors* and *Suppliers* is solely *Contractor*'s responsibility. *Consultant* and *Owner* assume no responsibility to act as an arbiter to establish subcontract limits between Sections or Divisions of the *Work*.

1.4 SPECIFICATIONS LANGUAGE AND STYLE

A. These specifications are written in the imperative mood and in streamlined form. The imperative language is directed to *Contractor*, unless stated otherwise.

B. Complete sentences by reading "shall", " *Contractor* shall", "shall be", and similar phrases by inference. Where a colon (:) is used within sentences and phrases, read the words "shall be" by inference.

C. Fulfill and perform all indicated requirements whether stated imperatively or otherwise.

D. When used in the context of a *Product*, read the word “provide” to mean “supply and install to result in a complete installation ready for its intended use”.

1.5 CONTRACT DOCUMENTS FOR CONTRUCTION PURPOSES

A. *Owner* will supply *Contractor* with a complete set of *Contract Documents* in electronic form before commencement of the *Work*. *Contractor* may print hard copies for construction purposes as required.

B. Unauthorized reproduction of *Contract Documents* is prohibited.

1.6 DOCUMENTS AT THE SITE

A. Keep the following documents at *Place of the Work*, stored securely and in good order and available to *Owner* and *Consultant* in hard copy form:
1. Current *Contract Documents*, including *Drawings*, *Specifications* and addenda.
2. *Change Orders*, *Change Directives*, and *Supplementary Instructions*.
3. Reviewed *Shop Drawings*, *Product* data and samples.
4. Field test reports and records.
5. Construction progress schedule.
6. Meeting minutes.
7. Manufacturer’s certifications.
8. Permits, inspection certificates, and other documents required by authorities having jurisdiction.
9. Current as-built drawings.
10. Material Safety Data Sheets (MSDS) for all controlled Products.
11. ULC firestopping details as needed for performance of the *Work.*

B. In the event that revised *Drawings* are issued after the *Work* has commenced, superseded *Drawings* are to be removed from the site.

1.7 CONTRACTOR’S USE OF PREMISES

A. *Contractor*'s access to the work areas will vary and are to be coordinated with the *Owner* prior to commencing work in each space.

B. Use of site is limited to the areas of work unless specific locations for hoarding and storage are indicated on the documents.

C. See Section 00 14 00 – Work Restrictions for further details of additional restrictions on the *Contractor*’s use of the premises.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SUMMARY OF WORK

SECTION 01 14 00
WORK RESTRICTIONS

PART 1 - GENERAL

1.1 RESTRICTIONS ON USE OF PREMISES

A. All contractors shall be screened when entering any Kingston Health Sciences Centre sites, and will need to have a valid hospital issued ID.

B. Comply with smoking restrictions. Smoking is not permitted within the building and only permitted within the designated areas on the building grounds.

C. Confine *Construction Equipment*, *Temporary Work*, storage of *Products*, waste products and debris, and all other construction operations to limits required by laws, ordinances, permits, and *Contract Documents*, whichever is most restrictive. Do not unreasonably encumber *Place of the Work*. The *Owner* reserves the right to remove any and all encumbrances at the *Contractor*'s expense.

D. Move stored products or equipment which interferes with operations of *Consultant*, *Owner* or *Other Contractors*.

E. Obtain and pay for use of additional storage or work areas needed for operations.

F. During the extent of the *Contract* and at any time the *Contractor*'s forces are on the site or within the boundaries of the Hospital, the *Contractor* is required to comply with all Hospital policies. Violation of any aspect of any portion of any listed policy is grounds for investigation, disciplinary action of those involved, and at the discretion of the *Owner*, termination of the *Contract*. A copy of the policies and procedures is available for viewing at the office of the *Owner*.

G. Prior to the start of the *Work*, all construction forces will be required to attend an *Owner*'s orientation session. Approximate time of session is 2 hours and will include Security, Fire Safety, Health and Safety and Infection Control. This session is a requirement of the Hospital and must be completed by any personnel who wish to access the site. Personnel with a current, valid ID Badge are required to take a refresher course prior to commencing work

1.2 WORK SEQUENCE

A. During the execution of the *Work*, the existing facility will be occupied and will remain operational at all times. The *Contractor* shall coordinate the *Work* so that the *Owner* can maintain the normal operation of the facility with little to no disturbance. All temporary partitions, fencing, hoarding and temporary exits will be required to be in place prior to commencing the *Work* and shall be constructed to meet the requirements of a Section 01 35 33 for additional infection control guidelines and procedures.

1.3 OWNER OCCUPANCY

A. *Owner* will occupy premises during entire construction period.

B. Cooperate with *Owner* in scheduling operations to minimize disruptions and to facilitate *Owner* usage.

1.4 RESTRICTED HOURS OF WORK

A. *Work* may be performed during *Owner*'s normal business hours which are Monday to Friday from 08:00 h to 17:00 h except as otherwise noted or coordinated with the *Owner*.

B. Any interruption involving the shutdown of any component of the existing mechanical / plumbing systems shall be completed between the hours of 17:00 h and 07:00 h weekdays or on the weekend.

C. Allow for hours of work restrictions in construction progress schedule.

1.5 NOISY WORK RESTRICTIONS IN OCCUPIED FACILITIES

A. Execute the *Work* with least possible interference or disturbance to occupants, public, and normal use of premises.

B. Schedule excessively noisy work to avoid disturbance to building occupants. Perform excessive noise generating work outside of *Owner*'s business hours, [or limited hours within regular business hours as stipulated by Owner for areas of work above, below or adjacent to areas containing patient sleep rooms].

C. Use powder actuated devices only with *Consultant*'s written permission.

D. From time to time, the *Contractor* may be asked to stop all work, or temporarily suspend a type of work due to the generation of noise or other disruption to the Hospital. In the event the *Owner* requests the *Contractor* to suspend or stop work and when no other work can reasonably be completed, the *Owner* will reasonably compensate the *Contractor* for the time lost. Compensation will be processed by means of a *Change Order*.

1.6 MAINTAINING LIFE SAFETY SYSTEMS IN OCCUPIED FACILITIES

A. Maintain operational life safety systems and public access to exits in occupied areas during all stages of the *Work*.

B. Determine nature and exact locations of existing fire and smoke sensors prior to the commencement of the *Work*. Avoid direct or indirect jarring while working in adjacent areas and exercise caution to avoid triggering these devices.

C. Be responsible for costs incurred by *Owner* on account of false fire alarms activated as a result of the execution of the *Work* without adequate precautions.

1.7 SITE SECURITY

A. At the end of each working day, the *Contractor* shall ensure that all access to any area of construction is locked and secure. Provide access keys to *Owner*'s security personnel in case of breach in security. Any tools, materials or property of the *Owner* that is damaged or stolen, due to inadequate security of the work area, shall be replaced at no cost to the *Owner*.

B. Where security may be reduced by the W*ork*, provide temporary means to maintain security. Coordinate necessary protection with the *Owner* and submit to the *Consultant* for review prior to installation.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF WORK RESTRICTIONS

SECTION 01 21 00
ALLOWANCES

PART 1 - GENERAL

1.1 CASH ALLOWANCES FOR TESTING AND LABORATORY SERVICES, AND VERIFICATION SERVICES

A. Amount of each cash allowance includes:
   1. All costs related to testing and laboratory services or verification services, excluding *Value Added Taxes*.
   2. *Subcontractor*'s and sub-*Subcontractor*'s overheads and profits related to the cash allowance.

B. Particular requirements for inspection and testing to be carried out by testing laboratory designated by the *Consultant* are specified under various sections.

C. *Consultant* will appoint and *Contractor* will use a cash allowance to pay for services of a testing laboratory except as follows:
   1. Inspection and testing required by laws, ordinances, rules, regulations or orders of public authorities.
   2. Inspection and testing performed exclusively for the own*er*'s convenience.
   3. Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems (i.e. elevators).
   4. Mill tests and certificates of compliance.
   5. Additional tests specified in the following paragraph.

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

E. Amount of each cash allowance does not include *Contractor*'s overhead and profit, and other related costs, which shall be included in the *Contract Price* and not in the cash allowance.

F. Allow the stipulated sum of $15,000.00 for Inspection and Testing services.

G. Allow the stipulated sum of $30,000.00 for Independent Verification services.

H. Allow the stipulated sum of $10,000.00 for Fire Alarm Verification services.

I. *Contractor*'s responsibilities:
   1. Furnish labour, equipment and facilities to provide access to *Work* to be inspected and tested.
      a. Facilitate inspections and tests.
      b. Make good *Work* disturbed by inspection and test.
      c. Provide on-site storage for laboratory's exclusive use to store equipment and cure test samples.
   2. Notify *Consultant* sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
   3. Where materials are specified to be tested, deliver representative samples, in required quantity, to testing laboratory.
   4. Pay costs for uncovering and making good *Work* that is covered before required inspection or testing is completed and approved by *Consultant*.

J.

1.2 EXPENDITURE OF CASH ALLOWANCES

A. *Owne*r, through *Consultant*, will provide *Contractor* with documentation required to permit pricing of a cash allowance item.

B. *Owner*, through *Consultant*, may request *Contractor* to identify potential *Suppliers* or *Subcontractors*, as applicable, and to obtain at least three competitive prices for each cash allowance item.

C. *Owner*, through *Consultant*, may request the *Contractor* to disclose originals of all bids, quotations, and other price related information received from potential *Suppliers* or *Subcontractors*.

D. *Owner,* through *Consultant*, will determine by whom and for what amount each cash allowance item will be performed. Obtain *Owner*'s prior written approval in the form of a *Change Order* before entering into a subcontract, amending an existing subcontract, or performing own forces work included in a cash allowance. Upon issuance of the *Change Order*, the *Contractor*'s responsibilities for a cash allowance item shall be the same as for other work of the *Contract*.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF ALLOWANCES

SECTION 01 25 00
SUBSTITUTION PROCEDURES

PART 1 - GENERAL

1.1 DEFINITION

A. In this Section "Substitution" means a *Product*, a manufacturer, or both, not originally specified in *Contract Documents* by proprietary name but proposed for use by *Contractor* in place of a *Product*, a manufacturer, or both, specified by proprietary name.

1.2 SUBSTITUTION PROCEDURES

A. *Contractor* may propose a Substitution wherever a *Product* or manufacturer is specified by proprietary name(s), unless there is accompanying language indicating that Substitutions will not be considered.

B. *Contractor* may propose a Substitution wherever a *Product* or manufacturer is specified by proprietary name(s) and accompanied by language such as "or equal", "or approved equal", or other similar words. Do not construe such language as an invitation to unilaterally provide a Substitution without *Consultant's* prior acceptance in writing. Do not order or install any Substitution without a *Supplemental Instruction* or *Change Order*.

C. Provided a proposed Substitution submission includes all of the information specified in this Section under Submission Requirements For Proposed Substitutions, *Consultant* will promptly review and accept or reject the proposed Substitution.

D. *Consultant* may accept a Substitution if satisfied that:
   1. the proposed substitute *Product* is the same type as, is capable of performing the same functions as, interfaces with adjacent work the same as, and meets or exceeds the standard of quality, performance and, if applicable, appearance and maintenance considerations, of the specified Product,
   2. the proposed substitute manufacturer has capabilities comparable to the specified manufacturer, and
   3. the Substitution provides a benefit to *Owner*.

E. If *Contractor* fails to order a specified *Product* or order a *Product* by a specified manufacturer in adequate time to meet *Contractor*'s construction schedule, *Consultant* will not consider that a valid reason to accept a Substitution.

F. If *Consultant* accepts a Substitution and subject to *Owner*'s agreement, the change in the *Work* will be documented in the form of either a *Supplemental Instruction* or *Change Order* as specified in Section 01 26 00 – Contract Modification Procedures.

G. If a Substitution is accepted in the form of a *Supplemental Instruction* or *Change Order*, *Contractor* shall not revert to an originally specified *Product* or manufacturer without *Consultant*'s prior written acceptance.

1.3 SUBMISSION REQUIREMENTS FOR PROPOSED SUBSTITUTIONS

A. Include with each proposed Substitution the following information:
   1. Identification of the Substitution, including product name and manufacturer's name, address, telephone numbers, and web site.
   2. Reason(s) for proposing the Substitution.
   3. A statement verifying that the Substitution will not affect the *Contract Price* and *Contract Time* or, if applicable, the amount and extent of a proposed increase or decrease in *Contract Price* and *Contract Time* on account of the Substitution.
   4. A statement verifying that the Substitution will not affect the performance [or warranty] of other parts of the *Work*.

5. Manufacturer's *Product* literature for the Substitution, including material descriptions, compliance with applicable codes and reference standards, performance and test data, compatibility with contiguous materials and systems, and environmental considerations.
6. Product samples as applicable.
7. A summarized comparison of the physical properties and performance characteristics of the specified *Product* and the Substitution, with any significant variations clearly highlighted.
8. Availability of maintenance services and sources of replacement materials and parts for the Substitution, as applicable, including associated costs and time frames.
9. If applicable, estimated life cycle cost savings resulting from the Substitution.
10. Details of other projects and applications where the Substitution has been used.
11. Identification of any consequential changes in the *Work* to accommodate the Substitution and any consequential effects on the performance of the *Work* as a whole. A later claim for an increase to the *Contract Price* or *Contract Time* for other changes in the *Work* attributable to the Substitution will not be considered.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SUBSTITUTION PROCEDURES

SECTION 01 26 00
CONTRACT MODIFICATION PROCEDURES

PART 1 - GENERAL

1.1 SCHEDULE OF LABOUR RATES

A. Prior to the first application for payment, submit for the *Consultant*'s review a schedule of labour rates for all trades and classifications of trades, such as journeymen, apprentices, and foremen that will be employed in the *Work*. Provide a breakdown of payroll burden component of labour rates.

B. Labour rates shall reflect the salaries, wages, and benefits paid to personnel in the direct employ of the *Contractor*, *Subcontractors*, and sub-*Subcontractors*, stated as hourly rates, that will be used when:
   1. preparing price quotations for *Change Orders*, and
   2. determining the cost of work attributable to *Change Directives*.

C. Labour rates stated in the schedule of labour rates shall be consistent with rates that will actually be paid, and payroll burden costs that will actually be incurred, in the normal performance of the *Work*, during regular working hours. Labour rates shall not include any additional overhead and profit component.

D. Where collective agreements apply, the labour rates shall not exceed those established by collective agreement.

E. Obtain the *Owner*'s written acceptance of the schedule of labour rates before submitting the first *Change Order* quotation.

F. Accepted schedule of labour rates will be used solely for evaluating *Change Order* quotations and cost of performing work attributable to *Change Directives*.

G. The *Contractor* may request amendments to the accepted schedule of labour rates if changes in the labour rates that will actually be paid, or payroll burden cost that will actually be incurred, in the normal performance of the *Work* can be demonstrated. Obtain the *Owner*'s written acceptance of such changes.

1.2 SCHEDULE OF EQUIPMENT RATES

A. Prior to the first application for payment, submit for the *Consultant*'s review a schedule of equipment rates for *Contractor* owned *Construction Equipment*.

B. Equipment rates shall reflect the rates that will be used when:
   1. preparing price quotations for *Change Orders*, and
   2. determining the cost of work attributable to *Change Directives*.

C. Equipment rates stated in the schedule shall be consistent with local equipment rental market rates and shall not include any additional overhead and profit component.

D. Obtain the *Owner*'s written acceptance of the schedule of equipment rates before submitting the first *Change Order* quotation.

E. Accepted schedule of equipment rates will be used solely for evaluating *Change Order* quotations and cost of performing work attributable to *Change Directives*.

F. The *Contractor* may request amendments to the accepted schedule of equipment rates if changes in local equipment rental market rates can be demonstrated. Obtain the *Owner*'s written acceptance of such changes.

1.3 VALUATION OF CHANGES BASED ON AGREED UNIT PRICES

A. The *Consultant* may, at the outset of the *Contract* or at any other time, request the *Contractor* to submit unit prices anticipated to be required in valuing changes in the *Work*.

B. The *Contractor* shall submit such unit prices promptly upon request.

C. The unit prices shall be valid for a specified duration.

D. The unit prices shall exclude all fees for overhead and profit and shall be subject to the percentage fees specified in this Section under Fees for Overhead and Profit – Change Orders.

E. The *Consultant* will evaluate the *Contractor*'s quoted unit prices and, if accepted by the *Owner* in writing, the agreed unit prices shall be used to value subsequent proposed changes in the *Work* wherever they are applicable.

1.4 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE ORDERS

A. Unless otherwise agreed, the adjustment of the *Contract Price* on account of a proposed change in the *Work* shall be based on a quotation for a fixed price increase or decrease to the *Contract Price* regardless of the *Contractor*'s actual expenditures and savings.

B. If unit prices included in the stipulated price contract are applicable to the proposed change, the adjustment of the *Contract Price* shall be based on those unit prices, to the extent they apply. If the actual quantities to which the unit prices apply vary from the estimated quantities by more than 12%, the unit prices shall be subject to negotiation.

1.5 CHANGE ORDER PROCEDURES

A. Upon issuance by the *Consultant* to the *Contractor* of a proposed change in the *Work*, and unless otherwise requested in the proposed change or unless otherwise agreed:
   1. Submit to the *Consultant* a fixed price quotation for the proposed change in the *Work* within 5 days after receipt of the proposed change in the *Work*.
   2. If requested in the proposed change, provide a detailed breakdown of the price quotation including the following to the extent applicable, with appropriate supporting documentation:
      a. Estimated labour costs, including hours and applicable hourly rates based on the accepted schedule of labour rates.
      b. Estimated Product costs, including *Supplier* quotations, estimated quantities and unit prices.
      c. Estimated *Construction Equipment* costs.
      d. Enumeration of all other estimated costs included in the price quotation.
      e. Estimated credit amounts for labour and *Products* not required on account of the proposed change.
      f. Fees, not exceeding the applicable percentages for overhead and profit as specified in this Section.
      g. Where applicable, *Subcontractor* quotations, also including a detailed breakdown of all of the above.
   3. Include in the quotation the increase or decrease to the *Contract Time*, if any, for the proposed change, stated in number of days.
   4. Include in the quotation the number of days for which the quotation is valid.
   5. The quotation will be evaluated by the *Consultant* and the *Owner* and, if accepted by the *Owner*, be documented in the form of a signed *Change Order*.

1.6 FEES FOR OVERHEAD AND PROFIT – CHANGE ORDERS

A. Where the *Contractor*'s price quotation for a *Change Order* results in a net increase to the *Contract Price*, the *Contractor*'s entitlement to a fee for overhead and profit in the quotation shall be as follows, as applicable:
   1. For work to be performed by the *Contractor*'s own forces,
      a. If the changes to the *Work* have a value of less than or equal to $50,000, 10% of the *Contractor*'s price quotation before the *Contractor*'s fee is applied

b. If the changes to the *Work* have a value greater than $50,000, 7.5% of the *Contractor*'s price quotation before the *Contractor*'s fee is applied

2. For work to be performed by a *Subcontractor*, 5% of the *Subcontractor*'s price quotation including the *Subcontractor*'s fee.

B. Where a *Subcontractor*'s price quotation for a *Change Order* results in a net increase to the *Subcontractor*'s contract price, the *Subcontractor*'s entitlement to a fee for overhead and profit in the quotation shall be as follows, as applicable:
1. For work to be performed by the *Subcontractor*'s own forces, 15% of the *Subcontractor*'s price quotation before the *Subcontractor*'s fee is applied.
2. For work to be performed by a sub-*Subcontractor*, 10% of the sub-*Subcontractor*'s price quotation including the sub-*Subcontractor*'s fee.

C. Where the *Contractor*'s or a *Subcontractor*'s price quotation for a *Change Order* results in a net decrease in price before adjustment for fees for overhead and profit, such a price quotation shall be for the net decrease without any adjustment for fees for overhead and profit.

1.7 METHOD OF CONTRACT PRICE ADJUSTMENT - CHANGE DIRECTIVES

A. Unless the *Owner* and the *Contractor* reach an earlier agreement on the adjustment to the *Contract Price* by means of a *Change Order* that cancels the *Change Directive*, the adjustment in the *Contract Price* for change carried out by way of a *Change Directive* shall be determined as specified in the *General Conditions* of *Contract* after the change in the *Work* is completed.

1.8 CHANGE DIRECTIVE PROCEDURES

A. If a *Change Directive* is issued for a change in the *Work* for which a proposed change was previously issued, but no *Change Order* has yet been signed, the *Change Directive* shall cancel the proposed change and any *Contractor* quotations related to that change in the *Work*.

B. When proceeding with a change in the *Work* under a *Change Directive*, keep accurate records of daily time sheets for labour and *Construction Equipment*, and invoices for *Product* and *Construction Equipment* costs. Submit such records to the *Consultant* daily, until the *Change Order* superseding the *Change Directive* is issued.

1.9 FEES FOR OVERHEAD AND PROFIT – CHANGE DIRECTIVES

A. The *Contractor*'s entitlement to a fee for overhead and profit on the *Contractor*'s expenditures and savings attributable to a *Change Directive* shall be as follows, as applicable:
1. For work performed by the *Contractor*'s own forces, 10% of the *Contractor*'s net increase in costs.
2. For work performed by a *Subcontractor*, 10% of the sum of the *Subcontractor*'s net increase in costs plus the *Subcontractor*'s fee.

B. A *Subcontractor*'s entitlement to a fee for overhead and profit on the *Subcontractor*'s expenditures and savings attributable to a *Change Directive* shall be as follows, as applicable:
1. For work performed by the *Subcontractor*'s own forces, 15% of the *Subcontractor*'s net increase in costs.
2. For work performed by a sub-*Subcontractor*, 10% of the sum of the sub-*Subcontractor*'s net increase in costs plus the sub-*Subcontractor*'s fee.

C. Where a *Change Directive* results in net savings on account of work not required to be performed and a net decrease in the *Contractor*'s or *Subcontractor*'s cost, the net savings to the *Contractor* or *Subcontractor* shall be calculated without any adjustment for fees for overhead and profit.

D. When a *Change Directive* is ultimately recorded as a *Change Order*, there shall be no additional entitlement to fees for overhead and profit beyond those specified in this article.

1.10 SUPPLEMENTAL INSTRUCTIONS

A. The *Consultant* may issue *Supplemental Instructions* to provide clarifications to the *Contract Documents*, provide additional information, or make minor variations in the *Work* not involving adjustment in the *Contract Price* or *Contract Time*.

B. If the *Contractor* considers a *Supplemental Instruction* to require an adjustment in *Contract Price* or *Contract Time*, the *Contractor* shall within ten (10) *Working Days* of the receipt of the *Supplemental Instruction* notify the *Consultant* in writing. If the *Contractor* needs additional information to determine whether a *Supplemental Instruction* involves an adjustment of the *Contract Price* or *Contract Time*, the *Contractor* may issue a written request to the *Consultant* seeking such additional information. Upon receipt of such additional information, the *Contractor* shall, within ten (10) *Working Days* notify the *Consultant* in writing of the opinion that the *Supplemental Instruction* involves an adjustment in the *Contract Price* or the *Contract Time.* Failure to provide written notification within the time stipulated above shall be deemed an acceptance of the *Supplemental Instruction* by the *Contractor* without adjustment to the *Contractor Price* or the *Contract Time.* If written notice is provided as outlined above, the *Contractor* shall not proceed with any work related to the *Supplemental Instruction* pending receipt of a *Change Order*, a *Change Directive*, or, in accordance with the dispute resolution provisions of the *General Conditions* of *Contract*, a *Notice in Writing* of a dispute and instructions to proceed.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF CONTRACT MODIFICATION PROCEDURES

SECTION 01 29 00
PAYMENT PROCEDURES

PART 1 - GENERAL

1.1 SCHEDULE OF VALUES

A. Prior to the first application for payment, submit for *Consultant*'s review an initial schedule of values. Modify the initial schedule of values if and as requested by *Consultant*. Obtain *Consultant*'s written acceptance of the initial schedule of values prior to the first application for payment.

B. Together with the first and all subsequent applications for payment, submit updated versions of the schedule of values to indicate the values, to the date of application for payment, of work performed and *Products* delivered to *Place of the Work*.

C. Provide the schedule of values in an electronic spreadsheet format that provides for inclusion of the following information:
   1. Identifying information including title and location of the *Work*, name of *Contractor*, number and date of application for payment, and period covered by the application for payment.
   2. A work breakdown structure that is sufficiently detailed and comprehensive to facilitate *Consultant*'s evaluation of applications for payment at an appropriate level of detail. Include separate line items for closeout procedures including closeout submittals, demonstration and training, start-up and testing, and commissioning collectively valued at minimum 5% of *Contract Price*.
   3. Provisions for approved *Change Orders* so that the breakdown amounts indicated in the schedule of values aggregate to the current total *Contract Price*. Also provide for indicating the estimated value of *Change Directives* within the schedule of values, separately from the current total *Contract Price*.
   4. Include a separate line item for *Value Added Taxes* as payable for each application.
   5. For each item in the work breakdown structure, provide as a minimum the following information, under headings as indicated:
      a. Breakdown Amount: A dollar amount, including an appropriate pro rata portion of *Contactor*'s overhead and profit.
      b. Performed to Date: The value of *Work* performed and *Products* delivered to *Place of the Work* up to the date of the application for payment, stated as a percentage of the *Contract Price* and in dollars.
      c. Previously Performed: The value of *Work* performed and *Products* delivered to the *Place of the Work* for which payment has been previously certified, stated in dollars.
      d. Current Period: The value of *Work* performed and *Products* delivered to *Place of the Work* for which *Contractor* is currently applying for payment, stated in dollars.
      e. Balance to Complete: The value of *Work* not yet performed and *Products* not yet delivered to *Place of the Work*, stated in dollars.

1.2 CLOSEOUT SUBMITTAL VALUE

A. ***The closeout submittal documents described in this Section shall carry a value of the total value of the Contract multiplied by 0.05*.** The value of these documents shall be clearly identified as a line item in the Contractor's schedule of values.

B. Payment for closeout submittals will not be authorized until documents are received, reviewed, deemed acceptable and in the possession of the Owner.

C. Since the maintenance of accurate, up-to-date document records have legal ramifications for the operation of the Hospital, should the Contractor fail to provide Closeout Submittal Manuals, in

the described, acceptable format, the Contractor may, at the Owner's discretion, be deemed to be unsuitable to undertake future work of the Owner.

1.3 CASH FLOW PROJECTION

A. Prior to the first application for payment submit, for *Consultant*'s review, a forecast of approximate monthly progress payments for each month of the *Contract Time*.

B. Submit revised cash flow forecasts when required due to significant changes in rate of progress of the *Work* or significant changes in the *Contract Price* when requested by *Consultant*.

1.4 WORKERS' COMPENSATION CLEARANCE

A. Submit proof of workers' compensation clearance with each application for payment.

1.5 STATUTORY DECLARATIONS

A. Submit a statutory declaration in the form of CCDC 9A – Statutory Declaration of Progress Payment Distribution by *Contractor* with each application for payment except the first.

1.6 PAYMENT FOR PRODUCTS STORED OFF SITE

A. *Owner* may, due to extraordinary circumstances and at *Owner*'s sole discretion, make payments for *Products* delivered to and stored at a location other than *Place of the Work*, subject to:
   1. a request submitted by *Contractor* in writing, with appropriate justification, and
   2. whatever conditions *Owner* or *Consultant* may establish for such payments, as required to protect *Owner*'s interests.

1.7 RELEASE OF HOLDBACK

A. See General Condition 5.4 SUBSTANTIAL PERFORMANCE OF THE WORK AND PAYMENT OF HOLDBACK and associated Supplementary Conditions in 3.23 of 00 73 00 Supplementary Conditions.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF PAYMENT PROCEDURES

SECTION 01 31 19
PROJECT MEETINGS

PART 1 - GENERAL

1.1 CONSTRUCTION START-UP MEETING

A. Promptly after *Contract* award, *Consultant* will establish the time and location of a construction start-up meeting to review and discuss administrative procedures and responsibilities. *Consultant* will notify *Contractor* at least 5 *Working Days* before the meeting.

B. Senior representatives of *Owner*, *Consultant*, subconsultants, and *Contractor*, including *Contractor*'s project manager and site superintendent, and major *Subcontractors*, shall be in attendance.

C. *Consultant*'s representative will chair the meeting and record and distribute the minutes.

D. Agenda will include following:
1. Introductions
2. Administrative Procedures (meetings, communications, approvals)
3. Project Team Directory
4. Current Project Status (permits, certificates, etc)
5. Job Site Documents
6. Review of Information from Contractor (construction schedule, schedule of values, etc.)
7. Site Issues (safety, orientation, IPAC, parking, loading, storage, waste, washrooms, hazardous materials)
8. Construction Services and Utilities (Use of existing, shut downs, etc)
9. Requirements for Pre-construction Surveys (recording existing conditions, etc)

1.2 CONSTRUCTION PROGRESS MEETINGS

A. Schedule regular construction progress meetings for the duration of the *Work*. Frequency and schedule of meetings to be determined between *Contractor, Consultant,* and *Owner*, but shall occur at least biweekly, or more often as deemed necessary. *Contractor* shall prepare meeting agendas, chair the meetings, and record and distribute the minutes.

B. Arrange for and provide physical space for meetings, unless Owner agrees to provide space within existing facilities.

C. *Contractor* shall record in the meeting minutes significant decisions and identify action items and action dates by attendees or the parties they represent.

D. *Contractor* shall distribute copies of minutes within three (3) Working Days after each meeting to meeting attendees and any affected parties who may not be in attendance.

E. Ensure that *Subcontractors* attend as and when appropriate to the progress of the *Work*.

F. Agenda for each meeting shall include the following, as a minimum:
1. Approval of minutes of previous meeting.
2. Work progress since previous meeting.
3. Field observations, including any problems, difficulties, or concerns.
4. Construction progress schedule.
5. Submittals schedule.
6. Proposed changes in the *Work*.
7. Requests for information.
8. Site safety issues.
9. Infection Control issues.
10. Other business.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF PROJECT MEETINGS

SECTION 01 32 00
CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 SUMMARY

A. This Section specifies *Contractor*'s responsibilities for preparation and submission of schedules and other documentation related to tracking construction progress.

B. The purpose of submitting progress schedules is to:
   1. inform *Owner* and *Consultant* of actual progress versus planned progress, and
   2. provide assurance that scheduling issues are being proactively identified and addressed in a timely manner, and that planned progress is being maintained as closely as possible.

1.2 SCHEDULES REQUIRED

A. Submit schedules as follows:
   1. Construction Phasing Schedule.
   2. Construction Progress Schedule.
   3. Submittal Schedule for Shop Drawings and Product Data.
   4. Submittal Schedule for Samples.
   5. Submittal Schedule for timeliness of Owner-furnished Products.
   6. Cash flow Schedule.

1.3 GENERAL SUBMISSION

A. Submit initial format of schedules within ten (10) *Working Days* after award of *Contract*.

B. Submit a electronic document in Portable Document Format (PDF) copy to be distributed by *Consultant*.

C. *Consultant* will review schedule and return reviewed copy within ten (10) days after receipt.

D. Resubmit finalized schedule within seven (7) days after return of reviewed copy.

E. Submit revised progress schedule with each application for payment, indicating all schedule modifications to date.

F. Distribute copies of revised schedule to:
   1. Job site office.
   2. Subcontractors.
   3. Consultants.
   4. Owner
   5. Authority Having Jurisdiction.

G. Instruct recipients to report to Contractor within ten (10) days, any problems anticipated by timetable shown in schedule.

1.4 CONSTRUCTION PROGRESS SCHEDULE

A. Format and Content:
   1. Prepare schedule in the form of a Critical Path Method (CPM) Gantt chart using appropriate scheduling software.
      a. Provide a separate bar for each major item of work trade or operation.
      b. Split horizontally for projected and actual performance.
      c. Provide horizontal time scale identifying each week.
      d. Format for listings: chronological order of start of each item of work.
      e. Identification of listings: by systems description.

2. Provide a work breakdown structure identifying key activities, work packages, and major milestones, including long delivery *Products*, inspection and testing activities, anticipated service and utility shutdown dates and durations, commissioning, preparation and review of mock-ups, shutdown or closure activities,
   demonstration and training activities, and similar items, at a sufficient level of detail to effectively manage construction progress.
3. Indicate milestone dates for *Substantial Performance of the Work, Ready-for-Takeover* and *Total Completion of the Work*.

B. Submission:
1. Prior to site mobilization, submit initial schedule to *Owner* and *Consultant* for their review and acceptance.
2. Submit schedule via e-mail as .pdf files, and as a hard copy.
3. *Consultant* will review format and content of initial schedule and request necessary changes, if any, within 10 *Working Days* after receipt.
4. If changes are required, resubmit finalized initial schedule within 5 *Working Days* after return of review copy.
5. Submit updated progress schedule monthly to *Owner* and *Consultant*, indicating actual and projected start and finish dates with report date line and progress.

1.5 SUBMITTALS SCHEDULE

A. Format and Content:
1. Prepare schedule identifying all required *Shop Drawing*, *Product* data, sample submissions, and including samples required for testing.
2. Prepare schedule in electronic format.
3. Provide a separate line for each required submittal, organized by *Specifications* section names and numbers, and further broken down by individual *Products* and systems as required.
4. For each required submittal, show planned earliest date for initial submittal and latest date for return of reviewed submittal without causing delay.
5. Allow time in schedule for resubmission of submittals, should resubmission be necessary.
6. Include dates when submittals delivery will be required for Owner-furnished products.

B. Submission:
1. Submit initial schedule to *Consultant* within 5 *Working Days* after *Contract* award.
2. Submit schedule via e-mail as .pdf files.
3. Consultant will review format and content of initial schedule and request necessary changes, if any, within 5 *Working Days* after receipt.
4. If changes are required, resubmit finalized schedule within 5 *Working Days* after return of review copy.
5. Submit updated submittals schedule monthly to *Owner* and *Consultant*..

1.6 SCHEDULE MANAGEMENT

A. A schedule submitted as specified and accepted by *Consultant* shall become the baseline schedule and shall be used as the baseline for updates.

B. At each regular progress meeting, review and discuss current construction progress and submittals schedules with *Consultant* and *Owner*, including activities that are behind schedule and planned measures to regain schedule slippage in key areas on or near the critical path. Schedule to be updated by *Contractor* following review by *Consultant*.

C. Activities considered behind schedule are those with start or completion dates later than the dates shown on the baseline schedule.

1.7 DAILY REPORTS/DAILY LOGS

A. The *Contractor* shall cause its supervisor, or such competent person as it may delegate, to prepare a daily log or diary reporting on weather conditions, work force of the *Contractor*, *Subcontractors*, Suppliers and any other forces on site and also record the general nature of Project

activities. Such log or diary shall also include any extraordinary or emergency events which may occur and also the identities of any persons who visit the site who are not part of the day-to-day work force.

B. The *Contractor* shall also maintain records, either at its head office or at the job site, recording manpower and material resourcing on the Project, including records which document the activities of the *Contractor* in connection with GC 3.4, and comparing that resourcing to the resourcing anticipated when the most recent version of the schedule was prepared pursuant to GC 3.4.

1.8 RECORDING ACTUAL SITE CONDITIONS ON AS-BUILT DRAWINGS

A. Obtain a hard copy set of construction *Drawings* for the purpose of creating as-built drawings. Record information and maintain as-built drawings in clean, dry and legible condition.

B. Clearly label each drawing as "AS-BUILT DRAWING". Record information concurrently with construction progress. Do not conceal *Work* until required information is recorded.

C. 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 pipes, ducts, conduits, outlets, fixtures, access panels, and appurtenances, referenced to visible and accessible features of construction.
4. Field changes of dimension and detail.
5. Changes made by *Change Orders* and *Supplemental Instructions*
6. References to *Shop Drawings*, where *Shop Drawings* show more detail.

D. Do not use as-built drawings for construction purposes.

1.9 PROGRESS PHOTOGRAPHS

A. Arrange for periodic digital photography to document and provide a photographic record of the progress of the *Work*.

B. Arrange for final photographs to be taken by a professional photographer at discretion of *Owner*.

C. Identify each photograph by project name and date taken.

D. Submission: Submit .jpg or .bmp format files in fine resolution via e-mail or via project web site.

E. Do not use progress or any other *Project* photographs for promotional purposes without *Owner*'s written consent.

F. Final photograph submission shall be submitted electronically. Identify media with project name and number. Media is to be organized in accordance of date of monthly submission, in same format. Submission of media shall form part of the Closeout Submittal manual, specified in Section 01 78 00.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF CONSTRUCTION PROGRESS DOCUMENTATION

SECTION 01 33 00
SUBMITTAL PROCEDURES

PART 1 - GENERAL

1.1 ADMINISTRATIVE

A. Submit specified submittals to *Consultant* for review. Submit with reasonable promptness and in orderly sequence so as to not cause delay in the *Work*. Failure to submit in ample time is not considered sufficient reason for an extension of *Contract Time* or for *Product* substitutions or other deviations from the *Drawings* and *Specifications*.

B. Where required by authorities having jurisdiction, provide submittals to such authorities for review and approval.

C. Do not proceed with *Work* affected by a submittal until review is complete.

D. Present *Shop Drawings*, *Product* data, and samples in SI metric units. Where items or information is not produced in SI Metric units, converted values are acceptable.

E. Review submittals, provide verified field measurements where applicable, and affix *Contractor*'s review stamp prior to submission to *Consultant*. *Contractor*'s review stamp represents that necessary requirements have been determined and verified, and that the submittal has been checked and coordinated with requirements of the *Work* and *Contract Documents*.

F. Notify *Consultant* in writing, at time of submission, identifying deviations from requirements of *Contract Documents* stating reasons for deviations.

G. Verify field measurements and that affected adjacent work is coordinated.

H. Submittals not meeting specified requirements will be returned with comments.

I. Reproduction of construction *Drawings* to serve as background for *Shop Drawings* is permitted. If construction *Drawings* are used for this purpose, remove references to *Consultant*.

J. Do not propose Substitutions or deviations from *Contract Documents* via *Shop Drawing*, *Product* data and sample submittals.

K. *Contractor*'s responsibility for errors and omissions in submission is not relieved by *Consultant*'s review of submittals.

L. *Contractor*'s responsibility for deviations in submission from requirements of *Contract Document*s is not relieved by *Consultant* review.

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

A. Indicate *Products*, methods of construction, and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the *Work*.

B. Where *Products* attach or connect to other *Products*, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross-references to *Drawings, Specifications* and other already reviewed *Shop Drawings*.

C. Accompany submittals with a transmittal information including:
1. Date.
2. *Project* title and number.
3. *Contractor*'s name and address.
4. Identification of each submittal item and quantity.
5. Other pertinent data.

D. *Shop Drawing* submittals shall include:
   1. Date and revision dates.
   2. *Project* title and number.
   3. Name and address of:
      a. Subcontractor.
      b. Supplier.
      c. Manufacturer.
   4. *Contractor*'s stamp, date, and signature of *Contractor*'s authorized representative responsible for *Shop Drawing* review, indicating that each *Shop Drawing* has been reviewed for compliance with *Contract Documents* and, where applicable, that field measurements have been verified.
   5. Details of appropriate portions of the *Work* as applicable:
      a. Fabrication.
      b. Layout, showing dimensions, including identified field dimensions, and clearances.
      c. Setting or erection details.
      d. Capacities.
      e. Performance characteristics.
      f. Standards.
      g. Operating weight.
      h. Wiring diagrams.
      i. Single line and schematic diagrams.
      j. Relationships to other parts of the *Work*.

E. *Product* data submittals shall include material safety data sheets (MSDS) for all controlled Products.

F. Submit one (1) hard copy and electronic copy of *Shop Drawings* where specified in the technical Specifications.

G. Submit one (1) hard copy and electronic copy of *Product* data sheets or brochures where specified in the technical Specifications.

H. Where a submittal includes information not applicable to the *Work*, clearly identify applicable information and strike out non-applicable information.

I. Supplement standard information to include details applicable to *Project*.

J. Allow ten (10) *Working Days* for *Consultant*'s review of each submittal .

K. If upon *Consultant*'s review no errors or omissions are discovered, or if only minor corrections are required as indicated, submittal will be returned and fabrication or installation of *Work* may proceed.

L. If upon *Consultant*'s review significant errors or omissions are discovered, a so noted copy will be returned for correction and resubmission. Do not commence fabrication or installation.

M. *Consultant*'s notations on submittals are intended to ensure compliance with *Contract Documents* and are not intended to constitute a change in the *Work* requiring change to the *Contract Price* or *Contract Time*. If *Contractor* considers any *Consultant*'s notation to be a change in the *Work*, promptly notify *Consultant* in writing before proceeding with the *Work*.

N. Resubmit corrected submittals through same procedure indicated above, before any fabrication or installation of the *Work* proceeds. When resubmitting, notify *Consultant* in writing of any revisions other than those requested by *Consultant*.

1.3 SAMPLES

A. Submit samples for *Consultant*'s review in duplicate where specified in the technical *Specifications*. Label samples as to origin, *Project* name, and intended use.

B. Deliver samples prepaid to *Consultant*'s business address.

C. Notify *Consultant* in writing of any deviations in samples from requirements of *Contract Documents*.

D. Where a required colour, pattern or texture has not been specified, submit full range of available *Products* meeting other specified requirements.

E. *Consultant* selection from samples is not intended to change the *Contract Price* or *Contract Time*. If a selection would affect the *Contract Price* or *Contract Time*, notify *Consultant* in writing prior to proceeding with the *Work*.

F. Resubmit samples as required by *Consultant* to comply with *Contract Documents*.

G. Reviewed and accepted samples will establish the standard against which installed *Work* will be reviewed.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF SUBMITTAL PROCEDURES

SECTION 01 35 30
HEALTH AND SAFETY REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCES

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

B. Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990.

C. Construction Projects - (Ontario Regulation 213/91 as last amended by O.Reg 426/21).

D. WHMIS (Ontario Regulation 860).

E. Ontario Regulations related to designated substances (Ontario Regulations 835-846).

F. Canadian Labour Code - Part Two.

G. Bill C-45, An Act to amend the Criminal Code (criminal liability of organizations).

H. Kingston Health Sciences Centre Policies and Procedures.

1.2 SUBMITTALS

A. Make submittals in accordance with Section 01 33 00.

B. Submit site-specific Health and Safety Plan within 7 days after date of Notice to proceed and prior to commencement of *Work*. Health and Safety Plan must include:
   1. Site specific safety hazard assessment.
   2. Safety and health risk or hazard analysis for site tasks and operation found in work plan.

C. Submit Construction Safety Checklists after completion.

D. Submit copies of reports or directions issued by Federal and Provincial health and safety inspector.

E. Submit copies of incident and accident reports.

F. Submit to *Consultant* with Material Safety Data Sheets (MSDS).

G. Submit personnel training requirements including:
   1. Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.

H. *Consultant* and *Owner* will review *Contractor*'s site-specific Health and Safety Plan and provide comments to *Contractor* within 5 days after receipt of plan. Revise plan as appropriate and resubmit plan to *Consultant* within 5 days after receipt of comments from *Consultant*.

I. On-site Contingency and Emergency Response Plan: address standard operating procedures to be implemented during emergency situations.

1.3 FILING OF NOTICE

A. File Notice with Provincial authorities prior to commencement of *Work*.

1.4 WORK PERMIT

A. Obtain building permit related to project prior to commencement of *Work*.

1.5 SAFETY ASSESSMENT

A. Perform *Place of the Work* specific safety hazard assessment related to the *Project*.

1.6 MEETINGS

A. Pre-construction meetings: attend health and safety pre-construction meeting.

B. All site personnel are required to attend the *Owner*'s Fire Safety training program prior to commencement of personnel working on the site. Approximately 1 hour per worker as required for the training session.

1.7 REGULATORY REQUIREMENTS

A. Comply with specified standards and regulations to ensure safe operations at sites containing hazardous or toxic materials.

1.8 GENERAL REQUIREMENTS

A. Develop written site-specific Health and Safety Plan based on hazard assessment prior to commencing *Work* and continue to implement, maintain, and enforce plan until final demobilization from *Place of the Work*. Health and Safety Plan must address *Project* specifications.

B. Relief from, or substitution for, any portion or provision of minimum Health and Safety Guidelines specified herein, or reviewed site-specific Health and Safety Plan must be submitted to *Consultant* in writing. *Consultant* will respond in writing, either accepting or requesting improvements.

1.9 RESPONSIBILITY

A. Be responsible for safety of persons and property on-site and for protection of persons off-site and environment to extent that they may be affected by conduct of *Work*.

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

C. Duties of employers:
   1. An employer shall ensure that:
      a. the prescribed equipment, materials and protective devices are provided;
      b. the equipment, materials and protective devices provided by the employer are maintained in good condition;
      c. the measures and procedures prescribed are carried out in the workplace;
      d. the equipment, materials and protective devices provided by the employer are used as prescribed; and
      e. a floor, roof, wall, pillar, support or other part of a workplace is capable of supporting all loads to which it may be subjected without causing the materials therein to be stressed beyond the allowable unit stresses established under the Building Code Act.

1.10 COMMUNICATION REQUIREMENTS

A. Comply with Ontario Health and Safety Act.

B. Comply with Canada Labour Code, Canada Occupational Safety and Health Regulations.

C. Provide *Consultant* with Material Safety Data Sheets (MSDS).

1.11 UNFORSEEN HAZARDS

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

1.12 HEALTH AND SAFETY CO-ORDINATOR

A. Employ and assign to *Work*, competent and authorized representative as Health and Safety Coordinator. Health and Safety Coordinator must:
   1. Have minimum 2 years' site-related working experience specific to activities associated with related projects.
   2. Have working knowledge of occupational safety and health regulations.
   3. Be responsible for completing *Contractor*'s Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter *Place of the Work* to perform *Work*.
   4. Be responsible for implementing, enforcing daily, and monitoring site-specific *Contractor*'s Health and Safety Plan.
   5. Be on site during execution of *Work* and report directly to and be under direction of site supervisor.
   6. Be deemed as 'competent' as defined by the Occupational Health and Safety Act and as noted above.
   7. Provide proof of the above qualifications to the *Consultant*, including the name of the individual responsible for health and safety during the *Work*.

1.13 POSTED DOCUMENTS

A. Provide the following documents, or obtain from *Consultant*, and post at *Place of the Work*:
   1. Safety Policy.
   2. Health and Safety Representative.
   3. General Requirements - Constructor's name.
   4. WSIA, Workers Safety Insurance Act.
   5. Ministry of Labour Orders for Province of Ontario.
   6. Occupational Health and Safety Act for Province of Ontario.
   7. Material Safety Data Sheets.
   8. Floor Plan.
   9. Notice of Project.
   10. Joint Health and Safety Committee Members.
   11. Infection Control documents; see section 01 35 33.

B. Comply with Provincial general posting requirements.

1.14 POWDER ACTUATED DEVICES

A. Do not use powder-actuated devices unless written permission is granted by the *Owner* and the *Consultant*.

1.15 WORK STOPPAGE

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

B. Assign responsibility and obligation to Health and Safety Officer to stop or start *Work* when said Officer deems, it is necessary or advisable for reasons of health or safety. *Consultant* may also stop *Work* for health and safety considerations.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION

3.1 ACCESS TO SITE

A. The *Owner*'s Health and Safety Coordinator (OHSC) shall have full access to the *Place of the Work*. The *Contractor* shall review site-related issues with the OHSC and make any corrections as required to ensure compliance with the Infection Control Plan.

END OF HEALTH AND SAFETY REQUIREMENTS

SECTION 01 35 33

INFECTION CONTROL GUIDELINES FOR CONSTRUCTION

PART 1 - GENERAL

1.1 REFERENCES

A. Occupational Health and Safety Act and Regulations for Construction Projects, R.S.O. 1990 as amended 426/21.

B. Canada Communicable Disease Report (CCDR) Construction-Related Nosocomial Infections In Patients in Health Care Facilities - Decreasing the Risk of Aspergillus Legionella and Other Infections July 2001 ISSN 1188-4169.

Web Browser at *http://www.phac-aspc.gc.ca/publicat/ccdr-rmtc/01pdf/27s2e.pdf*

C. Health Canada Infection Control Guidelines.

D. CSA Z317.13, Infection Control during Construction, Renovation and Maintenance of Health Care Facilities, latest edition.

E. *Kingston Hospitals*, Infection Control Manual, Prevention of Infections, Construction, Renovation and Maintenance, Section No. IC 2-70.01.

F. Fundamentals of Infection Control during Construction, Renovations or Maintenance of Health Care Facilities for Site Supervisors and Project Managers Course

1.2 SUBMITTALS

A. Make submittals in accordance with Section 01 33 00.

B. Prepare and submit site-specific Infection Control Plan within 7 days after date of Notice to Proceed and prior to commencement of *Work*. Infection Control Plan must include:

1. List of equipment to be utilized to provide and monitor negative pressure within areas of construction.
2. Location of exhaust penetration to the exterior and routing of ductwork.
3. Identification of systems which require isolation prior to commencement of construction or modification.
4. Location of temporary barriers and partitions including type of material to be used.
5. Location of proposed interior routing of new building products and waste materials.
6. Location of walk-off mats and tack mats.
7. *Certificate of Attendance for the Fundamentals of Infection Control during Construction, Renovations or Maintenance of Health Care Facilities for Site Supervisors and Project Managers*

C. *Owner*'s Infection Control Practitioner (ICP) will review *Contractor*'s site-specific Infection Control Plan and provide comments to *Contractor* within five (5) working days after receipt of plan. Revise plan as appropriate and resubmit plan prior to commencement of *Work*.

D. Review of *Contractor*'s final Infection Control Plan should not be construed as approval and does not reduce the *Contractor*'s overall responsibility for construction infection control measures.

1.3 MEETINGS

A. Prior to commencing *Work* and between each phase of the *Project*, schedule and administer an infection control meeting with the *Owner*'s Infection Control Practitioner and the *Consultant*.

B. Infection control shall be carried as a minuted topic in all construction meetings.

1.4 PROJECT/SITE CONDITIONS

A. In the areas of the project where the new construction connects to and disrupts existing construction in occupied areas, the *Contractor* shall employ the determined and identified infection control measures appropriate to the Construction Activity and Population Risk Group as determined by the *Owner*'s Infection Control Practitioner.

B. At all times during the completion of this *Project* the *Contractor* will be responsible for ensuring that the guidelines described herein are strictly adhered to.

C. For the purposes of this project, the *Contractor* shall carry out Preventative Measures to the requirements of the most current version of *CSA Z317.13* as required by the Construction Activity Type.

1.5 GENERAL REQUIREMENTS

A. Prior to commencement of *Work*, the *Owner* will provide the *Contractor* with a copy of the complete Infection Control Risk Assessment.

B. *Contractor* to develop a written site-specific Infection Control Plan based on the Infection Control Risk Assessment prior to commencing any site *Work* and continue to implement, maintain, and enforce plan until final demobilization from site. The Infection Control Plan must address project specifications. The plan will be based on the Infection Control Risk Assessment as prepared for the project by the *Owner*'s Infection Control Practitioner. A copy of the assessment for this project is included in this section for reference and information.

C. *Consultant* or *Owner*'s representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.6 RESPONSIBILITY

A. Be responsible for adhering to the Infection Control Plan and guidelines established by the *Owner*'s Infection Control Practitioners, for the safety of persons on site and for the protection of persons adjacent to site and environment, to extent that they may be affected by conduct of *Work*.

B. Comply with safety requirements of *Contract Documents*, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Infection Control Plan and guidelines, and enforce compliance by employees.

1.7 CONTRACTOR'S INFECTION CONTROL LIAISON

A. The *Contractor* shall employ a competent and authorized representative as Infection Control Liaison. Infection Control Liaison must:

1. Have minimum 2 years' site-related working experience specific to activities associated with related projects.
2. Have working knowledge of infection control regulations
3. Be responsible to ensure that all personnel carrying out work on site have successfully completed the *Owner*'s Infection Control Training Sessions prior to the commencement of *Work*.
4. Be responsible for implementing, enforcing daily and monitoring site-specific Infection Control Plan.
5. Be on site during execution of *Work* and report directly to and be under direction of site supervisor.
6. Provide proof of the above qualifications to the *Consultant*, including the name of the individual responsible for Infection Control during the work.

1.8 POSTING OF DOCUMENTS

A. Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations of Province having jurisdiction, and in consultation with *Consultant* and *Owner*.

1.9 CORRECTION OF NON-COMPLIANCE

A. Immediately address infection control non-compliance issues identified by *Owner*'s Infection Control Practitioner or by *Consultant*.

B. Provide *Consultant* with written report of action taken to correct non-compliance of Infection Control issues identified.

C. In the event that non-compliance activity occurs the *Contractor* is responsible for all costs relating to the clean-up and correction of said activity.

1.10 WORK STOPPAGE

A. *Owner*'s Infection Control Practitioner may stop *Work* if non-compliance of Infection Control measures is observed.

B. Costs associated with delays as a result of such a work stoppage shall be the responsibility of the *Contractor*.

1.11 CERTIFICATION

A. All equipment to be used for the purposes of providing mechanical ventilation or vacuum cleaning shall be certified. Equipment shall be appropriately labeled with date certification completed and recertification shall be performed every 12 months.

B. Once certification is complete, the equipment is to remain on site. Once equipment has left the site the equipment shall be recertified in accordance with this section.

C. General Contractors shall submit a Certificate of Attendance for the Fundamentals of Infection Control during Construction, Renovations or Maintenance of Health Care Facilities for Site Supervisors and Project Managers prior to mobilization.

PART 2 - PRODUCTS

2.1 MATERIAL AND EQUIPMENT

A. Provide a certified portable means of mechanical ventilation fan(s) and associated ductwork to provide means of exhaust from the *Place of the Work* directly to the exterior of the building. Fans are to be equipped with HEPA filtration, installed on the construction side of the temporary protection and shall be certified and labeled with date certification was completed. All ductwork in this exhaust system is to be free from any penetrations.

B. Walk-off mats: cut or level-loop pile on rubber backing of nominal minimum size 1000 x 2000 mm.

C. Tack mats: two-way self adhesive sticky plastic sheet as manufactured by Poly Tak or *Consultant* approved equivalent. Tack mats shall be appropriately sized such that both feet make contact with the mat on exit.

D. Differential Pressure Gauge *with digital data recorder* shall be provided on all Type III and Type IV construction barriers in order to ensure pressure differential is maintained at 7.5 Pa (0.03 Inches WC) between the construction site and remainder of the facility.

PART 3 - EXECUTION

3.1 IMPLEMENTATION

A. Prior to the start of work all barriers are to be inspected and approved by the *Owner*'s Infection Control Practitioner. Upon completion of any work that involves the removal of temporary barriers, the area of work shall be inspected and the cleaning approved by the *Owner*'s Infection Control Practitioner prior to removal of any barriers.

B. Implement individual Infection Control measures as outlined in related sections.

C. Place tack mats on both sides of each access route to and from construction areas. Replace mats daily or more often, as required, to ensure mats remain functional for intended purpose.

D. At the entrance/exit to the construction zone adjacent to occupied space, install two way tack mats at entrance/exit doorway to tack dust. Change tack sheet daily or as needed.

E. At entrance/exit to the construction zone, provide walk-off mats (minimum 6m long). Vacuum mats daily and change weekly or as needed.

F. Prior to commencing/completing work above accessible ceiling spaces, vacuum ceiling space in the area of work to prevent distribution of dust and debris. All vacuuming shall be completed with a HEPA filter-equipped device.

G. All mechanical ventilation fans are to be exhausted directly to the exterior of the facility at all times unless alternate method is approved by *Owner*'s Infection Control Practitioner.

3.2 ACCESS TO SITE

A. The *Owner*'s Infection Control Practitioner (ICP) shall have full access to the *Place of the Work*. The *Contractor* shall review site related issues with the ICP and make any corrections as required to ensure compliance with the Infection Control Plan.

3.3 CLEANING

A. Where cleaning is required, and not performed by the *Contractor* to the facility standards, the *Owner*'s housekeeping department will conduct the cleaning and associated costs will be passed back to the *Contractor*.

TABLE 1 - PREVENTATIVE MEASURES ANALYSIS

Population risk group[1]	Construction Activity Type[2]			
	Type A	Type B	Type C	Type D
Group 1	I	II	II	III/IV
Group 2	I	II	III	IV
Group 3	I	III	III/IV	IV
Group 4	I-III[3]	III/IV	III/IV	IV

Notes:

1. See *Table 2* to determine the population risk. Where applicable, refer also to infection control population risk drawings included in the bid documents.
2. See *Table 3* to determine the construction activity type.
3. When the risk group is Group 4 and the construction activity is Type A, the infection prevention and control department shall be consulted to determine the appropriate preventative measure (I, II or III).

TABLE 2 – POPULATION RISK GROUPS AND GEOGRAPHICAL AREAS

Population Risk Group	Typical Areas
Group 1 Lowest Risk	Office areas Unoccupied areas Public areas Laundry and soiled linen cleaning areas Physical plant workshops and housekeeping areas
Group 2 Medium Risk	Patient care areas, unless listed in Group 3 and 4 Outpatient clinics (except oncology and surgery) Admission and discharge units Waiting rooms Autopsy and morgue Occupational therapy areas remote from patient care areas Physical therapy areas remote from patient care areas
Group 3 Medium to high risk	Emergency (except trauma rooms) Diagnostic imaging Labour and birthing rooms (non-operating) Nurseries for healthy newborns Nuclear medicine Hydrotherapy Echocardiography Laboratories General medical and surgical wards Pediatrics Geriatrics Long-term care Food preparation, serving and dining areas Respiratory therapy Clean linen handling and storage areas
Group 4 Highest risk	Intensive care units Operating rooms (including prep., induction, post anesthesia care unit and scrub areas) Anesthesia storage areas and workrooms Oncology units and outpatient clinics for cancer patients Transplant units and outpatient clinics for transplant patients Wards and outpatient clinics for patients with AIDS or other immunodeficiency diseases Dialysis units Critical care nurseries (NICU) Labour and delivery rooms

	Cardiac catheterization and angiography
	Interventional Radiology
	Cardiovascular and cardiology patient areas
	Endoscopy
	Pharmacy admixture rooms
	Sterile processing rooms
	Sterile supply areas
	Burn care units
	Animal rooms
	Trauma rooms
	Protective environment isolation rooms
	Tissue culture laboratories
	Bronchoscopy
	Cystoscopy
	Pacemaker insertion rooms
	Dental procedure rooms
	Central processing department

TABLE 3 – CONSTRUCTION ACTIVITY TYPE

Type A	Inspection and non-invasive activities: These include, but are not limited to, activities that require removal of ceiling tiles for visual inspection (limited to 1 tile to 50 square feet), painting (but not sanding), wall covering, electrical trim work, minor plumbing (disrupts water supply to a localized patient care area [e.g. 1 room] for less than 15 minutes), and other maintenance activities that do not generate dust or require cutting of wall or access to ceilings other than for visual inspection.
Type B	Small scale, short duration activities that create minimal dust (e.g., <2 hours). These include, but are not limited to, activities that require access to chase spaces, cutting of walls or ceilings where dust migration can be controlled for the installation/repairs of minor electrical work, ventilation components, telephone wires or computer cables, and sanding walls for painting or wall covering to only repair small patches. It also includes plumbing that requires distribution to the water supply of more than one patient care area (e.g. > 2 rooms) for less than 30 minutes.
Type C	Any work that generates moderate to high level of dust or requires demolition or removal of any fixed building components or assemblies (e.g. counter tops, cupboards, sinks). These include, but are not limited to, activities that require sanding of walls for painting or wall covering, removal of floor-coverings, ceiling tiles and casework, new wall construction, minor duct work, or electrical work above ceilings, major cabling activities, and any activity that cannot be completed within a single work shift. It also includes plumbing that requires disruption to the water supply or more than one patient care area (e.g. > 2 rooms) for more than 30 minutes but less than 1 hour.
Type D	Major demolition, construction and renovation projects. These include, but are not limited to, activities that involve heavy demolition or removal of a complete cabling system and new construction requiring consecutive work shifts to complete. It also includes plumbing that results in disruption to the water supply of more than one patient care area (e.g. > 2 rooms) for more than 1 hour.

END OF INFECTION CONTROL GUIDELINES FOR CONSTRUCTION

SECTION 01 40 00
QUALITY REQUIREMENTS

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

A. "Reference standards" means consensus standards, trade association standards, guides, and other publications expressly referenced in *Contract Documents*.

B. Where an edition or version date is not specified, referenced standards shall be deemed to be the latest edition or revision issued by the publisher at the time of bid closing. However if a particular edition or revision date of a specified standard is referenced in an applicable code or other regulatory requirement, the regulatory referenced edition or version shall apply.

C. Reference standards establish minimum requirements. If *Contract Documents* call for requirements that differ from a referenced standard, the more stringent requirements shall govern.

D. If compliance with two or more reference standards is specified and the standards establish different or conflicting requirements, comply with the most stringent requirement. Refer uncertainties to *Consultant* for clarification.

E. Within the *Specifications*, reference may be made to the following standards writing, testing, or certification organizations by their acronyms or initialisms:
1. AA - Aluminum Association
2. ACI - American Concrete Institute
3. AISC - American Institute of Steel Construction
4. ANSI - American National Standards Institute
5. ASME - American Society of Mechanical Engineers
6. ASTM - American Society for Testing and Materials
7. AWMAC - Architectural Woodwork Manufacturers Association of Canada
8. AWPA - American Wire Producers Association
9. CaGBC - Canadian Green Building Council
10. CGSB - Canadian General Standards Board
11. CISC - Canadian Institute of Steel Construction
12. CPCI - Canadian Prestressed Concrete Institute
13. CSA - Canadian Standards Association
14. CSSBI - Canadian Sheet Steel Building Institute
15. CWB – Canadian Welding Bureau
16. ICEA - Insulated Cable Engineers Association
17. IEEE - Institute of Electrical and Electronics Engineers
18. IGMAC – Insulating Glass Manufacturers Association of Canada
19. LEED - Leadership in Energy and Environmental Design
20. MPP – Master Painters Institute
21. MSS - Manufacturers Standardization Society of the Valve and Fittings Industry
22. NAAMM - National Association of Architectural Metal Manufacturers
23. NEMA - National Electrical Manufacturers Association
24. NFPA - National Fire Protection Association
25. NHLA - National Hardwood Lumber Association
26. NLGA - National Lumber Grades Authority
27. SSPC – The Society for Protective Coatings
28. TTMAC - Terrazzo, Tile and Marble Association of Canada
29. ULC - Underwriters' Laboratories of Canada

1.2 INDEPENDENT INSPECTION AND TESTING AGENCIES

A. Except as otherwise specified, *Owner* will retain and pay for independent inspection and testing agencies to inspect, test, or perform other quality control reviews of parts of the *Work*.

B. Retain and pay for inspection and testing that is for *Contractor*'s own quality control or is required by regulatory requirements.

C. Employment of inspection and testing agencies by *Contractor* or *Owner* does not relieve *Contractor* from responsibility to perform the *Work* in accordance with *Contract Documents*.

D. Allow and arrange for inspection and testing agencies to have access to the *Work*, including access to off site manufacturing and fabrication plants.

E. For inspection and testing required by *Contract Documents* or by authorities having jurisdiction, provide *Consultant* and inspection and testing agencies with timely notification in advance of required inspection and testing.

F. Submit test samples required for testing in accordance with submittals schedule specified in Section 01 32 00 – Construction Progress Documentation.

G. Provide labour, *Construction Equipment* and temporary facilities to obtain and handle test samples on site.

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

1.3 INSPECTION AND TESTING AGENCY REPORTS

A. For inspection and testing required by *Contract Documents* or by regulatory requirements, and performed by *Contractor* retained inspection and testing agencies, submit to *Consultant* and *Owner* copies of reports. Submit within one day after completion of inspection and testing.

B. For inspection and testing performed by *Owner* retained inspection and testing agencies, copies of inspection and testing agency reports will be provided to *Contractor*.

C. Provide copies to *Subcontractor* of work being inspected or tested, or to the manufacturer or fabricator of material being inspected or tested.

1.4 TESTS AND MIX DESIGNS

A. Furnish test results and mix designs as requested.

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

1.5 MOCK-UPS

A. Prepare mock-ups of *Work* as specified in the technical *Specifications*. If a mock-up location is not indicated in the *Drawings* or *Specifications*, locate where directed by *Consultant*.

B. Modify mock-up as required until *Consultant* approval is obtained.

C. Approved mock-ups establish an acceptable standard for the *Work*.

D. Protect mock-ups from damage until the *Work* they represent is complete.

E. Unless otherwise specified in the technical *Specifications*, approved mock-ups forming part of the *Work* may remain as part of the *Work*.

F. Remove mock-ups only when the *Work* they represent is complete or when otherwise directed by *Consultant*.

1.6 MILL TESTS

A. Submit mill test certificates as requested or required by specification Sections.

1.7 EQUIPMENT AND SYSTEMS

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

B. Refer to Division 20 and 26 for definitive requirements for mechanical and electrical systems, commissioning, adjustments, balancing and testing.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF QUALITY REQUIREMENTS

SECTION 01 51 00
TEMPORARY UTILITIES

PART 1 - GENERAL

1.1 TEMPORARY UTILITIES - GENERAL

A. Provide temporary utilities as specified and as otherwise necessary to perform the *Work* expeditiously.

B. Remove temporary utilities after use.

1.2 TEMPORARY WATER SUPPLY

A. *Owner* will provide supply of water for construction use. The *Contractor* is responsible for providing connection to existing service, as required.

B. The *Contractor* shall be responsible for providing potable water for consumption by the workforce.

1.3 TEMPORARY HEATING AND VENTILATION

A. Arrange and pay for temporary heating and ventilation required during construction.

B. Vent construction heaters in enclosed spaces to the outside or use flameless type of construction heaters.

C. Provide temporary heat for the *Work* as required to:
1. Facilitate progress of *Work*.
2. Protect the *Work* against dampness and cold.
3. Prevent moisture condensation on surfaces, freezing, or other damage to finishes or stored *Products*.
4. Maintain specified minimum ambient temperatures and humidity levels for storage, installation and curing of *Products*.
5. Provide adequate ventilation to meet health regulations for safe working environment.
6. After building is enclosed, maintain interior temperature of minimum 10 degrees C.
7. In occupied space adjacent to construction areas, maintain an average ambient temperature of 18 degrees C.

D. Provide temporary ventilation for the *Work* as required to:
1. Prevent accumulations of fumes, exhaust, vapours, gases and other hazardous, noxious, or volatile substances in enclosed spaces, as required to maintain a safe work environment meeting applicable regulatory requirements.
2. Ensure that hazardous, noxious, or volatile substances do not migrate to Owner occupied spaces.
3. Dispose of exhaust materials in manner that will not result in harmful exposure to people.
4. Ventilate storage spaces containing hazardous or volatile materials.
5. Ventilate temporary sanitary facilities.
6. Continue operation of ventilation and exhaust system after completion of work process to assure removal of harmful contaminants.
7. Maintain negative pressure to the adjacent areas. Refer to Section 01 35 65 for additional requirements for negative pressure enclosures.

E. Permanent heating system of building may be used when available. Be responsible for damage to heating system if use is permitted.

F. On completion of *Work* for which permanent heating system is used, replace filters and clean radiation devices prior to occupancy.

G. Ensure date of *Substantial Performance of the Work* and warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by *Consultant*.

H. Maintain strict supervision of operation of temporary heating and ventilating equipment to:
1. Conform to 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.

I. Be responsible for damage to the *Work* due to failure in providing adequate heat and protection during construction.

1.4 TEMPORARY ELECTRICAL POWER AND LIGHTING

A. Arrange and pay for temporary power and lighting required during construction. Connect to utility power supply in accordance with Canadian Electrical Code and provide meters and switching.

B. Arrange and pay for necessary connections and disconnections of temporary power and lighting in accordance with regulatory requirements.

C. Provide and maintain temporary lighting throughout project. Ensure level of illumination on all floors and stairs is not less than 162 lx.

D. With prior approval of *Consultant*, and provided that guarantees are not affected, electrical power and lighting systems installed under this *Contract* may be used for Construction requirements. Make good damage to electrical system caused by use under this *Contract*. Replace lamps which have been used for more than 3 months.

1.5 TEMPORARY COMMUNICATION FACILITIES

A. Provide and pay for temporary telephone fax and internet hook up, lines and equipment necessary for own use.

1.6 FIRE PROTECTION

A. During performance of *Work*, provide and maintain temporary fire protection equipment required by insurance companies having jurisdiction and governing codes, regulations and bylaws.

B. If *Work* requires de-activation of the fire alarm system, or any part thereof, a "Utility Shutdown Form" must be completed and submitted. A copy of the "Utility Shutdown Form" is included in Section 01 14 00.

C. Provide and maintain a temporary fire alarm system through to project completion.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF TEMPORARY UTILITIES

SECTION 01 52 00
CONSTRUCTION FACILITIES

PART 1 - GENERAL

1.1 CONTRUCTION FACILITIES - GENERAL

A. Provide temporary construction facilities as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.

B. Maintain temporary construction facilities in good condition for the duration of the *Work*.

C. Remove temporary construction facilities from *Place of the Wor*k when no longer required.

1.2 CONSTRUCTION PARKING

A. Parking will not be permitted at *Place of the Work*. The *Contractor* is responsible to obtain and pay for parking as required.

1.3 VEHICULAR ACCESS

A. Provide and maintain adequate access to *Place of the Work*.

B. Existing roads at *Place of the Work* may be used for access to *Place of the Work*, provided *Contractor* assumes responsibility for any damage caused by construction traffic, and prevents or promptly cleans up any mud tracking or material spillage.

1.4 SITE OFFICES

A. The *Owner* will arrange for a space within the facility suitable for the use by the *Contractor* as a site office for the duration of the project. The *Contractor* is required to maintain the space in as found condition and is required to repair all damage caused to the space.

1.5 SANITARY FACILITIES

A. The *Owner* will designate a sanitary facility for the use of the *Contractor* in accordance with governing regulations and ordinances.

B. Post notices and take such precautions as required by local health authorities.

C. Ensure facility is maintained in sanitary condition at all times and cleaned in accordance with Section 01 74 00.

1.6 FIRE PROTECTION

A. Provide and maintain temporary fire protection systems and equipment during construction.

1.7 USE OF EXISTING ELEVATORS

A. Designated elevators may be used by construction personnel and for transporting *Products*. Co-ordinate use with *Owner*.

B. Provide protective coverings for finish surfaces of cars and entrances. Assume responsibility for and make good any damage to existing elevators caused by construction personnel.

C. The *Contractor* is responsible to ensure that posted loading is not exceeded for any reason.

D. *Contractor* is responsible to perform maintenance service on designated elevator at end or *Project*. *Owner* to provide maintenance provider contact.

1.8 LOADING

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

B. Do not block vehicular traffic or pedestrian access to the Hospital site while loading and unloading. Schedule delivery of *Products* shipped to loading dock with *Owner*'s representative a minimum of 48 hours prior to delivery. *Owner*'s operation will take precedence over that of the *Contractor*. Deliveries are not to be scheduled to take place at the loading dock between the hours of *16:00 h and 08:00 h*.

1.9 EQUIPMENT, TOOLS AND MATERIALS STORAGE

A. Do not unreasonably encumber premises with *Products*. Confine storage of *Products* to designated areas.

B. Provide and maintain, in a clean and orderly condition, lockable storage boxes suitable for tools, *Construction Equipment* and *Products*.

C. Locate *Products*, not used that day on site, in a manner to cause least interference with work activities.

D. The *Owner* is not responsible for any losses incurred by the *Contractor*.

1.10 SCAFFOLDING

A. Provide and maintain scaffolding, ramps ladders, platforms, and other equipment required to complete the *Work*.

1.11 HOISTING

A. Provide, operate and maintain hoists and temporary cranes required for moving of workers, materials and equipment. Make financial arrangements with *Subcontractors* for use thereof.

B. Hoist cranes shall be operated by qualified operators.

C. Hoisting equipment, labour and material shall be the responsibility of the *Contractor*.

1.12 PROJECT IDENTIFICATION SIGNS

A. No signs or advertisements, other than construction signs and warning signs, are permitted on site.

B. Signs and notices for safety and instruction shall be in both official languages. Graphic symbols shall conform to *CAN3-Z321*.

C. Maintain approved signs and notices in good condition for duration of project, and dispose of off-site on completion of project.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF CONSTRUCTION FACILITIES

SECTION 01 56 00
TEMPORARY BARRIERS AND ENCLOSURES

PART 1 - GENERAL

1.1 BARRIERS AND ENCLOSURES - GENERAL

A. Provide temporary barriers and enclosures necessary to protect the public and building occupants and to secure *Place of the Wor*k during performance of the *Work*.

B. Comply with applicable regulatory requirements.

C. Maintain temporary barriers and enclosures in good condition for the duration of the *Work*.

D. Remove temporary barriers and enclosures from *Place of the Work* when no longer required.

1.2 FENCING

A. Erect temporary security and safety site fencing, minimum 1.8 m high, using self-supporting wire fence sections enclosing entire site. Maintain site fencing in good repair until removed.

B. Provide lockable access gates as required to facilitate construction access.

1.3 EXTERIOR HOARDING

A. Erect temporary exterior site hoarding to comply with applicable regulatory requirements and as follows:
1. Use lumber framing and, minimum 13 mm thick exterior grade plywood.
2. Paint public side of hoarding in colour selected by *Consultant* with one coat primer to CGSB 1.189M and one coat exterior paint to CGSB 1.59. Maintain public side of hoarding clean and in good repair until removed.
3. Provide lockable access gates for *Construction Equipment* and lockable pedestrian doors as required to facilitate construction access.
4. Erect and maintain pedestrian walkways including roof and side covers, complete with pedestrian signage and electrical lighting.

1.4 WEATHER ENCLOSURES

A. Provide weather tight enclosures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.

B. Provide weather enclosures to protect floor areas where walls are not finished and to enclose work areas that require temporary heating.

C. Design weather enclosures to withstand wind pressure and snow loading requirements.

1.5 GUARD RAILS AND BARRICADES

A. Provide as required by governing authorities.

1.6 DUST TIGHT SCREENS

A. Where construction activities will occur within an occupied floor area for a period of time not exceeding 24 hours and where indicated, provide dust tight screens to localize dust generating activities, and for protection of workers, finished areas of Work and public and in areas where the construction must be isolated from the remainder of the floor area.

B. Dust tight screens are to be constructed using flash resistant tarpaulins on a non-combustible frame. Tarps are to be sealed to adjacent finishes and all joints to provide air tight screen. Tarps are to be sealed to undisturbed ceiling surfaces or to underside of structure above in areas where ceilings are removed.

C. Maintain and relocate protection until such work is complete.

D. Maintain work areas within existing occupied areas under negative pressure at all times.

E. Where existing wall, ceiling and floor materials or finishes are damaged as a result of barrier construction, repair materials or finishes to match existing.

1.7 TEMPORARY PARTITIONS

A. Where construction activities will occur within an occupied floor area for a period of time exceeding 24 hours and where indicated, provide insulated temporary partitions to localize dust generating activities, and for protection of workers, finished areas of Work and public and in areas where the construction must be isolated from the remainder of the floor area.

B. Temporary partitions are to be constructed to underside of structure above using metal studs and gypsum board construction to create a 1 hour fire separation in accordance with ULC design W408. Prime and paint partition exposed to occupied side of floor area.

C. Provide fire-rated hollow metal doors and frames and hardware where indicated and where required to maintain path of egress. Prime and paint door and frames faces exposed to occupied side of floor area.

D. Maintain and relocate protection until such work is complete.

E. Maintain work areas within existing occupied areas under negative pressure at all times.

F. Where existing wall, ceiling and floor materials or finishes are damaged as a result of barrier construction, repair materials or finishes to match existing.

1.8 ACCESS TO SITE

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

1.9 PUBLIC TRAFFIC FLOW

A. Do not impede public transportation and vehicle flow with construction vehicles.

1.10 FIRE ROUTES

A. Maintain fire access routes, including overhead clearances, for use by emergency response vehicles, and access to hydrants and siamese connections.

B. Review site restrictions, lay down areas and site access with the Authorities having Jurisdiction prior to construction start.

1.11 PROTECTION OF BUILDING FINISHES

A. Provide necessary temporary barriers and enclosures to protect existing and completed or partially completed finished surfaces from damage during performance of the *Work*.

B. Locations and installation schedule to be confirmed with Consultant three (3) days prior to installation.

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

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF TEMPORARY BARRIERS AND ENCLOSURES

SECTION 01 57 00
TEMPORARY CONTROLS

PART 1 - GENERAL

1.1 TEMPORARY CONTROLS - GENERAL

A. Provide temporary controls as necessary for performance of the *Work* and in compliance with applicable regulatory requirements.

B. Maintain temporary controls in good condition for the duration of the *Work*.

C. Remove temporary controls and *Construction Equipment* used to provide temporary controls from *Place of the Work* when no longer required.

1.2 PLANT PROTECTION

A. Protect trees and other plant material designated to remain on site where indicated on *Drawings*.

B. Protect trees and shrubs susceptible to damage during construction by encasing with protective wood framework from grade to height of two metres.

C. For trees designated to remain, protect roots inside dripline from disturbance or damage during excavation and grading. Avoid traffic, dumping and storage of materials over root zones.

D. Minimize stripping of topsoil and vegetation.

1.3 DUST AND PARTICULATE CONTROL

A. Implement and maintain dust and particulate control measures in accordance with applicable regulatory requirements.

B. Execute *Work* by methods that minimize dust from construction operations and spreading of dust on site or to adjacent properties.

C. Provide temporary enclosures to prevent extraneous materials resulting from sandblasting or similar operations from contaminating air beyond immediate work area.

D. Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

E. Use appropriate covers on trucks hauling fine, dusty, or loose materials.

1.4 DEWATERING

A. Provide temporary drainage and pumping as necessary to dewater excavations, trenches, foundations, and other parts of the *Work*. Maintain such areas free of water arising from groundwater or surface run-off, as required to keep them stable, dry, and protected from damage due to flooding.

B. Maintain standby equipment necessary to ensure continuous operation of dewatering system.

C. Do not pump water containing suspended materials or other harmful substances into waterways, sewers or surface drainage systems. Treat or dispose of such water in accordance with applicable regulatory requirements

1.5 SITE DRAINAGE

A. Maintain grades to ensure proper site drainage.

B. Prevent surface water runoff from leaving the site except as otherwise provided by stormwater management plan.

C. Prevent precipitation from infiltrating or from directly running off stockpiled materials. Cover stockpiled materials with an impermeable liner during periods of work stoppage including at end of each *Working Day*.

D. Control surface drainage from cuts and fills, from borrow and waste disposal areas, from stockpiles, staging areas, and other work areas as required to prevent erosion and sedimentation.

E. Control surface drainage by ensuring that gutters are kept open and water is not directed across or over pavements or sidewalks, except through pipes or properly constructed troughs. Ensure that runoff from unfinished areas is intercepted and diverted to suitable outlets.

1.6 EROSION AND SEDIMENT CONTROL

A. Minimize amount of bare soil exposed at one time. Stabilize disturbed soils as quickly as practical to minimize erosion. Remove accumulated sediment resulting from construction activity from adjoining surfaces, drainage systems, and watercourses, and repair damage caused by soil erosion and sedimentation.

B. Provide and maintain appropriate temporary measures such as silt fences, straw bales, ditches, geotextiles, drains, berms, terracing, riprap, temporary drainage piping, sedimentation basins, vegetative cover, dikes, and other measures that may be required to prevent erosion and migration of silt, mud, sediment, and other debris.

C. Do not disturb existing embankments or embankment protection.

D. Periodically inspect erosion and sediment control measures to detect evidence of erosion and sedimentation. Promptly take corrective measures when necessary.

E. If soil and debris from site accumulate in ditches or other low areas, remove accumulation and restore area to original condition.

1.7 POLLUTION CONTROL

A. Take measures to prevent contamination of soil, water, and atmosphere through uncontrolled discharge of noxious or toxic substances and other pollutants, potentially causing environmental damage.

B. Be prepared, by maintaining appropriate materials, equipment, and trained personnel on site, to intercept, clean up, and dispose of spills or releases that may occur. Promptly report spills and releases that may occur to:
   1. authority having jurisdiction,
   2. person causing or having control of pollution source, if known, and
   3. Owner and Consultant.

C. Contact manufacturer of pollutant, if known and applicable, to obtain material safety data sheets (MSDS) and ascertain hazards involved and precautions and measures required in cleanup or mitigating actions.

D. Take immediate action to contain and mitigate harmful effects of the spill or release.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF TEMPORARY CONTROLS

SECTION 01 61 00
COMMON PRODUCT REQUIREMENTS

PART 1 - GENERAL

1.1 GENERAL

A. Provide *Products* that are not damaged or defective, and suitable for purpose intended, subject to specified requirements. If requested by *Consultant*, furnish evidence as to type, source and quality of *Products* provided.

B. Unless otherwise specified, maintain uniformity of manufacture for like items throughout.

C. Permanent manufacturer's markings, labels, trademarks, and nameplates on *Products* are not acceptable in prominent locations, except where required by regulatory requirements or for operating instructions, or when located in mechanical or electrical rooms.

1.2 PRODUCT OPTIONS

A. Subject to the provisions of Section 01 25 00 –Substitution Procedures:
   1. Wherever a *Product* or manufacturer is specified by a single proprietary name, provide the named *Product* only.
   2. Wherever more than one *Product* or manufacturer is specified by proprietary name for a single application, provide any one of the named *Products*.

B. Wherever a *Product* is specified by reference to a standard only (Indicated as "Standard of Acceptance" in Technical Specifications), provide any *Product* that meets or exceeds the specified standard. If requested by *Consultant*, submit information verifying that the proposed *Product* meets or exceeds the specified standard.

C. Wherever a *Product* is specified by descriptive or performance requirements only (Indicated as "Basis of Design" in Technical Specifications, provide any *Product* that meets or exceeds the specified requirements. If requested by *Consultant*, submit information verifying that the proposed *Product* meets or exceeds the specified requirements.

1.3 PRODUCT AVAILABILITY AND DELIVERY TIMES

A. Promptly upon Contract award and periodically during construction, review and confirm *Product* availability and delivery times. Order *Products* in sufficient time to meet the construction progress schedule and the *Contract Time*.

B. If a specified *Product* is no longer available, promptly notify *Consultant*. *Consultant* will take action as required.

C. If delivery delays are foreseeable, for any reason, promptly notify *Consultant*.
   1. If a delivery delay is beyond *Contractor*'s control, *Consultant* will provide direction.
   2. If a delivery delay is caused by something that was or is within *Contractor*'s control, *Contractor* shall propose actions to maintain the construction progress schedule for *Consultant*'s review and acceptance.

1.4 STORAGE, HANDLING, AND PROTECTION

A. Store, handle, and protect *Products* during transportation to *Place of the Work* and before, during, and after installation in a manner to prevent damage, adulteration, deterioration and soiling.

B. Comply with manufacturer's instructions for storage, handling and protection.

C. Store packaged or bundled *Products* in original and undamaged condition with manufacturer's seals and labels intact. Do not remove from packaging or bundling until required in *Work*.

D. Comply with the requirements of the workplace hazardous materials information system (WHMIS) regarding use, handling, storage, and disposal of hazardous materials, including requirements for labeling and the provision of material safety data sheets (MSDS).

E. Store *Products* subject to damage from weather in weatherproof enclosures.

F. Store sheet *Products* on flat, solid, supports and keep clear of ground. Slope to shed moisture.

G. Remove and replace damaged *Products*.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF COMMON PRODUCT REQUIREMENTS

SECTION 01 71 00
EXAMINATION AND PREPARATION

PART 1 - GENERAL

1.1 SETTING OUT OF WORK

A. Assume full responsibility for and execute complete layout of the *Work* to locations, lines and elevations indicated.

B. Provide *Construction Equipment* needed to lay out and construct the *Work*.

C. Supply *Construction Equipment* to facilitate *Consultant's* inspection of the *Work*.

1.2 EXAMINATION, COOPERATION AND COORDINATION

A. *Subcontractors* are responsible to familiarize themselves with the *Contract Documents* and the work of all trades therein.

B. *Subcontractors* shall give timely instructions and information to the *Contractor* concerning their requirements as they relate to other parts of the *Work*.

C. Each trade shall report to the *Contractor* defects in surfaces or work prepared by other trades which affect their own, and ensure that conditions are appropriate for the carrying out of their portion of the *Work*. Commencement of the *Work* shall imply acceptance of conditions.

D. Cooperate with the *Consultant* and *Other Contractors* employed by the *Owner*.

1.3 LINES AND LEVELS

A. Prior to commencement of the *Work*, verify all grades, levels, lines and dimensions shown on the *Drawings* and report any errors and inconsistencies to the *Consultant*.

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

C. Upon completion, complete an accurate record drawing of the completed *Project*. Submit in accordance with Section 01 78 00.

1.4 SURVEYOR QUALIFICATIONS

A. Engage a registered land surveyor, licensed to practice in *Place of the Work*.

1.5 SURVEY SUBMITTALS

A. Submit name and address of registered land surveyor performing survey work.

B. Submit to *Owner* and *Consultant* the survey of the *Work* prepared and issued by a registered land surveyor as required by authorities having jurisdiction and on completion of the survey work.

1.6 SURVEY REFERENCE POINTS

A. Locate and confirm permanent reference points prior to starting site work. Preserve and protect permanent reference points on site during construction.

B. Do not change or relocate reference points without prior written notice to *Consultant*.

C. Report to *Consultant* when a reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations. Require registered land surveyor to replace reference points in accordance with original survey.

1.7 SURVEY REQUIREMENTS

A. Establish sufficient permanent benchmarks on site, referenced to established benchmarks by survey control points.

B. Confirm that existing survey reference points are in accordance with *Owner*'s survey and property limits.

C. Establish initial lines and levels for building layout.

D. Maintain a complete, accurate log of control and survey work as it progresses. Record locations with horizontal and vertical data in project record documents.

1.8 EXISTING UTILITIES AND STRUCTURES

A. Before commencing the *Work*, establish location and extent of service lines in area of work and notify *Consultant* of findings.

B. Promptly notify *Consultant* if underground utilities, structures, or their locations differ from those indicated in *Contract Documents* or in available project information. *Consultant* will provide appropriate direction.

C. Record locations of maintained, re-routed and abandoned utility lines.

1.9 VERIFICATION OF EXISTING CONDITIONS

A. The *Contractor* shall carefully examine the *Place of Work* and all conditions affecting the *Work* during the bidding period.

B. Claims for extra payments due to difficulties encountered, which could have been foreseen during examination, will not be considered.

C. Where work specified in any Section is dependent on the work of another Section or Sections having been properly completed, verify that work is complete and in a condition suitable to receive the subsequent work. Commencement of work of a Section that is dependent on the work of another Section or Sections having been properly completed, means acceptance of the existing conditions.

D. Verify that ambient conditions are suitable before commencing the work of any Section and will remain suitable for as long as required for proper setting, curing, or drying of *Products* used.

E. Ensure that substrate surfaces are clean, dimensionally stable, cured and free of contaminants.

F. Notify *Consultant* in writing of unacceptable conditions.

1.10 DETAILS AND MEASUREMENTS

A. Check and verify all dimensions wherever referring to the *Work*. Verify all dimensions when pertaining to the work of other trades with the *Subcontractor* concerned. Check dimensions and the actual material to be used on the *Work* with the various drawings and details before the *Work* commences, and report any variations to the *Consultant* for adjustment, if necessary.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF EXAMINATION AND PREPARATION

SECTION 01 73 00
EXECUTION

PART 1 - GENERAL

1.1 SUMMARY

A. Except where otherwise specified in technical *Specifications* or otherwise indicated on *Drawings*, comply with requirements of this Section.

1.2 CODES AND REGULATIONS COMPLIANCE

A. Perform Work in accordance with Ontario Building Code of Canada (OBC), Ontario Fire Code (OFC), Occupational Health and Safety Act and other codes of provincial or local application, provided that in case of conflict or discrepancy, more stringent requirements apply, including all amendments made up to the bid closing date.

B. Perform the *Work* in accordance with WHMIS regulations, the Occupational Health and Safety Act and Section 01 35 33.

1.3 MANUFACTURER'S INSTRUCTIONS

A. Install, erect, or apply *Products* in strict accordance with manufacturer's instructions.

B. Notify *Consultant*, in writing, of conflicts between *Contract Documents* and manufacturer's instructions where, in *Contractor*'s opinion, conformance with *Contract Documents* instead of the manufacturer's instructions may be detrimental to the *Work* or may jeopardize the manufacturer's warranty.

C. Do not rely on labels or enclosures provided with *Products*. Obtain written instructions directly from manufacturers.

D. Provide manufacturer's representatives with access to the *Work* at all times. Render assistance and facilities for such access so that manufacturer's representatives may properly perform their responsibilities.

1.4 CONCEALMENT

A. Conceal pipes, ducts, and wiring in floors, walls and ceilings in finished areas:
   1. After review by *Consultant* and authority having jurisdiction, and
   2. Where locations differ from those shown on *Drawings*, after recording actual locations on as-built drawings.

B. Provide incidental furring or other enclosures as required.

C. Notify *Consultant* in writing of interferences before installation.

D. Electrical conduit shall not be buried in concrete structures or slabs unless indicated otherwise.

1.5 FASTENINGS - GENERAL

A. Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials.

B. Prevent electrolytic action and corrosion between dissimilar metals and materials by using suitable non-metallic strips, washers, sleeves, or other permanent separators to avoid direct contact.

C. Use non-corrosive fasteners and anchors for securing exterior work and in spaces where high humidity levels are anticipated.

D. Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage.

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

F. Do not use fastenings or fastening methods that may cause spalling or cracking of material to which anchorage is made.

1.6 FASTENINGS - EQUIPMENT

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

B. Bolts shall not project more than one diameter beyond nuts.

1.7 FIRE RATED ASSEMBLIES

A. When penetrating fire rated walls, ceiling, or floor assemblies, completely seal voids with fire-stopping materials, smoke seals, or both, in full thickness of the construction element as required to maintain the integrity of the fire rated assembly.

1.8 LOCATION OF EQUIPMENT, FIXTURES, OUTLETS AND DEVICES

A. Consider location of equipment, fixtures, outlets, and devices indicated on *Drawings* as approximate.

B. Locate fixtures, outlets, and devices to provide minimum interference, maximum usable space, and as required to meet safety, access, maintenance, acoustic, and regulatory, including barrier free, requirements, and in accordance with manufacturer's recommendations for safety, access, and maintenance.

C. Promptly notify *Consultant* in writing of conflicting installation requirements for fixtures, outlets, and devices. If requested, indicate proposed locations and obtain approval for actual locations.

D. Inform *Consultant* of impending installation and obtain his approval for actual location.

E. Submit field drawings to indicate relative position of various services and equipment when required by the *Consultant*.

1.9 PROTECTION OF COMPLETED WORK AND WORK IN PROGRESS

A. Adequately protect parts of the *Work* completed and in progress from any kind of damage.

B. Promptly remove, replace, clean, or repair, as directed by *Consultant,* work damaged as a result of inadequate protection.

C. Do not load or permit to be loaded any part of the *Work* with a weight or force that will endanger the safety or integrity of the *Work*.

1.10 REMEDIAL WORK

A. Notify *Consultant* of, and perform remedial work required to, repair or replace defective or unacceptable work. Ensure that properly qualified workers perform remedial work. Coordinate adjacent affected work as required.

B. Restore *Work* with new *Products* in accordance with requirements of *Contract Documents*.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF EXECUTION

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 REQUEST FOR CUTTING, PATCHING AND REMEDIAL WORK

A. Submit written request in advance of cutting, coring, or alteration which affects or is likely to affect:
   1. Structural integrity of any element of the *Work*.
   2. Integrity of weather-exposed or moisture-resistant elements.
   3. Efficiency, maintenance, or safety of any operational element.
   4. Visual qualities of sight-exposed elements.
   5. Work of *Owner* or other contractors.
   6. Warranty of *Products* affected.

B. Include in request:
   1. Identification of *Project*.
   2. Location and description of affected work, including drawings or sketches as required.
   3. Statement on necessity for cutting or alteration.
   4. Description of proposed work, and *Products* to be used.
   5. Alternatives to cutting and patching.
   6. Effect on work of *Owner* or other contractors.
   7. Written permission of affected other contractors.
   8. Date and time work will be executed.

1.2 PRODUCTS

A. Unless otherwise specified, when replacing existing or previously installed *Products* in the course of cutting and patching work, use replacement *Products* of the same character and quality as those being replaced. Use materials whose installed performance will equal or surpass that of existing materials.

B. Where applicable, comply with *Specifications* for type *Work* to be performed.

C. If an existing or previously installed *Product* must be replaced with a different *Product*, submit request for substitution in accordance with Section 01 25 00 - Substitution Procedures.

1.3 PREPARATION

A. Inspect existing conditions in accordance with Section 01 71 00 - Examination and Preparation.

B. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

C. Before start of *Work*, obtain and pay for all permits required by all authorities having jurisdiction and notify all interested utilities companies.

D. Obtain approval of Owner and authorities having jurisdiction for Work which affects existing exit-ways, exit stairs, means of egress, or access to, or exit from, areas.
   1. Review with and obtain approval of authorities for any temporary construction which affects such areas.

E. Provide supports to ensure structural integrity of surroundings; provide devices and methods to protect other portions of the *Work* from damage.

F. Protect existing construction during cutting and patching to prevent damage

G. Provide protection from elements for areas that may be exposed by uncovering work.

H. Before proceeding, meet at *Place of the Work* with parties involved in cutting and patching, including mechanical and electrical trades.

1. Review areas of potential interference and conflict.
2. Coordinate procedures and resolve potential conflicts before proceeding.

I. After uncovering existing conditions for *Work*, inspect conditions affecting installation of new *e*.

1.4 EXISTING UTILITIES

A. When breaking into or connecting to existing services' utilities, execute the *Work* at times directed by local governing authorities, with a minimum of disturbance to the *Work*, pedestrian and vehicular traffic, and ongoing *Owner* operations. When traffic is disrupted, provide sign-men.

B. Where the *Work* involves breaking into or connecting to existing building services, complete and submit a "Request for Utility Shut-down" form for any interruptions to building services, for necessary interruptions of mechanical or electrical service throughout the course of the *Work*. A copy of the form and procedures for its use and completion, are included in this Section.

C. Where unknown services are encountered, immediately advise *Consultant* and confirm findings in writing.

D. Remove abandoned service lines within two feet of structures, unless indicated otherwise. Cap or otherwise seal lines at cut-off points as instructed by *Consultant* and to suit code requirements.

E. Avoid cutting existing utilities, pipe, conduit, or ductwork serving the building but scheduled to be removed or relocated until alternate provisions have been provided.

F. Maintain excavations free of water.

G. Keep duration of interruptions to a minimum.

H. Carry out interruptions after regular working hours of occupants, preferably on weekends, unless *Owner*'s prior written approval is obtained.

I. Protect and maintain existing active services. Record location of services, including depth, on as-built drawings.

J. Construct or erect barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures as required to protect pedestrian and vehicular traffic.

1.5 CUTTING, PATCHING, AND REMEDIAL WORK - GENERAL

A. Cutting of openings into new or existing structural members, other than those indicated, is strictly prohibited, unless authorized in writing by the *Consultant*.

B. Items to be salvaged and delivered to *Owner* shall be carefully removed and properly stored in an area easily accessible for removal by *Owner*.

C. The cutting and patching required for individual trades shall be the responsibility of the *Contractor*.

D. Ensure that all cutting and patching is completed in an acceptable manner without delay and to correct found deficiencies.

E. Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

F. Do not cut and patch structural elements in a manner that would change their load-carrying capacity or load-deflection ratio.

G. Do not cut and patch operating elements or related components in a manner that would result in reducing their capacity to perform as intended. Do not cut and patch operating elements or related components in a manner that would result in increased maintenance or decreased operational life or safety.

H. Do not cut and patch construction exposed on exterior or in occupied spaces in a manner that would, in *Consultant*'s opinion, reduce the building's aesthetic or visual qualities. Do no cut and patch construction in a manner that would result in visual evidence of cutting and patching. Remove and replace construction which was cut and patched in a visually unsatisfactory manner.

I. Coordinate and perform the *Work* to ensure that cutting and patching work is kept to a minimum.

J. Perform cutting, fitting, patching, and remedial work including excavation and fill, to make the affected parts of the *Work* come together properly and complete the *Work*.

K. Provide openings in non-structural elements of the *Work* for penetrations of mechanical and electrical work.

L. Refer to mechanical and electrical *Specifications* for details re: removal, capping and other alterations including but not limited to conduit, wiring, fixtures, ducts, piping and other service lines.

M. Perform cutting by methods to avoid damage to other work

N. Provide proper surfaces to receive patching, remedial work, and finishing.

O. Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.

P. Ensure that cutting, patching, and remedial work does not jeopardize manufacturers' warranties.

Q. Cut rigid materials using masonry saw or core drill. Do not use pneumatic or impact tools without *Consultant*'s prior approval.

R. Refinish surfaces to match adjacent finishes. For continuous surfaces refinish to nearest intersection. For an assembly, refinish entire unit.

S. Fit work to pipes, sleeves, ducts, conduit, and other penetrations through surfaces with suitable allowance for deflection, expansion, contraction, acoustic isolation, and firestopping, while maintaining airtightness.

T. Maintain fire ratings of fire rated assemblies where cutting, patching, or remedial work is performed. Completely seal voids or penetrations of assembly with firestopping material to full depth or with suitably rated devices.

1.6 CUTTING IN CONCRETE CONSTRUCTION

1.7 Where coring, cutting or drilling of existing roof and floor slabs is required to complete the scope of work, the *Contractor* is required to verify the location of each core, cut or drill and verify the location of buried or concealed services by means of Ferro scanning or ultra-sound scanning slabs. Confirm location of findings with *Consultant* and *Owner* prior to coring, cutting or drilling. Provide a minimum of 72 hours written notice to the *Owner* prior to the scheduled core, cut or drill. Obtain the written approval of the *Owner* prior to start of any cutting, coring or drilling.

1.8 During the cutting, coring and drilling operations the *Contractor* shall have representatives on site including the site superintendent, mechanical, plumbing and electrical subcontractor representatives.

1.9 The *Contractor* is to be aware of the extreme risks associated with the use of x-ray technology for scanning of existing assemblies. The use of this type of scan on hospital property is strictly prohibited. The use of this type of scan without the consent of the *Owner* may result in the termination of the *Contract* and possible legal action by the affected parties.

1.10 CUTTING IN STEEL FRAME AND METAL DECK CONSTRUCTION

A. Do not cut nor drill holes in webs and flanges of columns, beams, purlins, and joists without prior written approval of *Consultant*.
   1. When approval is obtained, comply with requirements and instructions of Architect and provide reinforcing at such locations when required.

B. When openings are cut into metal decks having cast-in-place concrete slab over metal deck:
   1. No reinforcing of holes is required for circular openings or sleeves up to diameter and for rectangular openings having no side dimension greater than .
   2. Reinforce openings between and 300mm with 0.9mm, 20ga flat steel sheet 300mm greater in dimension than opening. Fusion weld to top surface of deck at each corner and on each side midway between corners.
   3. Do not cut openings greater than 300mm without written approval and direction from *Consultant*.

C. When openings are cut into metal roof decks that have no concrete cast-in-place (except lightweight insulating cementitious roof fill) over deck obtain written approval and direction from *Consultant*.

1.11 CUTTING – FIRE SEPARATION ALTERATIONS

A. Maintain all existing fire separations for the duration of the *Work*.

B. Provide fire and smoke penetration sealants at alterations and repairs in accordance with Section 07 84 00.

C. Provide continuous, solid framing, blocking or masonry around service penetrations through fire separations in accordance with the fire penetration sealant design to maintain the continuity of the fire separation.

D. Inspect and provide *Work* necessary to ensure a continuous smoke seal where indicated to existing walls within the *Place of the Work*.

1.12 CUTTING – MECHANICAL AND ELECTRICAL ALTERATIONS

A. Refer to mechanical and electrical documents. Provide all cutting and patching for access to execute service alterations. Conceal capped services or remove back to main unless specifically noted otherwise.

B. Repair adjacent construction or surfaces disturbed as a result of alterations.

1.13 CUTTING TO ACCOMMODATE DEMOLITION AND REMOVALS

A. Execute cutting neatly and carefully, no larger than necessary, employing workers skilled in the erection of the part of the *Work*, or the part of the existing building being cut.

B. Maintain integrity and continuity of fire separations at all times. Provide smoke and fire seals at cut parts of the *Work*, equal to existing.

C. Saw-cut floors, walls and ceilings accurately. Provide openings no larger than necessary to accommodate new work. Core drill circular holes in concrete. Accurately cut new holes for mechanical and electrical devices and fixtures and for other recessed items.

1.14 REMOVAL OF FLOORING AND PREPARATION OF SUBSTRATE

A. Remove flooring and adhesive/setting bed materials completely, down to structural substrate unless otherwise noted.

B. Grind high spots and scrape substrate to a smooth, level surface. Remove any ridges or trowel marks.

C. Fill new and existing depressions, dished areas, low spots, voids, gaps, cracks, joints, holes and other substrate defects with skim coat and self-leveling topping to achieve a flat substrate t within the following tolerances. All materials used to prep the substrate must be compatible with finish floor adhesives etc.
   1. 3mm total maximum deviation + and – along a 3000mm straight edge applied omni-directionally over the entire floor area.

D. Provide skim coats, primers and bonding agent slurries to neutralize residue adhesives and setting beds and to provide a suitable substrate to received scheduled flooring type.

1.15 REMOVAL OF MASONRY WALLS AND TERRAZZO FLOOR BASES

A. Remove masonry walls and terrazzo floor bases completely back to structural substrate.

B. Remove sufficient material to provide a depression for leveling toppings to achieve flat substrate to receive new finishes.

C. Terrazzo floor base shall be removed completely in association with wall demolition as shown on drawings. Terrazzo floor base removal shall include the provision for and supply of concrete infill and cementitious topping as required to provide a level surface for new finish floor.

D. Where existing masonry walls are indicated to be removed, ensure adjacent walls are braced securely and all structural and decorative elements removed t the underside of the structure above.

1.16 REMOVAL OF CONCRETE TOPPINGS AND TERRAZZO AND/OR EPOXY FLOORING

A. Remove concrete toppings and terrazzo flooring completely back to structural substrate.

B. Remove all loose material and provide bonding agent to adhere new concrete infill to receive new finish flooring.

C. Remove terrazzo or epoxy flooring to a sufficient depth to provide a depression for leveling topping to be flush with surrounding floor slab. All new material to compatible with existing substrate and with new finish floor.

D. In locations where terrazzo or epoxy floor is indicated for removal, include provision for supply and installation of concrete infill, accessories and cementitious leveling compound to provide a level surface for new finish floor. If, at the direction of the *Consultant*, any terrazzo or epoxy flooring remains, the surface is to be rendered porous prior to the application of leveling compound, adhesives, primers or other preparation for new finish floor.

1.17 MATCHING AND PATCHING

A. Where items are removed from existing walls, ceilings, floors or partitions to remain, repair wall, ceiling, floor or partition disturbed by removal.

B. Where walls, ceilings, floors or partitions are removed, repair abutting walls, ceilings or floors disturbed by removal.

C. Where existing construction is cut, removed or otherwise disturbed to permit installation of new *Work*, match and patch existing disturbed construction.

D. Use methods and materials similar in appearance, and equal in quality to areas or surfaces being repaired.

E. Restore *Work* which has been cut or removed; install new products to provide completed *Work* in accord with requirements of *Contract Documents*.

F. Patch work to match existing work and adjacent surfaces.

G. Re-finish entire surfaces as necessary to provide an even finish to match adjacent finishes.
   1. Continuous surfaces; to nearest intersection or break in surface such as inside or outside corner or minimum 1525mm horizontally beyond patched area and full height of wall, whichever is nearest.
   2. Assembly - entire refinishing.

H. In existing areas remove and replace existing ceilings and finishes for installation of *Work* of other trades. Locations may not be identified on architectural drawings. Refer to mechanical and electrical documents for coordination of locations.
   1. If existing ceiling can not be satisfactorily reinstalled, replace with like materials and construction.
   2. Replace damaged construction with like materials.

1.18 PATCHING ADJACENT TO DEMOLITION AREAS

A. After cutting is completed, patch and re-finish existing surfaces to remain t the nearest break in surface such as inside and outside corners or a minimum 1525mm 5FT horizontally and full height of walls from floor to ceiling.

B. Patch parts of *Work* to match adjacent construction and finishes unless otherwise specified or indicated on drawings.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF CUTTING AND PATCHING

SECTION 01 74 00
CLEANING AND WASTE MANAGMENT

PART 1 - GENERAL

1.1 REGULATORY REQUIREMENTS

A. Comply with applicable regulatory requirements when disposing of waste materials.

B. Obtain permits from authorities having jurisdiction and pay disposal fees where required for disposal of waste materials and recyclables.

1.2 GENERAL CLEANING REQUIREMENTS

A. Provide adequate ventilation during use of volatile or noxious substances. Do not rely on building ventilation systems for this purpose.

B. Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

C. Prevent cross-contamination during the cleaning process.

D. In occupied spaces, vacuum cleaning of area of work to be done utilizing HEPA filter equipped vacuum.

E. Notify the *Consultant* of the need for cleaning caused by *Owner* or *Other Contractors*.

F. Before applying for *Substantial Performance of the Work*, the *Contractor* shall remove waste products and debris, other than that resulting from the work of the *Owner, Other Contractors*, or their employees, and shall leave the *Place of the Work* clean and suitable for use or occupancy by the *Owner*.

1.3 POLLUTION CONTROL

A. Control emissions from equipment and plant to local authorities emission requirements.

B. Prevent dust and other extraneous materials from contaminating air beyond application area, by providing temporary enclosures.

C. Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Wet down dusty materials prior to moving them through the existing building or cover with wet drape to prevent dust from tracking through building spaces.

1.4 PROGRESSIVE CLEANING AND WASTE MANAGEMENT

A. Maintain the *Work* in a tidy and safe condition, free from accumulation of waste materials and construction debris.

B. Fires and burning of rubbish at *Place of the Work* is not permitted.

C. Burying rubbish and waste materials at *Place of the Work* is not permitted.

D. Provide and pay for on-site clearly marked waste containers for collection of waste materials, recyclables and debris.

E. Remove waste materials and recyclables from work areas, separate, and deposit in designated containers at end of each *Working Day*. Collect packaging materials for recycling or reuse.

F. Remove waste materials and recyclables from *Place of the Work* daily. When removing waste through occupied areas, cover waste container with a wet drape.

G. Sort separate materials to be reused/recycled into specified sort areas.

H. Store volatile waste in covered metal containers and remove from premises at end of each *Working Day*.

I. Do not dispose of waste or volatile materials, such as mineral spirits, oil or paint thinner into waterways, storm or sanitary sewers.

J. Clean interior building areas prior to start of finish work and maintain free of dust and other contaminants during finishing operations.

K. Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly finished surfaces nor contaminate building systems.

L. Clear snow and ice from public sidewalks as required to comply with applicable municipal regulatory requirements.

1.5 FINAL CLEANING

A. Remove from *Place of the Work* surplus *Products*, waste materials, recyclables, *Temporary Work*, and *Construction Equipment* not required to perform any remaining work.

B. Standards include, but are not limited to:
1. Floors and baseboards are to be free of construction material, stains, visible dust and streaks.
2. Walls, ceilings and doors are to be free of visible dust, gross soils, streaks and handprints.
3. All horizontal surfaces are to be free of visible dust and streaks. This includes, but is not limited to, furniture, window ledges, overhead lighting, phones, picture frames, carpets, etc.
4. Bathroom fixtures, including toilets, sinks, tubs and showers, are to be free of streaks, soil and stains.
5. Mirrors and windows are to be free of visible dust and streaks.
6. Dispensers are to be free of dust.

C. Standards will be achieved through the following processes:
1. Wet mopping of floors.
2. Wet dusting of walls and horizontal surfaces.
3. Use of special products for glass, chrome and plastic to leave streak free.
4. Final vacuuming, using a power head and a HEPA filter equipped vacuum that will not generate dust.
5. Water and general purpose disinfecting solutions must be changed when they become cloudy or cause streaking on cleaned surfaces.

D. The Contractor will use chemical and products which are currently in use by the facility. A list of these chemicals and products will be available from the Owner and may change at any time without notice. It is the Contractors responsibility to be aware of and use the chemicals and products which are in use at the time cleaning operations commence. Information available will include:
1. Local supplier.
2. Name and order number of chemical or product.
3. Area of facility where chemical or product is currently in use.
4. Dilution of chemical or product acceptable to facility.
5. Finish and material for which chemicals or products are to be used.
6. Variations from products listed will not be accepted without prior written approval from Environmental Services or the Owner's Infection Control Practitioner.

E. Lock or otherwise restrict access to each room or area after completing final cleaning in that area.

F. Re-clean as necessary areas that have been accessed by *Contractor*'s workers prior to *Owner* occupancy.

G. Vacuum clean and dust exposed wall, floor, and ceiling surfaces, behind grilles, louvres, heating registers and screens, ducts, fans, blowers and coils if units were operated without filters during construction.

H. Clean mechanical, electrical, and other equipment. Replace filters for mechanical equipment if equipment is used during construction.

I. Wax, seal, shampoo or prepare floor finishes as recommended by manufacturer and in coordination with the *Owner*.

J. Remove waste material and debris from crawlspaces and other accessible concealed spaces.

K. Remove stains, spots, marks, and dirt from exterior facades.

L. Clean exterior and interior window glass and frames.

M. Clean and sweep roofs, clear roof drains, clean gutters and downspouts, sunken wells,.

N. Broom clean and wash interior as well as exterior walks, paved surfaces, concrete floors, steps and other similar surfaces.

O. Use leaf blowers to clean landscaped surfaces.

P. Make good any damage caused by the completion of the *Work*, outside the *Place of the Work*, including necessary cleaning.

Q. Upon completion of cleaning operations, close off area to all but authorized personnel.

R. Upon completion of final cleaning, remove cleaning equipment, excess materials and debris from building and site.

1.6 WASTE MANAGEMENT AND DISPOSAL

A. Dispose of waste materials and recyclables at appropriate municipal landfills and recycling facilities in accordance with applicable regulatory requirements.

B. Do not burn or bury waste materials at *Place of the Work*.

C. Do not dispose of volatile and other liquid waste such as mineral spirits, oil, paints and other coating materials, paint thinners, cleaners, and similar materials together with dry waste materials or on the ground, in waterways, or in storm or sanitary sewers. Collect such waste materials in appropriate covered containers, promptly remove from *Place of the Work*, and dispose of at recycling facilities or as otherwise permitted by applicable regulatory requirements.

D. Cover or wet down dry waste materials to prevent blowing dust and debris.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF CLEANING AND WASTE MANAGMENT

SECTION 01 77 00
CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 READY-FOR-TAKEOVER

A. The prerequisites to attaining *Ready-for-Takeover* of the *Work* are described in the General Conditions of the *Contract*.

1.2 INSPECTION AND REVIEW BEFORE READY-FOR-TAKEOVER

A. *Contractor*'s Inspection: Before applying for the *Consultant*'s review to establish *Ready-for-Takeover* of the *Work*:
   1. Ensure that the specified prerequisites to *Ready-for-Takeover* of the *Work* are completed.
   2. Conduct an inspection of the *Work* to identify defective, deficient, or incomplete work.
   3. Prepare a comprehensive and detailed list of items to be completed or corrected.
   4. Provide an anticipated schedule and costs for items to be completed or corrected.

B. *Consultant*'s Review: Upon receipt of the *Contractor*'s application for review, together with the *Contractor*'s list of items to be completed or corrected, the *Consultant* will review the *Work*. The *Consultant* will advise the *Contractor* whether or not the *Work* is *Ready-for-Takeover* and will provide the *Contractor* with a list of items, if any, to be added to the *Contractor*'s list of items to be completed or corrected. Provide the *Consultant* with a copy of the *Contractor*'s revised list.

C. *Consultant*'s Review: Upon receipt of the *Contractor*'s application for review, together with the *Contractor*'s list of items to be completed or corrected, the *Consultant* and the *Contractor* shall arrange a mutually satisfactory agreed date and time to jointly review the *Work*. The *Consultant* will advise the *Contractor* whether or not the *Work* is *Ready-for-Takeover*. Add additional items, if any, to the *Contractor*'s list of items to be completed or corrected. Provide the *Consultant* with a copy of the revised list.

D. Maintain the list of items to be completed or corrected and promptly correct or complete defective, deficient and incomplete work. The Contractor's inspection and *Consultant*'s review procedures specified above shall be repeated until the *Work* is *Ready-for-Takeover* and no items remain on the *Contractor*'s list of items to be completed or corrected.

E. When the *Consultant* determines that the *Work* is *Ready-for-Takeover*, the *Consultant* will notify the *Contractor* and the *Owner* in writing to that effect.

1.3 PREREQUISITES TO FINAL PAYMENT

A. After *Ready-for-Takeover* of the *Work* and before submitting an application for final payment in accordance with the General Conditions of Contract:
   1. Correct or complete all remaining defective, deficient, and incomplete work.
   2. Remove from the *Place of the Work* all remaining surplus *Products*, *Construction Equipment*, and *Temporary Work*.
   3. .3 Perform final cleaning and waste removal necessitated by the *Contractor*'s work performed after *Ready-for-Takeover*, as specified in Section 01 74 00 – Cleaning and Waste Management.

1.4 SUBSTANTIAL PERFORMANCE OF THE WORK

A. The prerequisites to, and the procedures for, attaining substantial performance of the *Work*, or similar such milestone as provided for in the lien legislation applicable to the *Place of the Work*, shall be:
   1. Independent of those for attaining *Ready-for-Takeover* of the *Work*, and
   2. In accordance with the lien legislation applicable to the *Place of the Work*.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF CLOSEOUT PROCEDURES

SECTION 01 78 00
CLOSEOUT SUBMITTALS

PART 1 - GENERAL

1.1 OPERATION AND MAINTENANCE MANUAL

A. Prepare a comprehensive operation and maintenance manual, in the language of the *Contract*, using personnel qualified and experienced for this task.

B. Submit an initial draft of the operation and maintenance manual for *Consultant*'s review. If required by *Consultant*'s review comments, revise manual contents and resubmit for *Consultant*'s review. If required, repeat this process until *Consultant* accepts the draft manual in writing.

C. Submit final version to *Consultant* in hard copy and electronic format. Provide one hard copy and two digital copies on separate storage devices.

D. Pay costs of transportation of submissions.

1.2 OPERATION AND MAINTENANCE MANUAL FORMAT

A. Organize data in the form of an instructional manual.

B. Binders: vinyl, hard covered, three (3) D-rings, loose leaf, letter size, with spine and face pockets.

C. When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine.

D. Cover: Identify each binder with typed or printed title "Project Record Documents", name of *Project* or facility, and subject matter of contents.

E. Arrange content by systems, under Section numbers and sequence of Table of Contents.

F. Provide tabbed fly leaf for each separate *Product* or system, with typed description of *Product* and major component parts of equipment.

G. Text: Manufacturer's printed data, or typewritten data.

H. Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

A. Provide digital copy of Operation and Maintenance Manual in PDF format, organized in same form as binders, on single USB memory stick.

1.3 OPERATION AND MAINTENANCE MANUAL – GENERAL CONTENT

A. Table of contents for each volume.

B. Introductory information including:
1. Title of *Project*.
2. Date of manual submission.
3. Complete contact information for *Consultant*, subconsultants, other consultants, and *Contractor*, with names of responsible parties.
4. Schedule of *Products* and systems indexed to content of volume.

C. For each *Product* or system, include complete contact information for *Subcontractors*, *Suppliers* and manufacturers, including local sources for supplies and replacement parts.

D. *Product* Data: mark each sheet to clearly identify specific products, options, and component parts, and data applicable to installation. Delete or strike out inapplicable information. Supplement with additional information as required.

E. Typewritten text: as required to supplement *Product* data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 40 00.

F. Reviewed *Shop Drawings*.

G. Drawings: supplement *Product* data to illustrate relations of component parts of *Products* and systems, to show control and flow diagrams.

H. Permits, certificates, letters of assurance and other relevant documents issued by or required by authorities having jurisdiction.

I. Warranties.

J. Operating and maintenance procedures, incorporating manufacturer's operating and maintenance instructions, in a logical sequence.

K. Training materials as specified in Section 01 79 00 - Demonstration and Training.

1.4 OPERATION AND MAINTENANCE MANUAL - EQUIPMENT AND SYSTEMS CONTENT

A. 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.

B. Panel Board Circuit Directories: provide electrical service characteristics, controls, and communications.

C. Include installed colour coded wiring diagrams.

D. 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.

E. Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer's printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide installed control diagrams by controls manufacturer.

K. Provide *Contractor*'s coordination drawings, with installed colour coded piping diagrams.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include testing and balancing reports.

O. Include additional content as specified in technical *Specifications* sections.

1.5 OPERATION AND MAINTENANCE MANUAL - PRODUCTS AND FINISHES CONTENT

A. Include *Product* data, with catalogue number, options selected, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured *Products*.

B. Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.

C. Include an outline of requirements for routine and special inspections and for regular maintenance to ensure that on-going performance of the building envelope will meet the initial building envelope criteria.

D. Include additional content as specified in technical *Specifications* sections.

1.6 OPERATION AND MAINTENANCE MANUAL - WARRANTIES CONTENT

A. Obtain warranties and bonds, executed in duplicate by warrantors within ten days after completion of the applicable item of work. Except for items put into use with *Owner*'s permission, leave date for beginning of time of warranty blank until the date of *Substantial Performance of the Work* is determined. Co-execute when required. Retain warranties and bonds until time specified for submittal.

B. Separate each warranty with index tab sheets keyed to Table of Contents listing.

C. List each warrantor with complete contact information.

D. Verify that documents are in proper form and contain full information. Ensure that warranties are for the correct duration and are in *Owner*'s name.

1.7 CONTRACTOR'S AS-BUILT DRAWINGS

A. Create one set of comprehensive as-built documents. Record information on set of black line, opaque drawings, and in the copy of Project Manual provided by *Consultant*.

B. Provide felt tip marking pens, maintaining separate colours for each major system, for recording information.

C. Record information concurrently with construction progress. Do not conceal work until required information is recorded.

D. *Drawings* and *Shop Drawings*: legibly mark each item to record actual construction, including:
1. Measured depths of elements of foundation in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
4. Field changes of dimension and detail.
5. Changes made by *Change Orders*.
6. Details not on original *Drawings*.
7. References to related *Shop Drawings* and modifications.

E. Project Manual: 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 *Change Orders*.

F. Other documents: maintain manufacturer's certifications, inspection certifications, field test records required by individual and specifications sections.

G. Prior to *Substantial Performance of the Work*, submit one set of completed as-built documents for review by the *Consultant*.

H. Following review and acceptance of as-built documents by the *Consultant*, transfer information to CAD drawings and Project Manual. Submit completed record documents for use by the *Owner*.

1.8 PROJECT RECORD DRAWINGS

A. Transfer all information marked up on the as-built drawings during the progress of the *Work* to a master set of record drawing files provided by *Consultant*, in PDF electronic format.

B. Mark revised drawings as "RECORD DRAWINGS".

C. Submit completed record drawings in hard copy and electronic form to *Owner* and *Consultant*. Provide one (1) hard copy set.

D. In addition to requirements in General Conditions, maintain at the site for *Consultant* one record copy of:
1. *Drawings*.
2. Project Manual.
3. Addenda.
4. *Supplemental Instructions*.
5. *Change Orders* and other modifications to the *Contract*.
6. Reviewed *Shop Drawings*, *Product* data, and samples.
7. Field test records.
8. Inspection certificates.
9. Manufacturer's certificates.

E. Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.

F. Label record documents and files in accordance with section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.

G. Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.

H. Keep record documents and samples available for inspection by *Consultant*.

1.9 SPARE PARTS, MAINTENANCE MATERIALS, AND SPECIAL TOOLS

A. Supply spare parts, maintenance materials, and special tools in quantities specified in technical *Specifications* sections.

B. Ensure spare parts and maintenance materials are new, not damaged nor defective, and of same quality, manufacturer, and batch or production run as installed *Products*.

C. If requested, furnish evidence as to type, source and quality of products provided.

D. Defective products will be rejected, regardless of previous inspections. Replace products at own expense.

E. Provide tags for special tools identifying their function and associated *Product*.

F. Deliver to and store items at location directed by *Owner* at *Place of the Work*. Store in original packaging with manufacturer’s labels intact and in a manner to prevent damage or deterioration.

G. Remove and replace damaged *Products* at own expense and to satisfaction of the *Consultant*.

H. Obtain receipt for delivered products and submit prior to final payment.

I. Catalogue all items and submit to *Consultant* an inventory listing organized by *Specifications* section. Include *Consultant* reviewed inventory listing in operation and maintenance manual.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF CLOSEOUT SUBMITTALS

SECTION 01 79 00
DEMONSTRATION AND TRAINING

PART 1 - GENERAL

1.1 SUMMARY

A. Demonstrate and provide training to *Owner*'s personnel on operation and maintenance of equipment prior to scheduled date of *Ready-for-Takeover of the Work*.

B. *Owner* will provide list of personnel to receive training and will coordinate their attendance at agreed upon times.

C. Coordinate and schedule demonstration and training provided by *Subcontractors* and *Suppliers*.

1.2 SUBMITTALS

A. Submit proposed dates, times, durations, and locations for demonstration and training of each item of equipment and each system for which demonstration and training is required. Allow sufficient time for training and demonstration for each item of equipment or system, or time as may be specified in technical *Specifications*.

B. *Consultant* and *Owner* will review submittal and advise *Contractor* of any necessary revisions.

C. Submit report(s) within five (5) *Working Days* after completion of demonstration and training:
1. identifying time and date of each demonstration and training session,
2. summarizing the demonstration and training performed, and
3. including a list of attendees.

D. Submit video record of demonstration and training together with report.

1.3 PREREQUISITES TO DEMONSTRATION AND TRAINING

A. Testing, adjusting, and balancing has been performed in accordance with *Contract Documents*.

B. Equipment and systems are fully operational.

C. Copy of completed operation and maintenance manual is available for use in demonstration and training.

D. Conditions for demonstration and training comply with requirements specified in technical *Specifications*.

1.4 DEMONSTRATION AND TRAINING

A. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, [ ] and maintenance of each item of equipment and system.

B. Review operation and maintenance manual in detail to explain all aspects of operation and maintenance.

C. Prepare and insert additional information in operation and maintenance manual if required.

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF DEMONSTRATION AND TRAINING

SECTION 01 91 00
GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 COMMISSIONING AGENCY

A. *Contractor* shall retain and pay for a commissioning agency to provide commissioning services for the *Project*.

1.2 CONTRACTOR RESPONSIBILITIES

A. Prepare each system ready for commissioning. Verify systems installation is complete and in operation.

B. Coordinate commissioning with and assist commissioning agency.

C. Perform and document verification, performance testing, adjusting, and balancing operations.

D. Cooperate with commissioning agency and provide access to equipment and systems.

E. Provide personnel and operate systems at designated times, and under conditions required for proper commissioning.

F. Make instruments available to commissioning agency to facilitate spot checks during commissioning.

G. Participate in commissioning meetings.

H. Complete commissioning forms as requested by commissioning agency.

I. Correct deficiencies identified in commissioning process.

J. Incorporate commissioning data into operation and maintenance manual.

K. Ensure that commissioning agency participates in demonstration and training as specified in Section 01 79 00 – Demonstration and Training.

L. Provide instruments necessary for commissioning.

1.3 COMMISSIONING AGENCY RESPONSIBILITIES

A. The commissioning agency will:
1. Prepare a commissioning plan, including systems to be commissioned, forms, checklists and responsibilities of commissioning team members.
2. Implement the commissioning plan and lead the commissioning team through start-up, verification, performance testing, training, and document preparation.
3. Convene, chair, prepare and distribute minutes of commissioning meetings.
4. Supervise commissioning activities and witness inspections and tests.
5. Make periodic site visits for the purpose of selective checking of accuracy of commissioning form submissions, witness testing, and review of mock-ups.
6. Review content of operations and maintenance manual.
7. Provide instruments necessary for commissioning.

1.4 CONSULTANT RESPONSIBILITIES

A. Consultant will:
1. Participate in commissioning meetings.
2. Coordinate commissioning agency's involvement in *Shop Drawing* review process.
3. Review verification and performance test results and direct *Contractor* to correct defects or deficiencies in the *Work*.

4. Initiate *Change Orders* or *Change Directives* identified as necessary by the commissioning process.
5. Review final commissioning report.

1.5 OWNER RESPONSIBILITIES

A. *Owner* will:
1. Assign operations and maintenance personnel to participate in meetings, and witnessing of demonstration, and training.
2. Designate a person to acknowledge receipt of reports.

1.6 SCHEDULE OF EQUIPMENT AND SYSTEMS TO BE COMMISSIONED

A. Division 26
1. Section 26 32 13 Power Generation Diesel – 2 MW Power Diesel Generator (Page 11 of 38)

B. Division 26
1. Section 26 23 00 Low-Voltage Switchgear (Page 1 of 13)

PART 2 - PRODUCTS NOT USED

PART 3 - EXECUTION NOT USED

END OF GENERAL COMMISSIONING REQUIREMENTS

SECTION 02 41 99
DEMOLITION

PART 1 - GENERAL

1.1 RELATED SECTIONS

A. Section 01 71 00 – Examination and Preparation

B. Section 01 74 00 – Cleaning and Waste Management

C. Section 02 61 33 – Designated Substance Report

1.2 REFERENCES

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

1.3 SUBMITTALS

A. Submit *Shop Drawings* in accordance with Sections 01 33 00.

B. Before proceeding with demolition of load bearing walls or of other walls and where required by authority having jurisdiction submit for review by *Consultant* shoring and underpinning drawings prepared by qualified professional engineer registered or licensed in the Province of Ontario, showing proposed method.

1.4 SITE CONDITIONS

A. Review "Designated Substance Report" and take precautions to protect environment.

B. Should material resembling spray or trowel-applied asbestos or other designated substance listed as hazardous be encountered, stop work, take preventative measures, and notify *Consultant* immediately.
   1. Do not proceed until written instructions have been received from *Consultant*.

C. Notify *Consultant* before disrupting building access or services.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 PREPARATION

A. Inspect area of work with *Consultant* and verify extent and location of items designated for removal, disposal, alternative disposal, recycling, salvage and items to remain.

B. Locate and protect utilities. Preserve active utilities traversing site in operating condition.

C. Notify and obtain approval of utility companies before starting demolition.

D. Disconnect, cap, plug or divert, as required, existing public utilities within the property where they interfere with the execution of the work, in conformity with the requirements of the authorities having jurisdiction. Mark the location of these and previously capped or plugged

services on the site and indicate location (horizontal and vertical) on the record drawings. Support, shore up and maintain pipes and conduits encountered.

1. Immediately notify *Consultant* and utility company concerned in case of damage to any utility or service, designated to remain in place.
2. Immediately notify the Engineer should uncharted utility or service be encountered, and await instruction in writing regarding remedial action.

3.2 PROTECTION

A. Prevent movement, settlement, or damage to adjacent structures, utilities, landscaping features and parts of building to remain in place. Provide bracing and shoring required.

B. Keep noise, dust, and inconvenience to occupants to minimum.

C. Protect building systems, services and equipment.

D. Provide temporary dust screens, covers, railings, supports and other protection as required.

E. Do *Work* in accordance with Section 01 35 30.

3.3 SALVAGE

A. Refer to demolition drawings and specifications for items to be salvaged for reuse.

B. Remove items to be reused, store as directed by *Consultant*, and re-install under appropriate section of specification.

3.4 SITE REMOVALS

A. Remove items as indicated.

3.5 DEMOLITION

A. Remove parts of existing building to permit new construction. Sort waste materials into appropriate piles for reuse and recycling.

B. Trim edges of partially demolished building elements to tolerances as defined by *Consultant* to suit future use.

3.6 DISPOSAL

A. Dispose of removed materials, to appropriate recycling facilities and reuse facilities except where specified otherwise, in accordance with authority having jurisdiction.

B. See also Section 01 74 00.

END OF DEMOLITION

SECTION 02 61 33
DESIGNATED SUBSTANCES REPORT

PART 1 - GENERAL

1.1 REGULATORY REQUIREMENTS

A. A Designated Substances Report for this site has been completed by the *Owner* to fulfill the requirements under Section 30 of the Ontario Occupational Health and Safety Act, Revised Statutes of Ontario, 1990, Chapter 0.1as amended by O. Reg. 631/94. The Designated Substances are identified in the Occupational Health and Safety Act O. Reg. 213/91 as amended by O. Reg. 426/21.

B. The disturbance of asbestos materials on construction projects is controlled by Ontario Regulation 278/05.

C. The revised Regulation of Ontario (1990), Regulation 843 as amended by Ontario Regulation 109/04 (formerly Ontario Ministry of Labour Regulation 536/81) under the Occupational Health and Safety Act outlines the requirement to control airborne lead in industrial establishments. Exposure levels and respiratory protection in this regulation also apply to construction projects at a workplace where workers are likely to be exposed to lead.

D. The revised Regulation of Ontario (1990), Regulation 845 as amended by Ontario Regulation 606/05 (formerly Ontario Ministry of Labour Regulation Respecting Silica 769/83) which amends the Occupational Health and Safety Act, outlines the requirement to control airborne silica in industrial establishments. Exposure levels and respiratory protection in this regulation also apply to construction projects at a workplace where workers are likely to be exposed to lead.

E. All *Contractors* requesting bids from *Subcontractors* shall provide the required information to *Subcontractors*.

1.2 VALIDITY DATE

A. A designated substances survey for the *Place of the Work* has been conducted. Information provided is based on previous site visits to the building and sample information obtained from *Owner*'s reports. Since that time, designated substances may have been removed from or added to the project area.

B. Prior to beginning work confirm with *Owner* that additional designated substances have not been brought to the *Place of the Work*.

C. Due to the nature of building demolition, some inherent limitations exist as to the possible thoroughness of the designated substance survey. The survey did not include the demolition of floors, floor finishes, plaster ceilings or walls or other areas to examine concealed conditions. In addition, the survey does not refer to substances that may be present in the day-to-day usage of specialized equipment.

D. There is a possibility that materials may exist which could not reasonably be identified within the scope of this assessment, or which were not apparent during the site visit.

1.3 OCCUPATIONAL HEALTH AND SAFETY ACT

A. The following is an amendment to Bill 208 "An act to amend the Occupational Health and Safety Act, The Workers' Compensation Act" subsequently identified as amendment 18a. The following outlines the responsibilities of each party of the *Contract* as it relates to amendment 18a.

B. Duty of *Owner*: Before beginning a project, the *Owner* shall determine whether any designated substances are present at the *Place of the Work* and shall prepare a list of all designated substances that are present at the site.
   1. Tenders: If any work on a *Project* is tendered, the person issuing the tenders shall include, as part of the tendering information, a copy of the list referred to in subsection (1).
   2. Idem: An *Owner* shall ensure that a prospective constructor of a project on the *Owner*'s property has received a copy of the list referred to in subsection (1) before entering into a binding contract with the constructor.

C. Duty of Constructors: The constructor for a project shall ensure that each prospective contractor and subcontractor for the project has received a copy of the list referred to in subsection (1) before the prospective contractor or subcontractor enters into a binding contract for the supply of work on the project.
   1. Liability: An *Owner* who fails to comply with this section is liable to the constructor and every contractor and subcontractor who suffers loss or damages as the result of the subsequent discovery on the *Project* of a designated substance that the *Owner* ought reasonably to have known of but that was not on the list prepared under subsection (1).
   2. Idem: A constructor who fails to comply with this section is liable to every contractor and subcontractor who suffers any loss or damages as the result of the subsequent discovery on the project of a designated substance that was on the list prepared under subsection (1).
   3. WHMIS Inventory is available from the *Owner* through the office of the *Consultant*

PART 2 - DESIGNATED SUBSTANCES

2.1 REPORTS

A. The report is entitled *"Hazardous Building Materials Assessment Kingston General Hospital, 76 Stuart Street, Kingston, Ontario"* prepared for *Kingston Health Sciences Centre* as completed by *Pinchin Ltd.* and is included within this Project Manual and available for viewing at the office of the *Owner* at the *Kingston Health Sciences Centre Planning Office* located at *24 Barrie Street, Kingston, Ontario*.

B. It is the *Contractor*'s responsibility to be aware of the contents of the report.

PART 3 - EXECUTION NOT USED

END OF DESIGNATED SUBSTANCES REPORT

PART 1 - GENERAL

1.1 SUMMARY

A. Products installed but not [[furnished] [supplied]] under this Section:
   1. fabricated components
   2. anchor bolts
   3. bearing plates
   4. sleeves
   5. other inserts to be cast in or embedded into concrete

1.2 RELATED REQUIREMENTS

A. Section 03 20 00 - Concrete Reinforcing

B. Section 03 30 00 - Cast-in-Place Concrete

C. Section 03 30 00.09 - Cast-in-Place Concrete - Short Form

D. Section 05 50 00 - Metal Fabrications

E. Section 05 51 00 - Metal Stairs and Ladders

F. Section 07 92 00 - Joint Sealants

1.3 ABBREVIATIONS AND ACRONYMS

A. HDO: High density overlay plywood

B. MDO: Medium density overlay plywood

1.4 REFERENCE STANDARDS

A. CSA Group (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 O151-17, Canadian softwood plywood
   5. CSA O153-13, Poplar plywood
   6. CSA O325-16, Construction sheathing
   7. CSA O437.0-93, OSB and Waferboard
   8. CSA S269.1-16, Falsework and formwork

B. ULC Standards (ULC):
   1. CAN/ULC-S701.1:20, Standard for Thermal Insulation, Polystyrene Boards

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordinate with:
   1. Section 03 20 00 - Concrete Reinforcing.
   2. Section 03 30 00 - Cast-in-Place Concrete.
   3. Section 05 50 00 - Metal Fabrications for items embedded or cast into concrete.

B. Pre-Installation Meetings: Conduct a site meeting in accordance with Section 01 31 19 - Project Meetings, attended by Departmental Representative, Consultant and related Subcontractors to:
   1. Verify project requirements.
   2. Review delivery, storage, and handling requirements.
   3. Review installation and substrate conditions.
   4. Coordinate with other Subcontractors.

5. Review manufacturer's instructions and warranty requirements.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures.

B. Product Data:
   1. Submit manufacturer's instructions, product literature, and data sheets for proprietary materials used in formwork liners, water stops and coatings, including product characteristics, performance criteria, physical sizes, finishes, and limitations.
   2. Submit WHMIS Safety Data Sheet (SDS).

C. Submit shop drawings for formwork [and falsework].
   1. Submit drawings stamped and signed by professional engineer registered or licensed in the Province of Ontario, Canada.
   2. Prepare shop drawings in accordance with CSA S269.1 for formwork and falsework.
   3. Indicate formwork design data, permissible rate of concrete placement, and temperature of concrete in formwork.
   4. Indicate sequence of erection and removal of formwork and falsework.
   5. When slip forming and lying forms are used, submit details of equipment and procedures for review by Consultant.
   6. Indicate method and schedule of construction, shoring, stripping and re-shoring procedures, materials, arrangement of joints, special architectural exposed finishes, ties, liners, and locations of temporary embedded parts.
   7. Include the following information on falsework shop drawings:
      a. Longitudinal, lateral, vertical, dead, live and impact loads used in design.
      b. Allowable bearing capacity of soil underneath mud sills.
      c. Maximum column, post and support loads.
      d. Deflection diagrams for beams with deflection of 10 mm or more.
      e. Deflection diagrams indicating initial and final elevation of deck surfaces, roofs and soffits.
      f. Grade of structural steel.
      g. Indicate steel posts, girders, beams, connections, bracing and welding, providing sufficient detail for safe performance of falsework.
      h. Fully detailed steel frame shoring.
      i. Species, grades and sizes of wood.
      j. Type and weight of equipment (moving or stationary) supported by falsework.
      k. Sequence, methods and rate of concrete placement.
      l. Proprietary equipment, adequately identified for checking purposes.
      m. Full details and locations of splices.

1.7 QUALITY ASSURANCE

A. Perform in accordance with Section 01 43 00 - Quality Assurance.

B. Retain a professional engineer registered or licensed in the Province of Ontario, Canada with experience in formwork and falsework design of comparable complexity and scope to this project to perform the following services as part of work of this Section:
   1. Design of formwork and falsework.
   2. Review, stamp, and sign fabrication and erection shop drawings, design calculations and amendments.
   3. Conduct on-site inspections. Prepare and submit inspection reports verifying this part of work is in accordance with Contract Documents and reviewed Shop Drawings.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Perform in accordance with Section 01 61 00 - Common Product Requirements.
   1. Storage and Handling Requirements: Maintain formwork liners for architectural concrete without defects or damages that could affect concrete appearance or cause staining.

B. Packaging Waste Management: Remove pallets, crates and all packaging materials for reuse by manufacturer and return as specified in Construction Waste Management Plan in accordance with Section 01 74 19 - Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials and resources in accordance with Section 01 47 15 - Sustainable Requirements: Construction.

B. Perform verification requirements in accordance with Section 01 33 29 - Sustainable Design Reporting.

C. Formwork Materials:
1. For concrete without special architectural features, use wood and wood product formwork materials to CSA O86, CSA O437.0 and CSA O153.
2. For concrete with special architectural features, use formwork materials to CSA O121 and CSA A23.1/A23.2.
3. Rigid insulation board: To CAN/ULC-S701.1.

D. Pan Forms: removable and permanent free of bends, dents, and residual concrete with a high potential for reuse.

E. Tubular Column Forms: Round, spirally wound, polyethylene impregnated virgin kraft interior layer and a waxed exteriorinternally treated with release material.

F. Form Ties:
1. For concrete not designated ‘Architectural’: Removable or snap-off metal ties, fixed or adjustable length, and free of devices leaving holes larger than 25 mm in diameter in concrete surface.
2. For architectural concrete: Snap ties complete with plastic cones and light grey precast concrete plugs.

G. Form Liner:
1. Plywood: Plywood: In accordance with CSA O121, G1S, high-density overlay, Douglas Fir
T&G edge, minimum 6 mm thick and G1S with resin bonded fibre coating for a smooth finish free of irregularities, dents and surface defects.
2. Waferboard: To CSA O325

H. Form Release Agent: Proprietary, non-volatile material that will not stain concrete or hinder the application of subsequent coatings, treatments, or flooring materials to the concrete surface.

I. Falsework Materials: To CSA S269.1.

J. Sealant: To Section 07 92 00 - Joint Sealants.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before placing concrete, clean formwork in accordance with CSA A23.1/A23.2.

3.2 FABRICATION AND ERECTION

A. Verify lines, levels, and centres before proceeding with formwork/falsework. Confirm that dimensions match the Drawings.

B. Obtain Departmental Representative's acceptance for use of earth forms framing openings not indicated on Drawings.

C. Hand trim sides and bottoms and remove loose soil from earth forms before placing concrete.

D. Fabricate and erect falsework in accordance with CSA S269.1.

E. Do not place shores and mud sills on frozen ground.

F. Provide site drainage to prevent washout of soil supporting mud sills and shores.

G. Fabricate and erect formwork in accordance with CSA S269.1 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA A23.1/A23.2.

H. Align form joints and make watertight.
   1. Minimize the number of form joints used.

I. Locate horizontal form joints for exposed columns 2 400 mm above finished floor elevation.

J. Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners and joints, unless otherwise indicated on Drawings.

K. Form chases, slots, openings, drips, recesses, and expansion and control joints as indicated.

L. Refer to architectural Drawings for concrete members requiring architectural exposed finishes.

M. Construct forms for architectural concrete and place ties as indicated on Drawings and as directed.
   1. Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.

N. Build in anchors, sleeves, and other inserts required to accommodate work specified in other Sections.
   1. Ensure that anchors and inserts will not protrude beyond surfaces designated to receive applied finishes, including painting.

O. Line forms for the following surfaces:
   1. Outer face of outside box structure and sidewalk slab.
   2. Soffit of girders and underside of bridge decks if exposed.
   3. Exposed faces of abutments, wingwalls, piers and pylons. Do not stagger joints of form lining material. Align joints to obtain uniform pattern.

P. Lining forms installation process:
   1. Secure lining taut to formwork to prevent folds.
   2. Pull down lining over edges of formwork panels.
   3. Ensure lining is new and not reused material.
   4. Ensure lining is dry and free of oil when concrete is poured.
   5. Application of form release agents on formwork surface is prohibited where drainage lining is used.
   6. If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
   7. Cost of textile lining is included in price of concrete for corresponding portion of work.

Q. When slip forming or flying forms are used, submit details as indicated in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section.

3.3 REMOVAL AND RESHORING

A. Leave formwork in place after placing concrete for a minimum:
   1. 4 days for walls, sides of beams, columns, footings and abutments.
   2. 14 days for beam soffits, slabs, decks and other structural members, or 3 days when replaced immediately with adequate shoring to standard specified for falsework.

B. Remove formwork when concrete has reached 70% of its 28-day design strength or minimum period noted above, whichever comes later, and replace immediately with adequate reshoring.

C. Provide necessary reshoring of members where early removal of forms may be required or where members may be subjected to additional loads during construction as required.

D. Space reshoring in each principal direction at not more than 3 000 mm apart.

E. Reuse formwork and falsework subject to requirements of CSA A23.1/A23.2.

3.4 SITE QUALITY CONTROL

A. Site Inspections:
1. Professional engineer responsible for signing and stamping shop drawings to conduct on-site inspections and prepare and submit inspection reports verifying this part of the work is in accordance with Contract Documents and reviewed shop drawings.
2. Perform inspections a minimum of two per month.

3.5 CLEANING

A. Cleaning: Perform in accordance with Section 01 74 00 - Cleaning.

B. Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.
1. Once a form can no longer be used, deposit in an on-site recycling bin.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Formwork And Falsework

B. Section 03 30 00 – Cast-in-Place Concrete

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Measure reinforcing steel in kilograms of steel incorporated into the Work, computed from theoretical unit mass specified in CSA G30.18 for lengths and sizes of bars as indicated or as authorized in writing by Departmental Representative.

1.3 DEFINITIONS

A. Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life cycle assessment information. Prepared in accordance with ISO 14025, 14040, 14044, and EN 15804 or ISO 21930 and have at least a cradle-to-gate scope.
   1. Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.
   2. Product-specific Type III EPD - Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

1.4 REFERENCE STANDARDS

A. American Concrete Institute (ACI):
   1. MNL-66-20, ACI Detailing Manual

B. ASTM International:
   1. ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
   2. ASTM A143/A143M-07, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement
   3. ASTM A641/A641M-19, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire
   4. ASTM A767/A767M-19, Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
   5. ASTM A775/A775M-19, Standard Specification for Epoxy-Coated Steel Reinforcing Bars
   6. ASTM A884/A884M-19e1, Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement
   7. ASTM A1064/A1064M-18a, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete

C. British Standards Institution (BSI Group):
   1. EN 15804:2012, Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products

D. CSA Group (CSA):
   1. CSA A23.1:19/CSA A23.2:19, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete
   2. CSA A283:19, Qualification Code for Concrete Testing Laboratories
   3. CSA A23.3:19, Design of Concrete Structures
   4. CSA G30.18-09, Carbon Steel Bars for Concrete Reinforcement

5. CSA G40.20-13/G40.21-13, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel
6. CSA W186:21, Welding of Reinforcing Bars in Reinforced Concrete Construction

E. International Organization for Standardization (ISO):
1. ISO 14025:2006, Environmental labels and declarations — Type III environmental declarations — Principles and procedures
2. ISO 14040:2006, Environmental management — Life cycle assessment — Principles and framework
3. ISO 14044:2006, Environmental management — Life cycle assessment — Requirements and guidelines
4. ISO 21930:2017, Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

F. Reinforcing Steel Institute of Canada (RSIC):
1. RSIC-2020, Manual of Standard Practice

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:
1. Coordinate with Section 03 30 00 – Cast-in-Place Concrete

B. Pre-Installation Meetings: In accordance with Section 01 31 19 - Project Meetings, hold pre-concrete pouring meeting one week before pouring concrete.
1. Ensure key personnel, site supervisor, Departmental Representative, Consultant, specialty contractor - finishing, forming concrete producer attend.
   a. Verify project requirements.
   b. Review reinforcing testing report.

1.6 ACTION AND INFORMATIONAL SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures.

B. Product Data:
1. Submit manufacturer’s instructions if available, product literature and data sheets for proprietary materials used in concrete reinforcement. Include product characteristics, performance criteria, physical sizes, finishes, and limitations.
2. When a chromate solution is used as a replacement for galvanizing non-prestressed reinforcement, submit a product description for review by Departmental Representative before its use.
3. Submit WHMIS Safety Data Sheet (SDS).

C. Shop Drawings:
1. Submit shop drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
   a. Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice and ACI MNL-66.
   b. Indicate placing of reinforcement and:
      1) Bar bending details.
      2) Quantities of reinforcement.
      3) Sizes, spacing, locations of reinforcement and mechanical splices if approved by Departmental Representative with identifying code marks to permit correct placement without reference to structural drawings.
      4) Indicate sizes, spacing and locations of chairs, spacers and hangers.
   c. Detail lap lengths and bar development lengths to CSA A23.3, unless otherwise indicated on Drawings.
      1) Provide Type B tension lap splices unless otherwise indicated on Drawings.
   d. Indicate position and size of openings in slabs and walls. Coordinate with the different trades requiring openings.

e. Indicate the concrete cover dimension to the reinforcement.

D. Certificates:
1. When requested, submit epoxy coating applicator certificate.

E. Test and Evaluation Reports:
1. When requested, submit certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks before beginning reinforcing work].

F. Source Quality Control Submittals:
1. When requested, submit, in writing, proposed source of reinforcement material.

1.7 QUALITY ASSURANCE

A. Qualifications:
1. Testing Laboratory: Certified to CSA A283.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Perform in accordance with Section 01 61 00 - Common Product Requirements.

B. Package bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

C. Storage and Handling Requirements:
1. Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.

PART 2 - PRODUCTS

2.1 SUSTAINABILITY CHARACTERISTICS

2.2 MATERIALS

A. Substitute different sized bars only if permitted in writing by Departmental Representative.

B. Reinforcing Steel: Billet steel, grade 400, deformed bars to CSA G30.18, unless otherwise indicated.

C. Reinforcing steel: Weldable low alloy steel deformed bars to CSA G30.18.

D. Cold-drawn annealed steel wire ties: To ASTM A1064/A1064M.

E. Deformed steel wire for concrete reinforcement: To ASTM A1064/A1064M.

F. Galvanizing of non-prestressed reinforcement: To ASTM A123/A123M coating Grade 85, minimum zinc coating 610 g/m^2 or ASTM A767/A767M.
1. Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
2. If chromate treatment is carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
a. Maintain temperature of solution at a minimum of 32°C and immerse galvanized steels for a minimum of 20 seconds.
3. If galvanizing steel at ambient temperature, add a 0.5% to 1% concentration of sulphuric acid as a bonding agent.
a. There are no temperature requirements for the aqueous solution.
4. Chromate solution of equal effectiveness manufactured for this purpose may replace aqueous solution.
a. Submit product description as described in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section.

G. Chairs, bolsters, bar supports, spacers: To CSA A23.1/A23.2.

H. Tie wire: 1.5 mm diameter annealed wire.

I. Mechanical splices: Subject to approval from Departmental Representative.

J. Plain round bars: To CSA G40.20/G40.21.

2.3 FABRICATION

A. Fabricate reinforcing steel in accordance with CSA A23.1/A23.2, ACI MNL-66 and Reinforcing Steel Manual of Standard Practice by the Reinforcing Steel Institute of Canada.

B. Obtain Departmental Representative written approval for locations of reinforcement splices other than those shown on Contract Drawings and shop drawings.

C. Upon approval from Departmental Representative, weld reinforcement in accordance with CSA W186.

PART 3 - EXECUTION

3.1 PREPARATION

A. Galvanizing to include chromate treatment.
   1. Duration of treatment: 1 hour per 25 mm of bar diameter.

B. Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

3.2 SITE BENDING

A. Do not bend or weld reinforcement on site except where indicated or when authorized by Departmental Representative.
   1. If site bending is authorized, bend reinforcement without heat, applying slow and steady pressure.
   2. Replace reinforcement bars that develop cracks or splits.

3.3 PLACING REINFORCEMENT

A. Cutting or puncturing vapour retarder is not permitted. Repair damage and reseal vapour retarder before placing concrete.

B. Place reinforcing steel as indicated on placing drawings and in accordance with CSA A23.1/A23.2.

C. Use plain round bars as slip dowels in concrete.
   1. Paint portion of dowel intended to move within hardened concrete with one coat of asphalt paint.
   2. After paint has dried, apply thick even film of mineral lubricating grease.

D. Before placing concrete, obtain Departmental Representative's approval of reinforcing material and placement.

E. Maintain minimum concrete cover to reinforcement during concrete placement.

3.4 SITE TOUCH-UP

A. Touch-up reinforcing steel where damaged and at cut ends of galvanized reinforcing to ASTM A780.

3.5 SITE QUALITY CONTROL

A. Site tests: Conduct tests on the following [in accordance with Section 01 45 00 - Quality Control] and submit report as described in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section:

1. Reinforcing steel and welded wire fabric.

B. Inspection and testing of reinforcing and reinforcing materials carried out by testing laboratory designated by Departmental Representative for review to CSA A23.1/A23.2.

C. Distribute test results for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.

D. Owner will pay for costs of tests as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

3.6 CLEANING

A. Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.

B. Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

C. Waste Management: Perform in accordance with Section 01 74 19 - Waste Management and Disposal.
1. Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

A. Section 03 10 00 - Concrete Forming and Accessories

B. Section 03 20 00 - Concrete Reinforcing

1.2 PRICE AND PAYMENT PROCEDURES

A. Measurement and Payment:
   1. Measurement Procedures: In accordance with Section 01 29 00 - Payment Procedures.
   2. Measure cast-in-place concrete in cubic metres calculated from neat dimensions authorized in writing by Departmental Representative.
      a. Concrete placed beyond dimensions indicated are not measured.
   3. No deductions made for volume of concrete displaced by reinforcing steel, structural steel, or piles.
   4. No deductions made for volume of concrete less than 0.1 m^3 in volume displaced by individual drainage openings.
   5. Cast-in-place concrete not measured but paid for as a fixed price item.
   6. Supply and installation of anchor bolts, nuts and washers and bolt grouting not measured but considered incidental to work.
   7. Measure supply and installation of waterstops in lineal metres installed.

1.3 ABBREVIATIONS AND ACRONYMS

A. Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement types:
   1. GU, GUb, GUL and GULb - General use cement
   2. MS, MSb and MSLB - Moderate sulphate-resistant cement
   3. MH, MHb, MHL and MSLB - Moderate heat of hydration cement
   4. HE, HEb, HEL and HELb - High early-strength cement
   5. LH, LHb, LHL LHLb - Low heat of hydration cement
   6. HS, HSb and HSLb - High sulphate-resistant cement

B. Fly ash types:
   1. F - with a maximum CaO content of 8%
   2. CI - with CaO content of 15% and 20%
   3. CH - with a minimum CaO content of 20%

C. Other Supplementary Cementitious Materials (SCM) types:
   1. S-GGBFS - Ground, granulated blast-furnace slag
   2. N – Natural pozzolan
   3. SF – Silica fume with minimum silicon dioxide (SiO_2) content of 85%
   4. SFI – Silica fume with silicon dioxide (SiO_2) content between 75% and 85%
   5. GL – Ground glass with maximum total alkali (NaEq) content of 4%
   6. GH – Ground glass with total alkali (NaEq) content between 4% and 13%

1.4 DEFINITIONS

A. Environmental Product Declaration (EPD): Third-party verified documentation with the supporting Product Category Rule (PCR) and Life Cycle Assessment information. Prepared in accordance with ISO 14025, ISO 14040, ISO 14044, and EN 15804 or ISO 21930 and having at least a cradle-to-gate scope.
   1. Industry-wide (generic) EPD with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

2. Product-specific Type III EPD - Products with third-party certification (Type III), including external verification in which the manufacturer is explicitly recognized as the participant by the program operator.

B. Supplementary Cementitious Materials (SCM)s: Materials added to concrete which contribute to the properties of hardened concrete through hydraulic or pozzolanic activity.

C. Workability: This term broadly describes the total properties and expectations for concrete delivered to site as follows:
1. Individual tested properties of concrete that account for confined or free flow slump, penetration, compaction, or relative plasticity of various concrete mix designs used for the project.
2. Overall properties involved with mixing, handling, transportation, and placement using vibratory compaction methods without loss of homogeneity of in-place concrete.

1.5 REFERENCE STANDARDS

A. ASTM International (ASTM):
1. ASTM C171-20, Standard Specification for Sheet Materials for Curing Concrete
2. ASTM C260/C260M-10a, Standard Specification for Air-Entraining Admixtures for Concrete
3. ASTM C309-19, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete
4. ASTM C494/C494M-17, Standard Specification for Chemical Admixtures for Concrete
5. ASTM C881/C881M-20a, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete
6. ASTM C1017/C1017M-13e1, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete
7. ASTM C1059/C1059M-21, Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete
8. ASTM D412-16, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension
9. ASTM D624- 00, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers
10. ASTM D1751- 18, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
11. ASTM D1752- 18, Standard Specification for Preformed Sponge Rubber, Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction

B. British Standards Institution (BSI Group):
1. EN 15804:2012, Sustainability of construction works — Environmental product declarations — Core rules for the product category of construction products

C. Canadian General Standards Board (CGSB):
1. CAN/CGSB-51.34-M 86, Vapour Barrier, Polyethylene Sheet for Use in Building Construction

D. CSA Group (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 A283: 19, Qualification Code for Concrete Testing Laboratories
3. CSA A3000- 18, Cementitious Materials Compendium

E. International Organization for Standardization (ISO):
1. ISO 14025:2006, Environmental labels and declarations — Type III environmental declarations — Principles and procedures
2. ISO 14040:2006, Environmental management — Life cycle assessment — Principles and framework

3. ISO 14044:2006, Environmental management — Life cycle assessment — Requirements and guidelines
4. ISO 21930:2017, Sustainability in buildings and civil engineering works — Core rules for environmental product declarations of construction products and services

1.6 ADMINISTRATIVE REQUIREMENTS

A. Pre-Installation Meetings: In accordance with Section 01 31 19 - Project Meetings, convene pre-installation meeting one week before beginning concrete works.
   1. Ensure key personnel, site supervisor,Departmental Representative, Consultant speciality Subcontractor - finishing, forming concrete producer attend.
      a. Verify project requirements.
      b. Discuss appropriate Subcontractor footwear that will not damage the underslab membrane, and other related precautions required to ensure the membrane's continuous integrity.

B. Coordination:
   1. Coordinate sequencing and installation of underslab waterproofing membrane with Section 07 26 00 - Vapour Retarders.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

A. Submit in accordance with Section 01 33 00 - Submittal Procedures.

B. Product Data:
   1. Submit manufacturer's instructions, product literature and data sheets for proprietary materials used in cast-in-place concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.
   2. Submit WHMIS Safety Data Sheet (SDS).

C. Samples:
   1. When requested, submit two samples a minimum 4 weeks before beginning work for review and acceptance of materials proposed for use as follows:
      a. 1 m length of each type of joint filler.
      b. 1 m length of each type of waterstop.
   2. Samples will [not] be returned for inclusion into work.

1.8 QUALITY ASSURANCE

A. Quality Assurance: In accordance with Section 01 43 00 - Quality Assurance.

B. Submit a valid and recognized certificate from the plant delivering the concrete a minimum of four weeks before starting concrete work for approval by Departmental Representative.
   1. Submit test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture meet specified requirements.

C. Inform Departmental Representative of fly ash source at least four weeks before beginning concrete work.
   1. Changing source of fly ash without written approval from Departmental Representative is prohibited.

D. Submit proposed quality control procedures a minimum four weeks before starting concrete work, for review by Departmental Representative on the following items:
   1. Falsework erection
   2. Hot weather concrete
   3. Cold weather concrete
   4. Curing
   5. Finishes
   6. Formwork removal
   7. Joints

E. Quality Control Plan: Submit written report to Departmental Representative verifying compliance that cast-in-place concrete meets performance requirements of concrete as established in PRODUCTS in Part 2 of this Section.

F. Mock-Ups: Construct site mock-up for architectural finished concrete indicating forming methods and materials, and procedures proposed to achieve architectural finish in accordance with Section 01 43 00 - Quality Assurance, to comply with the following requirements:
   1. Build mock-up in location and size as directed by Departmental Representative.
   2. Mock-up may form part of permanent structure when accepted by Departmental Representative.
   3. In the presence of Departmental Representative, intentionally damage part of exposed face for each finish, colour, and texture to demonstrate the proposed techniques and materials to be used for repairs to match adjacent undamaged surfaces.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
   1. Concrete hauling time: Deliver to site of Work and discharge within a maximum of 120 minutes after batching.
   2. Modifying maximum time limit before receiving written agreement from Departmental Representative and concrete producer as described in CSA A23.1/CSA A23.2 is prohibited.
   3. Submit deviations for review by Departmental Representative.
   4. Concrete delivery: Ensure continuous concrete delivery from plant meets CSA A23.1/CSA A23.2.

B. Packaging Waste Management: Remove pallets,crates,and packaging materials for reuse by manufacturer and return in accordance with Section 01 74 19 - Waste Management and Disposal.

1.10 SITE CONDITIONS

A. Placing concrete during rain or weather events that could damage concrete is prohibited.

B. Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/CSA A23.2

C. Cold weather protection:
   1. Maintain protection equipment in readiness on Site.
   2. Use protection equipment when ambient temperature is below 5°C, or when temperature may fall below 5°C before concrete has cured.
   3. Placing concrete upon or against surface at temperature below 5°C is prohibited.

D. Hot weather protection:
   1. Protect concrete from direct sunlight when ambient temperature is above 27°C.
   2. Prevent forms from getting too hot before concrete is placed. Apply accepted methods of cooling that will not negatively affect concrete.

E. Protect concrete from drying.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

A. Alternative 1 - Performance: To CSA A23.1/CSA A23.2, and as described in MIXES in PART 2 - PRODUCTS of this Section.

2.2 PERFORMANCE CRITERIA

A. Quality Control Plan: Ensure concrete supplier meets performance criteria of concrete as established by Departmental Representative and provide verification of compliance as described in QUALITY ASSURANCE in Part 1 of this Section.

B. Provide supplementary cementitious materials and products that contribute to a 15 % reduction in the Global Warming Potential (GWP) against the listed GWP identified in the industry-wide EPD and a reduction in the environmental impact categories as measured through a cradle-to-gate scope.

C. Provide supplementary cementitious materials and products that contribute to a maximum GWP of 250 kgCO 2 /m ^{3} against the listed GWP identified in the industry-wide EPD and a reduction in the environmental impact categories as measured through a cradle-to-gate scope.

D. Recycled Content: Use of supplementary cementitious materials that contribute to a 20 % reduction in the quantity of Portland cement used as part of a concrete mix design.
   1. Provide Supplementary Cementitious Materials (SCM) and products that contain or are sourced from processes that use post-consumer and pre-consumer recycled content.

2.3 MATERIALS

A. Portland Cement: GU, MS

B. Blended hydraulic cement: Type Gub to CSA A3000.

C. Supplementary non-cementitious materials: Reduction in cement through the use of CO 2 mineralization, in accordance with CSA A23.1/CSA A23.2 Annex S.

D. Water: To CSA A23.1/CSA A23.2.

E. Aggregates: To CSA A23.1/CSA A23.2.

F. Admixtures:
   1. Air entraining admixture: To ASTM C260/C260M.
   2. Chemical admixture: To ASTM C494/C494M. Departmental Representative to approve accelerating or set retarding admixtures during cold and hot weather placing.
   3. Corrosion-inhibiting admixture: To meets the requirements of ASTM C1582.
   4. Shrinkage-reducing admixture (SRA): To ASTM C494.

G. Post-Tensioning Ducts: To CSA A23.1/CSA A23.2.

H. Curing Compound: To CSA A23.1/CSA A23.2.

I. Pre-moulded Joint Fillers:
   1. Bituminous impregnated fibreboard: To ASTM D1751.
   2. Sponge rubber: To ASTM D1752..
   3. Self-expanding or Standard cork: To ASTM D1752.

J. Weep hole tubes: Galvanized steel.

K. Dovetail anchor slots: Minimum 0.6-mm-thick galvanized steel with insulation filled slots.

L. Concrete Bonding Agents: Epoxy to ASTM C881/C881M, Type V, Latex to ASTM C1059/C1059M.

2.4 MIXES

A. Alternative 1 - Performance Method for specifying concrete: To meet Departmental Representative, performance criteria to CSA A23.1/CSA A23.2.
   1. Concrete supplier to meet performance criteria as established below and provide verification of compliance as in Quality Control Plan.
   2. Provide concrete mix to meet the following hard state requirements:
      a. Compressive strength at 28 days age: Minimum 35 MPa.

b. Coarse aggregate size maximum 20 mm.

PART 3 - EXECUTION

3.1 PREPARATION

A. Obtain Departmental Representative's written approval before placing concrete.
   1. Provide a minimum of 24 hours notice before placing of concrete.

B. Place concrete reinforcing in accordance with Section 03 20 00 - Concrete Reinforcing.

C. During concreting operations:
   1. Development of cold joints not allowed.
   2. Ensure concrete delivery and handling facilitate placing with minimum amount of re-handling, and without damage to existing structure or Work.

D. Pumping of concrete permitted only after approval of equipment and mix.

E. Disturbing reinforcement and inserts during concrete placement is prohibited.

F. Before placing of concrete obtain Departmental Representative's approval of proposed method for protection of concrete during placing and curing.

G. Protect previous work from staining.

H. Clean and remove stains before application for concrete finishes.

I. Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.

J. In locations where new concrete is dowelled to existing work, drill holes in existing concrete.
   1. Place steel dowels [of deformed steel reinforcing bars] [smooth steel bars] and pack solidly with [shrinkage compensating grout] [epoxy grout] to anchor and hold dowels in positions as indicated.

K. Do not place load upon new concrete until authorized by [Departmental Representative] [DCC Representative] [Consultant].

3.2 INSTALLATION/APPLICATION

A. Do cast-in-place concrete work in accordance with CSA A23.1/CSA A23.2.

B. Sleeves and inserts:
   1. Do not permit penetrations, sleeves, ducts, pipes or other openings to pass through joists, beams, column capitals or columns, except where indicated or approved by Departmental Representative.
   2. Where approved by Departmental Representative, set sleeves, ties, pipe hangers and other inserts and openings as indicated or specified elsewhere.
   3. Sleeves and openings greater than 100 x 100 mm that are not indicated in the reviewed shop drawings must be approved by Departmental.
   4. Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from Departmental Representative before placing concrete.
   5. Confirm locations and sizes of sleeves and openings shown on drawings.
   6. Set special inserts for strength testing as indicated and as required by non-destructive method of testing concrete.

C. Installation - Anchor bolts:
   1. Set anchor bolts to templates in coordination with appropriate Subcontractor before placing concrete.

2. Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from Departmental Representative.
3. Protect anchor bolt holes from water accumulation, and snow and ice build-ups.
4. Set bolts and fill holes with epoxy grout.
5. Locate anchor bolts used in connection with expansion shoes, rollers and rockers taking into consideration ambient temperature at time of erection.

D. Installation - Drainage holes and weep holes:
1. Form weep holes and drainage holes in accordance with Section 03 10 00 - Concrete Forming and Accessories. If wood forms are used, remove them after concrete has set.
2. Install weep hole tubes and drains as indicated on Drawings.

E. Installation - Dovetail anchor slots: In accordance with Section 04 05 00 - Common Work Results for Masonry.
1. Install continuous vertical anchor slot to forms where masonry abuts concrete wall or columns.
2. Install continuous vertical anchor slots at 800 mm on centre where concrete walls are masonry faced.

F. Installation - Grout under base plates using procedures in accordance with manufacturer's recommendations which result in 100 % contact over grouted area.

G. Finishing and curing:
1. Finish concrete to CSA A23.1/CSA A23.2.
2. Use procedures as reviewed by Departmental Representative or those noted in CSA A23.1/CSA A23.2 to remove excess bleed water. Ensure surface is not damaged.
3. Cure concrete in accordance with CSA A23.1/CSA A23.2. If required, use curing compounds compatible with applied finish on concrete surfaces. Use sheet materials in accordance with ASTM C171 for curing concrete floor slabs.
4. Finish concrete floor to CSA A23.1/CSA A23.2.
5. Provide swirl-trowelled finish unless otherwise indicated.
6. Rub exposed sharp edges of concrete with carborundum to produce a minimum 3-mm radius edges unless otherwise indicated.

H. Installation - Waterstops:
1. Install waterstops to provide continuous water seal.
2. Do not distort or pierce waterstop in way as to hamper performance.
3. Do not displace reinforcement when installing waterstops.
4. Use equipment to manufacturer's requirements to site splice waterstops.
5. Tie waterstops rigidly in place.
6. Use only straight heat sealed butt joints on site.
7. Use factory welded corners and intersections unless otherwise approved by Departmental Representative.

I. Installation - Joint fillers:
1. Provide filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by Departmental Representative.
2. When more than one piece required for joint, fasten abutting ends and hold securely to shape by stapling or other positive fastening.
3. Locate and form isolation, construction and expansion joints as indicated.
4. Install joint filler.
5. Use 12-mm-thick joint filler to separate slabs-on-grade from vertical surfaces and extend joint filler from bottom of slab to finished slab surface unless otherwise indicated.

J. Installation - Damp-proof membrane:
1. Install damp-proof membrane under concrete slabs-on-grade inside building.
2. Lap damp-proof membrane a minimum 150 mm at joints and seal.
3. Seal punctures in damp-proof membrane before placing concrete.
4. Use patching material a minimum 150 mm larger than puncture and seal.

3.3 TOLERANCES

A. Concrete surface tolerance to CSA A23.1/CSA A23.2.

3.4 SITE QUALITY CONTROL

A. Site tests: Conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in ACTION AND INFORMATIONAL SUBMITTALS in Part 1 of this Section.
   1. Concrete pours
   2. Slump
   3. Air content
   4. Compressive strength at 7 and 28 days
   5. Air and concrete temperature

B. Inspection and testing of concrete and concrete materials carried out by testing laboratory designated by Departmental Representative to CSA A23.1/CSA A23.2.
   1. Ensure testing laboratory certified to CSA A283.

C. Distribute test results for discussion at pre-pouring concrete meeting between testing laboratory and Departmental Representative.

D. Owner will pay for costs of tests or as specified in Section 01 29 83 - Payment Procedures for Testing Laboratory Services.

E. Testing agency will take additional test cylinders during cold weather concreting. Cure cylinders on Project site under same conditions as concrete which they represent.

F. Non-Destructive Methods for Testing Concrete: To CSA A23.1/CSA A23.2.

G. Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.5 CLEANING

A. Clean in accordance with Section 01 74 00 - Cleaning.
   1. Provide appropriate area on Project site where concrete trucks can be safely washed.

B. Waste Management: Separate waste materials for reuse and recycling in accordance with Section 01 74 19 - Waste Management and Disposal.
   1. Divert unused concrete materials from landfill to local facility.
   2. Divert unused admixtures and additive materials (pigments, fibres) from landfill to official hazardous material collections site.
   3. Disposal of unused admixtures and additive materials, concrete, concrete washwater, or cleaning materials and residues into sewer systems, into lakes, streams, onto ground or in other locations that pose a health or environmental hazard is prohibited.
   4. Prevent admixtures and additive materials from entering drinking water supplies or streams.
   5. Using appropriate safety precautions, collect liquid or solidify liquid with inert, noncombustible material and remove for disposal.

END OF SECTION

1 General

1.1 SECTION INCLUDES

1.1.1 Design, labour, Products, equipment and services necessary for the structural steel Work in accordance with the Contract Documents.

1.2 REFERENCES

1.2.1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.2.2 ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

1.2.3 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).

1.2.4 ASTM A563M, Standard Specification for Carbon and Alloy Steel Nuts (Metric).

1.2.5 ASTM C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).

1.2.6 ASTM F436, Standard Specification for Hardened Steel Washers.

1.2.7 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

1.2.8 CSA S16, Design of Steel Structures.

1.2.9 CSA S136 PACKAGE, Consists of CAN/CSA-S136 - North American Specification for the Design of Cold-Formed Steel Structural Members and S136.1, Commentary on North American Specification for the Design of Cold-Formed Steel Structural Members.

1.2.10 CSA W47.1, Certification of Companies for Fusion Welding of Steel.

1.2.11 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.

1.2.12 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.

1.2.13 CSA W59, Welded Steel Construction (Metal Arc Welding).

1.2.14 CISC, Handbook of Steel Construction.

1.2.15 CISC/CPMA 2-75, A Quick-drying Primer for Use on Structural Steel.

1.2.16 CWB, Canadian Welding Bureau.

1.2.17 SSPC-SP6/NACE No. 3, The Society for Protective Coatings, Commercial Blast Cleaning.

1.2.18 SSPC-SP10/NACE No. 2, The Society for Protective Coatings, Near-White Blast Cleaning.ff1

1.3 DESIGN REQUIREMENTS

1.3.1 Design details and connections in accordance with requirements of CSA S16 and CSA S136 to resist forces, moments, shears indicated or implied and handling, transportation and erection loads and as indicated on the Contract Drawings.

1.3.1.1 Include in design for connections between columns, beams, girders, trusses and braces, and between such members as spandrel angles and beams, hangers, stiffeners and their supporting members.

1.3.1.2 Standard connections such as connections for shear only:

1.3.1.2.1 Select shear connections from the CISC, Handbook of Steel Construction.

1.3.1.2.2 If forces are not indicated, select or design connections to support reaction from maximum uniformly distributed load that can be safely supported by beam in bending, if no point loads act on beam, assuming fully supported compression flange.

1.3.1.2.3 Where new steel beam connects to the existing structure, contractor may design one end of the beam (only) shear connection with short horizontal slotted holes. Slotted holes shall be fabricated in one of the connecting parts of the connection only.

1.3.1.3 Non-standard connections: Shall be designed and stamped by a Professional Engineer, licensed in the Province of Ontario.

1.3.2 Structural design to accommodate active loads including live, dead, lateral, wind, seismic, handling, transportation and erection loads.

1.3.3 Design Connections:

1.3.3.1 To safely withstand the combined effects of shear, moment and torque at applicable design stresses.

1.3.3.2 Not to interfere with architectural clearance lines or finishes.

1.3.3.3 Of base plate and cap plate bearing on column to column section by welding or grinding column to bear.

1.3.3.4 Taking into account any eccentricity.

1.3.3.5 With direct fastening to flanges of spandrel beams to restrain twisting.

1.3.3.6 Single angle and fish-plate type connections are not permitted except for secondary, lightly loaded elements.

1.3.3.7 Make single angle connections of wrapped type.

1.4 SUBMITTALS

1.4.1 Submit in accordance with Section 01 33 00.

1.4.2 Shop Drawings:

1.4.2.1 Submit Shop Drawings in accordance with Section 01 33 23.

1.4.2.1.1 Include shop and field splices, cuts, copes, camber, connection details, holes, reinforcements, bearing plates, welds, anchors, identification marks, surface preparation and finishes.

1.4.2.1.2 Indicate welds in accordance with CSA W59 welding symbols standard.

1.4.2.2 Submit sketches and design calculations for structural members and connections with the corresponding Shop Drawings.

1.4.2.3 Indicate details and information necessary for assembly and erection purposes such as description of methods, sequence of erection, type of equipment used in erection and temporary bracings.

1.4.2.4 Reproduction of the Contract Drawings for use as Shop Drawings is not permitted. Do not use Contract CADD files.

1.4.3 Test Reports:

1.4.3.1 Four (4) weeks minimum, prior to structural steel fabrication, submit 2 copies of mill test reports by steel manufacturer indicating chemical and physical properties of steel to be used in the Work and confirming that tests completed are in accordance with CSA G40.20/G40.21.

1.4.4 Certifications:

1.4.4.1 Submit certifications for welding companies under Division 1 or 2.1 in accordance with CSA W47.1 for fusion welding of steel structures, and CSA W55.3 for resistance welding of structural components. Certification must include updated welding operator's licence for both shop welders and welders working on site.

1.4.4.2 Submit confirmation by the Professional Engineer that fabrication and erection complies with the Contract Documents.

1.4.5 Inspection Reports:

1.4.5.1 Submit field reports of shop and field inspections.

1.5 QUALITY ASSURANCE

1.5.1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in design, fabrication and erection of structural steel Work of comparable complexity and scope, to perform the following services as part of the Work of this Section:

1.5.1.1 Design of structural members and connections.

1.5.1.2 Stamp and sign Shop Drawings, design calculations and amendments.

1.5.1.3 Review and report on manufacturer's and fabricator's quality control tests and reports for compliance with the Contract Documents.

1.5.1.4 Conduct fabrication and erection inspections and prepare and submit written inspection reports verifying that the Work is in accordance with the Contract Documents and reviewed Shop Drawings.

1.6 DELIVERY, STORAGE AND HANDLING

1.6.1 Exercise care in handling primer finished materials.

1.6.2 Do not handle steel until primer paint has cured sufficiently to handle without damage to same. Use nylon slings for handling and a combination of wood or polystyrene blocking between units in stockpile and in transit.

1.6.3 Schedule and sequence the Work so a minimum of handling occurs prior to erection.

2 Products

2.1 MATERIALS

2.1.1 Rolled structural steel shapes and flat hot-rolled steel Products: In accordance with CSA G40.20/G40.21, Grade 300W AND 350W.

2.1.2 Hollow structural sections (HSS): In accordance with CSA G40.20/G40.21, Grade 350W, Class H.

2.1.3 Beam connections, columns, base plates, beams, purlins, girts and sag rods: In accordance with CSA G40.20/G40.21.

2.1.4 Surface preparation: Remove moisture, oil, grease, dirt, excessive rust, loose mill scale and clean in accordance with SSPC-SP10/NACE No. 2.

2.1.5 Shop paint primer (prime painted steel): In accordance with CISC/CPMA 2-75.

2.1.6 Hot-dip galvanizing: In accordance with ASTM A123/A123M; minimum zinc coating of 600 g/m².

2.1.7 Welding materials: In accordance with CSA W48 and certified by the CWB.

2.1.8 Anchor bolts: In accordance with ASTM A307, Grade C, with hexagon heads and nuts, lengths shown with a minimum of 13 mm projecting beyond the nut. Nuts: In accordance with ASTM A563M.

2.1.9 High strength bolts: In accordance with ASTM A325M, Type 1, heavy hexagon high strength bolts, of standard size, of lengths required for thickness of members joined and for type of connection.

2.1.9.1 Lock washers, lock nuts, burr thread to prevent bolts from working loose.

2.1.9.2 In accordance with ASTM A563M; hexagon semi-finished nuts.

2.1.9.3 In accordance with ASTM F436; flat, smooth hardened washers, quenched and tempered.

2.1.10 Shear studs: In accordance with CSA W59, Annex H.

2.1.11 Field touch-up primer (prime painted steel): In accordance with CISC/CPMA 2-75.

2.1.12 Field touch-up primer (galvanized steel): Galvanox by Carboline, Galvafroid by W.R. Meadows of Canada, Zinc Clad 5 by Sherwin Williams. Minimum 80% zinc content.

2.2 FABRICATION

2.2.1 Fabricate structural steel in accordance with CSA S16 and CISC, Handbook of Steel Construction fabrication tolerances except as indicated otherwise.

2.2.2 Splicing of members is not permitted except as indicated on the Contract Drawings or as accepted by EOR.

2.2.3 Clean, prepare surfaces and shop prime structural steel in accordance with CSA S16.

2.2.4 Prime interior structural steel in shop except if galvanized finish is indicated. Galvanize exterior structural steel unless indicated otherwise.

2.2.5 Do not paint surfaces which will be embedded in concrete.

2.2.6 Install shear studs in accordance with CSA W59.

2.2.7 Continuously weld structural steel members where indicated. Galvanize vent/weep holes for structural steel members.

2.2.8 Grind shop fabrication welds smooth.

2.2.9 Fabricate structural steel members true and without twists or open joints.

2.2.10 Weld in accordance with CSA W59.

2.2.11 Fabricate properly sized holes to accommodate other parts of the Work including holes required for attachment; locate holes to prevent appreciable reduction of structural member strength. Reinforce openings as necessary to maintain strength of structural members.

2.2.12 Fabricate HSS members with sufficient holes to prevent the accumulation of water.

2.3 STRUCTURAL GROUT

2.3.1 Premixed, flowable, non-shrink grout without aggregate fillers: In accordance with ASTM C1107/C1107M, Masterflow 713 by Master Builders Technologies Ltd.; Sika Grout 212 by Sika Canada Inc.

3 Execution

3.1 EXAMINATION

3.1.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to EOR. Commencement of Work means acceptance of existing conditions.

3.1.2 Obtain written approval from EOR prior to field cutting or altering of structural members.

3.2 MARKING

3.2.1 Mark materials in accordance with CSA G40.20/G40.21.

3.2.2 Match marking: Mark bearing assemblies and splices in shop for fit and match.

3.3 STRUCTURAL STEEL ERECTION

3.3.1 Supply and coordinate the location and placement of anchor bolts and base plates.

3.3.2 Erect structural steel in accordance with reviewed Shop Drawings and tolerances of CSA S16 and CISC, Handbook of Steel Construction tolerances except restrict the maximum variation in elevation to 6 mm.

3.3.3 Splicing of members is not permitted except as indicated on the Contract Drawings or as accepted by EOR.

3.3.4 Set steel accurately to lines and elevations indicated. Set column bases and shim to proper elevations. Install structural grouting in accordance with details and the manufacturer's recommendations.

3.3.5 Assemble structural steel members true, plumb and level, free of twists and open joints.

3.3.6 Make high strength bolted connections in accordance with CSA S16.

3.3.7 Weld in accordance with CSA W59.

3.4 FIELD TOUCH-UP PAINTING

3.4.1 Upon completion of erection, mechanically brush clean bolts, rivets, welds and burned or scratched surfaces.

3.4.2 Touch-up damaged surfaces and surfaces without shop coat with field touch-up primer or touch-up primer for galvanized steel as applicable.

END OF SECTION

SECTION 07 21 00
THERMAL INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes requirements for supply and installation of:
   1. Fibrous blanket thermal insulation used for:
      a. Wall stud spaces.
   2. Rigid board insulation used for:
      a. Cavity wall insulation.

1.2 REFERENCES

A. ANSI/ASHRAE/IESNA 90.1.

B. American Society for Testing and Materials (ASTM International):
   1. ASTM C1303/C1303M - Standard Test Method for Predicting Long-Term Thermal Resistance of Closed-Cell Foam Insulation.
   2. ASTM C1320 - Standard Practice for Installation of Mineral Fiber Batt and Blanket Thermal Insulation for Light Frame Construction.
   3. ASTM D1621 - Standard Test Method for Compressive Properties of Rigid Cellular Plastics.
   4. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics.
   5. ASTM D5113 - Standard Test Method for Determining Adhesive Attack on Rigid Cellular Foam.

C. Underwriters Laboratories Canada (ULC):
   1. CAN/ULC S102 - Standard Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.
   2. CAN/ULC S114 - Standard Method of Test for Determination of Non-Combustibility in Building Materials.
   3. CAN/ULC S129 - Standard Method of Test for Smoulder Resistance of Insulation (Basket Method).
   4. CAN/ULC S701 - Standard for Thermal Insulation, Polystyrene Boards.
   5. CAN/ULC S702 - Standard for Thermal Insulation Mineral Fibre for Buildings.
   6. ULC S702.2 - Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
   7. CAN/ULC 702.1 - Standard for Mineral Fibre Thermal Insulation for Buildings, Part 1: Material Specification.
   8. CAN/ULC S704 - Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.
   9. CAN/ULC 702.2 - Mineral Fibre Thermal Insulation for Buildings, Part 2: Application Guidelines.
   10. CAN/ULC S770 - Determination of Long-Term Thermal Resistance of Closed Cell Thermal Insulating Foams.
   11. CAN/ULC S773 - Thermal Insulation Terminology.

1.3 SUBMITTALS

A. Action Submittals:
   1. Product Data: Submit manufacturer’s product data indicating actual materials used for the work of this Section.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. When using fibrous batt insulation in fire resistant rated construction, provide materials that meet the following requirements:
   a. CAN/ULC S102 for flame spread rating of 25 or less.
   b. CAN/ULC S114 for non-combustibility.
   c. CAN/ULC S129 for smoulder resistance.

PART 2 - PRODUCTS

2.1 BLANKET INSULATION MATERIALS

A. Mineral Fibre Thermal Insulation: Unfaced, preformed mineral slag batt insulation in accordance with CAN/ULC S702, Type 1; having a nominal minimum RSI 0.67/25 mm R 3.8/inch; minimum density 32 kg/m³ 2 pcf; square edges, thickness as required to fill insulated spaces where not indicated; having maximum flame spread and smoke developed of 0/0 in accordance with CAN/ULC S102 and being non-combustible in accordance with CAN/ULC S114, and as follow:
   1. Acceptable Product Manufacturers:
      a. Knauf Insulation.
      b. Owens Corning Canada Inc.
      c. ROCKWOOL.
   2. Acceptable Products:
      a. KNAUF Insulation, EcoBatt.
      b. Owens-Corning Canada Inc., Thermafiber.
      c. Rockwool Inc., ComfortBatt.

2.2 BOARD INSULATION MATERIALS

A. Cavity Wall – Mineral Fibre Board Insulation: Unfaced, preformed rigid fibrous mineral fiber board insulation manufactured in accordance with CAN/ULC S702, Type 1 and as follows:
   1. Thermal Resistance: Not less than RSI 0.74/25 mm R 4.2 per inch.
   2. Fire Resistance Rated: Non-combustible in accordance with CAN/ULC S114 and having a flame spread rating of 5 or less in accordance with CAN/ULC S102.
   3. Density: Nominal 70 kg/m³ 4.37 psi density.
   4. Edges: Square edges.
   5. Board Size: Nominal 406 mm by 1220 mm 16 by 48-inch or 610 mm by 1220 mm 24 by 48-inch as appropriate to application by thickness required to achieve insulation value indicated on Drawings.
   6. Use products with black facer in open-joint wall panel systems.
   7. Acceptable Product Manufacturers:
      a. ROCKWOOL.
      b. Owens Corning Canada Inc.
   8. Acceptable Products:
      a. ROCKWOOL, CavityRock.
      b. Owens Corning, Thermafiber RainBarrier 45.

B. Cavity Insulation:
   1. Cavity Wall – Mineral Fibre Board Insulation: Unfaced, preformed rigid fibrous mineral fiber board insulation manufactured in accordance with CAN/ULC S702, Type 1 and as follows:
      a. Thermal Resistance: Not less than RSI 0.74/25 mm R 4.2 per inch.
      b. Fire Resistance Rated: Non-combustible in accordance with CAN/ULC S114 and having a flame spread rating of 5 or less in accordance with CAN/ULC S102.
      c. Density: Nominal 70 kg/m³ 4.4 pcf density.
      d. Edges: Square edges.
      e. Board Size: Nominal 406 mm by 1220 mm 16 by 48-inch or 610 mm by 1220 mm 24 by 48-inch as appropriate to application by thickness required to achieve insulation value indicated on Drawings.

f. Use products with black facer in open-joint wall panel systems.
g. Acceptable Products:
1) ROCKWOOL, CavityRock.
2) Owens Corning, Thermafiber RainBarrier 45.

2. Plastic Wall Insulation: Polystyrene, extruded type, in accordance with CAN/ULC S701, Type 3, thermal resistance not less than RSI 0.87/25 mm R 4.94 per inch; square edges, board size 406 mm by 2440 mm 16 by 96-inch by thickness required to achieve insulation value indicated on Drawings; minimum compressive strength 170 kPa 24.65 psi at 10% deformation in accordance with ASTM D1621, water absorption (% by volume) maximum 0.7% to ASTM D2842.
a. Acceptable Materials:
1) Dow Styrofoam CavityMate.
2) Owens-Corning Foamular NGX250.

2.3 ACCESSORIES

A. Tape: As recommended by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for Sections in which substrates and related work are specified and other conditions affecting performance.

B. Verify that all surfaces which are to receive rigid insulation are clean, free of deleterious matter and are sufficiently level to allow the proper installation of insulation.

C. Verify that all flashings provided under other Sections are installed and that they divert moisture to exterior of insulated systems.

3.2 PREPARATION

A. Clean substrates of substances harmful to insulations; remove projections that interfere with insulation attachment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 BLANKET INSULATION INSTALLATION

A. Install batt insulation where indicated and where required to maintain continuity of thermal insulation of the building envelope in accordance with ASTM C1320 or ULC S702.2, and as follows:
1. Install thermal insulation with continuous vapour retarder on the warm side of installation.
2. Cut and trim insulation neatly to fit spaces; butt ends and edges tight; fit insulation tightly to framing members and around pipes, conduits, and projecting structural members within insulated spaces.
3. Fill stud space of exterior framed walls with insulation full depth of stud only where no insulation/vapour retardant indicated on exterior face of stud walls.
4. Do not compress insulation to fit into spaces.
5. Fill stud space of temporary partitions with insulation.
6. Hold insulation in position with clips, wires or as recommended by manufacturer when insulation is installed in horizontal locations.

3.4 BOARD INSULATION INSTALLATION

A. Install insulation and accessories in accordance with manufacturer's written instructions applicable to products and application indicated and as follows:
1. Use insulation that is undamaged, dry, and unsoiled [and that has not been left exposed at any time to ice and snow].

2. Maintain continuous thermal insulation, vapour barrier and air tightness for building spaces and elements, and as follows:
   a. Install insulation full width and length between studs and framing members to fit snugly without buckling, creasing, or crushing.
   b. Saw cut and trim insulation neatly to fit spaces; fill voids with foamed in place insulation compatible with installed insulation.
   c. In walls, install lower batt first; upper batt installed to butt with the first and any extra length of insulation trimmed at the top. Butt edges and ends tight.
   d. Fit insulation tight against mechanical, electrical, and other items protruding through the plane of insulation.
   e. Fit insulation tight to electrical boxes, pipes, ducts, around exterior doors & windows, and other protrusions. Split insulation around wiring, plumbing or any other mid-wall interruption. Do not stuff insulation into corners or gaps - use rigid, spray, or semi-rigid insulation, as appropriate to fill gaps.
   f. Exterior and interior corners are to be designed to allow installation of insulation.
   g. Use insulation free of broken or chipped edges.
   h. Apply single layer of insulation to produce thickness indicated unless multiple layers are otherwise specifically shown or required to make up total thickness.
   i. Fit insulation firmly against substrate using mechanical fasteners spaced in accordance with manufacturers recommended spacing and pattern; in addition, adhere insulation to uneven substrate surfaces and provide additional fasteners to eliminate air spaces between insulation and substrate.
   j. Mechanically fasten insulation boards 50 mm 2 inches in from edges at 300 mm 12-inch centres.
3. Leave insulation joints unbonded over line of expansion and control joints; bond a continuous 150 mm 6-inch wide strip of primary vapour membrane over expansion and control joints using compatible adhesive.
4. Protect insulation from damage until it is covered; replace any broken, sunburned, crushed, or dented insulation immediately prior to covering; coordinate with backfilling operations.

B. Cavity Wall Insulation:
1. Fit courses of insulation between wall ties and other confining obstructions in cavity; butt edges tightly in vertical and horizontal directions and as follows:
   a. Install cavity insulation with a tight fit to substrate materials, provide adhesive and additional fasteners where uneven substrates cause air spaces behind insulation; apply adhesive to substrate in accordance with manufacturer’s instructions and in a continuous film not less than 3 mm 1/8-inch thick when wet and bed the insulation into adhesive before adhesive loses its tack or skins-over.
   b. Apply insulation fasteners using a minimum of six (6) fasteners in two rows located near the centre of the board along the narrow dimension and near the third points along the long dimension; secure boards with two clips at the centre where both dimensions are less than 600 mm 24 inches.
   c. Coordinate application of cavity wall insulation with installation of thermally improved clips and anchors specified in Section 07 05 43.
   d. Coordinate application of cavity wall insulation with installation of masonry ties and anchors specified in Section 04 22 00.
   e. Apply sheet membrane vapour retarder behind Z bars prior to installation of insulation between Z bars supporting preformed metal cladding.
   f. Install insulation clips to walls before sheet membrane vapour retarders are applied.

3.5 PROTECTION

A. Protect installed insulation from damage arising from harmful weather exposures, physical abuse, and other causes.

B. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

A. Aluminum Association Designation System for Aluminum Finishes-1980.

B. ASTM A 167-99, Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

C. ASTM D 523-89(1999), Test Method for Specular Gloss.

D. ASTM D 822-01, Practice for Conducting Tests on Paint and Related Coatings and Materials using Filtered Open-Flame Carbon-Arc Light and Water Exposure Apparatus.

E. CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.

F. CAN/CGSB-19.18-M87, Sealing Compound, One-Component, Silicone Base, Solvent Curing

1.2 DESIGN CRITERIA

A. Design metal cladding to provide for thermal movement of component materials caused by ambient temperature range of 80°C without causing buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.

B. Maximum deviation from vertical and horizontal alignment of erected panels: 1 to 1000

1.3 QUALIFICATION OF INSTALLER

A. Installation of double skin metal cladding by of Installers certified by manufacturer of system used.

1.4 SHOP DRAWINGS

A. Submit shop drawings in accordance with Section 01 33 00.

B. Indicate dimensions and thickness of panels, fastening and anchoring methods, detail and location of joints and gaskets, thermal movement provision, wall openings, head, jamb and sill details, materials and finish, compliance with design criteria and requirements of related work

1.5 SAMPLES

A. Submit samples in accordance with Section 01 33 00.

B. Submit duplicate 100 x 100mm samples of wall panels, representative of materials, finishes and colours.

1.6 PRODUCT DATA

A. Submit product data in accordance with Section 01 33 00.

B. Submit product data sheets for cladding system materials. Include product characteristics, performance criteria, limitations and colours

1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Testing Laboratory: Certified to CSA A283.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store and protect material in accordance with panel manufacturer's recommendations.

B. Do not expose panels with strippable film to direct sunlight or extreme heat.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Composite panels:
   1. Thickness: 3 mm.
   2. Core: extruded thermoplastic resin core.

B. Aluminum face sheets:
   1. Thickness: 0.51 mm.
   2. Alloy: AA-3003.

C. Aluminum extrusions: alloy AA-6063-T5.

D. Acceptable manufacturer:
   1. Alpolic panels system 3, as manufactured by Vicwest, or Consultant approved equivalent.

E. Accessories:
   1. Fasteners: aluminum extrusion, type rout and return continuous edge grip, concealed in accordance with manufacturer's recommendations.

2.2 ACCESSORIES

A. Proprietary aluminum extrusions: compatible with panel edges, manufacturer's standard profiles, vertical and horizontal joint closures and perimeter trim as required for a complete installation.

B. Fasteners: as recommended by manufacturer, concealed and non-corrosive.

C. Joint filler strip: same material and finish as panel material, size as required.

D. Insulation: to Section 07 21 3.

E. Liner Panel: sheet liner sheet, structural quality, grade 230 to ASTM A 446/A 446M-93, with Z275 zinc coating:
   1. Light duty modified silicone finish.
   2. Dry film thickness 0.025mm.
   3. Gloss:low.

2.3 PAINTED FINISHES

A. Prefinished sheet with factory applied polyvinylidene fluoride.
   1. Class F1S.
   2. colour selected by Consultant from manufacturer's standard range.
   3. Specular gloss: 30 units +/- in accordance with ASTM D 523-89(1999).
   4. Coating thickness: not less than 22 micrometres.
   5. Resistance to accelerated weathering for chalk rating of 8, colour fade 5units or less and erosion rate less than 20% to ASTM D as follows:
      a. Outdoor exposure period 2500hours.
      b. Humidity resistance exposure period 5000hours
   6. Colour shall be 4-4MBX-G30 Medium Bronze Metallic or similar to match existing

2.4 FABRICATION

A. Composition: two sheets of aluminum sandwiching a core of extruded thermoplastic formed in a continuous process with no glues or adhesives.

B. Factory fabricated.

C. Tolerances:
   1. Panel bow: maximum 0.8% of panel dimension in width and length.
   2. Panel dimensions: where final dimensions cannot be established by field measurement before completion of panel manufacturing, make allowance for field adjustments as recommended by manufacturer.

3. Panel lines, breaks and angles: sharp, true and surfaces free from warp or buckle

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation examine alignment of substrate and notify Consultant in writing if substrate does not comply with requirements of panel installer

3.2 INSTALLATION

A. Install composite panels in accordance with manufacturer's written instructions and shop drawings. Allow for thermal movement.

B. Maintain following installation tolerances:
1. Maximum variation from plane or location shown on shop drawings: 10 mm/10 m of length and up to 20 mm/100 m.
2. Maximum deviation for vertical member: 3 mm in an 8.5 m run.
3. Maximum deviation for a horizontal member: 3 mm in an 8.5 m run
4. Maximum offset from true alignment between two adjacent members abutting end to end, in line: 0.75 mm.

C. Remove strippable coating from panels as they are erected

3.3 CLEANING

A. Progress Cleaning: Clean in accordance with Section 01 74 00 - Cleaning.

B. Final Cleaning: Upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.

C. Waste Management: Perform in accordance with Section 01 74 00 - Waste Management and Disposal.
1. Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

SECTION 31 63 29
DRILLED CONCRETE PIERS AND SHAFTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
1. Drilled concrete piers.
2. Integrity testing, and other field quality control requirements, for drilled concrete piers.

B. Related Requirements: Include but are not necessarily limited to the following:
1. Section 03 05 05 - Concrete Testing and Inspection.
2. Section 03 21 00 - Reinforcement.
3. Section 03 31 30 - Concrete Materials and Proportioning.
4. Section 03 31 31 - Concrete Mixing, Placing, Jointing, and Curing.
5. Section 31 23 05 - Excavation and Fill.

1.2 PRICE AND PAYMENT PROCEDURES

A. Unit Prices:
1. The Work of this Section is Unit Price Work unless shown or indicated otherwise. Work covered by this Section but that is not eligible for payment under bid/pay items of Unit Price Work shall be performed at Contractor's cost.
2. Bid/pay items of Unit Price Work of this Section are indicated in the Bid Form, the Agreement (or exhibit thereto), and in Section 01 22 00 – Measurement and Payment.

B. Measurement:
1. Criteria for measurement for payment of this Section's Unit Price Work are indicated in the General Conditions (as may be modified by the Supplementary Conditions), Section 01 22 00 – Measurement and Payment, and this Section.
2. Before performing any drilled concrete pier Unit Price Work, discuss with Engineer [and Resident Project Representative] [Owner's Site Representative] [and] [geotechnical special inspector or consultant (responsibilities for which are indicated in this Section's Field Quality Control" Article)] means of measuring the drilled concrete pier Unit Price Work for payment, based on equipment to be used for drilled concrete pier Unit Price Work.

C. Generalized Scope and Description of Drilled concrete piers Work:
1. Contractor shall provide all labor, materials, construction equipment and machinery, tools, services, and incidentals necessary and required to furnish and install reinforced concrete piers, constructed in shafts excavated by drilling, in accordance with the Contract Documents.
2. Included in Drilled concrete pier Unit Price Work Item(s):
   a. Each bid/pay item for drilled concrete pier Unit Price Work, includes the following for the associated size and type of drilled concrete pier:
      1) Accessing the work area(s) for materials, construction equipment, machinery and tools needed for drilled concrete piers Work.
      2) Work necessary and required to excavate shafts for drilled concrete piers, including drilling.
      3) Removing and disposing of spoil resulting from excavation of shafts for drilled concrete piers and related Work.
      4) Providing drilling slurry for excavating shafts for drilled concrete piers.
      5) Furnishing, placing, and removing (as applicable) temporary [and permanent] casings, where necessary or required.
      6) Providing reinforcing [and access ducts for integrity testing] for drilled concrete piers.
      7) Dewatering, as necessary.

8) Providing concrete for drilled concrete piers.
9) Providing dowels of reinforcing steel and anchorages.
10) Required field quality control, including integrity testing.
11) Other associated materials, and providing all labor, equipment, installation supervision and accessories, necessary and required for providing drilled concrete piers.
12) Additional drilled concrete piers ordered by Engineer via an appropriate Contract modification [or allowance authorization].

3. Not Included in Unit Price Item(s) for Drilled Concrete Pier Work:
   a. Work specifically included under other bid/pay item(s).
4. Eligible for Payment under Other Items, Change Order(s), or Allowance Authorization(s):
   a. The following, when performed in accordance with the Contract Documents, are eligible for payment but may require authorization as Contract modification(s) or allowance authorization(s) (if any).
      1) Partially-constructed drilled concrete piers for which drilling is discontinued, at Engineer's direction, after unanticipated obstruction is encountered.
      2) Modified construction, duly authorized and performed in accordance with the Contract Documents, required where drilled concrete pier Work was discontinued at Engineer's direction.
5. Not Eligible for Payment:
   a. The following are not eligible for payment:
      1) Length of drilled concrete pier extending above top cut-off elevation shown or indicated in the Contract Documents.
      2) Length of drilled concrete pier extending below bottom tip elevation shown or indicated in the Contract Documents, unless otherwise directed by Engineer.
      3) Defective drilled concrete pier Work.
      4) Drilled concrete piers rejected by Engineer for reasons indicated elsewhere in this Section.

1.3 REFERENCES

A. Terminology:
   1. Terminology indicated below are not defined terms and are not indicated with initial capital letters, but when used in this section have the meaning indicated below:
      a. "Drilled concrete piers" means deep foundation systems used for supporting buildings or structures by transferring loads to stable bearing strata, such as rock. A drilled concrete pier includes a drilled shaft, reinforcing steel, other appurtenances such as access ducts for integrity testing, and cast-in-place concrete. The terms "drilled concrete piers", "drilled concrete piers and shafts", "drilled piers", "drilled shafts", "caissons", "cast-in-drilled hole" (CDIH), bored piles, and derivative terms, have the same meaning. In this Section, unless expressly indicated otherwise, the term "shaft" generally refers to the drilled excavation provided for the subsequently constructed reinforced concrete pier.

B. Reference Standards:
   1. American Concrete Institute (ACI):
      a. 117, Specification for Tolerances for Concrete Construction and Materials.
      b. 305R, Hot Weather Concreting.
      c. 306R, Cold Weather Concreting.
      d. 336.1 Specification for the Construction of Drilled Piers
   2. American Petroleum Institute (API):
      a. RP 13B-1, Recommended Practice for Field Testing Water-based Drilling Fluids.
      b. RP 13B-2, Recommended Practice for Field Testing Nonaqueous-based Drilling Fluids.
   3. American Society of Mechanical Engineers (AMSE):
      a. B36.10, Welded and Seamless Wrought Steel Pipe.
   4. American Welding Society (AWS)
      a. B2.1/B2.1M, Specification for Welding Procedure and Performance Qualification

b. D1.1/D1.1M, Structural Welding Code —Steel
c. D1.3/D1.3M, Structural Welding Code—Sheet Steel

5. ASTM International (ASTM):
   a. A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
   b. A252, Standard Specification for Welded and Seamless Steel Pipe Piles.
   c. C33, Standard Specification for Concrete Aggregates.
   d. C150, Standard Specification for Portland Cement.
   e. C595, Standard Specification for Blended Hydraulic Cements.
   f. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   g. D4380, Standard Test Method for Determining Density of Construction Slurries.
   h. D4945, Standard Test Method for High-Strain Dynamic Testing of Deep Foundations.
   i. D5882, Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations.
   j. D6760, Standard Test Method for Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing.
   k. D7949, Standard Test Methods for Thermal Integrity Profiling of Concrete Deep Foundations.

C. Pre-Installation Conference for Drilled Concrete Piers Work:
   1. Schedule and convene a pre-installation conference at the Site following Engineer's acceptance of drilled concrete piers installation plan Submittal, and not less than [14] days prior to commencing drilled concrete piers Work.
   2. Attendees shall be knowledgeable on the type(s) and extent of drilled concrete piers Work, subsurface conditions at the Site, and requirements of the Contract Documents relative to drilled concrete piers Work, and times for drilled concrete piers Work as allocated in the Progress Schedule accepted by Engineer. Attendees shall include individuals empowered to speak for and bind their respective organization regarding drilled concrete piers Work.
   3. Required attendees:
      a. Contractor's project manager and Site superintendent.
      b. Project manager and foreman for drilled concrete piers installer.
      c. Concrete Supplier.
      d. Integrity testing Subcontractor.
      e. Engineer [and Resident Project Representative].
      f. Owner's Site Representative, if any.
      g. [Special inspector for code-required special inspections and tests] [and] [geotechnical special inspector or consultant].
      h. Owner's project manager (when available) and other personnel invited by Owner (when available).
   4. Conference will be chaired by [Engineer] [or Resident Project Representative] [Owner's Site Representative], who will also advise required attendees of the conference's date, time, and location, and prepare and distribute to attendees (and others as appropriate) a record of topics discussed and decisions made during the conference.
   5. Topics to be discussed include:
      a. Procedures for measuring drilled concrete piers Unit Price Work.
      b. Schedule for drilled concrete piers Work, including required weather conditions.
      c. Shop Drawing and Plan Submittals Required Prior to Commencing the Drilled Concrete Piers Work.
      d. Site preparations for drilled concrete piers Work.
      e. Known and anticipated surface and subsurface conditions in each work area and effect on drilled concrete piers Work.
      f. Management, handling, using, and field quality control for drilling slurry.
      g. Providing access ducts for integrity testing.
      h. Providing drilled concrete piers, including installation tolerances.
      i. Required curing period.

j. Special details.
k. Responsibilities and limitations of authority of geotechnical special inspector or consultant.
l. Field quality control requirements including integrity testing, and associated criteria for acceptance.
m. Protection.
n. Requirements for as-constructed survey of drilled concrete piers Work.
o. Items deemed appropriate by Contractor.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Installer:
a. Installer of drilled concrete piers, whether Contractor or Subcontractor ("installer"), shall possess not less than [five] years' current, relevant experience constructing and installing drilled concrete piers on not less than [three] completed projects of size and complexity similar to the Work required by this Section, installed in subsurface conditions similar to those anticipated at the Site.
b. At the Site, drilled concrete piers Work shall be performed under the supervision of a foreman with not less than [five] years of relevant experience, employed in a supervisory or foreman capacity on not less than [three] completed projects of similar size and subsurface conditions to those for the Project. Do not replace the foreman without written advisory to Engineer.
c. Submit documentation of installer's compliance with qualifications requirements, for each prior project submitted as prior experience, indicate the following: name of project and contract designation, location of project, owner (including organization or entity name, address, owner's current employee sufficiently familiar with the subject project to serve as a reference, telephone number, email address), prime construction contractor, if other than installer (including organization or entity name, address, prime contractor's current employee sufficiently familiar with the subject project to serve as a reference, telephone number, email address), design professional or construction manager (including organization or entity name, address, design professional's or construction manager's current employee sufficiently familiar with the subject project to serve as a reference, telephone number, email address), months and year that drilled concrete piers construction was performed, and description of scope and extent of drilled concrete piers provided, together with description of subsurface conditions encountered. Indicate total number of years that installer's organization has been involved in performing drilled concrete piers construction.
2. Welders:
a. Qualify welding procedures and welding operators in accordance with AWS B2.1/B2.1M, D1.1/D1.1M, and AWS D1.3/D1.3M.
b. Upon Engineer's request, submit documentation of welders' qualifications and certifications.
3. Integrity Testing: Qualifications requirements for personnel performing integrity testing and evaluating results of integrity testing are indicated in this Section's "Field Quality Control" Article.

1.5 SUBMITTALS

A. Action Submittals: Submit the following:
1. Shop Drawings:
a. Drilled concrete piers Installation Shop Drawings, in accordance with the "Shop Drawings and Plan Submittals Required Prior to Installing Drilled Concrete Piers" Article of this Section. Submit concurrently with the drilled piers installation plan Submittal also required by this Section.
b. Clearly indicate on drilled concrete piers installation shop drawings piers that will include access ducts required for integrity testing. For each diameter of pier where

access ducts are required, submit Shop Drawings showing and indicating proposed layout of access ducts, in both plan and section. Indicate material of each type of access duct required, including types of, and locations of, joints proposed for access ducts.

c. Proposed concrete mix design for drilled concrete piers in accordance with Section 03 31 30 – Concrete Materials and Proportioning, [and Section 03 05 05 – Concrete Testing and Inspection], for requirements for mix design Submittal.

d. Do not begin installing drilled concrete piers until Engineer has approved proposed concrete mix design, layout of drilled concrete piers, reinforcing steel Shop Drawings, and associated installation plan Submittal.

2. Product Data:

a. Manufacturer's published literature of materials proposed for use, including catalog information, specifications, and similar information, marked to indicate proposed options and striking out options not proposed.

b. Acknowledgement that materials proposed for use comply with reference standards indicated in this Section.

c. Drilling Slurry Materials:

1) Manufacturer's published technical data, specifications, and mixing and handling instructions for drilling slurry materials.

2) For polymer slurry, Submittal shall indicate name and telephone number of manufacturer's representative.

3) Indicate source of water for drilling slurry.

B. Informational Submittals: Submit the following:

1. Procedural Submittals:

a. Drilled pier installation plan Submittal, in accordance with the "Shop Drawings and Plan Submittals Required Prior to Installing Drilled Concrete Piers" Article of this Section. Submit concurrently with the drilled concrete piers Shop Drawings also required by this Section.

2. Field Quality Control Submittals:

a. Results of field quality control testing of drilling slurry.

b. Drilled concrete pier installation report log for each individual drilled concrete pier submitted within the time frame indicated in this Section's "Drilled concrete piers Installation Report" Article.

c. Results of concrete strength testing for drilled concrete piers.

d. Results of integrity testing.

3. Qualifications Statements:

a. Installer:

1) Installer's experience and qualifications.

2) Experience and qualifications of installer's foreman.

b. Welders, when requested by Engineer.

C. Closeout Submittals: Submit the following:

1. Record Documents: Submit within 14 days after completing installation of final drilled concrete pier.

a. Drilled concrete piers installation report (combined report), covering all installed drilled concrete piers, as permanent record for Owner and Engineer.

b. As-constructed survey data and record drawings for drilled concrete piers, in accordance with requirements of this Section's "Closeout Activities" Article.

1.6 SHOP DRAWINGS AND PLAN SUBMITTALS REQUIRED PRIOR TO INSTALLING DRILLED CONCRETE PIERS

A. Drilled Concrete Piers Installation Shop Drawings: Prepare and submit to Engineer drilled concrete piers installation Shop Drawings, including the following:

1. Location of each drilled concrete pier and top of drilled concrete pier elevation as indicated on the Drawings. Clearly indicate any proposed variations to locations or elevations other than those shown on the Drawings. Indication of proposed deviations, if any, shall comply

with requirements elsewhere in the Contract Documents for showing and indicating deviations from Contract via Submittals.
2. Finished grade elevation at location of each drilled concrete pier.
3. Anticipated bottom tip elevation of each drilled concrete pier.
4. Size, wall thickness, type of steel, and length of permanent and temporary casings.
5. Details of reinforcing and placement, including support and cage centering methods. Show and indicate information on integrity testing access ducts, in accordance with the Submittals Article of this Section.
6. Reinforcing steel cage splicing method, if proposed or necessary, including details of dimensions, installation, splice location, support and cage centering methods, and estimated time required for splicing.
7. Shop Drawings of reinforcing steel, anchor bolts, dowels, and accessories required for drilled concrete piers. Comply with Section 03 21 00 – Reinforcement.
8. Proposed methods of final discharge of concrete at top of drilled concrete pier, and proposed measures for removing defective concrete Work.

B. Drilled Concrete Piers Installation Plan Submittal: Prepare and submit to Engineer drilled concrete piers installation plan Submittal, including the following:
1. Construction operation sequence and sequence of drilled concrete pier construction.
2. Drilled concrete piers excavation methods, (including equipment and procedures for verifying dimensions and alignment of each shaft for drilled concrete piers).
3. Location of existing, known utilities, including Underground Facilities, that could be affected by drilled concrete piers Work. Indicate on copies of site plan included in the Drawings and drilled concrete piers layout Shop Drawing.
4. Description, and sketches when necessary, of special access or setup necessary for positioning drilling equipment for shafts for drilled concrete piers.
5. Details of temporary casing and forms including material and splicing details. Indicate installation method, including specific length and diameter required to prevent pier installation method affecting adjacent drilled concrete piers, buildings, structures, Underground Facilities, transportation facilities, and other facilities.
6. Type and methods to mix, circulate, degrit, test, and dispose of drilling slurry. If polymer slurry is proposed, include in the Submittal manufacturer's data on load transfer and requirements for drilling slurry control. Include drilling slurry management plan, including testing requirements listed within this Section.
7. Proposed methods to clean drilled shafts, including air lift methods and spin bucket methods, as applicable.
8. Description of proposed methods for handling and installing reinforcing, including lifting equipment, and staging location for tied steel reinforcing cages.
9. Qualifications statements required in this Section.
10. Limitations on Engineer's Review:
    a. Engineer's acceptance of drilled concrete piers installation plan does not, in any way, modify Contractor's sole responsibility for complying with the Contract Documents, construction means, methods, procedures, techniques, or sequences, and safety and protection measures incident thereto.
    b. Nothing associated with Engineer's review, comments upon, or acceptance of Contractor's drilled concrete piers installation plan Submittal is for benefit of Contractor, Subcontractor, or Supplier. Engineer's review is only for purposes expressly indicated in the General Conditions, as may be modified by the Supplementary Conditions.

1.7 DRILLED CONCRETE PIERS INSTALLATION REPORT

A. Contractor shall prepare written record of each drilled concrete pier as installed, including:
1. Drilled concrete pier location by drilled concrete pier designations indicated on the Drawings.
2. Dates of shaft drilling, placement of reinforcing, and placement of concrete.
3. Bottom tip elevation.

4. Rock surface elevation (when applicable).
5. Top cut-off elevation.
6. Total vertical length of drilled concrete pier from bottom tip to top cut-off elevation.
7. Vertical length embedded in rock (when applicable).
8. Diameter of drilled concrete pier.
9. Whether shaft received temporary or permanent casing. When casing was provided, indicate whether casing was temporary or permanent, together with top and bottom elevations of each casing.
10. Deviation from allowable installation tolerances.
11. Stratigraphy of subsurface materials encountered during drilling of shafts.
12. Unusual or unexpected conditions encountered.
13. Description of drilled concrete piers that were rejected or discontinued at Engineer's direction.
14. Concrete delivery vehicle ticket numbers for concrete placed for each drilled concrete pier.
15. Signature of installer's foreman and geotechnical special inspector or consultant discussed in this Section's "Field Quality Control" Article.

B. Submittals of Drilled Concrete Pier Installation Report Logs:
1. Submit record of each pier within 24 hours of completion of concrete placing of associated drilled concrete pier. Submit simultaneously to Engineer and geotechnical special inspector or consultant discussed in this Section's "Field Quality Control" Article.
2. If third-party geotechnical special inspector or consultant determines report log includes incomplete or inaccurate information, revise and resubmit report log as necessary and required.
3. After installation of all drilled concrete piers, submit complete report of all drilled concrete pier logs to Engineer. Report shall be signed by installer [and special inspector] [and geotechnical special inspector or consultant], unless otherwise directed by Engineer.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Handling of Casings for Drilled Concrete Piers:
1. Deliver temporary and permanent casings to the Site, without damage and in good condition.
2. Handle and protect casings to maintain diameter within two percent of intended, nominal diameter.

PART 2 - PRODUCTS

2.1 REINFORCED CONCRETE FOR DRILLED CONCRETE PIERS

A. Concrete:
1. Comply with Section 03 31 30 – Concrete Materials and Proportioning, unless otherwise required by this Section.

B. Reinforcing for Drilled Concrete Piers – General:
1. Provide reinforcing steel in accordance with Section 03 21 00 – Reinforcement.
2. Reinforcing sizes, quantity, configuration, spacing, and lengths shall be as shown or indicated on the Drawings, and other Contract Documents.

2.2 DRILLING SLURRY

A. Drilling Slurry - General:
1. Provide and use [mineral slurry] [or] polymer slurry in the drilling process, unless other drilling fluid(s) and materials are acceptable to Engineer. When drilling slurry is used, such material shall be commercially prepared [mineral slurries] [or] polymer slurries. Drilling slurry constituents shall not contaminate groundwater and shall not result in a Hazardous Environmental Condition.
2. Use of water (without appropriate slurry materials) to stabilize drilled shafts is unacceptable.

3. Materials proportioning for drilling slurry and specific gravity of materials used in drilling slurry shall be sufficient for:
   a. Stabilizing excavated shafts; and
   b. Supporting proper concrete placement.

B. Polymer Slurry:
1. Use polymer slurry in accordance with polymer manufacturer's recommendations and this Section.
2. Refer to this Section's "Field Quality Control" Article for requirements for services of polymer manufacturer's technical representative.
3. Polymer slurry shall comply with the following:

Property	Test Method	Requirements
Density (pounds per cubic foot)	Mud Balance, ASTM D4380	64 (maximum)
Viscosity (sec/quart)	Marsh Funnel and cup, API 13B-2	40 to 90
pH	pH Paper ASTM D4972	7 to 12
Sand Content (percent by volume)	Sand screen set, ASTM D4381	See Note*

* Sand content of polymer slurry prior to final cleaning of bottom of excavated shaft, prior to placing reinforcing steel cage and immediately prior to placing concrete, shall be less than 1.0 percent.

2.3 CASINGS

A. Temporary Steel Casings
1. Provide steel casings in shafts excavated for drilled concrete piers, as necessary for:
   a. Cleaning and inspection of shaft bottoms; and
   b. To prevent caving of shaft and to prevent entry of groundwater.
2. Material and Performance Requirements for Temporary Casings:
   a. Temporary steel casings shall have sufficient strength to withstand:
      1) Handling stresses.
      2) Drilling and installation stresses.
      3) Concrete pressures.
      4) Pressure exerted by surrounding subsurface materials, including water.
      5) Water seepage.
      6) When necessary, protecting personnel.
      7) When necessary, to allow advancement of pier through caving substrata.
   b. Casing shall be rigid steel, smooth, clean, and watertight, in accordance with ASTM A252, and may be sectional. When sectional temporary casing is provided, concrete shall not discharge through spacing between sections into annulus between temporary casing and excavated shaft.
   c. Inside diameter of temporary casing shall be not less than size of drilled concrete pier shown or indicated in the Contract Documents.

B. Permanent Steel Casings
1. Performance Criteria for Permanent Steel Casings:
   a. Permanent steel casings shall have sufficient strength to withstand:
      1) Handling stresses.
      2) Drilling and installation stresses.
      3) Concrete pressures.
      4) Pressure exerted by surrounding subsurface materials, including water.
      5) Water seepage.
      6) When necessary, protecting personnel.

7) When necessary, to allow advancement of pier through caving substrata.

b. Casing shall be rigid steel, smooth, clean, and watertight, and may be sectional. Permanent sectional casings shall not discharge concrete through spacing between sections into annulus between casing and excavated shaft.

c. Inside diameter of permanent casing shall be not less than size of drilled concrete pier shown or indicated in the Contract Documents.

2. Material Requirements for Permanent Steel Casings:
   a. Casing shall be steel and rigid, smooth, clean, and watertight, in accordance with ASTM A252.
3. Fabrication of Permanent Steel Casings:
   a. Provide diameter and minimum steel wall thickness as shown on the Drawings, unless otherwise approved by Engineer via an appropriate Contract modification.
   b. Permanent steel casings shall be rigid, smooth, clean, and watertight.
   c. Welding shall comply with AWS B2.1/B2.1M, AWS D1.1/D1.1M, and AWS D1.3/D1.3M.

2.4 ACCESSORIES

A. Access Ducts (Tubing) for Integrity Testing:
   1. Description:
      a. Provide in [each drilled concrete pier] [every other drilled concrete pier] [every third drilled concrete pier] [every fifth drilled concrete pier] [designated drilled concrete piers] permanent access ducts (tubing) for the types of integrity testing required in this Section's "Field Quality Control" Article. Such access ducts shall comply with requirements of this Article.
   2. Materials and Fabrication:
      a. Access Ducts Materials and Fabrication – General: The following apply to all access ducts, regardless of purpose and material:
         1) Access ducts shall be straight with continuous, regular inside diameter, without obstruction or other hindrance to passage of probes necessary for integrity testing.
         2) Attach access ducts to reinforcing steel at intervals sufficient to prevent deforming during construction and placing of the reinforcing steel cage and concrete placing. Attach access ducts to reinforcing steel at intervals not greater than [five] feet, using wire required for reinforcing steel construction.
         3) Access ducts shall be watertight and gastight.
         4) Lower end of each access duct, near drilled concrete pier tip, shall be six inches above bottom of tip elevation. Provide permanent, watertight end cap, of same material as access duct, at bottom of access duct. Provide not less than [two] inches of concrete cover at end of access duct.
         5) Access ducts shall extend to top cut off elevation of the associated drilled concrete pier. Provide plastic, removable, watertight plug at top of each access duct.
      b. Access Ducts for Sonic Logging:
         1) Diameter: [1.5] [2]-inch, for each access duct required.
         2) Locations:
            a) Provide access ducts attached to inside face of reinforcing steel cage.
            b) Crosshole Sonic Logging (CSL): Provide the quantity of separate access ducts for each drilled concrete pier (for which access ducts are required), equidistant from each other, as follows:
               (1) Drilled concrete pier diameter of four feet and less: three.
               (2) Drilled concrete pier diameter between four and 5.5 feet: four.
               (3) Drilled concrete pier diameter between 5.6 to 8.3 feet: six.
         3) For crosshole sonic testing, provide preformed, Schedule 40, ASTM A53 black mild steel pipe in accordance with ASME B36.10, with either threaded joints, welded joints, or joints provided with appropriate, external couplings.
         4)

5) Upon completion of access duct installation within reinforcing steel cage, measure and record, in writing, to tolerance within 3/8-inch, the following: length of each access duct, separation of access ducts from each other at top, bottom, and midpoint along their respective lengths, and locations and details of joints in each tube. Maintain such records, for each separate drilled concrete pier for which access ducts are required, for use during integrity testing. Submit records of such measurements with results of integrity testing required under this Section's "Field Quality Control" Article.
6) Clearly label each reinforcing steel cage assembly (following installation of access ducts and recording of as-constructed information on access ducts) with its associated designation to ensure installation at its proper, associated location within the Work.

c. Access Ducts for Thermal Integrity Profiling:
1) Diameter: [1] [1.5] [2]-inch, for each access duct required.
2) Quantity: Provide one access duct for each foot of diameter and portion thereof for each drilled concrete pier requiring integrity testing.
3) Locations:
a) When one access duct is required, provide at centerline of drilled concrete pier.
b) When more than one access duct is required, provide access ducts attached to inside face of reinforcing steel cage, each spaced equidistant from vertical centerline of cage and equidistant from each other.
c) Access ducts for thermal integrity profiling shall be equally spaced from access ducts required for sonic logging.
4) Provide preformed Schedule 40 PVC pipe in accordance with ASTM D1785, with threaded joints, solvent-welded joints, or joints provided with appropriate, external couplings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
1. Verify field conditions at location of each drilled concrete pier required prior to commencing drilled concrete piers Work.
2. Comply with requirements of Section 31 23 05 – Excavation and Fill, regarding field conditions and examination.

B. Installing the Work constitutes Contractor's approval of underlying work, subgrades, and field conditions prevailing at the time of the Work.

3.2 PREPARATION

A. Submit and obtain Engineer's approval of required Shop Drawings and product data, and acceptance of drilled concrete piers installation plan Submittal, and required qualifications statements prior to commencing drilled concrete piers Work.

B. Layouts: Lines and Grades:
a. Furnish lines and grades for drilled concrete piers Work in accordance with the Contract Documents, including Section 01 71 23 – Field Engineering.
b. Contractor is solely responsible for placement and location of drilled concrete piers.

3.3 EXCAVATION OF SHAFTS FOR DRILLED CONCRETE PIERS

A. Excavation – General:
1. Provide drilled concrete piers with straight shafts, of uniform, required diameter [shown or indicated on the Drawings] [with bell-shaped bottoms where shown or indicated].
2. Provide drilled concrete piers to bottom tip elevation shown or indicated on the Drawings unless other bottom tip elevation is required via appropriate Contract modification, such as a

Field Order or Change Order. Compensation for variations in bottom tip elevation of drilled concrete piers shall be in accordance with the "Price and Payment Procedures" Article of this Section and other, related provisions of the Contract Documents.

3. For each drilled concrete pier, perform excavation, installation of reinforcing steel, and concrete installation all in one day.
4. Provide drilled concrete piers constructed in accordance with the "Installation Tolerances" Article of this Section.
5. Safety and Protection:
   a. Provide and use, as appropriate, gas sensing equipment, temporary ventilation equipment, protective cage, and other safety equipment necessary for inspection and cleaning of drilled concrete pier excavations and for other operations necessitating entry into shafts excavated for drilled concrete piers.
   b. Provide over each excavation for drilled concrete pier temporary cover suitable for safety and protection.
   c. Furnish, install, and use other appropriate items needed for Contractor's safety and protection related to drilled concrete piers Work.
   d. Requirements of this provision notwithstanding, Contractor is solely responsible for safety and protection measures necessary for drilled concrete piers Work. No representation is made that safety and protection requirements of this provision are, in any way, complete or limiting on Contractor relative to complete, appropriate safety and protection measures necessary.
6. Limitations on Drilled concrete pier Construction:
   a. Do not start excavating new shaft for drilled concrete pier adjacent to existing drilled concrete pier within 48 hours after placement of concrete in the existing, adjacent drilled concrete pier.
   b. Edge of new pier construction shall be not less than three shaft diameters clear from each new, completed pier, unless otherwise allowed in writing by Engineer.
7. Use appropriate, properly functioning construction equipment and machinery for excavating shafts for drilled concrete piers.
8. Do not begin excavation for drilled concrete piers until [geotechnical special inspector or consultant (whose responsibilities are indicated in this Section's "Field Quality Control" Article)] [Engineer or Resident Project Representative] is present to observe excavation operations.

B. Construction Method:
   1. Where permanent casing of excavated shafts is not required by the Contract Documents, construct drilled concrete piers by providing temporary casing when necessary to produce sound, durable, drilled concrete piers of uniform, required diameter, free of defects.
   2. Casing Method:
      a. Casing method is used to advance depth of shaft being excavated in unstable subsurface materials, including soils, gravel, water, and other materials. Undercutting to outside diameter of casing may be necessary.
      b. Provide steel casing as necessary or required to prevent:
         1) Caving that may result from vibrations or other construction activity.
         2) Drilled concrete pier installation from adversely affecting adjacent drilled concrete piers, buildings and structures, Underground Facilities, transportation facilities, and other existing facilities.
         3) Instability of shaft, resulting from groundwater.
   3. Drilling of Shafts for Drilled Concrete Piers:
      a. Excavate shafts for drilled concrete piers through any and all materials encountered, unless Engineer directs abandoning and filling incomplete shaft due to obstructions encountered, in accordance with the Contract Documents.
      b. Remove surface and subsurface obstructions.
      c. Furnish and use special tools, equipment, machinery, and procedures as necessary.
      d. Other provisions of the Contract Documents notwithstanding, blasting to excavate shafts for drilled concrete piers is unacceptable.

e. Contractor is responsible for selecting construction equipment and machinery, and methods appropriate for excavating shafts for drilled concrete piers, as well as all other means, methods, techniques, procedures, and sequences for providing drilled concrete piers Work.

C. Obstructions Encountered During Excavation of Shafts:
1. If underground obstruction is encountered during pier drilling that prevents advancing drilling to required depth or that produces evidence of damage to an existing Underground Facility, immediately advise Engineer [and Resident Project Representative] [Owners Site Representative], who will promptly visit the site of the subject drilled concrete pier Work. Promptly issue written notice(s) required by the Contract Documents.
2. Endeavor to determine nature of the obstruction; for example, whether the obstruction is a boulder, Underground Facility, or other, and immediately advise Engineer of findings and limitation(s) of the information available.
3. Engineer will respond in accordance with the Contract's provisions on differing subsurface or physical conditions and, when applicable, provisions on unforeseen Underground Facilities.
4. Engineer may order discontinuing the drilled concrete pier and filling the drilled shaft with concrete or other suitable material. Engineer will direct Contractor on changes in the design associated with discontinued excavation of shafts for drilled concrete piers.
5. Refer to this Section's "Price and Payment Procedures" Article regarding costs associated with discontinued pier drilling and associated changes in the design.

D. Drilling Slurry Use in Excavating Shafts for Drilled Concrete Piers:
1. During excavation, provide and use drilling slurry in accordance with requirements of this Section.
2. Drilling Slurry Mixing and Storage:
   a. Thoroughly pre-mix [mineral slurry] [or] polymer slurry with clean, potable water, and adequately hydrate drilling slurry in mixing tank, including providing sufficient hydration time and proper activation of active constituents in accordance with instructions of [mineral slurry] [or] polymer slurry manufacturer.
   b. Provide temporary tanks of adequate capacity for drilling slurry mixing, circulation, storage, treatment, and disposal.
   c. Using excavated pits for drilling slurry mixing, circulation, storage, treatment, and disposal is unacceptable.
   d. Mixing of drilling slurry in excavated shafts is unacceptable.
   e. Requirements for sampling and testing of drilling slurry for field quality control are indicated in this Section's "Field Quality Control" Article.
3. Percentage and specific gravity of materials used in drilling slurries shall be sufficient for maintaining stability of shaft and support proper placing of concrete.
4. Mineral slurry shall not stand for more than four hours in shaft without agitation. If drilling slurry remains in shaft for longer than four hours without agitation, remove filter cake from shaft walls.
5. During construction, maintain surface level of drilling slurry in shaft five feet or greater above highest expected piezometric pressure head along depth of drilled concrete pier.
6. Provide and use degritting equipment to control drilling slurry sand content. Degritting is not required for casing installation.
7. Prevent drilling slurry from "setting up" in shafts, by agitating, circulating, adjusting drilling slurry properties, or any combination thereof.
8. In event of sudden, significant loss of slurry to the excavation, halt construction of drilled concrete piers until either: methods to stop slurry loss, or an alternate construction procedure is acceptable to Engineer.
9. Maintain slurry temperature at or above 40 degrees F during mixing, excavation of shaft, and construction of drilled concrete piers.

10. When drilling slurry field quality control test results indicate non-compliance with requirements, or should other evidence of non-compliance be apparent, clean, recirculate, degrit, or replace drilling slurry. Ensure compliance with required drilling slurry properties.
11. Do not begin cleaning bottom of shaft and do not begin placing reinforcing steel or concrete in shaft until field test results indicate drilling slurry samples consistently comply with required properties.
12. Shaft Stability:
    a. Demonstrate to Engineer's satisfaction that stable conditions are being maintained in the excavation for the drilled concrete pier. "Stable conditions" include stability of sides of the drilled shaft.
    b. If Engineer believes stable conditions do not exist, immediately stabilize shaft. However, nothing in this Section, or elsewhere in the Contract Documents, creates any obligation, whether in whole or in part, for Engineer to evaluate shaft conditions for benefit of Contractor.
    c. Submit revised drilled concrete piers installation plan Submittal, which corrects stability problem(s) in shaft and prevents future instability.
    d. Do not continue shaft excavation until Engineer's acceptance of revised drilled shaft installation plan.

E. Bottoms of Shafts for Drilled Concrete Piers:
1. Maintain bottom of shafts excavated for drilled concrete piers free of loose, wet materials, frozen materials, mud, snow, and water until associated drilled concrete pier's concrete is placed.
2. Depth of water at bottom of excavated shaft shall not exceed one inch at time of concrete placement.
3. Completed bottom of each drilled concrete pier shall be level surface.
4. During installation of reinforcing steel and concrete, bottom of associated shaft shall be at elevation resulting in drilled concrete pier with the following properties:
    a. Depth as indicated on the Drawings.
    b. Anticipated bearing surface conditions.

F. Spoil Removed from Shafts:
1. Remove shaft spoil materials from perimeter of shafts as soon as shaft excavation for associated drilled concrete pier is completed.
2. Handle and dispose of spoil removed from shafts in accordance with Section 31 23 05 – Excavation and Fill. Do not dispose of spoil material onsite unless expressly allowed by the Contract Documents or by Owner's written authorization.

G. Preparation for Installing Reinforcing Steel and Concrete:
1. Do not install reinforcing steel or concrete in shaft until [Engineer or Resident Project Representative] [or] [in consultation with] [geotechnical special inspector or consultant] indicates agreement that conditions in shaft are in accordance with the Contract Documents.
2. When drilled concrete pier bottom elevation or conditions do not comply with the Contract Documents, provide remedy so the Work is in accordance with the Contract Documents.

3.4 INSTALLATION OF REINFORCED CONCRETE

A. Unless otherwise shown or indicated in this Section or other requirements of the Contract Documents specific to drilled concrete piers, provide reinforced concrete for drilled concrete piers in accordance with Section 03 21 00 – Reinforcement, and Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.

B. Reinforcing Steel Cage Construction and Placement:
1. Reinforcing steel cages shall each include longitudinal bars, ties, cage stiffener bars, spacers, cage centering devices, and other necessary appurtenances. Reinforcing steel cages shall be cylindrical in shape.
2. Provide access ducts (tubing) for integrity testing in accordance with the "Accessories" Article of this Section. Reinforcing steel and access ducts shall be plumb and vertical.

3. Reinforcing steel cages shall be completely assembled and placed immediately after acceptable drilled concrete pier excavation is observed by [Engineer or Resident Project Representative] [and] [or] geotechnical special inspector or consultant (in accordance with this Section's "Field Quality Control" Article) and appears to be in accordance with the Contract Documents, and prior to concrete installation. Such observation and concurrence, if any, that drilled concrete pier excavation appears to be in accordance with the Contract Documents does not constitute acceptance of the Work. Acceptance of the Work is only upon completion of all the Work and is documented in accordance with the General Conditions, as may be modified by the Supplementary Conditions, and Section 01 77 19 – Closeout Requirements.
4. Ties, Supports, and Spacers:
    a. Tie and support reinforcing steel in drilled concrete pier so that reinforcing steel remains within allowable tolerances indicated in ACI 117.
    b. Reinforcing added to stiffen a reinforcing steel cage will be at Contractor's expense.
    c. Provide approved, non-corrosive spacers, at sufficient vertical intervals, near cage top and bottom, and at intervals not greater than 10 feet, to provide concentric spacing for entire length of cage.
    d. Quantity of spacers at each interval shall be equal to shaft diameter measured in feet and rounded up to next whole number, and shall be not less than four.
    e. Spacers shall be of adequate dimensions to provide minimum clear distance of three inches or as shown in the Drawings, whichever is greater, between cage and sides of the excavated shaft, and be evenly spaced along outside circumference of reinforcing steel cage.
    f. When a reinforcing steel cage is required to be full depth of the drilled shaft, support cage bottom by approved, cylindrical feet to ensure bottom of cage is at proper distance above bottom tip elevation of excavated shaft.
5. Place each reinforcing steel cage in shaft not more than [two] hours prior to commencing placement of concrete. Install reinforcing steel in accordance with the Drawings and other relevant requirements of the Contract Documents.
6. Adequately support and anchor reinforcing steel cages from top, preventing movement from required location during concrete placing, and for, four hours thereafter.
7. When temporary casing is used, support reinforcing steel cage prior to removing casing, and for four hours following casing removal. Maintain reinforcing steel cage in plumb position . Cage shall not rest directly on bottom of shaft.
8. Verification of Reinforcing Steel Cage Location:
    a. Verify elevation of top of reinforcing steel cage before and after concrete is placed.
    b. If reinforcing steel cage is not in accordance with requirements of the Contract Documents, remedy the deficiencies until compliance is achieved.
    c. If problems with location or integrity of reinforcing steel cage are apparent in a drilled concrete pier, do not construct further drilled concrete piers until appropriately modifying reinforcing steel cage supports, so that problems are not encountered in subsequent drilled concrete piers.

C. Concrete Placing:
1. After concurrence that bottom of shaft of drilled concrete pier appears to be in accordance with the Contract Documents, and following [special inspector's] approval of installed reinforcing steel cage, dowels, and anchor bolts for the drilled concrete pier, provide concrete in the shaft for the drilled concrete pier as soon as practicable.
2. Method of Placing Concrete:
    a. Install concrete in manner that avoids: segregation of concrete aggregate and other components, infiltration of water and soil, other occurrence that may decrease strength of concrete, and decrease the structural capacity of finished drilled concrete pier.
    b. Provide formwork necessary for drilled concrete pier construction.
    c. Perform concrete pumping that avoids introducing air pockets in concrete.
    d. Continuously install concrete in each drilled concrete pier to avoid forming cold joints.
    e. Do not place concrete in drilled concrete piers against soft, loose, or frozen materials.

f. Do not allow concrete to free-fall through reinforcing steel.
g. Limit concrete free-fall to not greater than four feet.
h. Preserve integrity of access ducts (tubes) for integrity testing during concrete placing.
i. Promptly after installation of concrete, and not later than one hour after concrete placing, verify access ducts have no obstructions and completely fill access ducts (tubes) with potable water.

D. Removal of Temporary Casings:
1. When temporary casing is used for bracing drilled concrete pier excavation and maintaining watertightness during concrete placing, coordinate casing removal with concrete placing.
2. Bottom of temporary casing shall always be below surface of wet concrete in drilled concrete pier, to prevent reduction in pier diameter resulting from earth pressure, and to prevent soils and other subsurface materials, and ground water from entering and mixing with wet concrete.
3. During removal of temporary casings, maintain in tremie pipe head of not less than 10 feet of fluid concrete above concrete surface in shaft, except at top of shaft. Remove contaminated concrete from shaft.
4. Withdraw temporary casing from shaft using uniform, vertical hoisting force in-line with shaft axis, while maintaining casing being withdrawn in, continuously-plumb alignment, in manner allowing continuous observation of concrete surface in the drilled concrete pier.
5. Withdraw temporary casing from shaft at slow, uniform rate.

E. Consolidation of Concrete in Drilled Concrete Piers:
1. Consolidate uppermost [five] [10] feet of concrete in each drilled concrete pier by appropriate use of vibration, unless self-consolidating concrete is provided.
2. Place concrete in top 10 feet of drilled concrete pier in lifts with maximum thickness of two feet, vibrating each lift into the previous lift.
3. Perform vibration after removal of temporary casing, if any.

F. Top of Drilled concrete piers:
1. Surface of each drilled concrete pier at top cut-off elevation shall be level and have diameter required by the Contract Documents.
2. Where top surface of drilled concrete pier has a mushroomed configuration, remove excess concrete in manner that does not damage top of drilled concrete pier. Provide drilled concrete pier of diameter required.

G. Concrete Curing
1. After completing placing concrete for each drilled concrete pier, cure exposed top surface of drilled concrete pier for not less than seven days.
2. When ambient air temperature is less than 40 degrees F, maintain temperature of exposed surfaces of drilled concrete piers at not less than 50 degrees F throughout required curing period.
3. Comply with recommendations of ACI 306R for curing concrete in cold environments. Comply with recommendations of ACI 305R for curing concrete in hot environments.

3.5 INSTALLATION TOLERANCES

A. Provide each drilled concrete pier within tolerances indicated below, compared against the locations and dimensions shown or indicated in the Contract Documents:
1. Horizontal Location, Tolerance at Drilled concrete pier's Top Cut-Off Elevation: Allowable tolerance is the greater of: (a) 1/24 of diameter of the subject drilled concrete pier, or (b) three inches, from required location.
2. Tolerance from True Vertical: As measured along vertical centerline of pier, tolerance is the lesser of the following:
a. Five percent of the drilled concrete pier's length.
b. 12.5 percent of drilled concrete pier's diameter.
c. 15 inches.

3.6 FIELD QUALITY CONTROL

A. Field Tests and Inspections:
   1. Sampling and Testing of Drilling Slurry Used in Excavating Shafts for Drilled Concrete Piers:
      a. General – Drilling Slurry Sampling and Testing:
         1) Obtain and test samples of slurry prior to, during, and immediately following excavation of shafts for drilled concrete piers to verify quality of drilling slurry used.
         2) Provide and use suitable apparatus, capable of obtaining drilling slurry samples at any depth within shafts.
         3) Slurry test methods shall be as required for associated type of slurry indicated in this Section's requirements for drilling slurry.
         4) Sample and test drilling slurry in presence of [Owner's Site Representative] [Resident Project Representative] [or] [geotechnical special inspector or consultant], unless otherwise directed by Engineer.
         5) Before obtaining drilling slurry samples for testing, wait 30 minutes, after final drilling and scouring, to allow contaminants to settle.
         6) Record, in writing date, time, names of personnel performing sampling and testing of drilling slurry, and results of tests.
         7) Submit to Engineer drilling slurry test results upon completion of each excavated shaft for each drilled concrete pier, and during excavation of each shaft when requested by Engineer [or geotechnical special inspector or consultant].
      b. If polymer slurry is proposed, Contractor's drilling slurry management plan shall include detailed provisions for controlling quality of drilling slurry, including tests to be performed, frequency of tests, test methods, and drilling slurry properties required. Drilling slurry management plan shall include drilling slurry material manufacturer's written recommendations and shall include the following tests: density test (API RP 13B-1); viscosity test (Marsh funnel and cup, API RP 13B-1, Section 2.2 or suitable viscometer); pH test of drilling slurry (using either pH meter or litmus test); and sand content test (API sand content kit, API RB 13B-1, Section 5).
      c. Testing of Drilling Slurry Samples Obtained from Tanks:
         1) Prior to starting shaft excavation and introducing drilling slurry to shaft, obtain samples from drilling slurry tank and test for compliance with required material properties.
         2) Each set of samples tested shall include sample obtained at mid-height of tank and within two feet of tank bottom.
         3) Test tanks' contents not less than once per day prior to drilling operations.
      d. Testing of Drilling Slurry During Shaft Excavation:
         1) During shaft excavation, obtain and test sample sets of slurry, composed of samples taken at mid-height of shaft and within two feet of bottom of shaft, as necessary, and when required by Engineer [or geotechnical special inspector or consultant] to verify control of drilling slurry properties.
         2) Promptly submit to Engineer results of such testing.
         3) In addition to sampling and testing required above for contents of drilling slurry tanks, obtain and test sample sets of drilling slurry introduced to shafts, not less than once every two hours after beginning drilling slurry use and until reinforcing steel and concrete placing are complete.
         4) When test results indicate consistent compliance via not less than three tests with required drilling slurry properties, thereafter, obtain and test sample sets not less than once every four hours of drilling slurry use.
         5) When tests reveal samples do not consistently comply with required properties, recirculate or agitate drilling slurry using installer's shaft drilling equipment or machinery.
      e. Testing of Drilling Slurry After Shaft Excavation;

1) After placing reinforcing steel cage in excavated shaft, a sample set of drilling slurry shall be obtained from shaft and tested immediately prior to concrete placement.

2. Code-Required Special Inspections:
   a. Comply with Section 01 45 33 – Code-Required Special Inspections and Procedures.
   b. In this Section, the term geotechnical special inspector or consultant refers to the special inspector for drilled concrete piers Work.
   c. [Owner will employ] [Employ] a geotechnical special inspector or consultant to be onsite during critical portions of drilled concrete piers Work to provide Owner with greater assurance concerning subsurface conditions and quality of required drilled concrete piers Work. [Owner's furnishing of services of geotechnical special inspector or consultant is not for Contractor's benefit.] Owner and Engineer have the right to rely on accuracy and completeness of reports and observations of geotechnical special inspector or consultant.
   d. Qualifications of Geotechnical Special Inspector or Consultant:
      1) Professional engineer licensed and registered in the same jurisdiction as the Site and legally authorized to perform the services required.
      2) Possess valid, appropriate professional liability insurance.
      3) Possess experience and expertise appropriate for the type of construction required and subsurface conditions prevailing at the Site.
   e. Geotechnical Special Inspector or Consultant Scope:
      1) Perform testing, observations, and services indicated as geotechnical special inspector or consultant responsibilities in this Section and other responsibilities of special inspectors, if any, indicated in Section 01 45 33 – Code-Required Special Inspections and Procedures, relative to drilled concrete piers Work.
      2) When requested by Engineer, geotechnical special inspector or consultant shall review and furnish to Engineer comments on Contractor's drilled concrete piers Shop Drawings and drilled concrete piers installation plan Submittal, for Engineer's consideration as part of the Engineer's review of such Submittals.
      3) Inspect drilled concrete piers construction by appropriate visual observation and, where necessary, physical testing for compliance with the Contract Documents, compliance with drilled concrete pier installation Shop Drawings approved by Engineer, and drilled concrete piers installation plan Submittal accepted by Engineer.
      4) Observe drilling operations for drilled concrete piers.
      5) Verify placement locations and plumbness of shafts for drilled concrete piers.
      6) Verify diameters (plot of depth versus volume of concrete), bottom tip elevations, and top cut-off elevations of drilled concrete piers provided. Engineer may consider such information furnished by geotechnical special inspector or consultant when determining quantities of drilled concrete piers Work eligible for payment.
      7) Verify compliance of drilled concrete piers with installation tolerances required by the Contract Documents.
      8) Verify embedment (in vertical linear feet) of drilled concrete piers into rock (where applicable).
      9) Verify adequate end-bearing stratum and cleanliness.
      10) Observe performance of integrity testing required by the Contract or as ordered by Engineer, and assist Engineer with interpreting results of integrity testing.
      11) Furnish to Engineer and Contractor written results of observations and site visits, together with appropriate recommendations.
      12) Drilled Concrete Pier Installation Report:
         a) Independently verify completeness and accuracy of Contractor's drilled concrete pier installation report.
         b) Coordinate such Work with other special inspectors.
         c) Assist Engineer by recommending measures to remedy defective Work. However, Contractor is solely responsible for remedying defective Work,

regardless of recommendations proposed by geotechnical special inspector or consultant, and remains solely responsible for construction means, methods, techniques, procedures, and sequences, and associated safety and protection measures.

d) Issuing jointly to Engineer and Contractor signed certification of completeness and accuracy of data furnished, and compliance of drilled concrete piers Work with the Contract Documents, to best of geotechnical special inspector or consultant's knowledge, information, and belief, that, as an experienced design professional, the drilled concrete piers Work is in accordance with the Contract Documents. Geotechnical special inspector or consultant's certification does not relieve or mitigate Contractor's responsibilities under the Contract Documents.

13) Geotechnical special inspector or consultant shall critically observe and report findings to Engineer and Contractor.
14) Review and be familiar with results of field quality control tests and inspections performed by testing laboratories, whether retained by Owner, Contractor, or Engineer, and advise Engineer and Contractor when results of such tests and inspections indicate non-compliance with the Contract Documents, Laws and Regulations, or both.
15) Direct attention of Engineer and Contractor to subsurface conditions encountered which geotechnical special inspector or consultant believes may be unfavorable or unsuitable for the drilled concrete piers Work. In such situations, furnish to Engineer written recommendations for alternatives, based on geotechnical special inspector's or consultant's appropriate professional judgement.
16) When the Work is defective, geotechnical special inspector or consultant will direct attention of Engineer and Contractor to such defective Work.
17) Furnish to Engineer and Contractor written results of observations and site visits, together with appropriate recommendations.

f. Limitations of Authority of Geotechnical Special Inspector or Consultant:
1) Geotechnical special inspector or consultant is not Engineer's employee, agent, or representative.
2) Geotechnical special inspector or consultant will not supervise performance of any of Contractor's Work. Geotechnical special inspector or consultant shall not perform other duties for Contractor.
3) Geotechnical special inspector or consultant has no authority to modify or mitigate requirements of the Contract Documents, accept or reject any part of the Work, or otherwise perform Engineer's responsibilities.

g. Concrete Testing:
1) Furnish [one set of cylinders in accordance with Section 03 05 05 – Concrete Testing and Inspection] [three concrete test cylinders, each six inches in diameter and twelve inches tall] [four concrete test cylinders, each four inches in diameter and eight inches tall], for every 20 cubic yards of concrete or fraction thereof placed as part of the drilled concrete piers Work.
2) Clearly and permanently indicate on each concrete test cylinder specific drilled concrete pier from which each test cylinder was obtained.
3) Cylinders and testing shall be in accordance with Section 03 05 05 – Concrete Testing and Inspection.

3. Responsibilities and Duties of Contractor:
a. Use of testing laboratory [or geotechnical special inspector or consultant] in no way relieves Contractor of responsibility to provide Work in compliance with the Contract Documents.
b. When Owner furnishes services of testing laboratory, special inspector, consultant, or any combination thereof, for drilled concrete piers Work, Owner and Engineer do not represent that the sampling and testing performed by Owner-hired testing laboratory or inspections by Owner-hired special inspectors or consultants, is sufficient for

Contractor's purposes, or to monitor all aspects of the drilled concrete piers Work. If additional quality control is needed to verify that the Work performed and materials delivered to the Site are in accordance with the Contract Documents, Contractor may retain its own, independent testing laboratory to perform additional sampling and testing for Contractor's purposes.

c. To facilitate testing laboratory, special inspectors, and consultants, Contractor shall advise testing laboratory, special inspectors, and consultants not less than [two] days in advance of each relevant aspect of drilled concrete piers Work to allow for completion of field quality control testing and for assignment of personnel.

d. Contractor shall be responsible for providing required compaction for fill and other earth work related to drilled concrete piers.

4. Integrity Testing:

a. Qualifications of Personnel Performing Integrity Testing: Integrity testing shall be performed by personnel experienced in performing integrity testing of the types required. Such personnel shall have complete familiarity and experience with the specific testing apparatus employed, and be experienced in data evaluation and analysis for the types of integrity testing required.

b. Quantity of Tests Required:

1) For each type of integrity testing required by this provision, perform such testing on [each drilled concrete pier for which access ducts are provided] [20 percent of drilled concrete piers, with specific piers to be tested designated by Engineer at the Site] [drilled concrete piers designated on the Drawings as requiring integrity testing].

2) When directed by Engineer [who may consider advice of geotechnical special inspector or consultant], perform additional integrity testing of additional drilled concrete piers. Where drilled concrete piers for which such additional integrity testing is directed were not provided with access ducts with appropriate liner material, core-drill access ducts into concrete in accordance with ASTM D6760 and ASTM D7949 as applicable. Compensation for such additional testing and, where necessary, core-drilling, shall be in accordance with requirements of the General Conditions, as may be modified by the Supplementary Conditions, relative to uncovering Work.

c. Sonic Logging:

1) Perform crosshole sonic logging (CSL) in accordance with ASTM D6760, within three to seven days following concrete placing. Record data in accordance with ASTM D6760.

2) Following completion of sonic testing, completely remove water from each access duct regardless of whether sonic logging was performed for the associated drilled concrete pier. Ensure each access duct is dry before replacing temporary caps at top of access duct.

d. Thermal Integrity Profiling (TIP):

1) Perform TIP in accordance with ASTM D7949 Method A, at time that is, as near as possible, to time of peak temperature of concrete during curing. Prior to performing TIP, entirely remove water from within each access duct in which TIP will be performed.

2) Record data in accordance with ASTM D7949.

3) Following completion of TIP, completely remove water from each access duct, regardless of whether TIP was performed for the associated drilled concrete pier. Ensure each access duct is dry before replacing temporary caps at top of access duct.

e. Results of Integrity Testing:

1) Promptly upon completion of integrity testing, furnish results of integrity testing as Submittal.

2) Submit with results of integrity testing detailed, as-constructed measurements of access ducts, indicated for each drilled concrete pier, in accordance with requirements of the "Accessories" Article of this Section.
3) Written report of integrity testing shall include complete information on each drilled concrete pier tested, data evaluation and analysis, and narrative description of detected areas of potential defective Work.

f. Grouting of Access Ducts: When directed by Engineer, following Engineer's acceptance of written results of integrity testing, completely fill each access duct with non-shrink, non-metallic grout, in accordance with Section 03 31 30 – Concrete Materials and Proportioning, and Section 03 31 31 – Concrete Mixing, Placing, Jointing, and Curing.
g. Do not perform Work atop drilled concrete piers until results of integrity testing are acceptable to Engineer.

B. Defective Drilled Concrete Piers Work:
1. Defective drilled concrete piers may be identified by Engineer, Owner, [or geotechnical special inspector or consultant]. Contractor will be notified of defective Work by Engineer in accordance with the Contract Documents. [Engineer's opinion may be based in whole or in part on information furnished by geotechnical special inspector or consultant.] Defective Work is ineligible for payment.
2. In addition to drilled concrete piers provided outside of acceptable tolerances indicated in this Section and other non-compliance with the Contract Documents or damage, the following are express reasons for Engineer to reject drilled concrete piers Work as defective:
   a. Concrete 28-day compressive strength is less than required.
   b. Concrete is cracked, exhibits voids or honeycombing, concrete includes soft materials such as soil materials or other foreign matter, concrete has not acceptably passed results of field quality control tests and inspections (including integrity testing), or concrete has other defect(s) as perceived by Engineer. Engineer's opinion may be based in whole or in part on information furnished by geotechnical special inspector or consultant.
   c. Drilled concrete piers that do not comply with diameter and depth required by the Contract Documents.
3. When Engineer has reasonable belief that one or more drilled concrete piers may be defective, Engineer may require, and Contractor shall perform, additional non-destructive testing, which may include additional integrity testing (consisting of pulse echo, vibration methods, transient response, high strain or similar in accordance with ASTM D5882 or ASTM D4945,) or other testing, inspection, or both, as directed by Engineer. Promptly perform such testing and inspection and submit written results to Engineer. Responsibilities for uncovering concealed Work for additional testing and inspection, performance of additional testing and inspection as directed, and re-covering concealed Work are indicated in the General Conditions, as may be modified by the Supplementary Conditions.
4. Promptly remedy defective Work in accordance with the Contract Documents and at no additional cost to Owner or entities retained by Owner.

C. Manufacturer's Services:
1. When polymer slurry is used, polymer manufacturer's representative shall provide technical advice and assistance to drilled concrete piers installer regarding use of polymer slurry, as needed.

3.7 CLOSEOUT ACTIVITIES

A. As-Constructed Survey and Drawings of Drilled concrete piers:
1. Promptly following completion of drilled concrete pier installation and prior to constructing any other Work atop drilled concrete piers (such as, but not limited to, grade beams), retain services of licensed, professional land surveyor to survey and document final location of

each drilled concrete pier, on the Project's site plan and drilled concrete piers plan in the Drawings:

a. Location of each drilled concrete pier, based on the Project's coordinate system and GPS coordinates.
b. Horizontal variation of each installed pier from location shown or indicated in the Contract Documents.
c. Diameter of each drilled concrete pier.
d. Variation, if any, from diameter required by the Contract Documents.
e. Top cut-off elevation of each drilled concrete pier.
f. Vertical variation of each installed pier from top cut-off elevation shown or indicated in the Contract Documents.

2. Qualifications of surveyor and surveyor's field personnel shall be in accordance with Section 01 71 23 – Field Engineering.
   a. Submit as-constructed record drawings of drilled concrete piers, together with surveyor records required by Section 01 71 23 – Field Engineering, within time limit indicated in this Section's "Submittals" Article for closeout Submittals.

B. Item [number] – [36-inch] Diameter Drilled Concrete Piers:
   1. Measurement will be the vertical length, in vertical linear feet, of drilled concrete pier, measured along the drilled concrete pier's vertical centerline, from bottom tip to top cut-off elevation shown or indicated in the Contract Documents.
   2. Item Includes (all in accordance with the Contract Documents):
      a. As indicated in Section 31 63 29 – Drilled Concrete Piers and Shafts.
   3. Not included in this bid/pay item:
      a. As indicated in Section 31 63 29 – Drilled Concrete Piers and Shafts.
   4. Payment: Unit price per vertical linear foot for this item will be full compensation for all drilled concrete pier Work of the indicated size and type, and all related Work, performed under this item, complete in accordance with the Contract Documents, and not specifically included under other bid/pay items or contracts.

END OF SECTION

HHAngus

Mechanical Specification

FOR

EMERGENCY POWER SYSTEM CAPACITY & INFRASTRUCTURE REMEDIATION

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LIST OF SECTIONS - MECHANICAL
20 00 01

DIVISION 20 – COMMON WORKS FOR MECHANICAL

20 00 01	List of Sections
20 01 01	Mechanical General Requirements
20 01 02	Qualifications and Authorities - Ontario
20 01 13	Definitions and Abbreviations - Mechanical
20 05 01	Basic Materials and Methods
20 05 02	Painting for Mechanical Services
20 05 24	Welding and Brazing
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20 77 19.20	Closeout Requirements for Mechanical Work

DIVISION 23 – HEATING, VENTILATION AND AIR CONDITIONING

23 51 33	Insulated Sectional Chimneys

END OF SECTION

MECHANICAL GENERAL REQUIREMENTS
20 01 01

1 GENERAL

1.1 General Contract Documents

.1 Comply with General Conditions of the Contract, Supplementary Conditions of the Contract, and Division 01 - General Requirements.

.2 Where content in this Specification section duplicates requirements in various Division 01 Specification sections, this section and the applicable Division 01 sections are to be read together and the most stringent requirements apply.

1.2 Work Included

.1 Work to be done under Divisions 20, 21, 22, 23 and 25 to include furnishing of labour, materials and equipment required for installation, testing and putting into proper operation complete mechanical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

.2 Read drawings and specifications together as a whole and in conjunction with other such documents included under the Construction Contract.

1.3 Document Organization

.1 Applicable Divisions for Mechanical Work:

.1 Division 20 - Common Work for Mechanical

.2 Division 23 - Heating, Ventilation and Air Conditioning (HVAC)

.3 Division 25 - Building Automation System

.2 For clarity, any reference in the Contract Documents to Division 20 includes Divisions 23 and 25.

.3 The Specifications for these Divisions are arranged in sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.

.4 Contractor is responsible for completion of work whether or not portions are sublet.

1.4 Division 20, as it applies to Divisions 23 and 25

.1 Division 20 contains common work requirements that are applicable as necessary to the Work of Divisions 23 and 25 and apply as if written in full within those Divisions.

1.5 Language

.1 The specification is written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where a list follows a semi-colon (;) the punctuation is for clarity. Where a list follows a colon (:) the punctuation is to be read as a short-hand form of the verb “to be” or “to have” as context requires.

.2 It is not intended to debate with the Contractor the reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

1.6 Definitions and Abbreviations

.1 Specification section 20 01 13 *Definitions and Abbreviations – Mechanical* contains general definitions and abbreviations that apply to one or more specification sections of this Division of the Work. Other

specification sections of the mechanical Divisions of the Work may also include additional specific definitions and/or abbreviations that apply to that specification section.

.2 The following general terms apply to Divisions 20 to 25 of the Work:

.1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in this Specification, mean that material or item referred to is "indicated", "shown", "listed" or "noted" on Drawings or in Specification.

.2 Wherever the word “listed” is used in conjunction with a product and a product certification standard (including but not limited to CSA, ULC, CGSB, BNQ, UL), it shall be understood to mean that the product is “listed” by an accredited 3rd party testing laboratory as being certified to the referenced product standard.

.3 Wherever the words “approved”, or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to shall be “approved by” the Owner.

.4 Wherever the words “satisfactory”, “as directed”, “submit”, “permitted”, “reviewed”, or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides, to mean that material or item referred to shall be “satisfactory to”, “as directed by”, “submitted to”, “permitted by”, or “reviewed by” the Consultant.

.5 Instructions using any form of the word:

(a) “install” means to place in position and activate for service or use,

(b) “supply” means to procure and deliver materials to the place of the Work, or to make available labour or services for the stated purpose,

(c) "provide" means to supply material, labour and services to install the referenced item.

.6 The term “building code” means the edition of the applicable building code at the time of obtaining a building permit.

.7 Wherever manufacturers or manufacturer’s products are identified in lists under the phrase "Standard of Acceptance", these are manufacturers and/or products which meet the project standards in regard to performance, quality of material and workmanship.

1.7 Examination

.1 Examine any existing buildings, local conditions, building site, the specifications and drawings, and report any condition, defect or interference that would prevent execution of the work.

.2 No allowance will be made for any expense incurred through failure to make these examinations of the site and the documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.

.3 Before commencing work under this Division, examine the work of other Divisions of the Work and report any defect or interference.

1.8 Design Services

.1 Provide specialty design services for elements of the Work where specified in other sections of Division 20. Drawings and specifications prepared by such specialty design service providers shall be sealed by a professional engineer licensed in the jurisdiction of the Work.

1.9 Product Substitutions

.1 In the absence of requirements concerning product substation requests in Division 01, Contractor may propose a substitute product to that which is specified in accordance with the following.

.2 All proposed substitutions shall be submitted using the Consultant's product substitution form and include all information stated therein.

.3 The use of a substitute article or material which the Contractor represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions:

.1 a substitution will not be considered for reasons of meeting the construction schedule unless the contractor can demonstrate to the satisfaction of the Consultant they made all reasonable efforts to procure the specified product or material in a timely fashion,

.2 the manufacturer must advise the Consultant of this intention to use an alternative article or material before doing so,

.3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer and they shall supply all information necessary as required by the Consultant at no additional costs to the contract,

.4 the Consultant shall be the sole judge as to the quality and suitability of alternative materials and their decision to be final,

.5 where use of an alternative material involves redesign or changes to other parts of the work, the costs and the time required to effect such redesign or changes will be considered in evaluating the suitability of the alternative materials,

.6 no test or action relating to the approval of substitute materials is to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed. Such request to be made in ample time to permit appropriate review without delaying the work, taking into consideration that such a substitution request may be rejected and require providing the product or material as originally specified,

.7 whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials is to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,

.8 the costs of all testing required to prove equality of the material proposed to be borne by the manufacturer.

2 SHIPPING, HANDLING AND STORAGE

2.1 Shipping

.1 Provide adequate protection of equipment during shipping and handling so as to provide equipment at the Work site in ex-works condition when handled by commercial carrier systems.

.2 Provide, as necessary, removable bracing of the internal components in each item of equipment so that the equipment can be moved on its side or back, without sustaining damage.

.3 Where removeable internal bracing has been provided, the equipment to be provided with warning labels to call for the removal of the shipping bracing prior to energization.

.4 Any component that is packaged or shipped separately is to be individually crated and tagged with unit number and the equipment number of the assembly to which it belongs.

.5 Provide each "shipping section" with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

2.2 Storage

.1 Store equipment and materials at the worksite to protect them from any damage until placed into its final location. Maintain similar protection of installed equipment and materials to protect against damage until they are turned over to the Owner. Make good any damage to equipment or materials up to the time of ready for takeover.

.2 Store equipment in accordance with the manufacturer's instructions and not less than:

.1 stored in a dry, clean location,

.2 cover with polyethylene plastic sheeting,

.3 include a desiccant material under the protective sheeting to absorb moisture, or provide heated ventilated air

.3 Provide adequate ventilation and temporary heating to prevent condensation of moisture within the equipment.

2.3 Provisions for Handling and Field Erection

.1 For equipment that will require hoisting on site, provide removable side panels, lifting angles or lifting plates to accommodate the use of slings or crane hooks, for each shipping section.

.2 For floor mounted equipment, provide on each shipping section removable steel channel base plates to permit use of pipe rollers or dollies without damaging the equipment.

3 OWNER'S SPECIAL REQUIREMENTS FOR EXISTING SITES

.1 The following special requirements are in addition to the requirements of Division 01 of the Work.

.2 Provide a written list of names for employees and sub-trades entering the building, advising which areas they need access to at least 48 hours prior to expected time of arrival. This lead time is required to prearrange security passes.

.3 Security passes must be visibly worn at all times by all employees.

.4 Trades people to strictly adhere to owner's building security procedures otherwise entrance into the building will be denied.

.5 Trades people are to enter the entrance identified by the Owner.

.6 Park vehicles in designated areas. Do not block driveways.

.7 Use only the freight elevator to transport tools and material. Freight elevator door must be shut immediately after exiting the cab.

.8 Do not disable or activate any electrical or mechanical system without prior approval by the Owner's Project Manager. Also, prior to disabling or activation of any electrical or mechanical system, obtain approval from Building Operations and Building Security.

.9 Submit prior notification to Building Security Staff before any construction activity commences which will result in heat, smoke, dust or fumes, such as welding, saw cutting, soldering, spray painting, which might affect sensitive fire detection and protection equipment.

.10 Provide at least 48 hours prior notification to Building Operations for any fire system isolation requests.

.11 Schedule work and meet with sub-trades daily on site, to show trades people the work areas and work to be done.

.12 Trades-people are to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned by the Owner.

.13 Provide environmental cleaning of the job site daily during construction and upon completion. This includes above ceilings. Do not store materials or garbage on the loading dock.

.14 Provide special care, attention and protection when transporting equipment and materials to prevent accidental damage to fire protection equipment, finishes, furnishings and fixtures.

.15 "No Smoking" – this is a smoke-free building. Violators will be asked to leave and may be denied reentry. Smoking is not allowed on the roof.

.16 If Building Operations deems that work on a particular system requires security escort, allow 48 hours to make appropriate arrangements.

.17 For any open flame work, provide fire extinguishers and security fire watch.

.18 Obtain the approval of the Building Manager for the storage of materials on site.

.19 Perform a daily cleanup prior to leaving the site.

.20 Secure oxygen and acetylene cylinders at all times and capped nightly.

.21 Restore operating and redundant systems to their normal condition at the end of each work day unless otherwise approved by the Owner

.22 At the conclusion of each work day, the Contractor's superintendent/supervisor is to advise the Building Manager on the day's activities and plans for the next day's work.

4 PROGRESS PAYMENT PROCEDURE

4.1 Schedule of Values

.1 [Provide schedule(s) of values for progress payments in accordance with this part.

.2 Prepare and submit a schedule of values ("SOV") for the Division 20 Work.

.3 Each SOV is to be in the sample format shown in Article "Attachments", specifically that the SOV is to include four sections for:

.1 Contract price work element breakdown, which includes:

(a) detailed breakdown by work element as agreed with the Consultant,

(b) line items for coordination drawings, as-built documents and operating manuals,

(c) a summary line item for authorized Cash Allowance disbursements (if applicable),

(d) line items for each Itemized Price (if applicable),

(e) line items for each Separate Price (if applicable and included in the Contract Price)

(f) a line item for the total of the original contract work element values,

(g) a summary line item for approved change instructions,

.2 Cash Allowance disbursement authorization, with separate work elements for each cash allowance,

.3 Approved Change Instructions, with separate work elements for each change instruction,

.4 Outstanding Change Instructions which are either not quoted or not yet approved.

.4 Each work element in the SOV sections (except Outstanding Change Instructions) is to include:

.1 the original contract value and the percent of original contract total value (Contract Price section only),

.2 the completed to date amount and percent of original work element contract value,

.3 the previously billed amount and percent of original work element contract value,

.4 the current billing (payment request) amount and percent of original work element contract value, and

.5 the balance to complete amount and percentage of original work element contract value.

.5 The required Contract Price work element breakdown will be determined by the Consultant, with the level of breakdown appropriate to the project such as

.1 by trade,

.2 by specification section or portion thereof,

.3 by labour vs material,

.4 by location in the building,

.5 or any combination of the above.

.6 Submit a draft SOV for review and approval by the Consultant at least three weeks before the first request for progress payment. Do not submit requests for progress payments until the SOV has been reviewed and there are no outstanding comments from the Consultant.

.7 Make requests for progress payments using the values on the reviewed SOV.

.8 When a change in the Work has been approved by the Owner, include the approved changes on the SOV for the next payment application, whether or not payment is requested in full or in part for that change in that payment request period.

5 CONSTRUCTION CHANGES

5.1 General

.1 The valuation method to be used for a change instruction to the Work is to be determined by the Consultant from the following methods:

.1 by labour and material when the change instruction is by a Change Directive;

.2 by unit prices set out in the Contract or subsequently agreed upon for other change instructions;

.3 by a detailed quotation for other change instructions; or

.4 by a Cash Allowance Disbursement instruction.

5.2 Definitions

.1 The following definitions apply to this section

.1 Allpricer – *the material pricing guide/service provided by Allpricer Limited.*

.2 ***MCAA manual*** – the Mechanical Contractors Association of America publication *Labor Estimating Guide for Service* for labour units.

.3 ***Base wage rate*** – the hourly rate actually paid to the trades person, determined in accordance with applicable collective bargaining agreement, or in their absence the actual gross wages paid to the worker.

.4 ***Job Site Impact Multiplier*** – a multiplier expressed as a decimal number that is included in the Labour Rate to account for special job site conditions that affect labour availability, labour productivity, procurement of materials, and materials management, that are specific to the project and site conditions.

.5 ***Indirect labour –*** any labour that is neither journeyperson labour that directly performs the work nor labour that directly supervises journeyperson(s).

.6 ***Labour Rate*** – the actual fully burdened labour cost per hour of labour consumed by a trades person including statutory and regulatory burden, collective bargaining burden, and other project related burden. For greater clarity, the labour rate includes but is not limited to the following:

(a) base wage rate,

(b) vacation and statutory holiday pay,

(c) union deductions and additional union charges,

(d) Legislated burdens including EHT, WSIB, EI, CPP, RST on H/W

(e) wage-based taxes,

(f) job site impact multipliers,

(g) expendable small tools charge,

(h) project insurance,

(i) financing of payroll,

(j) estimating,

(k) rest breaks and idle time,

(l) safety including training, safety meetings, WHMIS, fall protection, personnel protection equipment, and safety committees,

(m) preparation and handling of shop drawings and other submittals,

(n) preparation of as-built documents, including operation and maintenance manuals,

(o) labour warranties,

(p) site facilities,

(q) clean-up,

(r) parking.

.7 ***Foreperson*** – a first level supervisory position having direct control over the work performed by journeypersons.

.8 ***Journeyperson*** – *a person working in a skilled construction trade which may be prescribed by regulation, and includes apprentices.*

.9 ***Labour Unit*** – the number of journeyperson labour hours or part thereof, required to perform a specific construction task, and includes but is not limited to:

(a) receiving, unloading, stockpiling, distribution and handling of materials and equipment,

(b) rigging or erecting of materials or equipment,

(c) fitting and joining of materials,

(d) pressure testing of piping and ductwork systems,

(e) testing of equipment and systems.

.10 ***Line materials*** – components that make up a distribution network for fluid, power, or electronic/digital information, and includes:

(a) piping, pipe fittings, valves (of all kinds), pipe strainers and other pipe mounted equipment,

(b) ducting, duct fittings, duct balancing dampers and other duct mounted equipment,

(c) conduit, cable tray, cable, conductors, and wiring,

(d) supports, hangers and restraints,

(e) vibration isolators and seismic restraints associated with line materials,

(f) instrumentation including gauges and sensors/transmitters,

(g) electrical, pneumatic, and hydraulic actuators for valves and dampers, and

(h) any coatings or other protective elements applied thereto including insulation and painting.

.11 ***Overhead*** – administrative expenses of the Contractor's business and the project which are not included in a Labour Rate or Labour Unit. For greater clarity, overhead includes but is not limited to the following:

(a) company office, storage, and fabrication spaces, and associated maintenance, utilities, and expenses,

(b) project site office, fabrication and storage spaces, washrooms, break rooms, and associated maintenance, utilities, and expenses,

(c) company office equipment, furniture and supplies,

(d) project site office equipment, furniture and supplies,

(e) labour time for project managers and project assistants,

(f) project site security,

(g) project site clean-up, recycling and waste disposal,

(h) materials management,

(i) property taxes, business licenses, and auto insurance,

(j) dues and subscriptions,

(k) postage and courier,

(l) advertising, telephone, IT services and equipment,

(m) legal and accounting fees and expenses,

(n) sales and marketing,

(o) salaries and benefits for company indirect labour including company management, sales force, dispatchers, estimators, clerical staff, and at-office general (non-trades) labour.

(p) all other indirect labour.

.12 Senior Foreperson – the second (and subsequent) level supervisory position having direct control over one or more Forepersons, where the number of Forepersons supervised is in accordance with local regulatory requirements or collective bargaining agreements. ("Superintendent" or "Supervisor" has the same meaning.

5.3 Change Directive Method

.1 Except where otherwise determined in the Construction Contract or Division 01 specification, the valuation of changes by the Change Directive method shall comply with the following:

.1 the form of presentation of costs and methods of measurement shall be agreed to by Consultant and Contractor before proceeding with the change,

.2 the adjustment in the Contract Price for a change carried out by way of Change Directive shall be determined on the basis of the cost of the Contractor's actual expenditures and savings attributed to the Change Directive. For clarity and by example, savings for deductions of similar materials, equipment, labour or services shall be valued at the same amount as for expenditures for additions of same.

.3 labour costs will be determined based on actual time spent and the agreed labour rate, the actual cost of installed line materials and equipment, and the agreed fee for overhead and profit,

.4 if the change results in a net decrease in Contract cost, the contract price will be decreased by the net decrease in the cost, without adjustment for the Contractor's percentage fee for overhead and profit,

.5 the Contractor shall keep accurate records, in an agreed upon form, of time, quantities and invoiced costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices,

.6 this time and material method shall be used until such time as a total cost estimate of the change is agreed between the Owner and the Contractor, at which time all payments made under this time and material method will be credited against the agreed total cost for the change.

5.4 Unit Price Method

.1 Costing of changes by the Unit Price method:

.1 Costs for work identified by agreed unit costs shall be charged at those rates, unless the Owner agrees to other rates.

5.5 Proposed Changes; Other Change Instructions Method

.1 For proposed changes to the Work or other similar instructions, submit a detailed quotation for approval.

.2 The adjustment in the Contract Price for a change carried out by way of proposed change or other similar instruction shall be determined on the basis of the cost of the Contractor's actual expenditures and savings attributed to the Proposed Change. For clarity and by example, savings for deductions of similar materials, equipment, labour or services shall be valued at the same amount as for expenditures for additions of same.

.3 Costs are to be approved by the Owner before the proposed change to the Work proceeds. The quotation for the change to the Work is to include a summary of charges made up of three components: labour charges, material costs and fees.

.4 Labour Charges:

.1 The labour unit hour estimates are to be based on the current MCAA estimating manual unless otherwise agreed by the Consultant;

.2 The labour cost is to be determined using the agreed labour rates.

.3 Labour rates for Foreperson and Senior Foreperson shall be as per agreement, or in absence of such agreement shall be 1.15 times the journeyperson labour rate. The maximum allowable labour hours for supervision are not to exceed:

(a) for a Foreperson, a maximum of 10% of the total calculated journeyperson hours on a change, and

(b) for a Senior Foreperson of all levels, a maximum combined amount of 3% of the total calculated journeyperson hours on a change.

(c) no other supervisory hours will be permitted.

.5 Material Charges:

.1 Material costs for line materials and installed equipment are to be net of trade discounts. The discount to be applied to list prices for items included in Allpricer manual shall not be less than:

(a) 20% for line materials, and

(b) 10% for equipment that is not line material.

.6 Fees:

.1 The Contractor and any sub-contractor is allowed a combined overhead and profit fee of 15% for work to be performed by their own forces,

.2 The Contractor and any sub-contractor is allowed a combined overhead and profit fee of 5% for work performed by a sub-contractor (in the case of the Contractor) or a sub-sub-contractor (in the case of work performed for a sub-contractor),

.3 For clarity, the allowable fees on direct work and on sub-contracted work apply to a sub-sub-contractor of any tier.

5.6 Cash Allowances; Contingency Allowances

.1 Instructions for changes to the Work to be performed under a cash allowance or contingency allowance ("Allowance") included in the contract price shall be authorized by a Cash Allowance Disbursement instruction.

.2 Except as described below, the determination of costs for Work performed under an Allowance shall be in accordance with the procedure for proposed changes unless otherwise instructed to proceed with the work, in which case the cost of such work shall be valued in accordance with the procedures for Change Directive.

.3 The contract price, not the Allowance, includes the overhead and profit fee for the value of the Allowance.

.4 Except where otherwise specified in the Construction Contract, where the cost of the Work performed under a Cash Allowance Authorization;

.1 is less than the Allowance value, the contract price includes the overhead and profit for the contractor and any sub-contractors. A change order will be issued for a credit for the balance of the Allowance, but shall not include the associated overhead and profit fee.

.2 exceeds the Allowance value, a Change Order will be issued for the amount in excess of the Allowance, and the excess amount is to include the agree fee for overheat and profit.]

6 SUBMITTALS

6.1 Shop Drawings and Product Data Sheets

.1 Submit shop drawings, manufacturers product data and samples in accordance with the requirements of Specification sections of Division 01, this Part, and as further required in other Specification sections of Division 20.

.2 Submit shop drawings in the same unit of measure as are used on the drawings. Both metric and U.S. customary units may be included.

.3 Submit shop drawings by email to: shopdrawings@hhangus.com, except where a project document management web-service is used.

.4 Include a H.H. Angus shop drawing cover sheet form prepared for this project for each shop drawing submittal (refer to part "Attachments" for an example of this form) , or include the same information on the general or trade contractor's submittal cover sheet;

.1 Information required on each submission:

(a) Client/Architect name,

(b) Project Name,

(c) H.H. Angus project number,

(d) Date,

(e) Contractor name,

(f) Contractor reference No.,

(g) Manufacturer name,

(h) Product type,

(i) Specification section number,

(j) Contractor trade category: architectural, structural, conveying equipment, user equipment, mechanical, electrical, telecommunications, civil or other.

(k) If a re-submission, the Consultant's previous submittal reference number.

.5 Submit shop drawings in PDF format except as follows;

.1 if the Consultant agrees to a shop drawing to be submitted in hardcopy format, submit in 8.5 x 11 or 11 x 17 size, black and white originals of graphic quality suitable for photocopying and digital scanning. Allow one additional week for processing of shop drawings submitted in hardcopy format.

.6 Manufacturer's letter sized product data sheets for standard items are acceptable in place of shop drawings provided that physical characteristics are identified and are related to specification references.

.7 Submit with manufacturers data sheets, typed schedules listing manufacturer's and supplier's name and catalogue model number.

.8 For plumbing fixtures and other permeant fixtures, submit fixture sheets with catalogue numbers. Identify and arrange fixture sheets in the same sequence and using the same identification number as shown in specification fixture lists.

.9 Shop drawings and/or product data sheets to show;

(a) dimensioned outlines of equipment and construction details,

(b) equipment weights and center of gravity,

(c) performance ratings,

(d) dimensioned details showing service connection points,

(e) elevations illustrating locations of visible equipment such as gauges, pilot lights, breakers and their trip settings, windows, meters, and access doors,

(f) description of operation,

(g) single line diagrams,

(h) general routing of bus ducts and connecting services,

(i) mounting and fixing arrangements,

(j) operating and maintenance clearances,

(k) access door swing spaces, and

(l) where products are required to be certified to a published standard, the mark of the testing organization who certified the product and the standard reference number to which it is certified.

.10 Shop drawings and product data to be accompanied by;

(a) detailed drawings of bases, supports and anchor bolts,

(b) sound power data, where applicable, and

(c) performance curve for each piece of equipment marked with point of operation.

.11 Shop drawing and data sheet submission is taken as certification that the products are;

.1 from the manufacturer's current production, and

.2 in compliance with applicable codes, standards, and regulations.

.12 For standard catalogued (non-custom) products, do not submit drawings showing internal construction details, component assemblies or interior piping and wiring diagrams. Such information may be necessary to understand correct functioning of equipment and are to be submitted with operating and maintenance data.

.13 Check and stamp each shop drawing as being correct before submission. Shop drawings without such stamps will be rejected and returned.

.14 Keep one copy of each reviewed shop drawing and product data sheet on site and have them available for reference purposes.

.15 Where equipment is delivered without reviewed shop drawings, equipment will be condemned and is to be removed from site and replaced with new equipment after shop drawings have been submitted and reviewed.

6.2 Coordination, Fabrication, or Installation Drawings

.1 Contractor coordination, fabrication, installation and/or sleeving drawings are to be provided in accordance with specification Section 20 01 03 *Mechanical Coordination and Installation Design Services.*

.2 Contractor's coordination, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal only will be returned identifying the submitted drawings have not been reviewed as a shop drawing.

.3 Maintain a copy on site of such drawings for reference by the Consultant.

.4 The Consultant reserves the right to request selected Contractor's coordination, fabrication, or installation drawings for review.

6.3 Effect of Consultants Review of Submittals

.1 Consultant's review of shop drawings is performed on a sampling basis only, to confirm to Consultant's satisfaction that the Contractor understands the Work to be performed and is interpreting the design documents correctly, and such reviews are performed for the benefit of the Owner.

.2 For greater certainty, the review of shop drawings by Consultant does not constitute a quality control function for the benefit of Contractor, nor does such a review relieve Contractor of their responsibility for complying with the Contract documents.

7 APPLICABLE CODES, STANDARDS AND REGULATIONS; PERMITS

7.1 Codes, Standards and Regulations

.1 Where a published product standard or installation code is adopted by statute or regulation by an applicable AHJ, the applicable edition of the standard or code is the one that has been adopted

.1 at the time of obtaining a permit for the applicable portion of the Work, or

.2 in the absence of a requirement for a permit, the start date of construction.

.2 Where a published product standard or installation code is not adopted by statute or regulation, then the most current edition of that standard or code at the start date of construction applies.

.3 Install mechanical and electrical systems in accordance with the applicable requirements adopted by the AHJ in the jurisdiction of the Work.

.4 Where requirements of the Specifications exceed those of applicable codes, standards, and regulations the requirements of the Specifications is to govern.

.5 In the event of a conflict between codes, bulletins, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring application of the most demanding requirements.

7.2 Confined Spaces

.1 Unless otherwise prescribed by the Constructor's / Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as confined spaces in accordance with applicable health and safety legislation, including but not limited to:

.1 horizontal and vertical service spaces, shafts, and tunnels,

.2 inside of equipment which permits entry of the head and/or whole body, and

.3 ceiling spaces which are identified as containing a hazardous substance.

7.3 Permits, Tests and Certificates

.1 Arrange and pay for permits, tests, and Certificates of Inspection required by the AHJ applicable to the element of the Work.

.2 Submit applications requiring Owner's signature before commencing work.

.3 Obtain and submit applicable AHJ Inspection certificates or reports including but not limited to:

(a) Electrical inspection,

(b) Plumbing and drainage inspection,

(c) HVAC inspection,

(d) Pressure Vessel Inspection.

(e) Piping and Boiler Inspection.

(f) Fuel safety Inspection.

.2 Renew certificates or reports so as to remain in force through the warranty period.

.4 Co-ordinate and perform testing required by an AHJ in accordance with the Part on Testing in this Section.

8 COMMON PRODUCT REQUIREMENTS

8.1 Standard of Material and Equipment

.1 Provide materials and equipment in accordance the requirements of Specification section of Division 01 and as follows.

.2 Materials and equipment:

.1 new and of uniform pattern throughout work,

.2 of Canadian manufacture where obtainable,

.3 standard products of approved manufacture,

.4 labeled or listed (certified) to applicable standards in accordance with Specification sections of the Work and as required by authorities having jurisdiction,

.5 registered in accordance with the requirements of the applicable provincial pressure vessels regulation and registered in accordance with CSA B51 for Canadian Registration Numbers, as applicable,

.6 in compliance with Standards and Regulations including but not limited to;

(a) chemical and physical properties of materials,

(b) design,

(c) performance characteristics, and

(d) methods of construction and installation.

.7 identical units of equipment to be by the same manufacturer. ,

.8 identical component parts of same manufacturer in similar units of equipment, but various component parts of each unit need not be from one manufacturer.

.3 Materials and equipment are described to establish standards of construction and workmanship. Where manufacturers and/or products are listed under “Standard of Acceptance”, select manufacturers and or products from these lists. Use of manufacturers or products other than as listed are subject to specification requirements concerning requests for substitution.

.4 Include items of material and equipment not specifically noted on Drawings or mentioned in Specifications but which are required to make a complete and operating system.

.5 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Sections, before such items are purchased.

.6 Factory fabricated control panels and component assemblies are to be listed for electrical safety requirements.

.7 Select materials and equipment in accordance with manufacturer's recommendations and these Specifications, and install same in accordance with manufacturer's instructions and these Specifications.

.8 Materials and equipment not satisfying these selection criteria will be condemned. Remove condemned materials from job site and provide properly selected and approved materials.

8.2 Manufacturers Nameplates

.1 Provide manufactured equipment with metal nameplate with raised or recessed lettering, mounted on each piece of equipment. On insulated equipment, mechanically fasten plates on metal stand-off bracket arranged to clear insulation.

.2 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating of motors, and approval listings.

.3 Certified products are to clearly show the mark of the certification agency when in the final installed state.

8.3 Factory Applied Painting

.1 Protect factory finished equipment during construction, and clean at completion of work.

.2 Touch-up factory painted prime and/or final coats damaged during construction, with colour matching paint recommended by the equipment manufacturer.

.3 Use heat resistant paint where conditions require.

8.4 Factory Applied Prime Painting

.1 Factory-prime paint other equipment fabricated from iron or steel, including equipment supports and hangers, access platforms, access doors, registers, grilles, diffusers, dampers, metal radiation enclosures and fire hose cabinets where separate product specifications do not require a factory applied final coat.

8.5 Field Painting

.1 After equipment has been installed and piping and insulation is completed, clean rust and oil from exposed iron and steel work provided under this Division, whether or not it has been factory prime painted.

.2 In "occupied" areas of building touch up any damage to prime coat resulting from shipping or installation and leave ready for final decorative painting under Finishes, Division 9.

.3 In "un-occupied" areas of the building such as mechanical equipment rooms, boiler rooms, fan rooms, crawl spaces, pipe tunnels and penthouses, provide corrosion coatings and floor sealers in accordance with specification section 20 05 02 *Painting for Mechanical Services*.

.4 In addition, apply prime and/or final paint coats to equipment and materials where specifically detailed in other Sections of these Divisions.

8.6 Provision for Future

.1 Where space is indicated as reserved for future equipment or for future extension to building, leave such space clear and install piping, raceways and equipment so that connections can be made to future apparatus or building.

.2 Identify provisions and service terminations for future on Record Drawings.

8.7 Maintenance of Bearings

.1 Turn-over rotating equipment at least once a month from delivery to site until start-up.

.2 Run-in sleeve type bearings in accordance with manufacturer's written recommendation. After "run-in", drain, flush out and refill with new charge of oil or grease.

.3 Protect bearings, shafts and sheaves against damage, corrosion and dust accumulation during building construction.

8.8 Pre-purchased Equipment; Damage and Ownership

.1 At time of receipt of pre-purchased or pre-tendered equipment at the job site by the installing mechanical contractor, provide the services of the manufacturer/distributor/supplier's technical representative to:

.1 inspect the equipment prior to unloading,

.2 witness the unloading and advise the contractor on the appropriate method for handling the equipment in order to avoid damage during the unloading, moving and setting in place phase of the equipment, and

.3 report any damage to the Consultant.

.2 In the event the equipment has been found to be damaged before unloading, it is to be returned immediately to the factory for repairs and/or replacement by the manufacturer/supplier.

.3 In the event of damage occurring at any time during unloading and until the equipment is accepted by the Owner, the installing contractor is responsible for repairs and/or replacement of the damaged equipment to the satisfaction of the Owner.

9 OFFICE AND STORAGE; TOOLS

9.1 Office and Storage

.1 Provide temporary office, washroom and lunchroom facilities, workshop, and tools and material storage space in accordance with Division 01.

9.2 Tools, Temporary Equipment and Materials

.1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, required to carry out the Work.

10 COORDINATION; INSTALLATION DRAWINGS

10.1 Coordination

.1 Consultant drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductwork, piping, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as “double line”, they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

.2 Lay out and coordinate Work to avoid conflict with work under other Divisions.

.3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of work of this Division.

.4 When equipment provided under other Sections connects with material or equipment supplied under this Section, confirm capacity and ratings of equipment being provided.

.5 Take information involving accurate measurements from dimensioned Architectural Drawings or at building.

.6 Install services and equipment which are to be concealed, close to building structure so that furring is kept to minimum dimensions.

.7 Location of pipes, ductwork, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.8 Location of floor drains, hub drains, combination drains, plumbing fixtures, convectors, unit heaters, diffuser, registers grilles and other similar items may be altered without extra cost provided instruction is given prior to roughing in. No claim will be paid for extra labour and materials for relocating items up to 3 m (10 ft) from original location nor will credits be anticipated where relocation up to 3 m (10 ft) reduces material and labour.

.9 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the work as an operating installation.

10.2 Field, Fabrication, and Installation Drawings

.1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services, and to demonstrate coordination with the work of other trades;

.1 drawing scale: minimum 1:50 (1/4"=1'-0")

.2 use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings,

.3 layout equipment and services to provide access for repair and maintenance,

.2 Circulate drawings to other trades involved in each area, and conduct coordination meetings with those trades.

11 ANCHORS AND INSERTS

.1 Supply anchor bolts and locating templates for installation in advance of concrete pouring.

12 CUTTING, PATCHING AND REMEDIAL WORK

12.1 General

.1 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing trades and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade whose work is involved to do such cutting and patching and pay for any resulting costs.

.2 Neatly cut or drill holes required in existing building elements to accommodate building services including ductwork, piping, cable, raceways, bus duct or cable tray.

.3 Arrange and pay for all cutting and patching as required for the Work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant's approval of location and methods in writing. Employ original installer or expert in the finishing of material required to perform cutting or patching for weather-exposed, moisture-resistant elements or sight-exposed surfaces.

12.2 Structure Scanning and Cutting

.1 Layout cutting of structural elements, such as floors slabs, walls, columns or beams and obtain approval before starting work. Conduct an initial electromagnetic scan of reinforcing rods and electrical conduit, and review with structural engineering Consultant.

Standard of Acceptance

- Hilti - fig. PS 300 Ferroscan

.1 Based on the preceding results, arrange and pay for supplemental radiographic examination where necessary to improve on locating concrete reinforcement, conduits and other embedment's.

.1 submit radiographic results to the structural engineer and obtain comments before starting work,

.2 the use of radiographic imaging methods is subject to approval by the Owner on a case by case basis.

.2 As an alternative to radiographic examination for areas where the Owner does not permit radiographic examination, based on the preceding results, provide two-dimensional ground penetrating radar scans to locate concrete reinforcement, conduits and other embedment's. Scanners to be operated by personnel trained by the measurement device manufacturer.

Standard of Acceptance

- Hilti PS1000 X-SCAN

.3 Relocate core drilling location if steel or conduit is found in the proposed location and repeat procedure. Reroute any circuits damaged by core drilling.

.4 Scan for all shots and anchors in floors, walls, and ceilings.

13 PROTECTION OF PERSONNEL, WORK, AND PROPERTY

13.1 Personnel Protection

.1 Without limiting the Contractor's responsibilities regarding occupational health and safety requirements at the construction site, provide specific personnel protection as follows:

.1 protect exposed live equipment during construction for personnel safety,

.2 shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage,

.3 arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician,

.4 do not leave conduit, wires, cables, tools, equipment or materials in such a way that they constitute a hazard,

.5 provide toe guards around openings in the roof or floor to prevent materials or debris from dropping down to a lower level,

.6 remove loose equipment and tools from overhead areas before leaving each day,

.7 cut off bolts at floor level to eliminate a possible tripping hazard.

13.2 Protection During Construction

.1 Provide protection required to enable existing building and equipment to remain in continuous and normal operation.

.2 Take the necessary precautions to protect equipment, existing building and service from damage during the Work. Accept responsibility for any damage and make good without cost to the Owner.

.3 Protect existing surfaces and items so that they are not damaged in any way whatsoever by the work of all trades. Take precautions as necessary to prevent damage to walls, floors, ceilings, windows, doors, door frames, moldings, finishes, piping, ductwork, light fixtures, etc. Provide protection, hoarding, tarpaulins, dust sleeves etc., as required. Any damage caused because of lack of adequate protection to be made good at no cost to the Owner.

.4 Take care when working above or around equipment that must remain in service.

.5 Take care to eliminate dust in equipment areas.

.6 Protect switchgear fronts from accidental breaker trips when working around or above them. Provide an extended shield constructed of 12 mm (½") fire retardant plywood a minimum of 450 mm (18") from board front to allow access to board.

13.3 Core Drilling

.1 Wherever core drilling is required, provide temporary dust proof screens.

.2 In areas where core drilling through a slab in an operating facility is necessary, clearly mark out the areas to be drilled on the underside of slab. Owner's representative to be notified at least 1 week prior to core drilling operation. Provide tarping of equipment supervised by the Owner.

.3 During core drilling operations, station at least one person directly below the area of drilling with a large plastic container pressed to underside of slab to capture and hold core and water upon completion of operations.

.4 Continuously use a wet/dry commercial quality vacuum at location of drilling operation to remove all excess water from the area.

13.4 Temporary Dust Proof Screens

13.5 Provide temporary dust proof screens in accordance with Division 01. Protection of Floors During Equipment Installation

.1 Provide protection of floor finishes during installation or removal of equipment, and at any other time when moving or installing heavy equipment.

.2 Install 19mm (¾") plywood over 6 mil plastic over finished floor areas when moving heavy equipment that could damage floor finish, or when installing equipment or line materials overhead.

.3 Repaint or re-tile any floors or walls damaged or scratched during construction.

13.6 Housekeeping

.1 Maintain a high level of cleanliness.

.2 Remove scrap and refuse from the work area daily.

.3 Whenever possible, clean up immediately following completion of work.

.4 Deposit oily and waste solvent rags in approved containers to minimize the fire hazard.

.5 Sweep and damp mop daily.

14 WORK IN EXISTING BUILDING

14.1 General

.1 Comply with Specification section of Division 01for restrictions on working in existing occupied buildings and as follows.

.2 During the tender period, the Contractor shall perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of as-built conditions to determine scope of renovation or demolition work required prior to submitting tender.

.3 The Work includes changes to existing building and changes at junction of old and new construction. Route pipes, ducts, conduits and other services to avoid interference with existing installation.

.4 Perform core drilling at a time coordinated with the Owner.

.5 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services required for proper installation of new work, including as required for temporary removal and re-installation to suit new installation work.

.6 Remove existing plumbing fixtures, lighting fixtures, piping, ductwork, wiring, and equipment to suit new construction. Cut back and cap drain, vent and water outlets, conduits and electrical outlets, not being used.

.7 Unless noted otherwise removed materials and equipment become the property of the Contractor and are to be taken from the site and disposed of appropriately.

.8 On completion of relocations, confirm relocated equipment are in proper working order.

.9 Where Owner wishes to take over renovated areas ahead of project completion date and these areas are to be fed from new distribution systems, make temporary connections to existing services in these areas. Reconnect to permanent services, at later date, when new distribution systems are available.

14.2 Continuity of Services

.1 Keep existing buildings in operation with minimum length of shutdown periods.

.2 Make connections to existing systems at approved times.

.3 Obtain written approval recording times when connections can be made.

.4 Arrange work so that physical access to existing buildings is not unduly interrupted.

.5 Be responsible for and make good any damages caused to existing systems when making connections.

.6 Provide premium time labour to tie-in to services at night or on weekends.

.7 For piping systems, make connections to existing piping by draining down the existing piping system. Use of hot-tapping or freezing of piping is only permitted where approved by the Owner and a specification section for such work has been included in the project specifications.

.8 Provide temporary services to drain down existing piping systems which convey liquids or steam condensate, including provision of temporary hoses, etc., and provide services to perform the drain down of these systems, except where the Owner elects to perform such drain-downs.

.9 For piping systems conveying liquids, after completion of new work to existing piping systems, refill the existing and new piping systems including provision of cleaning of new piping and addition of chemical treatments, as applicable, in accordance with the requirements of other sections of Division 20. Include for addition of replenishing chemical treatment for existing piping systems in accordance with the Owner's existing chemical treatment program, or in the absence of such, in accordance with the chemical water treatment requirements specified in other Sections of Division 20.

15 MOVING AND SETTING IN PLACE OF OWNER-SUPPLIED PRODUCTS

15.1 General

.1 The requirements of this Part applies to;

.1 Division 20 equipment that has been directly purchased by the Owner, and

.2 other Owner-supplied products or equipment (i.e. process equipment) that has building services requirements.

.2 Comply with the requirements of Division 01 and as specified herein.

15.2 Owner-Suppled Products (Supplied by Owner Equipment – "SBO")

.1 Items marked SBO on drawings are to be;

.1 purchased by the Owner,

.2 received, checked, and stored by the Contractor, and

.3 subsequently unpacked, uncrated, assembled and located in its final location by the Contractor, and installed in accordance with the manufacturer instructions,

.4 participate in the start-up and testing of the equipment and placing into service.

.2 Provide mechanical and electrical services to SBO equipment in accordance with the SBO equipment manufacturer's instructions and as otherwise shown.

15.3 Existing Owners Equipment to be Relocated (E.R. or Ex. Rel.)

.1 Applies to owners existing equipment which has mechanical and electrical services, and marked on the drawings as E.R. Ex.Rel. or otherwise so identified.

.2 Items so marked on drawings are to be moved from their present location and reinstalled by the Contractor.

.3 Disconnect and reconnect mechanical and electrical services to accommodate this equipment relocation.

16 TEMPORARY HEATING

16.1 During Construction

.1 Temporary heating required while building is under construction will be provided under Division 01.

.2 Permanent heating system may be used for temporary heating, when this equipment is installed in its permanent location and the building is closed-in and Contractor under Division 1 provides staff for operation and maintenance whenever permanent heating system is being used for temporary heating.

.3 Hot water boilers may not be used unless heating units, radiation, pumps and piping are complete, the piping system has been pressure tested, cleaned, and final chemical water treatment is in operation.

.4 Permanent heating equipment used for temporary heating to be thoroughly cleaned and put in first class operating condition and appearance at completion of the Work, as approved by the Owner.

17 FINAL CLEANING AND ADJUSTMENTS

17.1 Final Cleaning

.1 Conduct final cleaning in accordance with Division [01 74 00] requirements and as specified herein.

.2 Perform final cleaning after construction activities that create dust have been completed.

.3 Thoroughly clean exterior surface of exposed piping, and vacuum external surfaces of exposed ducts and interior surfaces of air handling units. Clean strainers in piping systems and install clean filters in air handling systems immediately prior to handover of the building to the Owner.

.4 HEPA vacuum the top and interiors of motor controllers, VFDs, control panels, and control cabinets followed by a thorough HEPA vacuuming of the service room floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.

.5 Remove tools and waste materials on completion of work and leave work in clean and perfect condition.

17.2 Final Adjustments

.1 Calibrate components and controls and check function and sequencing of systems under operating conditions.

.2 Supply lubricating oils and greases for proper operation of equipment and systems until work has been accepted.

18 RECORD DRAWINGS

18.1 Record Drawings

.1 Maintain record drawings in accordance with Division 01 during the course of the Work and as follows.

.2 A set of design drawings in AutoCad, Revit, or PDF format (as determined by the Consultant) will be provided by the Consultant. Record changes in actual installation as the Work progresses by the following method:

.1 make sets of white prints for each phase of Work and mark-up the print drawings, or

.2 revise the AutoCad or Revit file directly, and identify all changes made.

.3 Mark-up these record drawings to provide dimensioned locations of drains, pipes, ductwork, conduit, manholes, foundations and similar buried items within the building, with respect to building column centres. Mark level with respect to an elevation which will be provided.

.4 Retain on-site the survey information from excavation and backfill of site services, and after approval, transfer this information to the record documents.

.5 Retain these drawings and make available to Consultant for periodic review.

.6 At 50%, 75% and 90% project completion, scan marked-up drawings to PDF format and submit copy to the Consultant, or to the project on-line document management service if one is used.

18.2 As-Built Drawings

.1 Prior to testing, balancing and adjusting, transfer site record drawing information to a copy of the computer aided drafting/design program ("CAD") files, in the same software format used for the Consultants design drawings, to record final as-built condition.

.2 Obtain a current set of CAD files from the Consultant. The Consultant's CAD files may not reflect all or any construction changes.

.3 Drawings are to remain set to and follow Consultants CAD Standards - do not alter drawing scales, reference files, colours, layers or text styles,

.4 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. "Bubble" these revisions, and place these annotations on a separate and easily identified drawing layer.

.5 Show on mechanical as-built drawings final location of piping, ductwork, switches, starters, Motor Control Centres, thermostats, and equipment.

.6 Show on site services as-built drawings survey information provided by an accredited land surveying service.

.7 Identify each drawing in lower right hand corner in letters at least 12 mm (½ in) high with a note as follows:

AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed (Signature of Contractor) (Date).

.8 The site services drawings are to include the signature and stamp of the accredited surveyor adjacent to the note.

.9 Submit one (1) set of white prints of the draft as-built CAD files for Consultant's review.

.10 Once "AS BUILT DRAWINGS" white prints are reviewed, transfer Consultant's comments to the CAD files. Return CAD files modified to "As Built" condition to Consultants electronically by removable mass storage device or by electronic file transfer as designed by the Consultant.

.11 Submit three (3) sets of white prints and one (1) electronic copy of CAD files with Operating and Maintenance Manuals to the Owner.

19 OPERATING AND MAINTENANCE INSTRUCTIONS

19.1 Operating and Maintenance Manuals

.1 Provide operating and maintenance manuals in accordance with Section [01 78 00 *Closeout Submittals*] and as follows.

.2 Provide operation and maintenance data bound in vinyl covered, hard back, three-ring covers, nominally 50 mm (2 in) thick, suitable for paper size of 210 mm x 300 mm (8½ in x 11 in);

.1 organize material in volumes, generally grouped by Trade section;

(a) Table of Contents,

(b) General Information,

(c) Sub-contractors (list),

(d) Site services,
(e) Fire Protection,
(f) Plumbing,
(g) Heating and Cooling Plant and Distribution,
(h) Air Handling Equipment and Distribution,
(i) Building automation, Controls and Instrumentation,
(j) Testing Reports,
(k) As-Built Drawings,
(l) Warranties.

.2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear;
(a) Project Name,
(b) Project Number,
(c) Date,
(d) Trade Section,
(e) List of Contents.

.3 Provide three hard-copies to Owner.

.3 In addition, provide PDF files for each document, produced from original direct-to-digital file creations;

.1 organize documents into separate PDF files for each Trade Section identified above, and apply PDF Bookmarks to create a Table of Contents for each file.

.4 Operating data to include;

.1 control schematics for each system,

.2 description of each system and associated control elements,

.3 control operating sequences at various load conditions, reset schedules and anticipated seasonal variances,

.4 operating instructions for each system and each component,

.5 description of actions to be taken in event of equipment failure,

.6 valve schedules and flow diagrams,

.7 service piping identification charts.

.5 Maintenance data to include;

.1 manufacturer's literature covering servicing, maintenance, operating and trouble-shooting instructions for each item of equipment,

.2 fault locating guide,

.3 manufacturer's parts list,

.4 reviewed shop drawings,

.5 equipment manufacturer's performance sheets,

.6 equipment performance verification test results,

.7 voltage and ampere rating for each item of electrical equipment,

.8 spare parts list and an itemized cost,

.9 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.

.6 Approval procedure;

.1 submit one set of first draft of Operating and Maintenance Manuals for approval at least one month prior to planned substantial performance date,

.2 make corrections and resubmit for a final review,

.3 review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation.

.4 hand-over two (2) hard-copies and one (1) PDF copy on removable storage device of the Operating and Maintenance Manuals to the Owner's operating staff and obtain written confirmation of delivery. Provide a copy of the delivery record to the Consultant.

19.2 Operating and Maintenance Training

.1 Provide operating and maintenance training in accordance with Division 01 and as follows.

.2 Provide training to Owners operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections in these Divisions. Include classroom instruction and hands-on instruction, delivered by competent instructors.

.3 Develop the proposed training plan, and submit an outline of the training program for review, adjustment and approval by the Owner.

.4 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, utilizing the services of the manufacturers' representative as required.

.5 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each training topic, separated by approximately one week each. Develop the proposed training plan and obtain approval from the Owner before commencing training.

.6 All training to be scheduled and provided between the hours of 7 am to 5 pm, Monday to Friday. Where training is required to be performed outside of these hours due to availability of Owners operations personnel, if the trainers are paid for overtime outside of these hours, the overtime portion only is eligible to be paid by the Owner as an extra cost.

.7 Complete the training as close to Substantial Performance as possible, so that the operations staff are prepared to operate the systems after Substantial Performance is certified.

.8 Organize each training sessions as follows:

.1 HVAC – Division 23

.2 Building Management System – Division 25

.9 Keep records of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.

.10 For each training session, include the following topics;

.1 general purpose of system (design intent),

.2 use of O&M manuals,

.3 review of control drawings and schematics,

.4 start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming troubleshooting, and alarms,

.5 interaction with other systems,

.6 adjustments and optimizing methods for energy conservation,

.7 health and safety issues,

.8 special maintenance and replacement sources,

.9 occupancy interaction issues, and

.10 system response to different operating conditions.

.11 Develop and provide training material, including printed documents and electronic presentation aids (e.g. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and PDF format, in accordance with article on Operating and Maintenance Manuals.

.12 Sessions may be video recorded by the Owner as an aid to ongoing training of Owners staff.

20 CARE, OPERATION AND START-UP

.1 Provide all labour and materials as necessary to perform start-up and testing of equipment and systems.

.2 Arrange and pay for services of manufacturer's factory service technician to supervise start-up of the installation, check, adjust, balance and calibrate components and equipment as specified in the specification sections of Division 20.

.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 every aspect of the operation, care and maintenance thereof.

.4 Arrange and pay for services of applicable manufacturer's factory service engineer or certified independent testing organization to supervise initial start-up of specialized portions of installation and to check, adjust, balance and calibrate components including related wiring and controls. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of the installation in complete working order. Provide a certificate indicating that the equipment is free and clear of deficiencies.

21 TESTING

21.1 General

.1 The following describes the general requirements for testing of mechanical systems; refer to additional testing requirements in applicable sections of Division 20 of the Work.

.2 Conduct tests during progress of Work and at its completion to verify equipment and systems meet the contract documents. Submit details of test methods in writing and obtain approval before commencing work.

.3 Supply test equipment, apparatus, gauges, meters and data recorders, together with skilled personnel to perform tests and log results.

.4 Submit written notice 24 hours in advance of each test series, setting out the time, place and nature of the tests, to the Inspection Authority and personnel witnessing tests.

.5 The Owner reserves the right to witness any test; any such witnessing activity shall not be construed as acceptance of the system or equipment by the Owner.

.6 Conduct tests before application of external insulation and before any portion of pipes, ducts or equipment is concealed.

.7 Do not subject expansion joints, flexible pipe connections, meters, control valves, convertors, and fixtures, to test pressures greater than the stated working pressure of equipment. Isolate or remove equipment or devices during tests when prescribed test pressure is greater than working pressure of any piece of equipment or device.

.8 Should section of pipe, duct, or electrical cable fail under test, replace faulty piping, duct, or cable with new fittings, pipe, duct or cable and then retest. Do not repair threaded pipe joints by caulking nor welded joints by peening. Repeat tests until results are satisfactory.

.9 Where it is necessary to test portions of piping, ductwork or electrical cable system before system is complete, overlap successive tests so that no joint or section of duct or pipe is missed in testing.

.10 Upon completion of work and testing of same, submit logs to demonstrate that tests have been carried out satisfactorily. Repeat any tests if requested.

21.2 Testing of Integrated Life Safety and Fire Protections Systems

.1 Conduct testing of integrated life safety and fire protection systems in accordance with specification Section 20 08 11 *Testing of Integrated Electrical Life Safety and Fire Protection Systems*.

21.3 Testing - Piping

.1 Test fuel oil systems in accordance with CSA B139 *Installation Code for Oil Burning Equipment.*

.2 Test drainage, waste and vent piping for tightness and grade as required by the plumbing code in effect at the location of the Work.

.3 Test special service piping as detailed in other sections of Divisions 21, 22 and 23.

21.4 Testing - Electrical

.1 Make tests of equipment and wiring. Test wiring systems in accordance with section 20 05 12 *Wiring Requirements for Mechanical*.

.2 Replace defective equipment and wiring with new material.

22 COMMISSIONING

.1 Participate in commissioning of equipment and systems in accordance with Section 20 08 15 *Mechanical Commissioning*.

.2 Equipment supplied on this project will be subject to detailed factory inspection and/or on-site testing and commissioning prior to being placed in service. The electrical contractor, their major system and equipment suppliers, and the Independent Testing Agent (ITA) will be required to participate in special commissioning meetings to review progress and status of the commissioning program.

.3 Include in Bid amount for licensed electricians to participate in the commissioning program, to undertake temporary power connections, operation of equipment, opening and closing of panel boards and switchboards, testing of power and control wiring, and assisting the ITA and the equipment suppliers' field personnel in the startup and testing of the equipment.

.4 The contractor and equipment suppliers to include in the Bid amount the costs to accommodate and undertake factory and site testing.

23 TEMPORARY AND TRIAL USAGE

.1 Temporary and trial usage by Owner of any mechanical or electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance is not to be construed as evidence of acceptance by Owner.

.2 Owner to have privilege of such temporary and trial usage, as soon as that said work is claimed to be completed and in accordance with Contract Documents, for such reasonable length of time as is sufficient for making complete and thorough test of same.

.3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

.4 Defects in workmanship and materials identified during temporary and trial usage are to be rectified under warranty.

24 SPECIAL TOOLS AND SPARE PARTS

24.1 Spare Parts

.1 Prior to application for Substantial Performance, furnish spare parts as follows;

.1 one set of mechanical seals for one pump of each model size,

.2 one pump casing joint gasket for each model size,

.3 one head gasket for each shell-and-tube heat exchanger with removable heads,

.4 one glass for each gauge glass,

.5 one set of V-belts for each drive of the same model size,

.6 one set of filter cartridges for each filter or filter bank installed.

.2 Maintain an inventory record and delivery receipt record of spare parts delivered to the Owner, and include them in the Operating and Maintenance manuals.

25 CONSULTANT REVIEWS

25.1 General

.1 Consultant’s attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and as required by the local authority have jurisdiction. It is the Contractor’s responsibility to ensure that the Work is complete and constructed in accordance with the design documents.

25.2 Site Reviews

.1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances, before the work is completed, readily noticeable deficiencies may be recorded by the Consultant where the deficient item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Any such reported items, or lack thereof, shall not be relied on in any way as part of the Contractors quality assurance program nor relieve the Contractor in the performance of the Work, specifically in identification and rectification of deficiencies or incomplete Work.

.2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless otherwise shown.

25.3 Milestone Reviews

.1 Specific milestone reviews may be conducted at key stages by the Consultant, including;

.1 before backfilling of buried drainage,

.2 before closing of shafts,

.3 before closing of ceilings,

.4 before closing of walls,

.5 equipment demonstration,

.6 Substantial Performance deficiency review,

.7 Total Performance deficiency review.

.2 Coordinate with the Consultant the type and quantity of milestone reviews required by the Consultant and incorporate these requirements in the construction schedule.

.3 Notify the Consultant in writing seven (7) calendar days in advance of work to be concealed to arrange a site review prior to the Work being concealed where required by the Consultant. Any noted deficiencies are to be corrected before being concealed. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

25.4 Partial Occupancy Reviews

.1 Where the Work is planned to include occupancy by the Owner of a part of the Work but not the entire Work ("partial occupancy"), the procedures specified for Substantial Performance Review will apply to the portion of the Work being considered for partial occupancy.

25.5 Substantial Performance Review

.1 At the time of applying for project Substantial Performance, submit to Consultant a comprehensive list of items to be completed or corrected.

25.6 Final Review

.1 At project completion submit written request for final review of mechanical and electrical systems. Refer to section 20 08 19 *Project Close-Out.*

.2 Include with the request a written certification that:

.1 reported deficiencies have been completed,

.2 systems have been balanced and tested and are ready for operation,

.3 completed maintenance and operating data have been submitted and approved,

.4 equipment/line material tags are in place and equipment identification is completed,

.5 cleaning is finished in every respect,

.6 all mechanical equipment surfaces have been touched up with matching paint, or re-finished as required,

.7 spare parts and replacement parts specified have been provided and receipt acknowledged,

.8 As-built and Record drawings are completed and approved,

.9 Owner's operating personnel have been instructed in operation and maintenance of systems,

.10 fire protection verification is 100% completed and Verification Certificates have been submitted and accepted.

26 CONTRACTOR INSPECTIONS

26.1 General

.1 The Division 20 contractor shall assign one person responsible for ensuring that Work from all mechanical trades is complete prior to;

.1 closing in wall, ceilings or burying of services,

.2 partial-occupancy reviews, and

.3 substantial performance reviews.

.2 In conjunction with the Contractor's Mechanical and Electrical sub-contractors, the Contractor shall walk the site and thoroughly inspect that the work is complete, in good workmanship and installed according to the contract documents and derived documents therefrom. The Contractor shall then submit a report attesting to the completed state of the Work (the "Statement of Completion" report, as detailed later in this part).

.3 In the case of Contractor inspections for partial-occupancy or substantial performance, submit the Statement of Completion report at least 24 hours prior to the scheduled review by the Consultant.

26.2 Contractor Inspections for Partial Occupancy and Substantial Performance

.1 In preparation for the Consultants general review for partial-occupancy and/or substantial performance of the Work, the Contractor shall perform a comprehensive inspection of the Work to ensure that their contractual obligations are met before requesting a Consultant's review of the Work. In performing this inspection, the Contractor shall create a Statement of Completion report which is to include;

.1 date and time of the Contractor's inspection, signed by the person who conducted the inspection,

.2 names of the mechanical contractor's personnel who participated in the inspection,

.3 confirmation that previously noted deficiencies have been completed,

.4 confirmation that the work is 100% complete, tested, balanced and free of deficiencies, or include a list of outstanding deficiencies and incomplete Work with;

(a) a reason why the Work has not been completed (i.e. another trade has to complete their work)

(b) a plan of action to complete the Work, and

(c) a commitment date for completion of the Work including rectification of all deficiencies.

.2 The format of the Statement of Completion shall be approved by the Consultant.

.3 The Consultant shall review and sign-off the Statement of Completion Report and return a copy to the Contractor. The Contractor shall retain on-site a log of all signed off Statement of Completion reports.

.4 If a required Statement of Completion report is not received, the Consultant reserves the right to withhold conducting a review for partial-occupancy or substantial performance.

.5 After receipt of the Contractor's Statement of Completion report, if upon entering an area of the work covered by the Statement of Completion report the Consultant determines, in its sole opinion, that the applicable Work is not ready for review, the Consultant may elect to cancel the review of the Work or the affected portion of the Work, and shall assume no responsibility for any damages or losses as a result of cancellation of the review. The Contractor shall remedy the incomplete work and request another review with 72 hours prior written notice, and shall resubmit the revised Statement of Completion at least 24 hours prior to the new review.

27 CORRECTION AFTER COMPLETION

.1 At completion, submit a written warranty undertaking to remedy defects in work for a period of one year from date of substantial performance of the Work. This warranty is not to supplant other warranties of longer period called for on certain equipment or materials.

.2 Warranties are to encompass replacement of defective parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation of the corrected Work.

.3 Submit similar warranties for one year from date of acceptance for any part of work accepted by Owner, before completion of the whole Work.

28 ATTACHMENTS

28.1 Schedule of Values Form

.1 Attached sample of the Schedule of Values form layout.

28.2 Shop Drawing Submittal Form

.1 Attached sample of shop drawings submittal form.

SCHEDULE OF VALUES

Project Name: <<name of project>>
Owner Name: <<owner name>>
Contractor Name: <<name of trade contractor: mechanical, electrical, etc>>
Division(s) of the Work: <<i.e. 20, 21, 22...>>
For the billing period ending: dd-mmm-yyyy

This sheet is an example of a required schedule of values to be developed by the Contractor, to be submitted with each progress payment request.

Specifict level of detail for each work element to be approved by the Consultant.

Item	Base Contract Element	Contract Value		Complete to Date		Previsosly Billed		This Billing		Balance to Complete	
		$	%	$	%	$	%	$	%	$	%
1.1	<<work element>>	1,000,000.00	65.9%	400,000.00	40.0%	225,000.00	22.5%	175,000.00	17.5%	600,000.00	60.0%
1.2	<<work element>>	250,000.00	16.5%	30,000.00	12.0%	5,000.00	2.0%	25,000.00	10.0%	220,000.00	88.0%
1.3	<<work element>>	125,000.00	8.2%	50,000.00	40.0%	22,000.00	17.6%	28,000.00	22.4%	75,000.00	60.0%
X.X	Itemized Price No. 1	25,000.00	1.6%	0.00	0.0%	0.00	0.0%	0.00	0.0%	25,000.00	100.0%
X.X	Separate Price No. 1	12,500.00	0.8%	5,000.00	40.0%	0.00	0.0%	5,000.00	40.0%	7,500.00	60.0%
CCA.1	Cash Allowance Disbursements Summary	75,000.00	4.9%	34,000.00	0.0%	8,000.00	0.0%	26,000.00	0.0%	41,000.00	0.0%
X.X	Coordination drawings	15,000.00	1.0%		0.0%		0.0%		0.0%		0.0%
X.X	As-built doucmens and operating manuals	15,000.00	1.0%		0.0%		0.0%		0.0%		0.0%
	Original Contract Values	1,517,500.00	100.0%	519,000.00	34.2%	260,000.00	17.1%	259,000.00	17.1%	968,500.00	63.8%
CO.1	Approved Changes Summary	13,400.00		5,200.00	38.8%	2,000.00	14.9%	3,200.00	23.9%	8,200.00	61.2%
	Total Current Contract Values	**1,530,900.00**		**524,200.00**	**34.2%**	**262,000.00**	**17.1%**	**262,200.00**	**17.1%**	**976,700.00**	**63.8%**

Reference	Cash Allowance Disbursement	CA Value	Complete to Date		Previsosly Billed		This Billing		Balance to Complete	
		$	$	%	$	%	$	%	$	%
CAA_1	<<description of cash allowance>>	20,000.00	20,000.00	100.0%	8,000.00	40.0%	12,000.00	60.0%	0.00	0.0%
CAA_2	<<description of cash allowance>>	55,000.00	14,000.00	25.5%	-	0.0%	14,000.00	25.5%	41,000.00	74.5%
				0.0%		0.0%	0.00	0.0%	0.00	0.0%
	Total	75,000.00	34,000.00	45.3%	8,000.00	10.7%	26,000.00	34.7%	41,000.00	54.7%

Reference	Approved Changes	Change Value	Complete to Date		Previsosly Billed		This Billing		Balance to Complete	
		$	$	%	$	%	$	%	$	%
CO_01	<<description of change of work>>	5,800.00	-	0.0%	-	0.0%	0.00	0.0%	5,800.00	100.0%
CD-01	<<description of change of work>>	7,600.00	5,200.00	68.4%	2,000.00	26.3%	3,200.00	42.1%	2,400.00	31.6%
				0.0%		0.0%	0.00	0.0%	0.00	0.0%
	Total	13,400.00	5,200.00	38.8%	2,000.00	14.9%	3,200.00	23.9%	8,200.00	61.2%

Reference	Unquoted/Unapproved Changes	Status	Quotation
			$
CCN=01	<<description of change of work>>	Waitinf for approval	12,000.00
CCN-02	<<description of change of work>>	Unquoted	
	Total		12,000.00

HHAngus Toronto Montreal Vancouver Dallas Chicago

SHOP DRAWING SUBMITTAL

Include this cover page with each shop drawing submission.
Submissions without this form will be returned without review.
Submit one submittal form per shop drawing; do not group under one submittal sheet

Client/Architect: Click or tap here to enter text.

Project Name: Click or tap here to enter text.

HHA Project No: Click or tap here to enter text.

Contractor to complete the following for each submission.

Date: _____

Contractor Name: _____ Ref. No: _____

Manufacturer Name: _____

Product Type/Description: _____

Specification section number: _____

Contractor Trade Category:

☐ Architectural ☐ Structural ☐ Conveying Equipment ☐ User Equipment
☐ Mechanical ☐ Electrical ☐ Telecommunications ☐ Civil
☐ Other

If this is a resubmission, check here: ☐

Previous submission HHA reference no.: _____

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CANADA'S BEST MANAGED COMPANIES

END OF SECTION

QUALIFICATIONS AND AUTHORITIES - ONTARIO
20 01 02

1 GENERAL

1.1 Scope

.1 This specification section:

.1 describes the qualification requirements for tradesmen in the province of Ontario;

.2 defines the applicable authorities having jurisdiction related to construction in Ontario; and

.3 describes the responsibilities of the contractor and/or Owner for registration and inspection of systems and application for construction or installation permits.

1.2 Definitions

.1 ***TSSA***: Technical Standards and Safety Authority

.2 ***ESA***: Electrical Safety Authority

2 QUALIFICATIONS

2.1 Trades Qualification and Apprenticeship

.1 Tradesmen to hold a a certificate of qualification or be an apprentice in accordance with the *Building Opportunities in the Skilled Trade Act*, 2021, S.O. 2021, c. 28, including but not limited to the following prescribed trades in accordance with the *Prescribed Trades and Related Matters* regulation O.Reg. 876/21:

.1 Construction Millwright,

.2 Electrician – construction and maintenance,

.3 Fuel and electrical systems technician,

.4 Heat and frost insulator,

.5 Information technology – hardware technician,

.6 Information technology – network technician,

.7 Network cabling specialist,

.8 Instrumentation and control technician,

.9 Plumber,

.10 Refrigeration and air-conditioning systems mechanic,

.11 Sheet metal worker,

.12 Sprinkler and fire protection installer,

.13 Steamfitter,

2.2 Work-Specific Qualification Licenses

.1 Fabricators and installers of pressure piping and equipment which are subject to O.Reg. 220/01 *Boilers and Pressure Vessels* regulation shall hold the required license for performing such work, unless otherwise exempt by the regulation.

.2 Contractors performing work on liquid or gaseous fuel piping systems and related equipment shall hold certificates of authorization made under O.Reg. 215/01 *Fuel Industry Certificates* to perform work within the scope of the following regulations:;

.1 Gaseous Fuels, O.Reg. 212/01

.2 Propane Storage and Handling, O.Reg. 211/01

.3 Fuel Oil, O.Reg. 213/01

.4 Compressed Natural Gas, O.Reg. 214/01

3 AUTHOURITIES

3.1 Authorities having Jurisdiction

.1 When referenced in specification sections in Division 20 to 25, the authority-having-jurisdiction (“AHJ”) over regulated portions of the work are identified in the following table.

Work Element	Authority	AHJ Abbreviation
Fire Protection	Municipal Building Department or Fire Department	None
Plumbing	Municipal Building Department	None
HVAC	Municipal Building Department	None
Flammable and Combustible Liquids	Fire Department	None
Liquid fuels (for vehicle refueling)	Technical Standards and Safety Authority	TSSA
Heating Oil and Diesel Fuel	Technical Standards and Safety Authority	TSSA
Propane	Technical Standards and Safety Authority	TSSA
Pressure Piping	Technical Standards and Safety Authority	TSSA
Refrigeration	Technical Standards and Safety Authority	TSSA
Licensed Plant Operators	Technical Standards and Safety Authority	TSSA
Electrical	Electrical Safety Authority	ESA

4 PERMITS, REGISTRATION AND INSPECTION

4.1 Building Code Permits

.1

.2 Application for Building Permit including plumbing and HVAC has been made by the Owner. Arrange and coordinate for municipal inspections as required under the Ontario Building Code.

4.2 Other Work Permits, Registration and Inspection

.1 Arrange, provide documentation, and pay for permits, registration, and inspection of the following work elements:

.1 Electrical work performed under Division 20 to 25, and

.2 Where described elsewhere in Division 20 to 25.

.2 Arrange, provide documentation, and pay for variance approvals and field inspections where specified elsewhere in Division 20 to 25.

END OF SECTION

DEFINITIONS AND ABBREVIATIONS - MECHANICAL
20 01 13

1 GENERAL

1.1 Scope

.1 This specification provides definitions and abbreviations of terms which may apply to one or more specification sections under Division 20, 21, 22, 23 and 25.

.2 Additional definitions and/or abbreviations may also be included in other specification sections where they apply only to one specification section.

1.2 Definitions

.1 General definitions:

Authority having Jurisdiction ("AHJ"): the designated government body or regulatory agency responsible for enforcement of applicable statute.

Bronze: a copper alloy with a minimum copper content of 84%.

Building Automation System ("BAS"): the building control systems as specified in Division 25.

Class XXX: a numerical pressure-temperature designation "XXX" in accordance with ANSI/ASME B16 series of standards.

Canadian Registration Number ("CRN"): as defined in accordance with CSA B51.

Certificate of competency: a license, certificate or other document which attests to the qualifications of a construction tradesperson and which is recognized and/or required under prevailing provincial, territorial or federal statutes in the location of the project as an authorization to perform such work.

Cold Working Pressure ("CWP"): the maximum non-shock cold working pressure at temperatures as stated in a MSS valve standard.

Design Criteria: criteria that states the required performance of equipment or a system, and is also the minimum design basis for equipment, systems and contractor's design responsibilities.

Design Pressure: (in reference to a pressure piping system) - the maximum allowable internal pressure in a piping system at the indicated coincident Design Temperature that the piping system may be subjected under normal operating conditions and is the basis for determining the piping system hydrostatic or pneumatic test pressure requirements.

Design Temperature: (in reference to a pressure piping system) – the maximum allowable in-service temperature of the piping system.

Double Regulating Valve ("DRV"): a calibrated manual flow balancing valves with pressure test ports (also referred to as circuit balancing valve),

Dezincification Resistant ("DZR"): a brass copper alloy which by means of its alloy and method of manufacture is certified as being resistant to the process of dezincification.

Flow Limiting Regulating Valve ("FLRV"): an automatic calibrated flow control device which limits the maximum flow to a branch piping network.

Minimum Component Pressure Rating ("MCPR"): the minimum pressure at the indicated coincident temperature at which the component must be capable of withstanding, remain functional and not exceed its maximum allowable stress in accordance with its referenced standard.

National Pipe Taper ("NPT"): a pipe thread in accordance with ANSI/ASME B1.21.1

Operating Pressure: the estimated maximum expected internal operating pressure of a fluid in a pipe or equipment for the purpose of establishing a piping system Design Pressure; actual in-service gauge pressures may be lower. The operating pressure may be specified as a single value, or it may vary by location in the system. "Working pressure" has the same meaning.

Operating Temperature: the estimated maximum normal temperature of the fluid in a piping system

Potable water: has the same meaning as defined in the applicable plumbing code or building code in the jurisdiction of the project. "Domestic water" has the same meaning.

Steam Working Pressure ("SWP"): the maximum steam pressure at the indicated maximum steam temperature or it is the saturated steam pressure if a coincident temperature is not specified.

Service rooms: means a room provided in a building to contain equipment associated with building services, and which includes but is not limited to: boiler rooms; furnace rooms; incinerator rooms; garbage handling rooms; rooms to accommodate HVAC appliances, pumps, compressors and other related equipment; rooms containing electrical distribution equipment; and rooms containing telecommunications and data equipment.

Service space: means space provided in a building to facilitate or conceal the installation of building service facilities such as chutes, ducts, pipes, shafts or wires.

1.3 Abbreviations

AMCA	Air Movement and Control Association International
ANSI	American National Standards Institute
ASME	American Society of Mechanical Engineers
ASHRAE	American Society of Heating, Refrigeration and Air-Conditioning Engineers
ASPE	American Society of Plumbing Engineers
ASSE	American Society of Sanitary Engineers
ASTM	ASTM International (formerly American Society for Testing and Materials)
CSA	Canadian Standards Association
FM	Factory Mutual Approvals
MCAA	Mechanical Contractors Association of America
MCAC	Mechanical Contractors Association of Canada
MSS	Manufacturers Standardization Society
NECA	National Electrical Contractors Association

NEMA	National Electrical Manufacturers Association
NFPA	National Fire Protection Association
NSF	NSF International (formerly National Sanitary Foundation)
SMACNA	Sheetmetal and Air Conditioning Contractors' National Association
UL	Underwriters Laboratory (USA)
ULC	Underwriters Laboratory Canada

End of Section

BASIC MATERIALS AND METHODS
20 05 01

1 GENERAL

1.1 Scope

.1 Articles that are of a general nature, and applicable to each Section of Division 20 to 25.

2 ACCESSIBILITY FOR BUILDING CONTROL DEVICES

.1 Mount control devices, intended to be adjusted or to otherwise be operated by the occupant for the operation of building services or safety devices, as follows:

.1 room environmental controls, including thermostats/adjustable room temperature sensors: at 1200 (47 in) above the finished floor,

.2 all other controls: between 900 and 1100 mm (36 in. and 43 in.) above the finished floor.

.3 be positioned to have a clear space in front of and centered on the control device, of 810 x 375 mm (32 x 15 in).

.4 be operable using a closed fist and with a force not exceeding 22.2 N (5 lbsf).

.2 The above requirements do not apply to control devices that are solely located and used by the building operations staff.

3 ACCESS PANELS / DOORS

3.1 General

.1 Provide access doors to be installed at locations where equipment requiring inspection, service, maintenance or adjustment is "built-in" to work of other trades.

Standard of Acceptance

° Williams Brothers – fig. GP
° Elmdor/Acorn - fig. DW
° Mifab - fig. UA

3.2 Applicable Product Standards

.1 CAN/ULC-S104 Standard Method for Fire Testing of Door Assemblies

3.3 Construction:

.1 Standard access door:

.1 1.6 mm (16 ga) carbon steel door and door-frame with white satin coat prime coat finish, with door edges turned back to frame for rigidity,

.2 flush mounted with 180° opening door, round safety corners, concealed hinges, plaster lock and anchor straps,

.3 latch: screw driver operated,

.4 access doors in ceilings, where acoustic tile is applied to plaster or gypsum board, to be dish type designed to receive tile insert.

.5 size:

(a) 600 mm x 600 mm (24 in x 24 in) for personnel entry,

(b) 300 mm x 450 mm (12 in x 18 in) for hand entry,

.2 Variations:

.1 stainless steel variant:

(a) Type 304 stainless steel with No. 4 brush satin finish.

.2 waterproof variant:

(a) Type 304 stainless steel with No. 4 brush satin finish, with neoprene gasketed door.

.3 security access variant:

(a) keyed cylinder, with all cylinders keyed alike,

.4 fire rated variant:

(a) where access door is located in a horizontal or vertical fire separation that has a fire resistance rating of 2 hours or less,

(b) insulated door with 50 mm (2 in) fire retardant mineral wool insulation, and 0.95 mm (20 ga.) back liner,

(c) heavy duty spring for self-closing door action,

(d) rated for installation in masonry walls and fire rated shaft wall construction, or fire rated ceiling construction as applicable to the installation,

(e) listed to CAN/ULC-S104 for minimum 1.5 hour closure ratings.

.5 Submit shop drawings showing access door size, type and location.

3.4 Installation:

.1 Access doors are required at;

.1 expansion joints,

.2 dampers,

.3 fire dampers,

.4 air valves,

.5 air terminal units,

.6 isolation and control valves ,

.7 pressure reducing valves,

.8 heating or cooling coils,

.9 control wiring junction boxes.

.2 Supply access doors and make arrangements and pay for installation by Division in whose work they occur.

.3 Supply access doors with the required variations in accordance with the following table:

Space Type	Wall or Ceiling Finish	Variants		
		Stainless Steel	Water-proof	Key lock
Service rooms, Service corridors,	Drywall	---	---	---

Space Type	Wall or Ceiling Finish	Variants		
		Stainless Steel	Water-proof	Key lock
Public spaces and corridors - more than 2.4 m (8 ft) above the floor, Private spaces, washrooms	Tile or other hard finished surfaces	Yes	---	---
Public spaces and corridors - 2.4 m (8 ft or less above the floor, Mental health patient areas, Public washrooms	Drywall	---	---	Yes
	Tile or other Hard Surfaces	Yes	---	Yes
Shower rooms, bathtub rooms, Pools, saunas, Kitchens, laundries, Other damp, washdown or high humidity spaces	All	Yes	Yes	Yes

.4 Provide fire rated variant in addition to the above table variants, as applicable to the wall or ceiling construction.

.5 Size and locate access doors in applied tile, block or in glazed or unglazed structural tile to suit joint patterns.

.6 Access doors are not required in removable ceilings. Provide coloured marking devices after completion of ceilings, at four corners of each panel below point requiring access. Colour code markers to show service or device above.

.7 At time of instruction of owners operating staff, hand-over and obtain signed receipt for 4 sets of each type of key used for access doors with key-lock cylinders.

4 DIELECTRIC FITTINGS

4.1 General

.1 Provide dielectric fittings for connection between carbon/galvanized steel piping and either copper tube or stainless steel tube/piping in the following pipe systems:

.1 Non-Potable Water (NPW) piping systems which do not have any chemical treatment,

.2 Domestic hot water systems where galvanized steel pipe is used, including at connections to hot water heating equipment.

4.2 Products

.1 Dielectric unions – NPS 2 and under:

.1 body and union nut material selected to suit connecting piping materials, including carbon steel/copper, carbon steel/stainless steel, and copper/stainless steel,

.2 flat-face union design,

.3 tail-piece with NFPT ends with thermobaked epoxy coating, and Teflon shoulder gasket,

.4 head-piece with integral O-ring, with threaded or sweat pipe ends.

.5 union nut,

.6 pressure rating: Class 3000.

.7 dielectric coating resistance rating: minimum 500 V/mil thickness.

Standard of Acceptance

° Hart Industrial Unions - fig. D-3136 series

.2 Dielectric nipples – NPS 3 and smaller:

.1 for connecting copper to carbon steel piping,

.2 fitting body: Zinc-plated carbon steel tube to ASTM A513,

.3 liner: polypropylene covering entire inner surface of fitting body,

.4 fitting ends: threaded to ASME B1.20.1.

.5 design pressure: 2000 kPa (300 psi) at design temperature,

.6 design temperature: -40 to +110°C (-40 to +230°F)

Standard of Acceptance

° ASC - fig. 7090

.3 Dielectric insulating flanges – NPS 2-1/2 to NPS 4;

.1 For connecting copper to carbon steel piping.

.2 Ductile iron flanges, Class 125 to ANSI B16.42.

.3 Copper tailpiece for soldered joint,

.4 NFPT thread to AMSE B1.20.1 x copper solder joint,

.5 BUNA-N gasket,

.6 lead free materials to NSF 61+G.

.7 maximum design pressure: 1200 kPa (175 psi)

.8 maximum operating temperature: 82°C (180°F)

Standard of Acceptance

° Watts No. LF3100

.4 Dielectric insulated flange – single face with copper tube tailpiece – NPS 2-1/2 to NPS 4;

.1 For connecting copper to carbon steel piping.

.2 Van Stone style carbon steel flange with copper tailpiece with flared flaired end,

.3 carbon steel flange, Class 150 to ANSI B16.5, with powder coated finish.

.4 copper tailpiece with rolled flange face-end, and EPDM insulting gasket isolating the copper tube from the steel flange.

Standard of Acceptance

° CTS Flange Canada - fig. CTS Copper Flange Adaptor

.5 Dielectric Insulating gaskets for flanges NPS 6 and over:

.1 for use with ASME Class 150 and 300 dimensional flanges.

.2 suitable for connecting dissimilar piping materials, including carbon steel/copper, carbon steel/stainless steel, and copper/stainless steel,

.3 compatible with pressure and temperature service,

.4 BUNA-N or EPDM gasket seals compatible with potable water

.5 flange bolts run in insulating sleeves with insulating washers under nuts.

Standard of Acceptance

° Advance Products and Systems

4.3 Installation

.1 Provide dielectric isolation on specified piping systems between pipes of dissimilar metals with suitable insulating dielectric unions, dielectric nipples, insulating flanges, or insulating gaskets between flanges;

.1 place dielectric isolation between steel piping and bronze or brass valves,

.2 Do not use bronze or brass valves as dielectric fittings.

°

5 DRAIN VALVES

.1 Provide drain points with drain valves at low points of piping systems and at section isolating valves.

.2 Drain valves:

.1 NPS ¾ drain and valve for service pipes NPS 2-1/2 and smaller, complete with hose end male thread, cap and chain,

.2 NPS 2 drain and valve for services pipes NPS 3 and larger, complete with female Camlock coupling and dustcap.

.3 Where mechanical-compression fittings are used in the piping system, use only threaded fittings for the construction of the drain piping.

6 V-BELT DRIVES

6.1 Products

.1 Provide V-belt drive for each motor driven device which is not directly connected to the motor. Keep overhung loads on prime mover shafts within manufacturer's design guidelines.

.2 Sheaves for motors 7.5 kW (10 hp) and less, with not more than two belts:

.1 cast iron or steel secured to shafts with removable keys.

.2 adjustable pitch on motor, fixed pitch on driven device, giving plus or minus 10% speed range,

.3 selected to meet specified operating condition at mid position in pitch adjustment.

.3 Sheaves for motors greater than 7.5 kW (10 hp) or drives with three or more belts:

.1 cast iron or steel with split tapered bushing and keyway.

.2 fixed pitch.

.4 Belts:

.1 matched sets of 'B' section, selected for service factor of 2.0 times installed motor horsepower.

.2 capable of carrying load with one belt broken.

.5 Motor slide rails:

.1 adjustment plates for centre line alignment

.2 belt tension adjusting screws.

6.2 Installation

.1 Tension belts to manufacturer's recommendations before start-up and after first 100 hr of operation using calibrated belt tensioning gauge.

.2 Provide replacement pulleys and belts during start-up and balancing to suit field operating conditions.

7 DRIVE AND COUPLING GUARDS

7.1 Products

.1 Provide guards to protect belt drives, flywheels, rotating couplings on equipment and fan inlet and outlets.

.2 Guards:

.1 removable for servicing,

.2 arranged to permit lubrication with guards in place.

.3 Guards for belt drives:

.1 expanded metal screen welded to steel bar stock or angle frame,

.2 minimum 1.2 mm (18 ga) thick galvanized sheet metal tops and bottoms,

.3 40 mm (1½") diameter holes at both shaft centres for insertion of tachometer.

.4 Flexible coupling and flywheel guards:

.1 Removable "U" shaped, minimum 1.6 mm (16 ga) thick galvanized mild steel or expanded metal mesh on substantial welded angle iron or round barstock frame.

.5 Guards on unprotected fan inlets and outlets:

.1 Minimum 20 mm (¾ in) galvanized wire mesh or expanded metal screen with net free area of guard not less than 80% of fan opening.

7.2 Installation

.1 Belt guards to accommodate movement of motors for belt tension adjustment.

.2 Where equipment is installed on resiliently mounted base frame or pad, attach belt guard to this base

.3 Belt guards and fan inlet guards may be omitted where fan and motor is installed in plenum less than 1.4 m (4 ft) high and disconnect for fan motor is mounted adjacent to and outside access door to plenum.

.4 Fan inlet guards may be omitted where fan is fitted with inlet guide vanes.

8 SLEEVES

8.1 General

.1 Provided sleeves for pipes, ducts and conduits passing through walls, floors and roofs.

.2 Maintain fire-resistance integrity where pipes and ducts pass through walls, floors and partitions which are or form part of a fire separation.

.3 Manufactured sleeves and integral sleeves with firestopping may be used provided they meet the same performance requirements as specified for fabricated sleeves.

Standard of Acceptance

- Hilti
- 3M
- Marfab Metal Products

8.2 Floor and Wall Sleeves – Dry Locations ("Standard Sleeves")

.1 Sleeve dimensions in floor and wall fire separations having a fire-resistance rating:

.1 For piping, insulated piping, and conduit:

(a) opening sized to suit fire stopping methods employed but in no case having an inside dimension more than 50 mm (2 in.) larger than the outside dimension of the service.

(b) sleeves may be permanent or only provided as formwork in concrete and masonry construction,

.2 For ductwork:

(a) opening sized to suit duct fire damper and/or smoke damper with clearance required for thermal expansion between the wall/floor opening and the fire/smoke damper sleeve in accordance with the fire/smoke damper manufacturer installation instructions.

(b) opening sleeves may be permanent or only provided as formwork in concrete and masonry construction,

(c) in gypsum-board construction provide permanent opening sleeves or ensure that steel-stud framing is provided to line the opening in the construction.

.3 Sleeve length – permanent type:

(a) piping: extend 25 mm (1 in.) past each face of fire separation.

(b) ductwork fire damper sleeve: as required to allow for installation of retaining angles and installation of required access door.

.2 Sleeve dimensions for all other wall and floor types (except waterproof floors):

.1 For all services:

(a) opening sized to suit the outside dimension of the service, but in no case having an inside dimension of not less than 12 mm (1/2 in.) and not more than 50 mm (2 in.) larger than the outside dimension of the service.

(b) for clarity, for insulated pipes and insulated ducts the outside dimension of the service includes the insulation thickness.

.2 Sleeve length:

(a) flush to wall/floor construction or not to extend more than 25 mm (1 in.) past each face of wall or floor construction.

.3 Sleeve construction for pipes and conduits:

.1 for all types of floor and wall construction:

(a) minimum schedule 10 steel pipe,

(b) fabricated carbon steel sheet of same thickness as schedule 10 pipe, rolled to dimension, lapped and spot welded, or

(c) as required by specific firestop system listing requirements.

.4 Sleeve construction for ducts smaller than 0.4 m^2 (4 sq ft) cross sectional area including insulation:

.1 for wall construction other than as fire separations having a fire-resistance rating:

(a) 1 mm (20 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one, or

(b) sleeves are not required where wall openings are coordinated wall construction trades which includes any duct insulation.

.2 for floors and walls that are fire separations with required fire-resistance rating:

(a) as required by fire and/or smoke damper listing.

.5 Sleeve construction for ducts of 0.4 m^2 (4 sq ft) and larger cross sectional area including insulation through walls and floors:

.1 for wall construction other than fire separations having a fire-resistance rating:

(a) 1.6 mm (16 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one end.

.2 for floors and walls that are fire separations with required fire-resistance rating:

(a) as required by fire and/or smoke damper listing.

.6 Manufactured floor sleeves with integral fire stopping:

.1 floor sleeve with integrated firestopping, for insulated and non-insulated metal pipes, and plastic pipes,

.2 for installation in concrete floors and metal deck/concrete floors,

.3 adaptors for support or pipe riser clamps,

.4 listed to CAN/ULC-S115.

Standard of Acceptance

° Hilti - fig. CP 680 series

8.3 Slot Sleeves

.1 Application:

.1 where multiple pipes or conduits are grouped together in a linear arrangement to pass through a concrete floor or wall, or masonry wall, a common slot sleeve may be used,

.2 where slot openings are not shown on structural drawings, Contractor may propose location and sizes of slot openings for approval by the structural engineer. Where such approval is denied, use individual sleeves for each pipe or conduit.

.2 Formwork:

.1 provide removable formwork or instruct the contractor under Division 03 of the Work to set formwork for the required slot dimensions prior to pouring concrete or setting of masonry units.

.3 Slot dimensions:

.1 slot sleeve dimensions, pipe and conduit sizes, and location of services within the slot are subject to firestopping listing requirements.

8.4 Waterproof Floor Sleeves - Indoors

.1 Applications:

.1 where pipes, conduits and ducts pass through floors in areas subject to water, in building service rooms, in kitchens, in washing areas and in slabs over electric and telephone rooms.

.2 Fabricated waterproof sleeves for pipes and conduits, :

.1 minimum schedule 10 carbon steel pipe with either:

(a) hot dip galvanized to ASTM A123 after fabrication, or

(b) internally and externally painted with industrial anti-corrosion paint in accordance with Specification section 20 05 02 *Painting for Mechanical Services*, or

.2 schedule 10 stainless steel pipe,

.3 provided with water bars: 75 mm (3 in.) wide annular water bar flange continuously welded to sleeve.

.3 Fabricated waterproof sleeves for ducts:

.1 fabricated carbon steel sheet sleeve, continuously welded seams and joints, with angle-channel water bar welded to side of sleeve,

(a) 1 mm (20 ga) thick for ducts of less than 0.4 m^2 (4 sq ft) cross-section area including insulation,

(b) 1.6 mm (16 ga) thick for ducts 0.4 m^2 (4 sq ft) and larger cross-section area including insulation, and for openings with multiple ducts:

.2 sleeves internally and externally painted with industrial anti-corrosion paint in accordance with Specification section 20 05 02 *Painting for Mechanical Services*,

.3 water bars:

(a) new construction, embedded into floor concrete: 75 x 75 mm (3 x 3 in.) galvanized-steel angle channel continuously welded to sleeve,

(b) existing or new construction, surface mounted: 75 x 50 mm (3 x 2 in.) carbon steel angle channel, surface mounted to top of concrete housekeeping curb.

.4 Location of water bars:

.1 placed at mid-height of floor construction thickness in new floor construction,

.2 surface mounted on and fastened to top of concrete housekeeping curb in existing buildings or in new floor construction.

8.5 Foundation Wall Sleeves

.1 For installation in poured concrete foundation walls.

.2 Manufactured foundation wall sleeves:

.1 PVC wall sleeve with 50 mm (2 in) wide water bar,

.2 sized to suit pipe OD and pipe link-seal.

Standard of Acceptance

° Metraflex

.3 Fabricated wall sleeve:

.1 Method 1:

(a) schedule 10 Type 304 stainless steel pipe with 75 mm (3 in) wide water bar welded to mid-point of sleeve,

.2 Method 2:

(a) schedule 40 carbon steel pipe with 75 mm (3 in) wide water bar welded to mid-point of sleeve,

(b) sleeves internally and externally painted with industrial anti-corrosion paint in accordance with Specification section 20 05 02 *Painting for Mechanical Services*,

.3 sized to suit pipe OD and pipe link-seal.

8.6 Roof Sleeves for Pipe and Conduit

.1 Manufactured roof sleeves:

.1 one-piece spun aluminium sleeve, minimum 1.6 mm (0.064 in) wall thickness, with integral continuous welded flashing,

.2 insulated with polyurethane insulation for hot and cold piping,

.3 with 135° gooseneck for flexible electrical conduit, with minimum clearance from gooseneck outlet to flashing flange of:

(a) minimum 300 mm (12 in) for installation on conventional roofs,

(b) minimum 450 mm (18 in) for installation on inverted roofs.

.4 with vented flashing insert and flashing cap for hot piping,

.5 with ventilation perforations at top of sleeve and a flashing cap for natural gas piping,

.6 stainless steel fasteners,

.7 EPDM base seal between conduit or pipe and bottom of sleeve,

.8 EPDM top seal, with triple pressure seal, either integral to the sleeve or as a two-piece sleeve and flashing cap,

.9 sleeve height: 300 mm (12 in),

.10 suitable for hot and cold piping, with or without pipe insulation, and rigid and flexible electrical conduit.

Standard of Acceptance

° Thaler – fig. MEF series

Application	Thaler Model
Hot piping	MEF-3A
Cold piping	MEF-3A
Natural gas piping	MEF-9
Rigid electrical conduit	MEF-1
Flexible electrical conduit	MEF-2A

8.7 Installation

.1 Provide sleeves for the passage of services through walls, floors and roofs in accordance with the following table:

Construction Element	Fire Resistance Rating	Element Construction	Mechanical Service	Opening Sleeve Required
Roof	Any or none	All	All	Yes
Walls	>0 hrs		Pipe and Conduit	As required for formwork

		Concrete, Masonry Units	Ductwork	As required for formwork
		Gypsum Board	Pipe and Conduit	Yes
			Ductwork	As required by fire or smoke damper listing
Wall (smoke barrier)	0 hrs	All	All	Yes, or wall tightly finished to sides of service
Acoustic Isolation Walls	None [1]	All	All	Yes
All other walls	None [1]	All	All	None unless otherwise shown
Floors	>0 hrs	Concrete	Pipe and Conduit	As required for formwork
			Ductwork	As required by fire or smoke damper listing
Waterproof Floors	Any or none	Concrete	Pipe and Conduit	Yes
			Ductwork	Yes or Curb

Notes:
[1] Walls are not fire separations of any type.

.2 Place and secure sleeves in concrete form work for floors, walls and roofs.

.3 Supply sleeves to be set in masonry walls with installation detail drawings setting out locations of sleeves.

.4 Standard sleeves:

.1 terminate flush with surfaces of concrete and masonry walls.

.2 standard sleeves may be omitted where the services pass through walls which are not fire-separations and are concealed above opaque ceilings.

.5 Waterproof sleeves in new construction:

.1 extend sleeves 50 mm (2 in.) above top of housekeeping curbs,

.2 extend sleeves 150 mm (6 in.) above finished floors where housekeeping curbs are not used,

.3 install sleeves with water bar embedded within the concrete floor or with water bar sitting on top of concrete housekeeping curb. Where mounted on top of housekeeping pad, mechanically fasten sleeve and water bar to concrete housekeeping curb.

.4 where water bars are exposed, grind smooth any edges to allow application and adhesion of floor/curb paint finishes.

.6 Waterproof sleeves in existing concrete buildings:

.1 install sleeves in neatly cut or drilled holes in existing construction,

.2 carry out cutting and drilling of structural elements, such as floors, slabs, and walls in accordance with procedure set out in Article "Cutting and Patching".

.3 provide 150 wide x 150 high mm (6 x 6 in.) housekeeping curb for each penetration.

.4 extend sleeves 50 mm (2 in.) above top of housekeeping curbs, with water bar mechanically fastened to curb,

.7 Seal the void between sleeve and service:

.1 except for sleeves for fire dampers and smoke dampers, fill void between sleeve and pipe, conduit or duct in accordance with Article "Fire Stopping and Smoke Seals" in this Section for sleeves located in fire separations,

(a) for waterproof sleeves, use firestopping material which is also suitable for exposure to water under normal operating conditions.

.2 at other locations, pack the void between sleeve and pipe, conduit or duct for full depth of sleeve, with mineral wool insulation and seal both ends with silicone-free caulking compound.

.8 Roof sleeves for pipe and conduit:

.1 install manufactured roof flashing sleeves in accordance with manufacturer instructions, specifically in accordance with requirements applicable to the type of roofing membrane requirements,

.2 where limestone ballast is used, apply asphalt or similar protective coating onto flashing sleeve to a height of 50 mm (2 in) above ballast layer.

.9 Where shown, provide floor, wall or roof sleeves for future use. Coordinate with trade contractor under Division 03 of the Work to have such sleeves filled with light weight concrete.

9 LINK SEALS

9.1 General

.1 Fit each pipe passing through floor slab in contact with ground or basement walls below grade with link seal between sleeve and bare pipe.

.2 Submit manufacturer’s literature and schedule showing location, service, inside diameter of wall opening, sleeve length and pipe outside diameter.

.3 Link seal:

.1 Manufactured from modular synthetic rubber links with stainless steel hardware.

.2 Loosely assembled with bolts to form continuous rubber belt around pipe, with pressure plate under each bolt head and nut.

.3 Constructed to provide electrical insulation between pipe and sleeve.

Standard of Acceptance

- Power Plant Supply – fig. Thunderline Linkseal
- Advance Products & Systems – fig. Innerlynx
- Metraflex - fig. MetraSeal

9.2 Installation

.1 Determine inside diameter of each wall opening or sleeve before ordering seal.

.2 Position seal in sleeve around pipe and tighten bolts to expand rubber links until watertight seal is obtained.

10 FIRE STOPPING AND SMOKE SEALS

10.1 General

.1 Provide fire stopping and smoke seals where ducts, pipes or conduits penetrate fire separations.

.2 Fire stop materials to be impervious to water when installed in a horizontal separation, including waterproof service sleeves.

.3 Firestop material manufacturer or their designated service representative to provide the following services:

.1 selection of listed fire stopping assemblies for each applicable service penetration and fire separation assembly/rating,

.2 provide training of contractor's staff for proper installation of fire stopping assembly; create and maintain a log of those personnel who obtain training,

.3 inspect the completed installation of all penetrations and submit a written report to the Consultant, including photo record of randomly selected instances of each fire stopping method. Where deficiencies are discovered, note the deficiencies in the report and provide remedial instructions to the contractor to correct the deficiency. After deficiencies are corrected, re-inspect the deficiencies to conform their correction, update and resubmit the report to the Consultant.

.4 Submit a complete fire stopping and smoke seal shop drawing schedule to the Consultant for review. Include details, cut sheets, system description and location for each proposed fire stopping and smoke sealing application.

10.2 Products

.1 Materials and firestopping system to be listed for conformance with CAN/ULC-S115 "*Standard Method of Fire Tests of Firestop Systems*".

.2 Firestop systems to have F duration rating equal to the fire resistance rating of the applicable fire separation. In addition, where required by the applicable building code for the specific service penetration, the fire stop assembly shall:

.1 have a F rating equal to the fire resistance rating of the applicable fire separation with a pressure differential of 50 Pa (0.2 in.w.c.) between exposed and unexposed side with the highest pressure on the exposed side, and

.2 have an FT rating equal to the fire resistance rating of the applicable fire separation,

Standard of Acceptance

- Hilti Firestop Systems
- 3M
- Nelson Firestop Products
- Eastern Wire + Conduit (Royal Quickstop)

.3 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

10.3 Installation

.1 Install firestopping and smoke seals in accordance with the manufacturer's recommendations and in accordance with its listing.

.2 Firestopping and smoke seals to be installed only by personnel trained by the manufacturer on the installation of such systems.

.3 Seal space between penetrating service and sleeve or opening in in fire rated floors and walls with a firestop and smoke sealing system.

.4 Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.

.5 At time of application of materials, surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials.

.6 Select firestopping system to allow insulation and vapour barrier to pass un-broken through assembly.

.7 Do not apply fire stopping materials to fire or smoke dampers.

11 WALL AND FLOOR PLATES

11.1 General

.1 Provide finishing plates fitted to ducts, pipes, and electrical services provided under Division 20 of the Work which pass through walls, floors and ceilings in finished areas.

11.2 Products

.1 Escutcheons for small diameter piping and small diameter electrical conduit:

.1 manufactured chrome plated two-piece split type with hinge and set-screw.

.2 Finishing plates for ducts, larger pipes, larger electrical conduits and electrical cables:

.1 finishing plate (ring) fabricated from minimum 0.9 mm (20 ga) thick T304 stainless steel with No. 4 brushed finish, with minimum 25 mm (1 in) high collar ring,

.2 mounting holes drilled at not less than three (3) symmetrically location positions around the ring to allow mechanical fastening,

.3 plate diameter to be sufficiently sized to overlap the wall, floor or ceiling opening by not less than 25 mm (1 in) all around the opening.

11.3 Installation

.1 Escutcheons;

.1 secure escutcheons to pipe and electrical conduit with mechanical fastener.

.2 Finishing plates:

.1 set finishing plates flat against the finished surfaces, and secure to the surface with stainless steel pan-head mechanical fasteners. Provide insert anchor plugs in the finished surface as necessary to secure the fasteners.

12 PIPE SUPPORTS, EQUIPMENT SUPPORTS, AND TRENCH COVERS

12.1 General

.1 Design and fabricate supplementary supporting steel for piping, ductwork and equipment supports, and trench and pit covers, from steel plate and sections. For clarity, the contractor under these Division 20 to 25 of the Work is responsible for design, fabrication and installation of such materials.

.2 Concrete housekeeping bases for mechanical and electrical equipment which are in direct contact with floor slab, are to be provided by this Division 20.

.3 Concrete for equipment supported on vibration isolated inertia bases is to be provided by this Division 20.

.4 Work to be done by firms specializing in these fields.

.5 Submit shop drawings for steel and concrete work, prepared by Professional Engineers licensed in the jurisdiction of the Work

12.2 Applicable Codes and Standards

.1 Legislation:

.1 Ontario Building Code,

.2 R.R.O. 1990, Reg. 851 Industrial Establishments

.2 Installation codes and standards:

.1	CAN/CSA-S16.1	Limit States Design of Steel Structures.
.2	CSA W59	Welded Steel Construction (Metal Arc Welding).

.3 Product standards:

.1	ASTM A36	Standard Specification for Carbon Structural Steel
.2	ASTM A53/A53M	Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
.3	ASTM A123	Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
.4	ASTM A 307	Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
.5	CAN/CSA G40.20/G40.21	General Requirements for Rolled or Welded Structural Quality Steel.

12.3 Supplementary Supports and Support Brackets

.1 Provide supplement supports and brackets for the support of equipment, piping and ductwork.

.2 Fabricate supports from structural grade steel with anchor bolts and fastenings, so that horizontal supporting beam deflections do not exceed 1/360 for the span, and not exceed an absolute deflection of 5 mm (0.20 in), with a safety factor of 1:4 to the ultimate strength of the material

.3 Design the supports in consultation with the building structural Consultant, to transfer live loads and dead loads to the building structural elements,

.4 Construct the supports as frames bracketed from walls, and/or supported from building structure above, and/or floor below.

12.4 Slide Pads for Equipment Support

.1 General:

.1 slide pads for equipment supports for equipment subject to thermal expansion,

.2 designed for continuous-weld and/or tack-welding of backing plate to the equipment support,

.3 assembled in pairs per load point.

Standard of Acceptance

° Piping Technologies & Products Inc.

.2 Composite 25% glass-filled PTFE bearing plate bonded to carbon steel backing plate:

.1	PTFE thickness:	0.1 mm (3/32 in.)
.2	backing plate:	3 mm (1/8 in.) thick carbon steel plate,
.3	compressive strength:	19.3 MPa (2800 psi)
.4	temperature rating:	-45 to +260°C (-50 to +500°F)
.5	coefficient of friction:	0.15

.3 Graphite bearing plate bonded to carbon steel backing plate:

.1 graphite thickness: 13mm & 6mm (1/2 in & 1/4 in.)

.2 backing plate: 6 mm (1/4 in.) thick carbon steel plate,

.3 compressive strength: 19.3 MPa (2800 psi)

.4 temperature rating: -45 to +537°C (-50 to +1000°F)

.5 coefficient of friction: 0.15.

12.5 Trench Covers, and Pit Covers

.1 Fabricated with:

.1 75 mm x 75 mm x 9.5 mm (3 in x 3 in x ⅜ in) welded angle frame with anchor bars,

.2 25 mm x 9.5 mm (1 in x ⅜ in) trim bar to fit concrete pit, and with matching checker-plate cover,

.3 hot dip galvanized after fabrication

12.6 Installation - General

.1 Locate supporting steel to permit removal of parts for service or repair, and to allow clear access to valves, fittings, and equipment,

.2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, vibration mountings and snubbers.

.3 Set equipment base plates on housekeeping pads on minimum 13 mm (½ in) epoxy grout and fill hollow portion of base with concrete.

.4 Install anchor bolts, vibration mountings and snubbers between equipment and housekeeping pad, or inertia pad and housekeeping pad.

.5 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.6 Make field connections with bolts to CAN/CSA-S16.1, or by welding.

.7 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.

.8 Touch-up field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

.9 Where trench covers are cut in field or damaged, touch up with zinc rich paint.

END OF SECTION

PAINTING FOR MECHANICAL SERVICES
20 05 02

1 GENERAL

1.1 Scope

.1 Provide industrial sealer and anti-corrosion coatings for mechanical and electrical building services and related construction elements including:

.1 mechanical and electrical services and supporting elements as specified under other sections of Divisions 20 to 25

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 01 01 Mechanical General Requirements

.2 20 05 01 Mechanical Basic Materials and Methods

.3 23 11 13 Fuel Oil Piping and Accessories

.2 In addition to building elements to be painted as specified herein, refer to other Specification sections of Division 20 to 25 for other mechanical equipment to be painted.

1.3 Submittals

.1 Submit product data sheets which demonstrate compliance with LEED VOC requirements.

1.4 Applicable Codes and Standards

.1 Legislation:

.1 SOR/2009-264 Canadian Environmental Protection Act, *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations*

.2 Installation standards and codes:

.1 LEED v4 New Construction, credit EQ Cr 4.2

.2 SSPC-SP1 Solvent Cleaning

.3 SSPC-SP2 Hand Tool Cleaning

.4 SSPC-SP11 Bare Metal Power Tool Cleaning

.5 SSPC-SP13 Surface Preparation of Concrete

.3 Product standards:

.1 Green Guard GC-03 Green Seal Environmental Criteria for Anti-Corrosion Paints

2 PRODUCTS

2.1 Industrial Anti-Corrosion Coatings – Carbon Steel Materials

.1 Outdoor applications:

.1 For carbon steel materials and structural steel support components.

.2 Top coat: Industrial urethane alkyd enamel top coat, or single compound 100% acrylic coating.

.3 Primer coat: as per manufacturers' recommendation for coating of steel piping.

.4 Colour: Sherwin Williams No. SW4027 (Galvano), unless specified elsewhere.

.5 VOC limit: 340 g/L of product less water and excluded compounds.

Standard of Acceptance

- Sherwin Williams – Pro Industrial Urethane Alkyd Enamel
- Sherwin Williams – Pro Industrial Acrylic

.2 Indoor applications:

.1 For carbon steel materials and structural steel support components.

.2 Top coat: single compound 100% acrylic coating.

.3 Primer coat: as per manufacturers' recommendation for coating of steel piping.

.4 Colour: Sherwin Williams No. SW4027 (Galvano), unless specified elsewhere.

.5 LEED: certified to Green Guard standard GC-03 for anti-corrosion coatings.

.6 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Pro Industrial Acrylic

.3 Zinc rich primer applications:

.1 For field painting of carbon steel material, or touch-up of galvanized steel material.

.2 Top coat: as specified for interior or exterior applications.

.3 Primer: single or multi-part zinc rich coating.

.4 Colour: gray-green.

.5 LEED: certified to Green Guard standard GC-03 for anti-corrosion coatings.

.6 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Zinc Clad III HS 100

2.2 Industrial Coatings – Poured Concrete

.1 For field painting of concrete safety bollards.

.1 Resistant to fuel oil, general solvents and water.

.2 Top coat: water based urethane floor enamel

.3 Primer: water based epoxy

.4 Colour: Sherwin Williams Deck Gray

.5 Colour: Sherwin Williams Safety Yellow where shown.

.6 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Armorseal Floor Plex 7100 Primer / Amorseal 1K Topcoat

3 EXECUTION

3.1 General

.1 Refer to requirements for services to be painted in the relevant sections of Division 20 to 25 and as specified herein, including but not limited to:

.1 general requirements for painting in accordance with Specification section 20 01 01,

.2 painting of pipe sleeves in accordance with Specification section 20 05 01,

3.2 Repair of Factory Coatings

.1 Touch up any damage to factory prime coat finishes resulting from shipping or installation with appropriate primer for indoor/outdoor installation followed by an appropriate top-coat colour to match existing. Materials to be compatible with the original factory finish.

.2 Touch up any damage to factory galvanized finish resulting from site welding, shipping or installation with zinc rich primer.

3.3 Paint Installation

.1 Surface preparation and protection:

.1 Clean surfaces to be painted in accordance with paint manufacturer recommendations and as follows.

.2 Surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials at time of application of paint materials.

.3 For carbon steel materials, remove all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing in accordance with SSPC-SP2 or use power tool cleaning in accordance with SSPC-SP11

.4 For galvanized steel material, solvent clean to SSPC-SP1. If galvanized surface is already rusty, remove loose rust and dirt in accordance with SSPC-SP2 or SSPC-SP11 and prime the exposed metal the same day as being cleaned.

.5 For concrete materials, clean surfaces to SSPC-SP13 / NACE 13 by mechanical, chemical or thermal methods.

.6 Tape-off adjacent materials which are not to be painted.

.7 Provide drop sheets to protect other material from falling paint or over-spray.

.2 Application - General:

.1 Apply one coat of primer to carbon steel items.

.2 Use primer unadulterated, as prepared by manufacturer.

.3 Apply top coat in the number of coats recommended by the manufacturer, to obtain 100% coverage to the minimum recommended thickness, free of streaks, drips and sags.

.4 Do not paint when temperature is lower than 7°C.

.3 Application – Galvanized base metal finish:

.1 Where material is galvanized, touch up welded sections or other locations where protective galvanized surface has been damaged, with zinc rich primer.

.2 Apply a top coat to match base material colour.

.4 Application – Concrete safety bollards

.1 Apply one coat of primer and two top-coats.

.2 Seal joints between floors and curbs or housekeeping pads, and between floors and walls , with a silicone based industrial caulking in matching colour after paint has dried.

End of Section

WELDING AND BRAZING
20 05 24

1 GENERAL

1.1 Scope

.1 Weld or braze pipe and fittings for work of Division 20.

1.2 Definitions

.1 The following definitions apply to this specification section:

AHJ (BPV): *the authority having jurisdiction which is responsible for boiler, pressure vessel and pressure piping safety in the province of the project.*

.2 In this specification,

.1 the word “piping” also includes tubing as the case applies.

.2 the words “welding” or “welder” shall be read as to also refer to “brazing” or “brazer” unless the context otherwise dictates one or the other.

1.3 Applicable Codes and Standards

.1 Installation codes and standards:

.1	ASME B31.1	Pressure Piping
.2	ASME B31.3	Process Piping
.3	ASME B31.9	Building Services Piping
.4	ASME BPVC Section V	Nondestructive Examination
.5	ASME BPVC Section IX	Welding and Brazing Qualifications
.6	CSA B51.	Boiler, Pressure Vessel, and Pressure Piping Code

1.4 Quality Control

.1 Welding of piping systems which have specified design pressures greater than 100 kPa (15 psi) to be carried out using approved welding procedures by welders certified for pressure piping by the AHJ (BPV), whether or not the piping system is subject to registration as pressure piping.

.2 Welding procedures shall be registered with the AHJ (BPV), in accordance with CSA B51 and as qualified in accordance with ASME BPVC Section IX.

.3 Welders shall be certified for welding of pressure piping in accordance with the requirements of the AHJ (BPV). Welders shall be qualified by their employer on the employers welding procedures.

.4 For piping systems which have specified design pressure of 100 kPa (15 psi) or less, welding procedures and welders shall be qualified by the Contractor in accordance with the requirements of ASME B31.9.

2 PRODUCTS

2.1 Not used

3 EXECUTION

3.1 Welding Method and Quality

.1 Welding, both shop and field, to be electric arc in accordance with recommendations of Canadian Welding Bureau unless other welding methods are specified in the piping specification sections.

.2 Welds to be solid homogeneous part of metals joined and free from pits, slag-inclusions, and scale.

.3 Weld surfaces to be smooth and regular and weld metal deposition to achieve full penetration grove weld fused to the base metal throughout joint thickness. Fillet welds, where permitted or required by applicable piping codes, shall achieve adequate depth of fusion of the base metal as required by those codes.

.4 Brazed joints to use brazing filler and fluxes as specified for each applicable piping system. For socket joints, the tube and joint are to overlaped not less than four times the thickness of the thinner base material, with filter material penetrating to this full depth and finished with well-developed fillet.

3.2 Welded Connections to Existing Pressure Piping Systems

.1 At the commencement of the Work, where registration and/or inspection of the piping system is required in accordance with provincial boiler and pressure vessel regulations, review with the AHJ (BPV) inspector to determine their weld testing requirements to validate the proposed welding procedures for connecting to existing piping, including but not limited to:

.1 acceptable dimensional misalignment between old and new pipe;

.2 requirements, if any, for metallurgical analysis of exiting piping;

.3 sample butt weld guided-bend test; and

.4 sample fillet weld test.

.2 After testing requirements are determined, provide a proposed schedule for tie-in connections and required existing service shut-down periods, for approval prior to commencing work.

.3 Prior to shut-down of existing piping systems for tie-ins, inspect the existing pipe O.D. dimensions to confirm their suitability for pipe attachment. Specifically, where the work requires a complete transection of an existing pipe, check the existing pipe for excessive out-of-roundness which would otherwise exceed the allowable misalignment as defined in the applicable ASME piping code. Where necessary, trim the pipe ends in accordance with the referenced piping code.

3.3 Welding Examination

.1 For piping systems which are specified to be constructed to ASME B31.1 or ASME B31.3, examination of pipe welds, including both visual and other nondestructive examination performed in accordance with those piping codes shall be arranged and paid for by the Contractor, and are to be performed by a specialist testing company whose personnel are qualified to perform such examinations in accordance with ASME BPVC Section V.

.2 For piping systems which are specified to be constructed to ASME B31.9, examination of pipe welds in accordance with that piping code shall be performed by the Contractor using personnel who are suitably experienced for such examinations.

.3 Acceptance criteria for weld examination shall be in accordance with the specified ASME piping code applicable to each piping system and as may be specified in other Specification sections of Division 21 to 23.

.1 for clarity, where ASME B31.9 code applies to a piping system, the weld examinations and weld defect acceptance criteria are summarized in the following table.

(a) Notwithstanding the listed weld defect criteria, the overall quality of the weld shall also be able to meet the requirements for incomplete weld penetration and weld root concavity. However, examination of the interior surface of the weld is not required.

Table 1: Weld Defect Acceptance Criteria – ASME B31.9

Type of Weld	Weld Defect	Acceptance Criteria
Girth (butt) weld, Groove weld, Fillet weld, Socket weld, Seal weld	Cracks	None
	Lack of fusion	Length of unfused areas ≤ 20% of pipe circumference or total length of weld, and not more than 25% in any 150 mm (6 in.) of weld
	Undercut	Not exceed the lessor of 1 mm (1/32 in.) or 12.5% of wall thickness.
	Weld surface	Weld reinforcement not to exceed 4.8 mm (3/16 in.)

3.4 Welding Inspection

.1 Arrange and pay for any required inspection of welds by the AHJ (BPV).

.2 Welders certificates and welding procedures used for the Work to be made available for inspection by the AHJ (BPV) on demand. Provide traceability of welders work by either stamping each weld with the welder's identifying number, or maintain a record log to record and identify each welders work.

END OF SECTION

IDENTIFICATION FOR MECHANICAL SERVICES
20 05 53

1 GENERAL

1.1 Scope

.1 Provide identification nameplates, labeling for piping, ductwork, equipment, and valves, and specialty signage.

1.2 Applicable Codes and Standards

.1 Installation codes and standards:

.1	ANSI Z535.1	Standards for Safety Signs and Labels
.2	ASME A13.1	Scheme for the Identification of Piping Systems

1.3 Submittals

.1 Shop drawings:

.1 Submit product data sheets for materials specified herein.

2 PRODUCTS

2.1 General

.1 Manufactured identification systems:

.1 resistant to general chemical, and ultraviolet stabilized for outdoor use,

.2 minimum operating temperature: -25°C (-12°F),

.3 maximum operating temperature: 121°C (250°F).

.4 language: English

Standard of Acceptance

- Brady - identification tapes, bands, and markers.
- Seton - Setmark Pipe Markers.
- Smillie McAdams Summerlin.
- Craftmark Identification Systems.
- Primark

2.2 Engraved Equipment Identification Nameplates

.1 Laminated nameplates:

.1 laminated two-layer coloured plastic plates, with engraved lettering,

.2 minimum size: 90 mm x 40 mm x 2.5 mm (3 in x 1½ in x ⅛ in),

.3 letter height:

(a) ID and name: 20 mm (3/4 in.) minimum

(b) power source: 10 mm (⅜ in) minimum,

.4 provided with Class 125 barcode and tag file,

.5 nameplate colours:

(a) nameplate and letter colours are dependent on type of electrical power supply to equipment.

Power Source	Background Colour	Letter Colour
Normal or None	White	Black
Life-Safety/ Emergency	Red	White
Stand-by (non-life safety)	Orange	White
UPS	Blue	White

2.3 Piping Identification – Piping Systems

.1 General:

.1 conform to ASME A13.1 and as shown in Schedule A at the end of this Section for marking colours and global harmonization system (GHS) hazard identification symbols.

.2 text height:

Pipe/Tube NPS	Marker Length mm (in)	Text Height mm (in)
≤ 1-1/4	200 (8)	13 (0.5)
1.5 to 2	200 (8)	19 (0.75)
2.5 to 6	300 (12)	32 (1.25)
8 to 10	600 (24)	65 (2.5)
>10	800 (32)	90 (3.5)

.2 Flexible coil-wrap manufactured markers:

.1 PVC plastic coated markers with integral printing, or plastic cover with field applied self-adhesive markers,

.2 reversing text with integral arrow markers,

.3 application method:

(a) NPS ½ to NPS 6: full wrap of pipe

(b) NPS 8 and over: partial pipe wrap with perforations for securing with nylon tie-wraps, tie-wraps included.

.3 Self-adhesive polyester pipe name marking tape:

.1 reversing text with integral flow direction arrow markers,

.2 tape height: 65 mm (2.5 in) minimum.]

.4 Self-adhesive vinyl flow direction marking bands:

.1 colour band tape with flow direction arrows,

.2 colours: as specified for pipe name markers.

.3 tape width: 50 mm (2 in)

.4 tape length: wrapped around pipe or covering with ends overlapping one pipe diameter but not less than 25mm (1 in).

.5 flow arrow: 20 mm (¾ in) minimum high

2.4 Valve Identification

.1 Engraved plastic laminate tags:

.1 text for valves:

(a) piping system fluid service, area location description, following by a series number

(b) where a valve is shown on drawings to be normally closed, include “Normally Closed”

.2 tag background colour and test colour: same as for pipe markers in accordance with Schedule A at the end of this section.

.3 brass or stainless steel chain.

2.5 Miscellaneous Identification

.1 Self-adhesive polyester marking labels with global harmonized system (GHS) hazard pictograms.

.1 red border on white field,

.2 symbol height: 100 mm (4 in) minimum.

2.6 Signage

.1 Rigid plastic signs, UV stabilized and suitable for indoor and outdoor installation, for surface mounting.

.2 Graphic symbols:

.1 graphic image in accordance with WHIMS and ISO 7010,

.2 sign dimensions:

(a) indoors: 300 x 300 mm (12 in. x 12 in.)

(b) outdoors: 450 x 450 mm (18 in. x 18 in.)

.3 Colours:

.1 Field and text colours in accordance with ANSI Z535.1

Information Type	Background Colour	Letter Colour	Primary Notification Text
General information	Blue	White	NOTICE
General Safety, Exiting	Green	White	---
Caution	Yellow	Black	CAUTION
Warning	Orange	Black	WARNING
Danger	Red	White	DANGER
Biological	Fluorescent Orange	Black	BIOHAZARD

3 EXECUTION

3.1 Equipment Identification

.1 Where required:

.1 provided for equipment identified with number designations shown in equipment schedules, drawings, specifications, and/or equipment selection sheets.

.2 marked with equipment ID, service name, and power source using wording and numbering used in contract documents.

.3 for clarity, equipment identification nameplates are in addition to manufacturers plates.

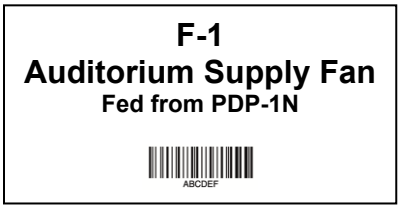
.2 Locate nameplates to be easily read, and fasten securely with mechanical fasteners. For pressure vessels, secure nameplates to equipment with high-tensile epoxy adhesive.

.3 Do not paint over equipment manufacturer or field installed nameplates.

.4 Provide metal standoffs on insulated equipment.

.5 Examples:

.1 at equipment (fan, pump, etc.), illustrated for Normal Power:



.2 at motor starter, adjustable frequency drive, and separate local disconnect, illustrated for Emergency Power:

3.2 Piping Identification - General

.1 Except where otherwise specified herein, provide manufactured pipe markers of the following types based on area of the building:

.1 self-adhesive type:

(a) indoor uninsulated piping,

(b) indoor insulated piping with PVC or smooth metal jackets,

.2 flexible coil-wrap:

(a) outdoor piping,

(b) indoor insulated piping with any type of jacket.

.3 Install self-adhesive markers on cleaned and prepared surfaces free of dirt and oil.

.2 Install pipe markers in the following locations:

.1 maximum every 6 m (20 ft) along length of pipe for fuel oil,

.2 within 1 m (3 ft) of each side of barriers, floors and walls,

.3 within 1 m (3 ft) of and behind access doors ,

.4 within 1 m (3 ft) of piping termination point.

.3 Marker colours and hazard identification:

.1 Use the existing piping marker colour coding system for building additions and alterations.

3.3 Valve Identification

.1 Provide valves with a numbered tag showing valve type and size, attached to valve stem or wheel handle with chain.

.1 Valve identification is not required at the following valves:

(a) inside fire hose cabinets,

(b) radiation heating units, unit heaters, or fixture stops,

(c) plumbing fixture service stops,

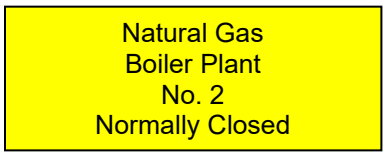
(d) within 4 m (12 ft) and in sight of equipment, fixtures, or apparatus that the valve controls provided there is no branch piping between the valve and equipment served,

(e) existing valves that are not provided under this project.

.2 Identification information – manual valves:

.1 each valve tag to indicate fluid service, sequential valve number (unique for each service) including supply or return, location identifier, and normal operating position

.2 examples (colour coding shown for illustration):



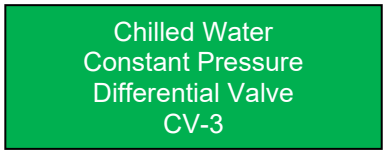
.3 Identification information – automatic control valves:

.1 provide valve tags for all automatic control valves except as follows:

(a) within sight of equipment that the valve controls.

.2 each valve tag to indicate fluid service, control function, control valve identification number,

.3 examples (colour coding shown for illustration):



.4 Provide a tag schedule for each system, designating valve numbers, fluid service, function, valve size, and location of each tagged item and normal operating position of each valve. Submit copies in original file format (Excel, Word) on two (2) removable mass storage devices.

3.4 Schedules

.1 The following Schedules form part of this specification section.

.1 Schedule A: Piping Marker Colours and Hazard Labels

Schedule A – Piping Marker Colours and Hazard Labels

Fluid Service Category	Piping Services	Background Colour	Lettering Colour	GHS Hazard Symbol
Combustible Liquids	Diesel	Brown	White	None
Compressed Air	Compressed Air	Blue	White	None
Other Gases	Plumbing Vents	Grey	White	None

END OF SECTION

CLOSEOUT REQUIREMENTS FOR MECHANICAL WORK
20 77 19.20

1 GENERAL

1.1 Scope

.1 Provide documentation deliverables at completion of the Work for the following milestone events:

.1 Occupancy permit (where applicable) (Form OP1M),

.2 Substantial Performance of the Work (Form SP1M),

.3 Ready for take-over by Owner (Form RFT1M),

.4 Total Performance of the Work (Form TP1M).

1.2 Definitions

.1 The following definitions apply to this section.

.1 ***Occupancy permit*** – means either: (i) a permit issued by a regulatory authority to allow the Owner to occupy the building subject to the building permit, or (ii) a building permit close-out procedure where documentation must be submitted to the building authority for that purpose.

1.3 General

.1 The prerequisites and submittal of supporting documentation for the aforementioned milestone events may be combined as a single submission at one point in time for the following combination of events:

.1 Occupancy Permit, and Substantial Performance.

.2 Where a prerequisite is listed in more than one milestone event, it shall be included in the earliest-occurring milestone event unless expressly specified otherwise.

1.4 Occupancy Permit

.1 Submit the reviewed final record of the Testing of Integrated Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit, where such a report is required.

.2 Complete the Occupancy Permit Checklist and submit with required documentation to support the Owner's application for occupancy.

1.5 Substantial Performance

.1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.

.2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.

.3 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.6 Ready-for-Takeover by Owner

.1 The basic prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions and Supplementary General Conditions of the Contract.

.2 Complete the Ready-for-Takeover Checklist and submit with required documentation when applying for Ready-For Takeover of the Work.

1.7 Total Performance

.1 Complete the Total Performance Checklist and submit with required documentation when applying for Total Performance of the Work.

Form OP1M: OCCUPANCY PERMIT CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

☐ Building department inspection reports.
☐ AHJ pressure piping inspection reports (if applicable).
☐ AHJ fuel system inspection reports (if applicable).
☐ AHJ electrical systems inspection reports.

☐
☐

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

Form SP1M: SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Occupancy permit has been issued by the AHJ (where applicable).
- ☐ Systems have been started-up, tested, and demonstrated to Owner or Consultant.
- ☐ First submission TAB reports have been submitted to Consultant.
- ☐ Controls / BMS operation report submitted to Consultant (if specified).
- ☐ Equipment, pipeline, and valve identification completed
- ☐ Spare parts and replacement parts turned over to Owner, transmittal attached.

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

Form RFT1M: READY-FOR-TAKEOVER APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Substantial Performance has been certified or verified.
- ☐ Occupancy permit has been issued by the AHJ (where applicable).
- ☐ Final cleaning and waste removal completed.
- ☐ Delivery to Owner of Operating and Maintenance documents for systems being taken-over by Owner.
- ☐ Submit copies of up-to-date as-built drawings.
- ☐ Final start-up, testing and balancing reports completed and submitted to Owner, including any items requiring corrections identified by Consultant.
- ☐ The portions of the building being turned over to the Owner can be secured by Owner.
- ☐ Demonstration and training are completed, or Contractor and Owner has agreed to a schedule to provide such training to be completed within one month after the date of Ready-for-Takeover.
- ☐ All commissioning activities except for those activities that are identified or otherwise agreed by the Owner to be deferred commission activities which may be completed after Ready-for-Takeover of the Work.
- ☐ Integrated systems testing of fire protection and life safety systems.
- ☐ All warranties have been submitted to the Owner.
- ☐ A comprehensive list of items to be completed or corrected is provided to Owner and Consultant and included in the application for Ready-for-Takeover, and includes a schedule of when such work will be completed.

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

Form TP1M: TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ All final Operating and Maintenance documents have been delivered to Owner.
- ☐ All final up-to-date as-built drawings have been delivered to Owner.
- ☐ Any follow-up testing and balancing reports have been submitted to Owner.
- ☐ All demonstration and training are completed.
- ☐ All commissioning activities are completed, including deferred alternate season commissioning activities.
- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ All inspections and tests required to be performed by Contractor or manufacturer's prior to expiry of the warranty period have been completed, and documentation for those inspections and tests are included in this application.

Consultant Review		
Status:	□ Reviewed	□ Incomplete or deficient - resubmit
Signed:		
Date:		

End of Section

INSULATED SECTIONAL CHIMNEYS
23 51 33

1 GENERAL

1.1 Scope

.1 Provide chimneys and chimney connectors as shown for;

.1 oil appliances.

1.2 Definitions

.1 In this section the following definitions apply:

.1 ***Chimney***: a vertical conduit conveying flue gases to the outside atmosphere,

.2 ***Chimney connector***: has the meaning as defined in CSA *B139*

.3 ***Low heat appliances****:* appliances with a flue gas outlet temperature of 540°C (1000°F) or less.

.4 ***Vent***: (as it applies to a vent flue) has the meaning as defined in CSA B139 and CSA B149.1

.5 ***Vent connector***: (as it applies to a vent flue) has the meaning as defined in CSA B139 and CSA B149.1

1.3 Applicable Codes and Standards

.1 Installation standards and codes:

.1	CSA B139	Installation Code for Oil Burning Code, as amended by adopting legislation.
.2	CSA B149.1	Natural Gas and Propane Installation Code, as amended by adopting legislation.

.2 Product standards:

.1	CAN/ULC-S604	Standard for Factory-Built Type A Chimneys
.2	CAN/ULC-S609	Standard for Low Temperature Vents Type L
.3	CAN/ULC-S629	Standard for 650°C Factory-Built Chimneys
.4	ULC/ORD-C378	Guide for the Investigation of Draft Equipment
.5	ULC/ORD-C959	540°C and 760°C Industrial Chimneys
.6	UL 2561	1400 Degree Fahrenheit Factory-Built Chimneys

1.4 Design Criteria

.1 Chimney systems to be self-supporting without guy wires unless otherwise shown.

.2 Design external chimneys to withstand wind loading in accordance with the applicable building code at the place of the Work.

.3 Chimney systems to be seismically designed to restrain equipment when subjected to the seismic forces as determined in accordance with specification section 26 05 48.

1.5 Seismic Qualification

.1 Seismically qualify (certify) the following equipment specified herein:

.1 Insulated sectional chimneys and chimney connectors.

.2 The seismic qualification of the above-listed equipment is to conform to Specification section 26 05 49.23 for the following seismic qualification level and certification method:

.1 Attachment seismic qualification (Level I) and Structural seismic qualification (Level II): by static analysis, dynamic analysis or shake table testing,

.3 The following equipment specific seismic force parameters are to be used:

C_p	A_r	R_p	h_x/h_n
1.00	2.50	2.50	1.0

1.6 Manufacturer Design Services

.1 Manufacturer to provide engineering services for design of chimney and chimney connectors based on appliance layout and general routing of chimney and chimney connectors as shown. Include:

.1 layout and sizing drawings,

.2 bill of materials,

.3 thermal analysis including theoretical draft and available draft,

.4 wind loading restraint, seismic restraint, and structural support details.

1.7 Submittals

.1 Submit shop drawing data sheets for manufactured products and standard fittings showing dimensions and describing construction.

.2 Submit engineering shop drawings including layout and installation details.

.3 Submit certification test certificate for seismic qualification in accordance with Specification section 26 05 49.23

2 PRODUCTS

2.1 General Requirements

.1 Chimneys and chimney connectors to be manufacturer's catalogued products.

.2 Chimney and chimney connector systems to include sectional pipe lengths, fittings and couplings, clean-outs, drain fittings, roof flashings, storm collars, Belmont top, roof and wall supports, roof and wall ventilated thimbles, guy sections, firestop spacers, and all other required mounting and installation accessories.

2.2 Industrial Chimneys

.1 Application:

.1 diesel stationary engine-driven equipment,

.2 General:

.1 listed to ULC/ORD-C959,

.2 listed to UL 2561 for positive pressure of 14.9 kPa (60 in.w.c.),

.3 flue gas temperature: 482°C (899°F) continuous,

.4 vent pressure: positive pressure,

.5 fuels: diesel fuel

.6 size: Ø600 mm (24in. dia.) liner ID.,

.7 clearance to combustibles: 50 mm to 100 mm (2 in - 4 in) maximum depending on chimney size.

.3 Construction:

.1 double wall construction for chimney and chimney connectors;

(a) flue liner: T304 stainless steel,

(b) outer casing: T304 stainless steel,

(c) annular space insulation: mineral wool or ceramic fibre.

(d) annular minimum insulation thickness: 100 mm (4 in.) as specified under Part 3 of this specification section.

.2 joints: veebands and sealant for liner flanges and draw band for shell flanges, or proprietary band joints, as per listing requirements.

.3 joint sealant: manufacturer's product suitable for the flue gas temperature specified herein,

.4 Special fittings:

.1 expansion joints:

(a) low-spring rate expansion bellows,

(b) with internal flow liner,

(c) with outer shell cover,

(d) suitable for installation in the vertical or horizontal position.

.2 overpressure relief valves:

(a) spring-loaded and guided overpressure relief disc,

(b) bolting flange, with gaskets, bolts, nuts and washers to fastening to matching flange on chimney pipe.

Standard of Acceptance

- Selkirk – fig. IPSC1, IPSC2, IPSC4
- Van-Packer – fig. DWPlus
- ICC - fig. VIP+Pressure Vent
- Schebler – fig. P1, P2, P4

3 EXECUTION

3.1 General

.1 Chimneys and chimney connectors serving liquid fuel appliances to be installed by tradesmen certified for installation of fuel fired appliances.

.2 Select chimney type base on flue gas temperature and required chimney size in accordance with the following table:

Type of Appliances	Maximum Flue Gas Temperature Limit	Appliance Flue Outlet Size	Chimney Type	Annular Insulation Thickness
Stationary Engines	≤750°C (1400°F)	600 mm (24 in.)	Industrial Chimney	100 mm (4 in.)

3.2 Installation – General Requirements

.1 Install chimney system in accordance with chimney manufacturer and appliance manufacturer installation requirements.

.2 Maintain clearance between chimney connectors and combustible materials or building insulation in accordance with product installation instructions.

.3 Position chimneys inside of enclosures to maintain minimum clearances to:

.1 combustible material in accordance with chimney listing requirements, and

.2 non-combustible materials as follows:

(a) 100 mm (4 in) for chimney OD size larger than 450 mm (18 in).

.4 Support chimneys at roof penetrations and provide roof flashing and counter-flashing.

.5 Provide anchors, guides and expansion joints as required to maintain chimney system true-in-line both during operation and not in operation, and to control forces imposed on associated appliances and the building structure.

.6 Erect chimneys true and plumb to within 1 in 1200.

.7 For multiple appliances, manifold the chimney connectors in accordance with manufacturer installation requirements.

.8 Where an offset is required, make offset with 45° elbow fittings whenever possible.

.9 Provide clean-outs at base of chimney and provide access to clean-outs.

.10 Seal double wall pressure stacks and breechings:

.1 seal inner joints bead of high temperature sealant,

.2 fill channel of vee band with high temperature sealant and install and tension vee-band,

.3 install insulation filler strips in air space between inner and outer walls, and secure outer shell with draw band,

.4 caulk upper edge of drawbands exposed to the weather with silicone sealant.

.11 Make connector connection to equipment, flue gas outlet with slip type joints and mechanically fasten with a minimum of three (3) screw fasteners.

.12 Where chimney passes through combustible floor or wall construction, provide fire-stop fitting.

.13 Where breeching system is designed to absorb thermal expansion make connection with flange adaptor.

3.3 Guy Wires

.1 Where guy wires are permitted to be used as shown;

.1 provide aircraft grade stainless steel wire, turnbuckles and roof anchor points of sufficient structural capacity to withstand wind loadings and seismic movement.

.2 Install guy wire anchor points and secure to building structure;

.1 for concrete roofs, fasten guy wire anchors with bolt anchors directly bolted to the concrete roofs, fastened below the roofing insulation and membrane,

.2 for steel-deck roofs, provide anchors with load plates sitting on top of the steel deck, with threaded rod passing through the deck and secured to supplementary steel on the underside of the roof deck. Include for supplementary steel, including connection to main roof structural steel, and all required fasteners.

(a) welding of guy wire anchors to supplementary steel, or supplementary steel to building structural steel, may be used where approved by the structural engineer.

3.4 Overpressure Relief Fitting Installation

.1 Provide overpressure relief fittings on chimney systems serving engines;

.1 install relief fitting as close as possible to the outlet of the appliance or the outlet of any flue-gas sound attenuating equipment,

.2 the relief valve may be installed within the service room containing the engine, or be located outdoors,

(a) where located inside of the service room, position the relief valve so that it may be readily visible to allow inspection of the discharge opening.

END OF SECTION

HHAngus

Electrical Specification

FOR

EMERGENCY POWER SYSTEM CAPACITY & INFRASTRUCTURE REMEDIATION

Kingston Health Sciences Centre
Kingston General Hospital
76 Stuart St.
Kingston, ON
K7L 2V7

100% IFT
07/15/2026

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LIST OF SECTIONS – ELECTRICAL, COMMUNICATIONS, AND SECURITY
26 00 01

DIVISION 26 – ELECTRICAL

26 00 01	List of Sections – Electrical; Communications; and Security
26 01 01	Electrical General Requirements
26 01 02	Qualifications and Authorities - Ontario
26 05 01	Electrical Basic Materials and Methods
26 05 02	Painting for Electrical Services
26 05 07	Excavation and Backfill
26 05 19	Low-Voltage Electrical Power Conductors
26 05 26.16	Secondary Grounding and Bonding for Electrical Systems
26 05 29	Hangers and Supports for Electrical Systems
26 05 32	Splitters; Junction and Pull Boxes; Cabinets
26 05 33	Conduits; Fastenings and Fittings
26 05 35	Outlet Boxes; Conduit Boxes and Fittings
26 05 36	Cable Tray for Electrical Systems
26 05 48	Vibration Isolation for Electrical Systems
26 05 49.20	Seismic Restraint for Electrical Services
26 05 49.23	Seismic Qualification for Electrical Equipment
26 05 53	Identification for Electrical Systems
26 05 73.15	Independent Power System Testing
26 07 03	Wiring for Mechanical Services
26 08 06	Electrical System Studies and Reports
26 08 11	Testing of Integrated Fire Protection and Life Safety Systems
26 08 15	Electrical Commissioning
26 22 13	Low-Voltage Distribution Transformers
26 23 00	Low-Voltage Switchgear
26 27 28	Wire and Box Connectors 0-1000 V
26 28 16.16	Disconnect Switches up to 1000 V
26 28 16.19	Low- Voltage Power Circuit Breakers
26 32 13	Power Generation Diesel
26 32 13.33	Emergency Power Control System
26 50 00	Lighting
26 77 19.20	Closeout Requirements for Electrical Work

DIVISION 27 – COMMUNICATIONS

Not Used

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

28 46 11	Fire Alarm Initiating and Input Devices

28 46 21.11	Addressable Fire Alarm System
28 46 23	Fire Alarm Notification and Output Devices

PROJECT MANUAL

Table of Contents – Project Manual Reference 1 (Commercial)

ME 02: 2 MW Diesel Generator – Letter of Award (LOA) and Agreements

- Generator LOA
- Proposal

Table of Contents – Project Manual Reference 2 (Technical)

ME 02: 2 MW Diesel Generator – Technical

- Request for Proposal: RFP 10434805-ME-02
- Request for Proposal Addenda 1–3: RFP 10434805-ME-02
- Shop Drawings

END OF SECTION

ELECTRICAL GENERAL REQUIREMENTS
26 01 01

1 GENERAL

1.1 General Contract Documents

.1 Comply with General Conditions of the Contract, Supplementary Conditions of the Contract and Division 01 - General Requirements.

.2 Where content in this Specification section duplicates requirements in various Division 01 Specification sections, this section and the applicable Division 01 sections are to be read together and the most stringent requirements apply.

1.2 Work Included

.1 Work to be done under Divisions 26, 27 and 28 to include furnishing of labour, materials, equipment and services required for installation, testing and putting into proper operation complete electrical systems as shown, as specified, as intended, and as otherwise required. Complete systems to be left ready for continuous and efficient satisfactory operation.

.2 Read drawings and specifications together as a whole and in conjunction with other such documents included under the Construction Contract.

1.3 Document Organization

.1 Applicable Divisions for Electrical Work:

.1 Division 26 - Electrical

.2 Division 27 - Communications

.3 Division 28 - Electronic Safety and Security

.2 For clarity, any reference in the Contract Documents to Division 26 includes Division 27 and 28.

.3 The Specifications for these Divisions are arranged in Sections for convenience. It is not intended to recognize, set or define limits to any subcontract or to restrict Contractor in letting subcontracts.

.4 Contractor is responsible for completion of the Work whether or not portions are sublet.

1.4 Division 26, as it Applies to Division 27 and 28

.1 Division 26 contains common work requirements that are applicable as necessary to the Work of Divisions 27 and 28 and apply as if written in full within those Divisions.

1.5 Language

.1 Specifications are written as a series of instructions addressed to the Contractor, and by implication to subcontractors and to suppliers. For clarity and brevity, use is made of numbered lists and bulleted lists. Where the list follows a semi-colon (;) punctuation is for clarity, where the list follows a colon (:) punctuation is to be read as short-hand form of verb “to be” or “to have” as context requires.

.2 It is not intended to debate with the Contractor reasons for these instructions, and words associated with justification for an instruction or restatement of anticipated performance have been omitted to avoid possible ambiguities.

1.6 Definitions and Abbreviations

.1 Other specification sections of Divisions 26 to 28 of the Work may also include additional specific definitions and/or abbreviations that apply to that specification section.

.2 The following terms apply to Divisions 26 to 28 of the Work:

.1 The words "indicated", "shown", "noted", "listed" or similar words or phrases used in these Specifications, mean that the material or item referred to is "indicated", "shown", "listed" or "noted" on the Drawings or in the Specifications.

.2 Wherever the word “listed” is used in conjunction with a product and a product certification standard (including but not limited to CSA, ULC, CGSB, BNQ, UL), it shall be understood to mean that the product is “listed” by an accredited 3rd party testing laboratory as being certified to the referenced product standard.

.3 Wherever the words “approved”, or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides to mean that material or item referred to shall be “approved by” the Owner.

.4 Wherever the words “satisfactory”, “as directed”, “submit”, “permitted”, “reviewed”, or similar words or phrases are used in the Specification they shall be understood, unless the context otherwise provides to mean that material or item referred to shall be “satisfactory to”, “as directed by”, “submitted to”, “permitted by”, or “reviewed by” the Consultant.

.5 Instructions using any form of the word:

(a) “install” means to place in position for service or use.

(b) “supply” means to procure and deliver materials, or to make available labour or services for the stated purpose.

(c) "provide" means to supply material, labour and services to install the referenced item.

.6 The term “building code” means the edition of the applicable building code at the location of the Work at the time of obtaining a building permit.

.7 The terms “electrical code” and “electrical safety code” mean the edition of the applicable electrical safety code adopted by regulation at the location of the Work at the time of obtaining an electrical works permit.

.8 The term “AHJ” and “local authority” means the “Authority Having Jurisdiction” and can include the local building inspector, the local fire department and the electrical safety inspector or their agents.

.9 Wherever manufacturers or manufacturer’s products are identified in lists under the phrase "Standard of Acceptance", these are manufacturers and/or products which meet the project standards in regard to performance, quality of material and workmanship.

.3 The following abbreviations apply to this specification section:

.1 NECA – National Electrical Contractors Association

1.7 Examination

.1 Examine any existing buildings and services, local conditions, building site, Specifications, and Drawings and report any condition, defect or interference that would prevent execution of the Work.

.2 No allowance will be made for any expense incurred through failure to make these examinations of the site and documents prior to Tender or on account of any conditions on site or any growth or item existing there which was visible or known to exist at time of Tender.

.3 Before commencing work under this Division, examine the work of other Divisions of the Work and report any defect or interference.

1.8 Design Services

.1 Provide specialty design services for elements of the Work where specified in other sections of Division 26. Drawing and specifications prepared by such specialty design service providers shall be sealed by a professional engineer licensed in the jurisdiction of the Work.

1.9 Product Substitutions

.1 In the absence of requirements concerning product substation requests in Division 01, Contractor may propose a substitute product to that which is specified in accordance with the following.

.2 All proposed substitutions shall be submitted using the Consultant's product substitution form and include all information stated therein.

.3 The use of a substitute article or material which the Contractor represents to be of at least equal quality and of the required characteristics for the purpose intended may be permitted, subject to the following provisions:

.1 a substitution will not be considered for reasons of meeting the construction schedule unless the Contractor can demonstrate to the satisfaction of the Consultant that all reasonable efforts have been made to procure the specified product or material in a timely fashion,

.2 the manufacturer to advise the Consultant of the intention to use an alternative article or material before doing so,

.3 the burden of proof as to the quality and suitability of alternatives to be upon the manufacturer, the manufacturer to supply all information necessary, as required by the Consultant, at no additional costs to the contract,

.4 the Consultant to be the sole judge as to the quality and suitability of alternative materials and the Consultant's decision to be final,

.5 where use of an alternative material involves redesign or changes to other parts of the Work, the costs and the time required to affect such redesign or changes will be considered in evaluating the suitability of the alternative materials,

.6 no test or action relating to the approval of substitute materials is to be made until the request for substitution has been made in writing by the manufacturer and has been accompanied by complete data as to the quality of the materials proposed, such request to be made in ample time to permit appropriate review without delaying the Work, taking into consideration that such a substitution request may be rejected requiring that the product or material as originally specified be provided,

.7 whenever classification, listing, or other certification by a recognized standards body is a part of the specifications for any material, proposals for use of substitute materials is to be accompanied by reports from the equivalent body indicating compliance with the requirements of the specifications,

.8 the costs of testing required to prove equality of the material proposed to be borne by the manufacturer.

2 SHIPPING, HANDLING AND STORAGE

2.1 Shipping

.1 Provide adequate protection of equipment during shipping and handling to provide equipment at the site in ex-works condition when handled by commercial carrier systems.

.2 Each drawout element such as high voltage circuit breakers, power circuit breakers, transfer switch modules, etc. to be packaged separately from its associated enclosure.

.3 Provide as necessary, removable bracing of the internal components in each item of equipment so that the equipment can be moved on its side or back, without sustaining damage.

.4 Where removeable internal bracing has been provided, the equipment to be provided with warning labels to call for the removal of the shipping bracing prior to energization.

.5 Any component packaged or shipped separately to be individually crated and tagged with unit number and the equipment number of the assembly to which it belongs.

.6 Provide each "shipping section" with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

2.2 Storage

.1 Store equipment and materials at the worksite to protect them from any damage until placed into its final location. Maintain similar protection of installed equipment and materials to protect against damage until they are turned over to the Owner. Make good any damage to equipment or materials up to the time of ready for takeover.

.2 Store electrical materials and equipment such as switchboards, panels, transformers, bus ducts, fire alarm devices, luminaires, etc., in a dry, clean location and cover with polyethylene plastic to preserve factory finish.

.3 Protect exposed or free standing equipment with plastic to minimize entry of dust and dirt and marring of finished surfaces during progress of work.

.4 Schedule luminaires, lamps, diffusers and fire detectors for installation as late as possible during construction in order to minimize accumulation of dust and/or dirt on them. Clean luminaires and diffusers, not acceptable because of dust and dirt, in an approved manner in accordance with the manufacturer’s instructions. Wrap surface mounted and suspended luminaires and fire detectors, installed prior to painting or dusty construction being completed in the area, in plastic to prevent dirt or paint from settling on them.

.5 Wrap bus ducts in heavy gauge plastic to adequately prevent moisture and dirt from entering bus duct. Wrapping to remain until bus ducts are ready to be energized.

.6 Provide adequate ventilation and temporary heating to prevent condensation of moisture within the enclosed equipment.

2.3 Provisions for Handling and Field Erection

.1 For equipment that will require hoisting on site, provide removable side panels, lifting angles or lifting plates to accommodate the use of slings or crane hooks, for each shipping section.

.2 For floor mounted equipment, provide on each shipping section, removable steel channel base plates to permit use of pipe rollers or dollies without damaging the equipment.

3 OWNER’S SPECIAL REQUIREMENTS FOR EXISTING SITES

.1 The following special requirements are in addition to the requirements of Division 01 of the Work.

.2 Provide a written list of names of employees and sub-trades employees entering the building, advising which areas they need access to at least 48 hours prior to expected time of arrival. This lead time is required to prearrange security passes.

.3 Security passes to be visibly worn at all times by all employees.

.4 Trades people to strictly adhere to Owner’s building security procedures otherwise entrance into the building will be denied.

.5 Trades people are to enter via the entrance identified by the Owner.

.6 Park vehicles in designated areas. Do not block driveways.

.7 Use only the freight elevator to transport tools and material. Freight elevator door to be shut immediately after exiting the cab.

.8 Do not disable or activate any electrical or mechanical system without prior approval by the Owner's Project Manager. Also, prior to disabling or activation of any electrical or mechanical system, obtain approval from Building Operations and Building Security.

.9 Submit prior notification to Building Security Staff before any construction activity commences which will result in heat, smoke, dust or fumes, such as welding, saw cutting, soldering, spray painting, which might affect sensitive fire detection and protection equipment.

.10 Submit notifications sufficiently in advance such that the Owner will have at least 48 hours to make the necessary arrangements should Building Operations deem that work on a particular system requires a security escort. A security escort will be required for any work being done in secured areas, e.g. raised floor, computer room and mechanical/electrical rooms.

.11 Provide at least 72 hours prior notification to Building Operations for any fire system isolation requests.

.12 Schedule work and meet with sub-trades daily on site, to show trades people the work areas and work to be done.

.13 Trades-people are to supply and use their own tools. No tools, ladders or equipment, etc. will be loaned by the Owner.

.14 Provide environmental cleaning of the job site daily during construction and upon completion. This includes both under raised floor and above ceiling. Do not store materials or garbage on the loading dock.

.15 Provide special care, attention and protection when transporting equipment and materials to prevent accidental damage to fire protection equipment, finishes, furnishings and fixtures.

.16 “No Smoking” – this is a smoke-free building. Violators will be asked to leave and may be denied reentry. Smoking is not allowed on the roof or on property exterior.

If Building Operations deems that work on a particular system requires security escort, allow 48 hours to make appropriate arrangements.

.17 For any open flame work, a fire extinguisher and security fire watch is required, and will be provided and paid for by the Owner. Provide 72 hours prior notice to allow the Owner to make the necessary arrangements.

.18 Obtain the approval of the Building Manager for the storage of materials on site.

.19 Perform a daily cleanup prior to leaving the site.

.20 Secure oxygen and acetylene cylinders at all times and capped nightly.

.21 Restore operating and redundant systems to their normal condition at the end of each work day.

.22 At the conclusion of each work day, the Contractor's superintendent/supervisor is to advise the Building Manager on the day's activities and plans for the next day's work.

4 PROGRESS PAYMENT PROCEDURE

4.1 Schedule of Values

.1 Provide schedule(s) of values for progress payments in accordance with this part.

.2 Prepare and submit a schedule of values (“SOV”) for the Division 26 Work.

.3 Each SOV is to be in the sample format shown in Article “Attachments”, specifically that the SOV is to include four sections for:

.1 Contract price work element breakdown, which includes:

(a) detailed breakdown by work element as agreed with the Consultant,

(b) line items for coordination drawings, as-built documents and operating manuals,

(c) a summary line item for authorized Cash Allowance disbursements (if applicable),

(d) line items for each Itemized Price (if applicable),

(e) line items for each Separate Price (if applicable and included in the Contract Price)

(f) a line item for the total of the original contract work element values,

(g) a summary line item for approved change instructions,

.2 Cash Allowance disbursement authorization, with separate work elements for each cash allowance,

.3 Approved Change Instructions, with separate work elements for each change instruction,

.4 Outstanding Change Instructions which are either not quoted or not yet approved.

.4 Each work element in the SOV sections (except Outstanding Change Instructions) is to include:

.1 the original contract value and the percent of original contract total value (Contract Price section only),

.2 the completed to date amount and percent of original work element contract value,

.3 the previously billed amount and percent of original work element contract value,

.4 the current billing (payment request) amount and percent of original work element contract value, and

.5 the balance to complete amount and percentage of original work element contract value.

.5 The required Contract Price work element breakdown will be determined by the Consultant, with the level of breakdown appropriate to the project such as

.1 by trade,

.2 by specification section or portion thereof,

.3 by labour vs material,

.4 by location in the building,

.5 or any combination of the above.

.6 Submit a draft SOV for review and approval by the Consultant at least three weeks before the first request for progress payment. Do not submit requests for progress payments until the SOV has been reviewed and there are no outstanding comments from the Consultant.

.7 Make requests for progress payments using the values on the reviewed SOV.

.8 When a change in the Work has been approved by the Owner, include the approved changes on the SOV for the next payment application, whether or not payment is requested in full or in part for that change in that payment request period.

.9 For each SOV, include a line item “As-Builts & Operating Manuals” and includes a value that is the greater of:

.1 the value of the work or,

.2 1% of the Division 26 contract price.

Payment of the indicated amount will not be made until satisfactory documents have been received by the Consultant. Where satisfactory documents are not received, a Change Directive and an associated Change Order will be issued to delete this work element and the amount from the Contract Price.]

5 CONSTRUCTION CHANGES

5.1 General

.1 The valuation method to be used for a change instruction to the Work is to be determined by the Consultant from the following methods:

.1 by labour and material when the change instruction is by a Change Directive;

.2 by unit prices set out in the Contract or subsequently agreed upon for other change instructions;

.3 by a detailed quotation for other change instructions; or

.4 by a Cash Allowance Disbursement instruction.

5.2 Definitions

.1 The following definitions apply to this section

.1 ***RS Means manual*** – the trade pricing reference book published by Cordian Group Inc. that is applicable to the jurisdiction of the project.

.1 ***Base wage rate*** – the hourly rate actually paid to the trades person, determined in accordance with applicable collective bargaining agreement, or in their absence the actual gross wages paid to the worker.

.2 ***Job Site Impact Multiplier*** – a multiplier expressed as a decimal number that is included in the Labour Rate to account for special job site conditions that affect labour availability, labour productivity, procurement of materials, and materials management, that are specific to the project and site conditions.

.3 ***Indirect labour –*** any labour that is neither journeyperson labour that directly performs the work nor labour that directly supervises journeyperson(s).

.4 ***Labour Rate*** – the actual fully burdened labour cost per hour of labour consumed by a trades person including statutory and regulatory burden, collective bargaining burden, and other project related burden. For greater clarity, the labour rate includes but is not limited to the following:

(a) base wage rate,

(b) vacation and statutory holiday pay,

(c) union deductions and additional union charges,

(d) Legislated burdens including EHT, WSIB, EI, CPP, RST on H/W

(e) wage-based taxes,

(f) job site impact multipliers,

(g) expendable small tools charge,

(h) project insurance,

(i) financing of payroll,

(j) estimating,

(k) rest breaks and idle time,

(l) safety including training, safety meetings, WHMIS, fall protection, personnel protection equipment, and safety committees,

(m) preparation and handling of shop drawings and other submittals,

(n) preparation of as-built documents, including operation and maintenance manuals,

(o) labour warranties,

(p) site facilities,

(q) clean-up,

(r) parking.

.5 ***Foreperson*** – a first level supervisory position having direct control over the work performed by journeypersons.

.6 ***Journeyperson*** – *a person working in a skilled construction trade which may be prescribed by regulation, and includes apprentices.*

.7 ***Labour Unit*** – the number of journeyperson labour hours or part thereof, required to perform a specific construction task, and includes but is not limited to:

(a) receiving, unloading, stockpiling, distribution and handling of materials and equipment,

(b) rigging or erecting of materials or equipment,

(c) fitting and joining of materials,

(d) pressure testing of piping and ductwork systems,

(e) testing of equipment and systems,

(f) electrical labour productivity factors in accordance with NECA.

.8 ***Line materials*** – components that make up a distribution network for fluid, power, or electronic/digital information, and includes:

(a) piping, pipe fittings, valves (of all kinds), pipe strainers and other pipe mounted equipment,

(b) ducting, duct fittings, duct balancing dampers and other duct mounted equipment,

(c) conduit, cable tray, cable, conductors, and wiring,

(d) supports, hangers and restraints,

(e) vibration isolators and seismic restraints associated with line materials,

(f) instrumentation including gauges and sensors/transmitters,

(g) electrical, pneumatic, and hydraulic actuators for valves and dampers, and

(h) any coatings or other protective elements applied thereto including insulation and painting.

.9 ***NECA manual*** – the trade pricing reference book published by the National Electrical Contractors Association.

.1 ***Overhead*** – administrative expenses of the Contractor's business and the project which are not included in a Labour Rate or Labour Unit. For greater clarity, overhead includes but is not limited to the following:

(a) company office, storage, and fabrication spaces, and associated maintenance, utilities, and expenses,

(b) project site office, fabrication and storage spaces, washrooms, break rooms, and associated maintenance, utilities, and expenses,

(c) company office equipment, furniture and supplies,

(d) project site office equipment, furniture and supplies,

(e) labour time for project managers and project assistants,

(f) project site security,

(g) project site clean-up, recycling and waste disposal,

(h) materials management,

(i) property taxes, business licenses, and auto insurance,

(j) dues and subscriptions,

(k) postage and courier,

(l) advertising, telephone, IT services and equipment,

(m) legal and accounting fees and expenses,

(n) sales and marketing,

(o) salaries and benefits for company indirect labour including company management, sales force, dispatchers, estimators, clerical staff, and at-office general (non-trades) labour.

(p) all other indirect labour.

.2 ***Senior Foreperson*** – the second (and subsequent) level supervisory position having direct control over one or more Forepersons, where the number of Forepersons supervised is in accordance with local regulatory requirements or collective bargaining agreements. ("Superintendent" or "Supervisor" has the same meaning.

5.3 Change Directive Method

.1 Except where otherwise determined in the Construction Contract or Division 01 specification, the valuation of changes by the Change Directive method shall comply with the following:

.1 the form of presentation of costs and methods of measurement shall be agreed to by Consultant and Contractor before proceeding with the change,

.2 the adjustment in the Contract Price for a change carried out by way of Change Directive shall be determined on the basis of the cost of the Contractor's actual expenditures and savings attributed to the Change Directive. For clarity and by example, savings for deductions of similar materials, equipment, labour or services shall be valued at the same amount as for expenditures for additions of same.

.3 labour costs will be determined based on actual time spent and the agreed labour rate, the actual cost of installed line materials and equipment, and the agreed fee for overhead and profit,

.4 if the change results in a net decrease in Contract cost, the contract price will be decreased by the net decrease in the cost, without adjustment for the Contractor's percentage fee for overhead and profit,

.5 the Contractor shall keep accurate records, in an agreed upon form, of time, quantities and invoiced costs and present an account of the cost of the change in the Work, together with vouchers, material receipts and invoices,

.6 this time and material method shall be used until such time as a total cost estimate of the change is agreed between the Owner and the Contractor, at which time all payments made under this time and material method will be credited against the agreed total cost for the change.

5.4 Unit Price Method

.1 Costing of changes by the Unit Price method:

.1 Costs for work identified by agreed unit costs shall be charged at those rates, unless the Owner agrees to other rates.

5.5 Proposed Changes; Other Change Instructions Method

.1 For proposed changes to the Work or other similar instructions, submit a detailed quotation for approval.

.2 The adjustment in the Contract Price for a change carried out by way of proposed change or other similar instruction shall be determined on the basis of the cost of the Contractor's actual expenditures and savings attributed to the Proposed Change. For clarity and by example, savings for deductions of similar materials, equipment, labour or services shall be valued at the same amount as for expenditures for additions of same.

.3 Costs are to be approved by the Owner before the proposed change to the Work proceeds. The quotation for the change to the Work is to include a summary of charges made up of three components: labour charges, material costs and fees.

.4 Labour Charges:

.1 The labour unit hour estimates are to be based on the current RS Means estimating manual or NECA manual unless otherwise agreed by the Consultant;

.2 The labour cost is to be determined using the agreed labour rates.

.3 Labour rates for Foreperson and Senior Foreperson shall be as per agreement, or in absence of such agreement shall be 1.15 times the journeyperson labour rate. The maximum allowable labour hours for supervision are not to exceed:

(a) for a Foreperson, a maximum of 10% of the total calculated journeyperson hours on a change, and

(b) for a Senior Foreperson of all levels, a maximum combined amount of 3% of the total calculated journeyperson hours on a change.

(c) no other supervisory hours will be permitted.

.5 Material Charges:

.1 Material costs for line materials and installed equipment are to be net of trade discounts. The discount to be applied to list prices for items included in RS Means manual or NECA manual shall not be less than:

(a) 20% for line materials, and

(b) 10% for equipment that is not line material.

.6 Fees:

.1 Refer to Division 01 regarding fees for overhead and profit on changes to the Work

5.6 Cash Allowances; Contingency Allowances

.1 Instructions for changes to the Work to be performed under a cash allowance or contingency allowance ("Allowance") included in the contract price shall be authorized by a Cash Allowance Disbursement instruction.

.2 Except as described below, the determination of costs for Work performed under an Allowance shall be in accordance with the procedure for proposed changes unless otherwise instructed to proceed with the work, in which case the cost of such work shall be valued in accordance with the procedures for Change Directive.

.3 The contract price, not the Allowance, includes the overhead and profit fee for the value of the Allowance.

.4 Except where otherwise specified in the Construction Contract, where the cost of the Work performed under a Cash Allowance Authorization;

.1 is less than the Allowance value, the contract price includes the overhead and profit for the contractor and any sub-contractors. A change order will be issued for a credit for the balance of the Allowance, but shall not include the associated overhead and profit fee.

.2 exceeds the Allowance value, a Change Order will be issued for the amount in excess of the Allowance, and the excess amount is to include the agree fee for overheat and profit.]

6 SUBMITTALS

6.1 Shop Drawings and Product Data

.1 Submit shop drawings, manufacturers and product data and samples in accordance with the requirements of Specification sections of Division 01, this Part, and as further required in other specification Sections of Division 26.

.2 Submit for each item of equipment.

.3 Submit shop drawings in the same unit of measure as used on the drawings. Both metric and U.S. customary measures may be included.

.4 Submit shop drawings by email to: shopdrawings@hhangus.com , except where a project document management web-service is used.

.5 Include an H.H. Angus shop drawing cover sheet form prepared for this project, for each shop drawing submittal (refer to part "Attachment" for an example of this form), or, include the same information on the contractors submittal cover sheet:

.1 Provide the following information on each submission;

(a) Client/Architect name,
(b) Project Name,
(c) H.H. Angus project number,
(d) Date,
(e) Contractor name,
(f) Contractor reference No.,
(g) Manufacturer name,
(h) Product type,
(i) Specification section number,
(j) Contractor trade category: architectural, structural, conveying equipment, user equipment, mechanical, electrical, telecommunications, civil or other.
(k) If a re-submission, the Consultant's previous submittal reference number.

.6 Submit shop drawings in PDF format except as follows;

.1 if the Consultant agrees to a shop drawing to be submitted in hardcopy format, submit in 11 x 17, black and white originals of graphic quality suitable for photocopying and digital scanning. Allow one additional week for processing of shop drawings submitted in hardcopy format.

.7 Manufacturers' printed product data sheets for standard items are acceptable in place of shop drawings provided that physical characteristics are identified and are related to specification references.

.8 Submit manufacturers' data sheets with typed schedules listing manufacturers' and suppliers' name and catalogue model numbers for such items as fire alarm system components, etc.

.9 For luminaires, submit bound sets of luminaire fixture sheets with manufacturers' names and catalogue numbers for all luminaires to be used on the project. Identify and arrange the luminaire fixture sheets and catalogue numbers in the same sequence as the Specification Luminaire List.

.10 Shop drawings and/or product data sheets to show;

.1 CSA or equivalent approval,
.2 dimensioned outlines of equipment and construction details,
.3 equipment weights and center of gravity,
.4 performance ratings,
.5 dimensioned details showing service connection points,
.6 general routing of bus ducts and connecting services,
.7 mounting and fixing arrangements,
.8 operating and maintenance clearances,
.9 access door swing spaces,

.11 Where applicable, include;

.1 wiring, single line and schematic diagrams,
.2 diagrams showing interconnection with work of other Sections,
.3 elevations illustrating locations of visible equipment such as pilot lights, breakers and their trip settings, windows, meters, and access doors,
.4 component assemblies,
.5 trip settings,
.6 description of operation.

.12 Check and stamp each shop drawing as being correct before submission. Shop drawings without such stamps will be rejected and returned.

.13 Keep one copy of each reviewed shop drawing and product data sheet on site and have them available for reference purposes.

.14 Where equipment is delivered without reviewed shop drawings, equipment will be condemned and is to be removed from site and replaced with new equipment after shop drawings have been submitted and reviewed.

6.2 Coordination, Fabrication, or Installation Drawings

.1 Contractor's coordination, fabrication, installation, and/or sleeving drawings will not be reviewed as shop drawings. If submitted as a shop drawing, a transmittal will be returned identifying that the submitted drawings have not been reviewed as a shop drawing.

.2 Maintain a copy on site of such drawings for reference by the Consultant.

.3 The Consultant reserves the right to request selected Contractor's coordination, fabrication, or installation drawings for review.

6.3 Effect of Consultants Review of Submittals

.1 Consultant's review of shop drawings is performed on a sampling basis only, to confirm to Consultant's satisfaction that the Contractor understands the Work to be performed and is interpreting the design documents correctly, and such reviews are performed for the benefit of the Owner.

.2 For greater certainty, the review of shop drawings by Consultant does not constitute a quality control function for the benefit of Contractor, nor does such a review relieve Contractor of their responsibility for complying with the Contract documents.

7 APPLICABLE CODES AND STANDARDS; PERMITS

7.1 Codes, Standards and Regulations

.1 Where a published product standard or installation code is adopted by statute or regulation by an applicable AHJ, the applicable edition of the standard or code is the one that has been adopted

.1 at the time of obtaining a permit for the applicable portion of the Work, or

.2 in the absence of a requirement for a permit, the start date of construction.

.2 Where a published product standard or installation code is not adopted by statute or regulation, then the most current edition of that standard or code at the start date of construction applies.

.3 Install electrical systems in accordance with the electrical safety code adopted by the AHJ responsible for electrical safety at the location of the Work.

.4 Install underground systems in accordance with the latest edition of CSA C22.3 No.7 *Underground Systems* except where specified otherwise.

.5 Comply with CSA Certification Standards and safety bulletins issued by the AHJ for electrical safety applicable to the place of the Work

.6 Where requirements of this specification exceed those of the above mentioned codes, standards, bulletins, this specification is to govern.

.7 In the event of a conflict between codes, bulletins, regulations, or standards, or where work shown is in conflict with these documents, obtain interpretation before proceeding. Failure to clarify any ambiguity will result in an interpretation requiring the application of the most demanding requirements.

7.2 Confined Spaces

.1 Unless otherwise prescribed by the Constructor's/Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces" in accordance with applicable health and safety legislation, including but not limited to;

.1 horizontal and vertical service spaces, shafts, and tunnels,

.2 inside of equipment which permits entry of the head and/or whole body, and

.3 ceiling spaces which are identified as containing a hazardous substance.

7.3 Permits, Fees and Inspections

.1 Where required by legislation at the place of the Work, submit to the AHJ for electrical safety the necessary number of drawings and specifications for examination and approval prior to commencement of work.

.1 for information, the Consultant has submitted or will be submitting the drawing plans to the AHJ for electrical safety for plans review.]

.2 Arrange and pay for permits, tests, and Certificates of Inspection required by the AHJ for electrical safety.

.3 Consultant will provide drawings and specifications required by the AHJ for electrical safety at no cost.

.4 Notify Consultant of changes required by the AHJ for electrical safety prior to making changes.

.5 Furnish to Consultant, Certificates of Acceptance from the AHJ for electrical safety upon completion of the Work.

8 COMMON PRODUCT REQUIREMENTS

8.1 Standard of Material and Equipment

.1 Provide materials and equipment in accordance with This Division.

.2 Materials and equipment:

.1 new and of uniform pattern throughout the Work,

.2 of Canadian manufacture where obtainable,

.3 standard products of approved manufacture,

.4 labelled or listed (certified) to applicable standards in accordance with specification sections of the Work and as required by the AHJ for electrical safety; where there is no alternative to supplying equipment which is not certified, obtain special approval from the AHJ for electrical safety.

.5 in compliance with Standards and Regulations with respect to;

(a) chemical and physical properties of materials,

(b) design,

(c) performance characteristics, and

(d) methods of construction and installation,

.6 identical units of equipment to be of same manufacture within any unit of equipment,

.7 identical component parts to be of same manufacture, but various component parts comprising the unit need not be from one manufacturer.

.3 Materials and equipment are described to establish standards of construction and workmanship. Where manufacturers and/or products are listed under "Standard of Acceptance", select manufacturers and or products from these lists. Use of manufacturers or products other than as listed are subject to specification requirements concerning requests for substitution.

.4 Include items of material and equipment not specifically noted on Drawings or mentioned in Specifications but which are required to make a complete and operating system.

.5 Confirm capacity or ratings of equipment being provided, when based on ratings of equipment being provided under other trade Sections, before such items are purchased.

.6 Provide equipment marked for use with 75°C wiring or with a higher temperature rating. If equipment is not marked with a temperature rating or if the only rating available is less than 75°C, increase the associated conductor sizes accordingly, to the satisfaction of the consultant.

.7 Factory fabricate control panels and component assemblies are to be listed for electrical safety requirements.

.8 Select materials and equipment in accordance with manufacturer's recommendations and these Specifications, and install in accordance with manufacturer's instructions and these Specifications,

.9 Materials and equipment not satisfying these selection criteria will be condemned. Remove condemned materials from job site and provide properly selected and approved materials.

8.2 Voltage Ratings

.1 Operating voltages: to latest edition of CAN3-C235.

.2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

8.3 Manufacturers Nameplates

.1 Provide manufactured equipment with metal nameplate with raised or recessed lettering, mounted on each piece of equipment.

.2 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating, and approval listings.

.3 Certified products are to clearly show the mark of the certification agency when in the final installed state.

8.4 Finishes

.1 Primary and final painting for Work, other than items specified as factory primed or finished, to be done under Finish Division 9.

.2 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.

.3 Touch-up factory painted prime and/or final coats damaged during construction, with colour matching paint recommended by the equipment manufacturer.

.4 Leave a quart can or a pressurized spray can of paint, as used with switchboards, with Owner for touch-up purposes.

.5 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

8.5 Provision for Future

.1 Where space is indicated as reserved for future equipment or for future extension to building, leave such space clear and install piping, raceways and equipment so that connections can be made to future apparatus or building.

.2 Identify provisions and service terminations for future on Record Drawings.

8.6 Pre-purchased Equipment; Damage and Ownership

.1 At time of receipt of pre-purchased or pre-tendered equipment at the job site by the installing electrical contractor, provide the services of the manufacturer/distributor/supplier's technical representative to:

.1 inspect the equipment prior to unloading,

.2 witness the unloading and advise the contractor on the appropriate method for handling the equipment in order to avoid damage during the unloading, moving and setting in place phase of the equipment, and

.3 report any damage to the Consultant.

.2 In the event that the equipment or cable is found to be damaged before unloading it is to be returned immediately to the factory for repairs and/or replacement by the manufacturer/supplier.

.3 In the event of damage occurring at any time during unloading and until the equipment is accepted by the Owner, the installing contractor is responsible for repairs and/or replacement of the damaged equipment to the satisfaction of the Owner.

9 OFFICE, STORAGE & TOOLS

9.1 Office and Storage

.1 [Provide temporary office and lunchroom facilities, workshop, tools and material storage space in accordance with Division 1

9.2 Tools, Temporary Equipment and Materials

.1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, as required to carry out the Work.

10 COORDINATION; INSTALLATION DRAWINGS

10.1 Coordination

.1 Consultant's drawings are diagrammatic and illustrate the general location of equipment, and intended routing of ductbanks, conduits, cable trays, feeders, etc. and do not show every structural detail. In congested areas drawings at greater scale may be provided to improve interpretation of the Work. Where equipment or systems are shown as "double line", they are done so either to improve understanding of the Work, or simply as a result of the use of a CAD drawing tool, and in either case such drawings are not represented as fabrication or installation drawings.

.2 Lay out and coordinate the Work to avoid conflict with work under other Divisions.

.3 Make good damage to Owner's property or to other trade's work caused by inaccurate layout or careless performance of the Work.

.4 Where equipment provided under other Divisions connects with material or equipment supplied under this Division, confirm capacity and ratings of equipment being provided.

.5 Take information involving accurate measurements from dimensioned Architectural Drawings or at the building.

.6 Install services and equipment which are to be concealed, close to the building structure so that furring is kept to minimum dimensions.

.7 Location of conduit, bus duct, raceways and equipment may be altered without extra cost provided instruction is given or approval is obtained, in advance of installation of items involved. Changes will be authorized by site instructions and are to be shown on Record Drawings.

.8 Include incidental material and equipment not specifically noted on Drawings or mentioned in Specifications but which is needed to complete the Work as an operating installation.

10.2 Field, Fabrication, and Installation Drawings

.1 Prepare field, fabrication, and/or installation drawings to show location of equipment and relative position of services and to demonstrate coordination with the work of other trades;

.1 drawing scale: minimum 1:50 (1/4"=1'-0"),

.2 use information from manufacturer's shop drawings for each trade and figured dimensions from latest Architectural and Structural Drawings,

.3 layout equipment and services to provide access for repair and maintenance,

.2 Circulate drawings to other trades involved in each area, and conduct coordination meetings with those trades.

11 ANCHORS AND INSERTS

.1 Supply anchor bolts and locating templates for installation in advance of concrete pouring.

12 CUTTING AND REMEDIAL WORK

12.1 General

.1 Assume responsibility for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing and similar work. Should any cutting or repairing of either unfinished or finished work be required because such installation was not done, employ the particular trade, whose work is involved, to do such cutting and patching and pay for any resulting costs.

.2 Neatly cut or drill holes required in existing building elements to accommodate equipment such as cables, raceways, bus ducts, cable trays, etc.

.3 Arrange and pay for cutting and patching as required for the Work. Before cutting, drilling, or sleeving structural load bearing elements, obtain the Consultant’s approval of location and methods in writing. Employ original installer or expert in the finishing of material required to perform cutting or patching for weather-exposed, moisture-resistant elements or sight-exposed surfaces.

12.2 Structure Scanning and Cutting

.1 Layout cutting of structural elements, such as floor slabs, walls, columns or beams and obtain approval before starting work. Conduct an initial electromagnetic or ground-penetrating radar scan of reinforcing rods and electrical conduit, such as by use of Hilti PS200/250 Ferroscan, and review with Structural Engineer.

.2 Layout cutting of structural elements, such as floors slabs, walls, columns or beams and obtain approval before starting work. Conduct an initial electromagnetic scan of reinforcing rods and electrical conduit, and review with structural engineering Consultant.

Standard of Acceptance

° Hilti - fig. PS 300 Ferroscan

.3 Based on the preceding results, arrange and pay for supplemental radiographic examination where necessary to improve on locating concrete reinforcement, conduits and other embedment’s.

.1 submit radiographic results to the structural engineer and obtain comments before starting work,

.4 As an alternative to radiographic examination for areas where the Owner does not permit radiographic examination, based on the preceding results, provide two-dimensional ground penetrating radar scans to locate concrete reinforcement, conduits and other embedment’s. Scanners to be operated by personnel trained by the measurement device manufacturer.

Standard of Acceptance

- Hilti PS1000 X-SCAN

.5 Relocate core drilling location if steel, conduit or other embedment is found in the proposed location and repeat procedure. Repair and reroute any circuits damaged by core drilling.

.6 Scan for all shots and anchors in floors, walls, and ceilings.

13 PROTECTION OF PERSONNEL, WORK, AND PROPERTY

13.1 Personnel Protection

.1 Without limiting the Contractor's responsibilities regarding occupational health and safety requirements at the construction site, provide specific personnel protection as follows:

.1 protect exposed live equipment during construction for personnel safety,

.2 shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage,

.3 arrange for installation of temporary doors for rooms containing electrical distribution equipment. Keep these doors locked except when under direct supervision of electrician,

.4 do not leave conduit, wires, cables, tools, equipment or materials in such a way that they constitute a hazard,

.5 provide toe guards around openings in the roof or floor to prevent materials or debris from dropping down to a lower level,

.6 remove loose equipment and tools from overhead areas before leaving each day,

.7 cut off bolts at floor level to eliminate a possible tripping hazard.

13.2 Protection During Construction

.1 Provide protection required to enable existing building and equipment to remain in continuous and normal operation.

.2 Take the necessary precautions to protect equipment, existing building and service from damage during the Work. Accept responsibility for any damage and make good without cost to the Owner.

.3 Protect existing surfaces and items so that they are not damaged in any way whatsoever by the work of all trades. Take precautions as necessary to prevent damage to walls, floors, ceilings, windows, doors, door frames, moldings, finishes, piping, ductwork, light fixtures, etc. Provide protection, hoarding, tarpaulins, dust sleeves etc., as required. Any damage caused because of lack of adequate protection to be made good at no cost to the Owner.

.4 Take care when working above or around equipment that must remain in service.

.5 Take care to eliminate dust in equipment areas.

.6 Protect switchgear fronts from accidental breaker trips when working around or above them. Provide an extended shield constructed of 12 mm (½") fire retardant plywood a minimum of 450 mm (18") from board front to allow access to board.

13.3 Core Drilling

.1 Wherever core drilling is required, provide temporary dust proof screens.

.2 In areas where core drilling through a slab in an operating facility is necessary, clearly mark out the areas to be drilled on the underside of slab. Owner's representative to be notified at least 1 week prior to core drilling operation. Provide tarping of equipment supervised by the Owner.

.3 During core drilling operations, station at least one person directly below the area of drilling with a large plastic container pressed to underside of slab to capture and hold core and water upon completion of operations.

.4 Continuously use a wet/dry commercial quality vacuum at location of drilling operation to remove all excess water from the area.

13.4 Temporary Dust Proof Screens

.1 Provide temporary dust proof screens in accordance with Division 1.

13.5 Protection of Floors During Equipment Installation

.1 Provide protection of floor finishes during installation or removal of equipment, and at any other time when moving or installing heavy equipment.

.2 Install 19mm (¾") plywood over 6 mil plastic over finished floor areas when moving heavy equipment that could damage floor finish, or when installing equipment or line materials overhead.

.3 Repaint or re-tile any floors or walls damaged or scratched during construction.

13.6 Housekeeping

.1 Maintain a high level of cleanliness.

.2 Remove scrap and refuse from the work area daily.

.3 Whenever possible, clean up immediately following completion of work.

.4 Deposit oily and waste solvent rags in approved containers to minimize the fire hazard.

.5 Sweep and damp mop daily.

14 WORK IN EXISTING BUILDING

14.1 General

.1 Comply with Specification section of Division 01for restrictions on working in existing occupied buildings and as follows.

.2 During the tender period, perform a site inspection of the place of work and surroundings including the accessible ceiling spaces and other areas where access could be considered reasonable. Make a thorough investigation of the as built conditions to determine the scope of renovation and demolition work required prior to submitting a tender.

.3 The Work includes changes to the existing building and changes at junction of old and new construction. Route cabling, ducts, conduits and other services to avoid interference with existing installation.

.4 Perform core drilling off hours or on weekends. Coordinate with Owner for specific times.

.5 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services as necessary to accommodate the Work.

.6 Maintain or relocate existing services which pass through the area of renovation or demolition, but which feed items located outside of these areas. Rewire devices to the original circuits.

.7 Remove existing lighting fixtures, wiring, devices and equipment to suit new construction. Cut back and cap conduits and electrical outlets not being used, so that finished work presents a neat and clean appearance. Disconnect at point of electrical supply, remove obsolete wiring and conduits, and make existing systems safe. Blank off openings in panels or boxes created by the removal of cables, conduits, wireways or ducts.

.8 Where an existing ceiling is to be removed and reinstalled or replaced under another trades scope of work, and the existing electrical items such as luminaires, fire detectors, speakers, exit signs, emergency lighting heads etc., are to be reused, provide the following regarding the electrical items:

.1 remove,

.2 store in a secure, clean, dry location,

.3 install in the new ceiling, extend wiring and raceways as necessary,

.4 provide new items to match existing where existing items have been lost or damaged,

.5 make connections,

.6 clean,

.7 relamp luminaires,

.8 test,

.9 verify fire alarm devices,

.10 replace defective items with new, then retest/reverify,

.11 submit test and verification reports.

.9 Unless noted otherwise removed materials and equipment become the property of the Contractor and are to be taken from the site and disposed of appropriately.

.10 Review removed luminaires and equipment with the Owner's representative, and if the Owner instructs they wish to keep any items, move them to a designated location on the site. Luminaires and equipment that the Owner does not want become the property of the Contractor and are to be taken from the site and disposed of appropriately.

.11 For devices, fixtures and equipment to be relocated, provide junctions boxes, outlet boxes, wiring, plates, supports, etc., as necessary.

.12 Revise panelboard directories accordingly if affected by the Work.

.13 Clean and relamp relocated luminaires and replace any faulty ballasts.

.14 On completion of relocations, confirm that relocated devices and luminaires are in proper working order.

.15 Co-ordinate work affecting fire alarm system, fire safety, or protection systems with the Owner, Consultant, fire alarm system manufacturer and authorities having jurisdiction prior to commencing work. Retain the original fire alarm system manufacturer to verify relocated fire alarm devices, modified equipment and revised wiring. Provide temporary fire protection and/or a fire watch in all areas affected by the demolition and as required by authorities having jurisdiction.

.16 Where the Owner wishes to take over renovated areas ahead of the project completion date and these areas are intended to be fed from the distribution systems in the new building, make temporary connections to the existing services in these areas. Reconnect to permanent services at a later date, when the new distribution systems are available.

14.2 Continuity of Services

.1 Keep existing buildings in operation with minimum length of shutdown periods.

.2 Make connections to existing systems at approved times.

.3 Obtain written approval, recording times when connections can be made.

.4 Arrange the Work so that physical access to the existing buildings is not unduly interrupted.

.5 Be responsible for and make good any damages caused to existing systems when making connections.

.6 Provide premium time labour to tie-in feeders or wiring at night or on weekends.

.7 Provide temporary feeders and connections as required to maintain systems in operation where shutdown periods will exceed 8 hours, or extend beyond the allowable time frame determined by the Owner.

15 MOVING AND SETTING IN PLACE OWNER'S EQUIPMENT

15.1 General

.1 The requirements of this Part applies to;

.1 Division 26 equipment that has been pre-tendered or pre-purchased by the Owner, and

.2 other Owner-supplied products or equipment (i.e. process equipment) that has building services requirements.

.2 Comply with the requirements of Specification section of [01 11 00 *Summary of Work]* and as specified herein.

15.2 Supplied by Owner Equipment (SBO)

.1 Items marked SBO on drawings are to be;

.1 purchased by the Owner,

.2 received, checked, stored, by the Contractor, and

.3 subsequently unpacked, uncrated, assembled and located in its final location by the Contractor, and installed in accordance with the manufacturer instructions,

.4 participate in the start-up and testing of the equipment and placing into service.

.2 Provide electrical services to this equipment.

15.3 Existing Owners Equipment to be Relocated

.1 Applies to owners existing equipment which has mechanical and electrical services, and marked on the drawings as existing to be relocated.

.2 Except as indicated below, items so marked on drawings will be moved from their present location and reinstalled by the Contractor. Disconnect and reconnect electrical services to accommodate the relocation of this equipment.

.3 Disconnect, remove, store as necessary, move into place, reinstall, clean and reconnect electrical items so marked, such as;

.1 luminaires,

.2 fire detectors,

.3 speakers,

.4 switches,

.5 receptacles,

.6 disconnects,

.7 splitters,

.8 panelboards,

.9 switchgear,

.10 transformers,

.11 etc.

16 CONSTRUCTION POWER AND TEMPORARY ELECTRICAL SERVICES

16.1 Temporary Power Service

.1 Refer to Division 1.

16.2 Temporary Construction Power and Lighting

.1 Refer to Division 1.

.2

17 FINAL CLEANING

17.1 Final Cleaning

.1 Conduct final cleaning in accordance with Division 01 requirements and as specified herein.

.2 Perform final cleaning after construction activities that create dust have been completed.

.3 Clean electrical equipment and devices installed as part of this project.

.4 Clean lighting reflectors, lenses, and other lighting surfaces that have been exposed to construction dust and dirt, including the top surface, whether exposed or in the ceiling space.

.5 Clean switch, receptacle, and communications outlets, cover plates, and exposed surfaces.

.6 Clean and vacuum any smoke detectors exposed to construction dust, do not use compressed air.

.7 Electrical rooms, generator rooms and electrical or communication closets:

.1 Thoroughly vacuum and clean interiors and buswork of switchboards, panels, cabinets and other electrical equipment of construction debris and dust prior to energization using a HEPA vacuum cleaner. Final clean using clean lint free cloths with a cleaning liquid as recommended by the manufacturer for the purpose.

.2 HEPA vacuum the top of switchboards, panels, cabinets, bus ducts, cable trays and conduits, and mechanical duct work in the room, followed by a thorough HEPA vacuuming of the floors. Thoroughly wash floors with wet mop and clean water. Control access to the room after cleaning. Provide temporary filter media on air supply ducts to these rooms to prevent re-contamination from other areas of construction.

.3 Thoroughly re-clean as necessary prior to final turn over.

.4 Do not lay permanent switchboard matting in electrical rooms until rooms are thoroughly re-cleaned, and floors wet mopped and dried, immediately prior to final turn over.

18 RECORD DRAWINGS

18.1 General

.1 Maintain record drawings in accordance with Division 1 during the course of the Work and as follows.

.2 A set of design drawings in AutoCAD, Revit, or PDF format (as determined by the Consultant) will be provided by the Consultant. Record changes in actual installation as the Work progresses by the following method:

.1 make sets of white prints for each phase of Work and mark-up the print drawings, or

.2 revise the AutoCAD or Revit file directly, and identify all changes made.

.3 Mark-up these record drawings to provide dimensioned locations of drains, pipes, ductwork, conduit, manholes, foundations and similar buried items within the building, with respect to building column centres. Mark level with respect to an elevation which will be provided.

.4 Retain on-site the survey information from excavation and backfill of site services, and after approval, transfer this information to the record documents.

.5 Retain these drawings and make available to Consultant for periodic review.

.6 At 50%, 75% and 90% project completion, scan marked-up drawings to PDF format and submit copy to the Consultant, or to the project on-line document management service if one is used.

18.2 As-built Drawings

.1 Prior to testing, balancing and adjusting, transfer site record drawing information to a copy of the computer aided drafting/design program (“CAD”) files, in the same software format used for the Consultants design drawings, to record final as-built condition.

.2 Obtain a current set of CAD files from the Consultant, The Consultant's CAD files may not reflect all or any construction changes.

.3 Drawings are to remain set to and follow Consultants CAD Standards - do not alter drawing scales, reference files, colours, layers or text styles,

.4 Where items have been deleted, moved, renumbered or otherwise changed from contract drawings, revise the CAD files to record these changes. “Bubble” these revisions, and place these annotations on a separate and easily identified drawing layer.

.5 Show on electrical as-built drawings final locations of conduit, outlets, panels, branch wiring, system wiring, pull boxes, bus ducts, and equipment.

.6 Show on site services as-built drawings survey information provided by an accredited land surveying service.

.7 Identify each drawing in lower right hand corner in letters at least 12 mm (½") high with a note as follows:

AS-BUILT DRAWINGS. This drawing has been revised to show systems as installed (Signature of Contractor) (Date).

.8 Submit one (1) set of white prints of the draft as-built CAD files for the Consultant’s review.

.9 Once “AS BUILT DRAWINGS” white prints are reviewed, transfer Consultant's comments to the CAD files. Return CAD files modified to “As Built” condition to Consultant in electronic format by removable mass storage device or by electronic file transfer as designed by the Consultant.

.10 Submit three (3) sets of white prints and one (1) electronic copy of CAD files with Operating and Maintenance Manuals to the Owner.

19 OPERATING AND MAINTENANCE INSTRUCTIONS

19.1 Operating and Maintenance Data

.1 Provide operating and maintenance manuals in accordance with Division 1 and as follows.

.2 Provide operation and maintenance data bound in vinyl covered, hard back, three-ring covers, nominally 50 mm (2 in) thick, suitable for paper size of 210 mm x 300 mm (8½ in x 11 in)

.1 Organize material in volumes, generally grouped by Division Section;

(a) Table of Contents

(b) General Information

(c) Sub-contractors (list)

(d) Site services,
(e) Power,
(f) Lighting,
(g) Low Voltage Systems,
(h) Fire Alarm,
(i) Security,
(j) Testing Reports,
(k) As-Built Drawings,
(l) Warranties.

.2 Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear;
(a) Project Name,
(b) Project Number,
(c) Date,
(d) Trade Section, and
(e) List of Contents.

.3 Provide three hard-copies to Owner.

.3 In addition, provide PDF files for each document, produced from original direct-to-digital file creations.

.1 Organize documents into separate PDF files for each Division Section identified above, and apply PDF Bookmarks to create a Table of Contents.

.2 Manuals will be rejected if Table of Contents and PDF Bookmark is not included.

.4 Operating and maintenance data to include;

.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 not acceptable,

.3 wiring and schematic diagrams and performance curves,

.4 names and addresses of local suppliers for items included in maintenance manuals,

.5 reviewed shop drawings,

.6 operating characteristics of the equipment supplied such as calibration curves and coordination data to allow proper co-ordination with Owner’s equipment,

.7 description of operation of the controls and protective devices used,

.8 maintenance and adjustment procedures,

.9 lifting and jacking instructions,

.10 fault locating guide,

.11 spare parts list and an itemized price list,

.12 name and telephone numbers of service organization and technical staff that will provide warranty service on the various items of equipment.

.5 Approval procedure;

.1 submit one set of first draft of Operating and Maintenance Manuals for approval at least one month prior to planned substantial performance date,

.2 make corrections and resubmit for a final review,

.3 review contents of Operating and Maintenance Manuals with Owner's operating staff or representative to ensure thorough understanding of each item of equipment and its operation,

.4 hand-over two (2) copies and one (1) PDF copy on removable storage device of the Operating and Maintenance Manuals to the Owner's operating staff and obtain written confirmation of delivery. Provide a copy of the delivery record to the Consultant.

19.2 Operating and Maintenance Training

.1 Provide operating and maintenance training in accordance with Division 1 and as follows.

.2 Provide training to Owner's operations staff to thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections. Include classroom instruction and hands-on instruction, delivered by competent instructors.

.3 Develop the proposed training plan, and submit an outline of the training program for review and adjustment by the Owner. Obtain approval from the Owner before commencing training.

.4 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each item of equipment, utilizing the services of the manufacturers' representative as required.

.5 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each training topic, separated by approximately one week each. Develop the proposed training plan and obtain approval from the Owner before commencing training.

.6 All training to be scheduled and provided between the hours of 7 am to 5 pm, Monday to Friday. Where training is required to be performed outside of these hours due to availability of Owners operations personnel, if the trainers are paid for overtime outside of these hours, the overtime portion only is eligible to be paid by the Owner as an extra cost.

.7 Complete the training as close to Substantial Performance as possible, so that the operations staff are prepared to operate the systems after Substantial Performance is certified.

.8 Keep a record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.

.9 For each training session, include the following topics;

.1 general purpose of the system (design intent),

.2 use of O & M manuals,

.3 review of single line drawings and control schematics,

.4 start-up, normal operation, shutdown, unoccupied operation, seasonal changeover, manual operation, control set-up and programming, troubleshooting and alarms,

.5 interaction with other systems,

.6 adjustments and optimizing methods for energy conservation,

.7 maintenance requirements,

.8 special maintenance and replacement sources,

.9 health and safety issues,

.10 occupancy interaction issues, and

.11 system response to different operating conditions.

.10 Develop and provide training material, including printed documents and electronic presentation aids (e.g. MS PowerPoint) for each session. Submit three (3) copies of materials in both hardcopy and PDF format, in accordance with article on Operating and Maintenance Manuals.

.11 Sessions may be videotaped by the Owner as an aid to ongoing training of Owner's staff.

20 CARE, OPERATION AND START-UP

.1 Provide all labour and materials as necessary to perform start-up and testing of equipment and systems.

.2 Arrange and pay for services of manufacturer's factory service technicians to supervise start-up of installation, check, adjust, balance and calibrate components and equipment as specified in the specification sections of Division 26.

.3 Provide these services for such periods, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with every aspect of the operation, care and maintenance thereof.

.4 Arrange and pay for services of applicable manufacturer's factory service engineer or certified independent testing organization to supervise initial start-up of specialized portions of installation and to check, adjust, balance and calibrate components including related wiring and controls. Provide these services for such periods, and for as many visits as may be necessary to put applicable portion of the installation in complete working order. Provide a certificate indicating that the equipment is free and clear of deficiencies.

21 TESTING

21.1 General

.1 The following describes the general requirements for testing of electrical systems; refer to additional testing requirements in applicable sections of Division 26 of the Work.

.2 Conduct and pay for the following tests;

.1 power distribution system including phasing, voltage, grounding and load balancing,

.2 circuits originating from branch distribution panels,

.3 lighting and its control,

.4 motors, heaters and associated control equipment including sequenced operation of systems where applicable,

.5 systems: fire alarm system, communications,

.6 additional testing as specified in other Sections.

.3 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.

.4 Insulation resistance testing;

.1 megger circuits, feeders and equipment up to 350 V with a 500 V instrument,

.2 megger 350-600 V circuits, feeders and equipment with a 1000 V instrument,

.3 check resistance to ground before energizing.

.5 Carry out tests in presence of Consultant.

.6 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

.7 Submit test results for Consultant's review. Test electrical equipment to standards and function of specifications, applicable codes and standards in an approved manner. Replace defective equipment and wiring with new material and leave entire system in complete first class operating condition.

21.2 Testing of Integrated Life Safety and Fire Protections Systems

.1 Conduct testing of integrated life safety and fire protection systems in accordance with specification Section 26 08 11 *Testing of Integrated Electrical Life Safety and Fire Protection Systems* .]

22 LOAD BALANCE

.1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes. Revise circuit labelling as appropriate.

.2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.

.3 Submit, at completion of work, report listing phase and neutral current on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

23 CO-ORDINATION OF PROTECTIVE DEVICES

.1 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings as per equipment manufacturers' recommendations for each piece of equipment.

24 COMMISSIONING

.1 Participate in commissioning of equipment and systems in accordance with Section 26 08 15 *Electrical Commissioning.*

.2 Equipment supplied on this project will be subject to detailed factory inspection and/or on-site testing and commissioning prior to being placed in service. The electrical contractor, their major system and equipment suppliers, and the Independent Testing Agent (ITA) will be required to participate in special commissioning meetings to review progress and status of the commissioning program.

.3 Include in Bid amount for licensed electricians to participate in the commissioning program, to undertake temporary power connections, operation of equipment, opening and closing of panel boards and switchboards, testing of power and control wiring, and assisting the ITA and the equipment suppliers' field personnel in the startup and testing of the equipment.

.4 The contractor and equipment suppliers to include in the Bid amount the costs to accommodate and undertake factory and site testing.]

25 TEMPORARY AND TRIAL USAGE

.1 Temporary and trial usage by Owner of any electrical device, machinery, apparatus, equipment or any other work or materials before final completion and written acceptance, is not to be construed as evidence of acceptance by the Owner.

.2 Owner to have the privilege of such temporary and trial usage, as soon as the Contractor claims that said work is completed and in accordance with specifications, for such reasonable length of time as is deemed to be sufficient for making a complete and thorough test of same.

.3 No claims will be considered for damage to or failure of any parts of such work so used which may be discovered during temporary and trial usage, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

.4 Defects in workmanship and materials identified during temporary and trial usage are to be rectified under warranty.

26 CONSULTANT REVIEWS

26.1 General

.1 Consultant's attendance at site including but not limited to site meetings, demonstrations, site reviews and any resulting reports are for the sole benefit of the Owner and as required by the local authority have jurisdiction. It is the Contractor's responsibility to ensure that the Work is complete and constructed in accordance with the design documents.

26.2 Site Reviews

.1 General reviews and progress reviews do not record deficiencies during the course of the Work until such time as a portion or all of the work is declared complete. In some instances, before the work is completed, readily noticeable deficiencies may be recorded by the Consultant where the deficient item is indicative of issues such as poor workmanship, incorrect materials or installation methods, or may be difficult to correct at a later date. Any such reported items, or lack thereof, shall not be relied on in any way as part of the Contractors quality assurance program nor relieve the Contractor in the performance of the Work, specifically in identification and rectification of deficiencies or incomplete Work.

.2 Deficiency reviews conducted by the Consultant are performed on a sampling basis, and any deficiency item is to be interpreted as being indicative of similar locations elsewhere in the Work, unless indicated otherwise.

26.3 Milestone Reviews

.1 Specific milestone reviews may be conducted at key stages by the Consultant, including;

.1 before backfilling of buried services,

.2 before closing of shafts,

.3 before closing of walls,

.4 before closing of ceilings,

.5 equipment demonstration,

.6 Substantial Performance deficiency review,

.7 Total Performance deficiency review.

.2 Coordinate with the Consultant the type and quantity of milestone reviews required and incorporate these requirements into the construction schedule.

.3 Prior to Work being concealed, notify the Consultant in writing seven (7) calendar days in advance of the planned concealment to arrange a site review, where required by the Consultant. Correct noted deficiencies before concealing the Work. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

26.4 Partial Occupancy Reviews

.1 Where the Work is planned to include occupancy by the Owner of a part of the Work but not the entire Work ("partial occupancy"), the procedures specified for Substantial Performance Review will apply to the portion of the Work being considered for partial occupancy.

26.5 Substantial Performance Review

.1 At the time of applying for project Substantial Performance, submit to Consultant a comprehensive list of items to be completed or corrected.

26.6 Final Review

.1 At project completion submit written request for final review of electrical systems. Refer to section 26 77 19.20 Close-Out Requirements for Electrical Work.

.2 Include with the request a written certification that;

.1 deficiencies noted during job inspections have been completed,

.2 systems have been balanced and tested and are ready for operation,

.3 completed maintenance and operating data have been submitted and approved,

.4 equipment/line material tags are in place and equipment identification is completed,

.5 cleaning is finished in every respect,

.6 electrical panels, switchboards, cabinets, and equipment surfaces have been touched up with matching paint, or re-finished as required,

.7 spare parts and replacement parts specified have been provided and receipt acknowledged,

.8 As-built and Record drawings are completed and approved,

.9 Owner's operating personnel have been instructed in the operation and maintenance of systems,

.10 fire alarm verification is 100% completed and Verification Certificate has been submitted and accepted.

27 CONTRACTOR INSPECTIONS

27.1 General

.1 The Division 26 contractor shall assign one person responsible for ensuring that Work from all electrical trades is complete prior to;

.1 closing in wall, ceilings or burying of services,

.2 partial-occupancy reviews, and

.3 substantial performance reviews.

.2 In conjunction with the Contractor’s Mechanical and Electrical sub-contractors, the Contractor shall walk the site and thoroughly inspect that the work is complete, in good workmanship and installed according to the contract documents and derived documents therefrom. The Contractor shall then submit a report attesting to the completed state of the Work (the “Statement of Completion” report, as detailed later in this part).

.3 In the case of Contractor inspections for partial-occupancy or substantial performance, submit the Statement of Completion report at least 24 hours prior to the scheduled review by the Consultant.

27.2 Contractor Inspections for Partial Occupancy and Substantial Performance

.1 In preparation for the Consultants general review for partial-occupancy and/or substantial performance of the Work, the Contractor shall perform a comprehensive inspection of the Work to ensure that their contractual obligations are met before requesting a Consultant’s review of the Work. In performing this inspection, the Contractor shall create a Statement of Completion report which is to include;

.1 date and time of the Contractor’s inspection, signed by the person who conducted the inspection,

.2 names of the electrical contractor’s personnel who participated in the inspection,

.3 confirmation that previously noted deficiencies have been completed,

.4 confirmation that the work is 100% complete, tested, balanced and free of deficiencies, or include a list of outstanding deficiencies and incomplete Work with;

(a) a reason why the Work has not been completed (i.e. another trade has to complete their work)

(b) a plan of action to complete the Work, and

(c) a commitment date for completion of the Work including rectification of all deficiencies.

.2 The format of the Statement of Completion shall be approved by the Consultant.

.3 The Consultant shall review and sign-off the Statement of Completion Report and return a copy to the Contractor. The Contractor shall retain on-site a log of all signed off Statement of Completion reports.

.4 If a required Statement of Completion report is not received, the Consultant reserves the right to withhold conducting a review for partial-occupancy or substantial performance.

.5 After receipt of the Contractor's Statement of Completion report, if upon entering an area of the work covered by the Statement of Completion report the Consultant determines, in its sole opinion, that the applicable Work is not ready for review, the Consultant may elect to cancel the review of the Work or the affected portion of the Work, and shall assume no responsibility for any damages or losses as a result of cancellation of the review. The Contractor shall remedy the incomplete work and request another review with 72 hours prior written notice, and shall resubmit the revised Statement of Completion at least 24 hours prior to the new review.

28 CORRECTION AFTER COMPLETION

28.1 General

.1 At completion, submit a written warranty, undertaking to remedy defects in work for a period of one year from date of substantial performance of the Work. This warranty is not to supplant other warranties of longer period called for on certain equipment or materials.

.2 Warranties are to encompass replacement of defective workmanship, parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation of the corrected Work.

.3 Submit similar warranties for one year from date of acceptance for any part of work accepted by Owner, before completion of the whole Work.

29 ATTACHEMENTS

29.1 Schedule of Values Form

.1 Attached sample of the Schedule of Values form layout.

29.2 Shop Drawing Submittal Form

.1 Attached sample of shop drawings submittal form.

SCHEDULE OF VALUES

Project Name: <<name of project>>
Owner Name: <<owner name>>
Contractor Name: <<name of trade contractor: mechanical, electrical, etc>>
Division(s) of the Work: <<i.e. 20, 21, 22...>>
For the billing period ending: dd-mmm-yyyy

This sheet is an example of a required schedule of values to be developed by the Contractor, to be submitted with each progress payment request.

Specifiel level of detail for each work element to be approved by the Consultant.

Item	Base Contract Element	Contract Value		Complete to Date		Previsosly Billed		This Billing		Balance to Complete	
		$	%	$	%	$	%	$	%	$	%
1.1	<<work element>>	1,000,000.00	65.9%	400,000.00	40.0%	225,000.00	22.5%	175,000.00	17.5%	600,000.00	60.0%
1.2	<<work element>>	250,000.00	16.5%	30,000.00	12.0%	5,000.00	2.0%	25,000.00	10.0%	220,000.00	88.0%
1.3	<<work element>>	125,000.00	8.2%	50,000.00	40.0%	22,000.00	17.6%	28,000.00	22.4%	75,000.00	60.0%
X.X	Itemized Price No. 1	25,000.00	1.6%	0.00	0.0%	0.00	0.0%	0.00	0.0%	25,000.00	100.0%
X.X	Separate Price No. 1	12,500.00	0.8%	5,000.00	40.0%	0.00	0.0%	5,000.00	40.0%	7,500.00	60.0%
CCA.1	Cash Allowance Disbursements Summary	75,000.00	4.9%	34,000.00	0.0%	8,000.00	0.0%	26,000.00	0.0%	41,000.00	0.0%
X.X	Coordination drawings	15,000.00	1.0%		0.0%		0.0%		0.0%		0.0%
X.X	As-built documens and operating manuals	15,000.00	1.0%		0.0%		0.0%		0.0%		0.0%
	Original Contract Values	1,517,500.00	100.0%	519,000.00	34.2%	260,000.00	17.1%	259,000.00	17.1%	968,500.00	63.8%
CO.1	Approved Changes Summary	13,400.00		5,200.00	38.8%	2,000.00	14.9%	3,200.00	23.9%	8,200.00	61.2%
	Total Current Contract Values	**1,530,900.00**		**524,200.00**	**34.2%**	**262,000.00**	**17.1%**	**262,200.00**	**17.1%**	**976,700.00**	**63.8%**

Reference	Cash Allowance Disbursement	CA Value	Complete to Date		Previsosly Billed		This Billing		Balance to Complete	
		$	$	%	$	%	$	%	$	%
CAA_1	<<description of cash allowance>>	20,000.00	20,000.00	100.0%	8,000.00	40.0%	12,000.00	60.0%	0.00	0.0%
CAA_2	<<description of cash allowance>>	55,000.00	14,000.00	25.5%	-	0.0%	14,000.00	25.5%	41,000.00	74.5%
				0.0%		0.0%	0.00	0.0%	0.00	0.0%
	Total	75,000.00	34,000.00	45.3%	8,000.00	10.7%	26,000.00	34.7%	41,000.00	54.7%

Reference	Approved Changes	Change Value	Complete to Date		Previsosly Billed		This Billing		Balance to Complete	
		$	$	%	$	%	$	%	$	%
CO_01	<<description of change of work>>	5,800.00	-	0.0%	-	0.0%	0.00	0.0%	5,800.00	100.0%
CD-01	<<description of change of work>>	7,600.00	5,200.00	68.4%	2,000.00	26.3%	3,200.00	42.1%	2,400.00	31.6%
				0.0%		0.0%	0.00	0.0%	0.00	0.0%
	Total	13,400.00	5,200.00	38.8%	2,000.00	14.9%	3,200.00	23.9%	8,200.00	61.2%

Reference	Unquoted/Unapproved Changes	Status	Quotation
			$
CCN=01	<<description of change of work>>	Waitinf for approval	12,000.00
CCN-02	<<description of change of work>>	Unquoted	
	Total		12,000.00

HHAngus Toronto Montreal Vancouver Dallas Chicago

SHOP DRAWING SUBMITTAL

Include this cover page with each shop drawing submission.
Submissions without this form will be returned without review.
Submit one submittal form per shop drawing; do not group under one submittal sheet

Client/Architect: Click or tap here to enter text.

Project Name: Click or tap here to enter text.

HHA Project No: Click or tap here to enter text.

Contractor to complete the following for each submission.

Date: _____

Contractor Name: _____ Ref. No: _____

Manufacturer Name: _____

Product Type/Description: _____

Specification section number: _____

Contractor Trade Category:

☐ Architectural ☐ Structural ☐ Conveying Equipment ☐ User Equipment
☐ Mechanical ☐ Electrical ☐ Telecommunications ☐ Civil
☐ Other

If this is a resubmission, check here: ☐

Previous submission HHA reference no.: _____

hhangus.com

CANADA BEST MANAGED COMPANIES

END OF SECTION

QUALIFICATIONS AND AUTHORITIES - ONTARIO
26 01 02

1 GENERAL

1.1 Scope

.1 This specification section:

.1 describes the qualification requirements for tradesmen in the province of Ontario;

.2 defines the applicable authorities having jurisdiction related to construction in Ontario; and

.3 describes the responsibilities of the contractor and/or Owner for registration and inspection of systems and application for construction or installation permits.

1.2 Definitions

.1 ***ESA***: Electrical Safety Authority

2 QUALIFICATIONS

2.1 Trades Qualification and Apprenticeship

.1 Tradesmen to hold a certificate of competency for the following applicable trades:

.1 Electrician, R.R.O. 1990, Reg. 1051

3 AUTHOURITIES

3.1 Authorities having Jurisdiction

.1 When referenced in specification sections in Division 26 to 28, the authority-having-jurisdiction (“AHJ”) over regulated portions of the work are identified in the following table.

Work Element	Authority	AHJ Abbreviation
Electrical	ESA	ESA

4 PERMITS, REGISTRATION AND INSPECTION

4.1 Building Code Permits

.1 Application for Building Permit has been made by the Owner. Submit and pay for separate electrical permits and arrange and coordinate for municipal inspections required under the Ontario Building Code

4.2 Other Work Permits, Registration and Inspection

.1 Arrange, provide documentation, and pay for permits, registration, and inspection of the following work elements:

.1 Electrical work performed, and

.2 Where described elsewhere in Division 26 to 28.

.2 Arrange, provide documentation, and pay for variance approvals and field inspections where specified elsewhere in Division 26 to 28.

END OF SECTION

ELECTRICAL BASIC MATERIALS AND METHODS
26 05 01

1 GENERAL

1.1 Scope

.1 Articles that are of a general nature, apply to each Section of Divisions 26, 27 and 28.

2 SLEEVES AND CURBS

2.1 Materials

.1 Sleeves for bus ducts, wireways and cable trays: minimum 3 mm (1/8") galvanized steel or PVC.

.2 Integral flashing clamp on sleeves that pass through floors with a waterproof membrane.

.3 Removable (non fire rated) sealing material: Duxseal or acceptable alternative.

.4 Fire rated sealing material: per Article “Fire Stopping and Smoke Seals”.

2.2 Installation

.1 Provide sleeves for bus ducts, wireways, conduits and cable runs passing through;

- .1 concrete walls, beams, slabs and floors,
- .2 fire rated walls, partitions and ceilings.

.2 Place and secure sleeves in concrete form work.

.3 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.

.4 Terminate sleeves flush with surfaces of concrete and masonry walls.

.5 Extend sleeves 100 mm (4") above finished floor.

.6 Size sleeves to accommodate fire stopping materials where required.

.7 Make watertight connections between sleeves and waterproof membranes.

.8 Fill any spaces between sleeves and masonry walls;

- .1 with non-shrink grout,
- .2 with a rated fire stopping material for rated walls.

.9 Seal spare sleeves and the space between sleeves and the through conduits, cables, wireways, bus ducts etc;

- .1 using removable sealing material,
- .2 using a rated fire stopping material for floors and rated walls,
- .3 seal watertight where sleeves penetrate a floor slab.

.10 Sleeves in existing concrete and masonry walls and floors;

- .1 cutting and drilling of structural elements, such as floors, slabs, walls, columns, or beams to be carried out in accordance with procedure set out in Article “Cutting and Remedial Work” in Section “Electrical General Requirements”,
- .2 neatly cut or drill holes in existing construction,
- .3 terminate sleeves flush with surfaces of concrete and masonry walls,
- .4 extend sleeves 100 mm (4") above finished floor with flange, countersunk, and bolted down flush into floor surface,

.5 fill opening between sleeve and wall;

(a) with non-shrink grout,

(b) with a rated fire stopping material for rated walls.

.6 fill opening between sleeve and floor with rated fire stopping material with water barrier,

.7 seal as indicated above.

.11 Provide concrete curbs, minimum 100 mm (4") high above finished floor surrounding sleeves and openings for;

.1 conduits,

.2 cables,

.3 telephone cable risers,

.4 bus ducts,

.5 wireways,

.6 cable trays, and

.7 other openings for electrical services through slabs above grade.

.12 Size concrete curbs for bus ducts to provide sufficient area to adequately carry bus duct support brackets.

.13 Size openings to accommodate fire stopping materials as required.

3 WALL AND FLOOR PLATES

3.1 General

.1 Provide finishing plates fitted to electrical conduits and cables which pass through walls, floors and ceilings in finished areas.

3.2 Products

.1 Escutcheons for small diameter electrical conduit:

.1 manufactured chrome plated two-piece split type with hinge and set-screw.

.2 Finishing plates for electrical cables and large diameter electrical conduits:

.1 finishing plate (ring) fabricated from minimum 0.9 mm (20 ga) thick T304 stainless steel with No. 4 brushed finish, with minimum 25 mm (1 in) high collar ring,

.2 mounting holes drilled at not less than three (3) symmetrically location positions around the ring to allow mechanical fastening,

.3 plate diameter to be sufficiently sized to overlap the wall, floor or ceiling opening by not less than 25 mm (1 in) all around the opening.

3.3 Installation

.1 Escutcheons;

.1 secure escutcheons to electrical conduit with mechanical fastener.

.2 Finishing plates:

.1 set finishing plates flat against the finished surfaces, and secure to the surface with stainless steel pan-head mechanical fasteners. Provide insert anchor plugs in the finished surface as necessary to secure the fasteners.

4 FIRE STOPPING AND SMOKE SEALS

4.1 General

.1 Maintain the integrity of floor and wall, fire separations and smoke seals, around EMT, conduits, electrical raceways, cables, bus ducts, boxes and any other electrical equipment passing through rated floors or walls.

.2 Fire stop materials to be impervious to water when installed in a horizontal separation, including waterproof service sleeves.

.3 Firestop material manufacturer or their designated service representative to provide the following services:

.1 selection of listed fire stopping assemblies for each applicable service penetration and fire separation assembly/rating,

.2 provide training of contractor's staff for proper installation of fire stopping assembly; create and maintain a log of those personnel who obtain training,

.3 inspect the completed installation of all penetrations and submit a written report to the Consultant, including photo record of randomly selected instances of each fire stopping method. Where deficiencies are discovered, note the deficiencies in the report and provide remedial instructions to the contractor to correct the deficiency. After deficiencies are corrected, re-inspect the deficiencies to conform their correction, update and resubmit the report to the Consultant.

4.2 Submit a complete fire stopping and smoke seal shop drawing schedule to the Consultant for review. Include details, cut sheets, system description and location for each proposed fire stopping and smoke Products

.1 Materials and firestopping system to be listed for conformance with CAN/ULC-S115 "*Standard Method of Fire Tests of Firestop Systems*".

.2 Firestop systems to have F duration rating equal to the fire resistance rating of the applicable fire separation. In addition, where required by the applicable building code for the specific service penetration, the fire stop assembly shall:

.1 have a F rating equal to the fire resistance rating of the applicable fire separation with a pressure differential of 50 Pa (0.2 in.w.c.) between exposed and unexposed side with the highest pressure on the exposed side, and

.2 have an FT rating equal to the fire resistance rating of the applicable fire separation,

Standard of Acceptance

- Hilti Firestop Systems
- 3M
- A/D Fire Protection System Inc.
- Eastern Wire + Conduit

.3 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.

4.3 Installation

.1 Install firestopping and smoke seals in accordance with the manufacturer's recommendations and in accordance with the ULC or cUL listing.

.2 Firestopping and smoke seals to be installed only by personnel trained by the manufacturer on the installation of such systems.

.3 Seal space between penetrating service and sleeve or opening in fire rated floors and walls with a fire stopping and smoke sealing system.

.4 Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.

.5 At time of application of materials, surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint, loose concrete or masonry and foreign materials.

.6 Wiring may penetrate a fire rated assembly provided it is enclosed in non-combustible conduit, and the passage of the conduit in turn is suitably sealed to the assembly with fire stop and smoke sealing materials.

.7 Where wiring with a combustible covering and not enclosed in non-combustible conduit penetrates a fire resistance rated assembly, group the wiring into separate fire and smoke sealed penetrations to ensure the overall diameter of the combined wire(s) in each penetration does not exceed 25 mm.

.8 Arrange single conductor metal sheathed cables to individually penetrate the fire rated assembly and be individually fire stopped and smoke sealed. Where these cables have combustible jackets, space cables at least 300mm apart throughout the penetration.

.9 Where wiring is installed in cable trays and penetrates a fire rated assembly;

.1 terminate and independently support the cable tray on each side of the fire rated assembly, and

.2 provide sufficient working room to properly install and inspect the fire stopping and smoke sealing materials.

.10 Smoke seal and fire stop electrical boxes that penetrate a fire rated wall using fire rated putty pads, install putty pads on the outside of boxes.

.11 Smoke seals and fire stopping in horizontal separations to be watertight with sleeves terminating not less than 100mm (4”) above the finished floor.

.12 Co-ordinate installation of cast-in-place fire stopping devices with the Division responsible for the placement of concrete.

5 SPRINKLER PROTECTION

5.1 Materials

.1 Surface panelboards, switchboards and other electrical equipment in sprinklered areas to be fitted with watertight hubs with insulated throat, for each conduit entrance.

Standard of Acceptance

- ABB Installation Products Ltd. (T & B) - Series 401
- Efcor of Canada Ltd. - Series 40-50B

.2 Provide equipment in sprinklered areas, with hoods or shields and gasketted doors for protection against entry of sprinkler discharge. Alternatively, and where indicated, provide indoor weatherproof equipment.

.3 Ventilation openings to be overhanging drip proof type.

.4 Indoor weatherproof equipment, where noted in the specifications and/or drawings to have CSA type 3R enclosures in accordance with the requirements of CSA Standard C22.2 No. 94.

6 PENETRATIONS OF BELOW GRADE WALLS AND SLABS ON GRADE

6.1 Materials

.1 Expanding cement water stop material.

.2 Submit manufacturer's literature.

Standard of Acceptance

- Cetco WATERSTOP-RX
- W.R. Meadows WATERSTOP EC PLUS
- or acceptable equivalent

6.2 Installation

.1 Fit each cable, conduit and duct passing through floor slab in contact with ground or walls below grade, with a water stop.

.2 Submit schedule showing location, service.

.3 Install water stop in accordance with the manufacturer's instructions.

.4 Encircle each cable, conduit and duct and the perimeter of the wall opening with the water stop material.

.5 Fill the wall openings around the cables, conduits or ducts with hydraulic cement injected for the full width of the wall.

.6 Seal the exterior of the wall around the cables, conduits or ducts with a waterproof coating. Waterproof coating to be compatible with any existing waterproofing.

7 EQUIPMENT SUPPORTS, AND BASES

7.1 Supports for Electrical Work

.1 Equipment supplementary supports to be provided by this Division.

.2 Concrete housekeeping bases for electrical equipment to be provided by this Division.

.3 Work to be done by firms specializing in these fields.

.4 Submit shop drawings for steel and concrete work, prepared by licensed Professional Engineers.

7.2 Supplementary Supports and Support Brackets:

.1 Fabricated from structural grade steel with anchor bolts and fastenings.

.2 Designed in consultation with building structural consultant to transfer live loads and dead loads to building structural elements.

.3 Constructed as frames bracketed from walls, and/or supported from building structure above, and/or floor below.

7.3 Concrete Bases for Housekeeping Pads

.1 Constructed using plywood form work and 20 Mpa (3000 lb) concrete.

.2 Dowelled to concrete floor slab with steel rods not less than 13 mm (1/2 in) in diameter. For existing concrete floors, floors are to be drilled and dowels secured in the holes with chemically-hardening adhesive.

.3 [Refer to Specification section 26 05 49.13 *Seismic Restraint for Electrical Systems* for additional requirements for housekeeping pads where equipment is to be seismically restrained.]

.4 Finish to make flat, level, smooth, neat surfaces.

.5 Chamfer corners 25 mm (1 in).

.6 Dimensions:

.1 75 mm (3 in) larger all around than base of apparatus for non-seismic applications,

.2 minimum 200 mm (8 in) larger all around than equipment-base anchor attachment points for seismically restrained equipment.

.3 height: 100 mm (4 in)

7.4 Installation

.1 Locate supporting steel to permit service or repair, and to allow clear access to junction boxes and equipment.

.2 Set equipment on supporting frames and brackets and install hangers, anchor bolts, and vibration mountings.

.3 Install anchor bolts, and vibration mountings between equipment and housekeeping pad.

.4 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

.5 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

.6 Make field connections with bolts to CAN/CSA-S16.1, or weld.

.7 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.

.8 After completion of erection, touch-up field welds, bolts and burnt or scratched surfaces with primer.

.9 Where gratings or trench covers are cut in field or damaged, touch up with zinc rich paint.

8 GENERAL WIRING REQUIREMENTS

8.1 Wiring Terminations

.1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

.2 Manufacturers' and CSA labels to be visible and legible after equipment is installed.

8.2 Location of Outlets

.1 Locate outlets in accordance with Division 01 - General Requirements.

.2 Do not install outlets back-to-back in wall.

.3 Where back boxes on opposite sides of a wall occupy the same stud bay, apply acoustical putty pads to the outside of the boxes.

.4 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm (10'), and information is given before installation.

.5 Locate light switches on latch side of doors. Locate disconnect devices in mechanical and elevator machine rooms on latch side of door.

8.3 Mounting Heights

.1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.

.2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

.3 For Barrier Free areas verify the mounting heights with the authority having jurisdiction prior to rough-in.

.4 Install wall-mounted electrical devices at elevations in accordance with the Architectural drawings. In the absence of such drawings, install at elevations in accordance with the following heights unless otherwise shown.

Description	Barrier Free	General Area
Local switches	1050 mm (41")	1200 mm (47")
Wall receptacles: General	450 mm (18")	300 mm (12")
Wall receptacles: Hospitals	450 mm (18")	450 mm (18")
Wall receptacles: above top of continuous baseboard heater	200 mm (8")	200 mm (8")
Wall receptacles: above top of counters or counter splash backs	175 mm (7")	175 mm (7")
Wall receptacles shown above top of counters where there is no counter: height above finished floor	1050 mm (41")	1200 mm (47")
Wall receptacles: In Mechanical rooms	1050 mm (41")	1200 mm (47")
Telephone outlets	450 mm (18")	300 mm (12")
Outlets for wall mounted telephones	1000 mm (39")	1500 mm (59")
Fire alarm pull stations	1200 mm (47")	1500 mm (59")
Fire alarm bells	2100 mm (83")	2100 mm (83")
Wall mounted speakers	2100 mm (83")	2100 mm (83")
Wall mounted door operator push pads	1000mm (39”)	1000mm (39”)
Wall or floor mounted, vertical panel type door operator controls	from ≤200mm to ≥900mm (from ≤7.9” to ≥36”)	from ≤200mm to ≥900mm (from ≤7.9” to ≥36”)
Television outlets	450 mm (18")	300 mm (12")
Clocks	2100 mm (83")	2100 mm (83")
Other controls	1050 mm (41")	1200 mm (47")
Panelboards	As required by code or as indicated	As required by code or as indicated

8.4 Conduit and Cable Installation

.1 Install embedded conduit prior to pouring of concrete.

.2 Arrange for holes through exterior walls and roof to be flashed and made weatherproof under Division 7.

.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.

.4 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions and assistance to locate and install inserts.

.5 Secure inserts firmly to form work before concrete is poured.

.6 Provide insert drawings as required.

8.5 Plywood Backboards

.1 Provide plywood backboards in electrical and telecommunications rooms and closets where indicated or specified for mounting of equipment.

.2 Plywood to be securely attached to the building structure.

.3 Plywood to be 19mm, void free, good one side, mounted with good side exposed.

.4 Plywood to be Class A fire retardant, FSC certified and contain no added urea formaldehyde.

END OF SECTION

PAINTING FOR ELECTRICAL SERVICES
26 05 02

1 GENERAL

1.1 Scope

.1 Provide industrial sealer and anti-corrosion coatings for electrical building services and related construction elements including:

.1 electrical services and supporting elements as specified under other sections of Divisions 26 to 28,

.2 concrete curbs, housekeeping pads, floor trenches and electrical containment floor areas,

.2 General painting of service room floors and decorative finish painting of building services is provided under Division 09.

1.2 Applicable Codes and Standards

.1 Legislation:

.1	SOR/2009-264	Canadian Environmental Protection Act, *Volatile Organic Compound (VOC) Concentration Limits for Architectural Coatings Regulations*

.2 Installation standards and codes:

.1	LEED v4	New Construction, credit EQ Cr 4.2
.2	SSPC	Society for Protective Coatings, Surface Preparation Standards

.3 Product standards:

.1	Green Guard GC-03	Green Seal Environmental Criteria for Anti-Corrosion Paints

1.3 Submittals

.1 Submit product data sheets which demonstrate compliance with LEED VOC requirements.

2 PRODUCTS

2.1 Industrial Anti-Corrosion Coatings – Carbon Steel Materials

.1 Outdoor applications:

.1	top coat:	industrial urethane alkyd enamel top coat, or single compound 100% acrylic coating,
.2	primer coat:	as per manufacturers' recommendation for coating of steel piping,
.3	colour:	Sherwin Williams No SW4027 (Galvano), unless specified elsewhere,
.4	VOC limit:	340 g/L of product less water and excluded compounds.

Standard of Acceptance
- Sherwin Williams – Pro Industrial Urethane Alkyd Enamel
- Sherwin Williams – Pro Industrial Acrylic

.2 Indoor applications:

.1	top coat:	single compound 100% acrylic coating,
.2	primer coat:	as per manufacturers' recommendation for coating of steel piping,
.3	colour:	Sherwin Williams No SW4027 (Galvano), unless specified elsewhere,

.4 LEED: certified to Green Guard standard GC-03 for anti-corrosion coatings,

.5 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Pro Industrial Acrylic

.3 Zinc rich primer applications for field painting of carbon steel material, or touch-up of galvanized steel material:

.1 top coat: as specified for interior or exterior applications,

.2 primer: single or multi-part zinc rich coating,

.3 colour: gray-green,

.4 LEED compliance: certified to Green Guard standard GC-03 for anti-corrosion coatings,

.5 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Zinc Clad III HS 100

2.2 Industrial Coatings – Poured Concrete

.1 For field painting of concrete floor trenches, housekeeping pads, and curbs in service rooms:

.1 resistant to fuel oil, general solvents and water,

.2 top coat: water based urethane floor enamel,

.3 primer coat: water based epoxy,

.4 colour: Sherwin Williams Deck Gray,

.5 colour: Sherwin Williams Safety Yellow where shown,

.6 VOC limit: 250 g/L of product less water, U.S. EPA method 24.

Standard of Acceptance

- Sherwin Williams – Armorseal Floor Plex 7100 Primer / Amorseal 1K Topcoat

3 EXECUTION

3.1 General

.1 Refer to requirements for services to be painted in the relevant sections of Division 26 to 28 and as follows.

.2 Touch up any damage to factory prime coat resulting from shipping or installation with appropriate primer for indoor/outdoor installation with appropriate top coat, of colour to match existing. Materials to be compatible with the original factory finish.

.3 Touch up any damage to factory galvanized finish resulting from site welding, shipping or installation with zinc rich primer.

3.2 Installation

.1 Surface preparation

.1 Clean surfaces to be painted in accordance with paint manufacturer recommendations and as follows.

.2 Surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials at time of application of paint materials.

.3 For carbon steel materials, remove all loose mill scale, loose rust, loose paint, and other loose detrimental foreign matter by hand chipping, scraping, sanding, and wire brushing in accordance with SSPC-SP2 Hand Tool Cleaning.

.4 For galvanized steel material, solvent clean to SSPC-SP1 Solvent Cleaning. If galvanized surface is already rusty, remove loose rust and dirt in accordance with SSPC-SP2 and prime the exposed metal the same day as being cleaned.

.5 For concrete materials, clean surfaces to SSPC-SP13/NACE 13 by mechanical, chemical or thermal methods.

.6 Tape-off adjacent materials which are not to be painted. Provide drop sheets to protect other surfaces from falling paint or over-spray.

.2 Application - General

.1 Apply one coat of primer to metal items, with exception of galvanized or concrete encased items.

.2 Use primer unadulterated, as prepared by manufacturer.

.3 Apply top coat in the number of coats recommended by the manufacturer, to obtain 100% coverage to the minimum recommended thickness, free of streaks, drips and sags.

.4 Do not paint when temperature is lower than 7^{o}C.

.3 Application – Galvanized base metal finish

.1 Where material is galvanized, touch up welded sections or other locations where protective galvanized surface has been damaged, with zinc rich primer.

.2 Apply a top coat to match base material colour.

.4 Application – Concrete trenches, housekeeping pads, curbs:

.1 Apply one coat of primer and two top-coats.

.2 After paint has dried, seal joints between curbs and floors with a silicone based industrial caulking in matching colour.

End of Section

EXCAVATION AND BACKFILL
26 05 07

1 GENERAL

1.1 Scope

.1 Excavation and backfilling both inside and outside building and poured in place concrete for outside buried services will be done under other Divisions.

.2 Coordinate with the site services work to be performed under other Divisions of the Work.

1.2 Applicable Codes and Standards

.1 Legislation:

.1 Occupational Health and Safety Act, and Regulations for Construction Projects

.2 Occupational Health and Safety Act, and Regulations for Industrial Establishments.

.2 Installation codes and standards:

.1 ASTM D698 Test method for Laboratory compaction characteristic of soil using standard effort.

.2 [Ontario Provincial Standard Specification 401 Construction Specification for Trenching, Backfilling, and Compacting].

.3 Product standards:

.1 Ontario Provincial Standard Specification 1010 Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material

1.3 Position and Extent of Existing Services

.1 Drawings are schematic and show the approximate routing of underground conduits, ducts, cables and duct banks.

2 PRODUCTS

2.1 Aggregates

.1 Gradations to be within limits specified when tested to ASTM C136 and ASTM C117. Sieve sizes to CAN/CGSB-8.1.

.2 Fine aggregates to be one, or blend of the following:

.1 natural sand,

.2 manufactured sand,

.3 screenings produced in crushing of quarried rock, boulders, gravel or slag.

.3 Coarse aggregates to be one of or blend of the following:

.1 crushed rock,

.2 gravel composed of naturally formed particles of stone.

2.2 Asphalt Material

.1 Anionic emulsified asphalt to CAN/CGSB-16.2, grade SS-1.

.1 aggregate material of crushed stone or gravel.

.2 thoroughly mixed to achieve a uniform coating of asphalt over the aggregate.

2.3 Concrete

.1 As specified in Division 3, Cast-in-Place Section.

2.4 Warning Tapes

.1 Non-Detectable Warning tape:

.1 suitable for direct burial,

.2 polyethylene,

.3 150 mm (6”) wide,

.4 continuous black lettering on red background, indicating buried electrical services below.

.2 Detectable warning tape:

.1 waterproof and corrosion proof, suitable for direct burial,

.2 detectable from grade using a metal detector,

.3 metallic core encased in polyethylene or polyester,

.4 continuous black lettering indicating buried electrical services below.

3 EXECUTION

3.1 Preparation Prior to Excavation

.1 Carefully review drawings of other trades.

.2 Examine Architectural Drawings to determine where excavations for this Work interfere with new or existing paved areas, curbs, walks, concrete floors and other finished floors.

.3 Obtain current “locates reports” for existing buried services from:

.1 local government source,

.2 service providers as applicable, or

.3 a professional locate service.

.4 Review “locates reports” for any interferences with the Work.

.5 Carefully check on site, the actual locations of existing services shown on the drawings and report any serious discrepancies.

.6 Layout the final routing of services.

3.2 Excavation

.1 Saw cut pavements, curbs and sidewalks before proceeding with excavation.

.2 Excavate as required for the Work, both inside and outside the building.

.3 Remove and dispose of concrete, masonry paving, walks, demolished foundations, rubble, and other obstructions encountered in course of excavation.

.4 Shore and brace excavations exceeding 1200 mm (48 in) in depth in accordance with applicable Occupational Health and Safety Act and provincial regulations.

.5 Provide bracing, shoring and underpinning as required to prevent movement or settlement of adjacent structures, earth, services, walks, paving, trees, curbs, adjacent grade.

.6 Carefully check and avoid disturbing or damaging any existing underground piping, conduit or other services uncovered during execution of the Work.

.7 Prior to any excavation close to building footings, obtain approval from project structural engineer.

.8 Do not excavate within the 45 degree splay of bearing from the bottom of any footing without written permission from the project structural engineer.

.9 Do not disturb soil within branch spread of trees or shrubs that are to remain. Where excavating through roots, excavate by hand and cut roots with sharp axe or saw. Seal cuts with approved tree wound dressing.

.10 Make good at no cost to the Owner any damage caused by settlement resulting from the excavation.

.11 Cleanly cut and trim banks of excavations and shore as required to prevent caving in.

.12 Replace, in an acceptable manner, excavation which has been carried to a depth greater than shown or authorized, with10 MPa concrete, at no additional expense to Owner, to give a bearing value equal to that provided by undisturbed soil.

.13 Prepare excavation for underground services so that no portion of any conduit, duct, cable or duct bank bears directly against any rock or other hard surface.

.14 Form bottoms of trenches so that pipes, conduits, duct banks, etc. are supported on undisturbed soil and will not be subject to undue strain.

.15 Grade bottoms of excavation for conduits, ducts or duct banks to provide drainage.

.16 Report to the Consultant any unsuitable sub grade conditions.

.17 Remove rock encountered by drilling and wedging. Blasting will not be allowed unless approved and authorized in writing.

.18 Break up rocks and boulders removed from excavations as required to permit handling.

3.3 Protection

.1 Store excavated materials in acceptable locations and in a manner so as to minimize damage to existing surfaces.

.2 Cover excavated materials and provide protection to prevent runoff into local drainage facilities.

.3 Protect from freezing, excavated earth that is to be used for backfilling.

.4 Grade around excavations to prevent surface water runoff into excavated area.

.5 Keep excavations dry by bailing, pumping or other acceptable means.

.6 Cleanly cut and trim banks of excavations and shore as required to prevent caving in.

.7 Keep sides and bottoms of excavations from freezing and protect as required to prevent damage to the Work or to existing services, by weather or other conditions.

3.4 Backfilling

.1 Prior to backfilling, remove formwork, shoring etc.

.2 Do not commence backfilling until approval has been obtained.

.3 Backfill as required for the Work, both inside and outside the building

.4 Provide detectable warning (tracer) tape directly above centerline of buried services.

.5 Provide non-detectable warning (marker) tape midway between buried services and finished grade.

.6 For trenches exceeding 500 mm (20") in width, provide two non-detectable warning (marker) tapes, one laid 100 mm (4") from each trench edge, midway between buried services and finished grade.

.7 Backfill excavations, required in close proximity to, or below footing level with 10 MPa concrete up to the top of highest adjacent footing.

.8 Where solid undisturbed soil is not obtainable at the trench level eg: adjacent to a foundation wall or maintenance hole, provide granular 'A' material from undisturbed soil, compacted in 300mm (12") layers up to bottom of trench.

.9 Do not use frozen earth for backfilling nor place any backfilling on or against frozen earth.

.10 Repair, at no cost to the Owner, any of the Work and existing services damaged during backfilling.

.11 Backfill trenches under building floors, roads and paved areas with sand placed in layers and compacted in an approved manner to achieve 95% modified Proctor compaction. Do not use material from excavation for backfilling.

.12 For conduits, ducts and cables;

.1 provide a base layer of sand at least 100mm (4") deep,

.2 tamp sand around and over conduits, ducts and cables, in 150 mm (6") layers to a height of at least 300 mm (12") above top of conduits, ducts and cables.

.3 compact each sand layer,

.4 fill remainder of trench in 300 mm (12") layers with approved excavated material, free from stone,

.5 compact each layer to prevent undue settlement.

.13 For duct banks at maintenance holes and foundation walls;

.1 backfill in 300mm (12") layers with Granular 'A' material to height of at least 300 mm (12") above top of duct banks,

.2 compact each layer,

.3 fill remainder of space in 300 mm (12") layers with approved excavated material, free from stone,

.4 compact each layer to prevent undue settlement.

.14 Where excavations interfere with new or existing paved areas, curbs, walks, concrete floors and other finished floors, backfill with sand.

.15 Patch paved areas, walls, walks, lawns and road surfaces, damaged by the Work, in an acceptable manner.

.16 Make up settlement of backfilling as soon as possible. Fill depressions to restore the correct grade after a period, adequate to reveal settlement, has passed. Make good any subsequent settlement of such fill.

.17 Pay costs to make good paving, lawns, curbs and any other surfaces damaged by settlement and subsequent restoration.

.18 Dispose of excess excavated material and leave the site clean.

3.5 Traffic Control

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

.2 When working on traveled way:

.1 place equipment in positions to present minimum of interference and hazard to traveling public,

.2 keep equipment units as close together as working conditions permit and preferably on same side of traveled way,

.3 do not leave equipment on traveled way overnight.

.3 Do not close any lanes of road without approval of Consultant.

.4 Before re-routing traffic erect suitable signs and devices.

.5 Keep traveled way graded, free of pot holes and of sufficient width for required number of lanes of traffic.

3.6 Informational and Warning Devices

.1 Provide and maintain signs, [flashing warning lights] and other devices required to indicate construction activities or other temporary and unusual conditions resulting from the Work that requires road user response.

.2 Supply and erect signs, delineators, barricades and miscellaneous warning devices as required by the Provincial Standards.

.3 Place signs and other devices in acceptable locations.

.4 Meet with the Consultant prior to commencement of the Work to prepare a list of signs and other devices required. If the situation on site changes, revise the list, acceptable to the Consultant.

.5 Continually maintain traffic control devices in use by:

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

.2 relocating, removing or covering signs and other devices which do not apply to the prevailing conditions,

.3 adding signs and other devices to suit the prevailing conditions.

3.7 Control of Public Traffic

.1 Provide flag persons, trained in accordance with, and properly equipped as specified in, MUTCD and Provincial Standards for Roadways and Public Works, in the following situations:

.1 when public traffic is required to pass working vehicles or equipment which block all or part of traveled roadway,

.2 when it is necessary to institute one-way traffic system through the construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use,

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

.4 where temporary protection is required while other traffic control devices are being erected or taken down,

.5 for emergency protection when other traffic control devices are not available,

.6 in situations where it is deemed necessary for the protection of workmen, equipment and public traffic.

.2 Where a roadway, carrying two-way traffic, is restricted to one lane, for 24 h each day, provide a portable traffic signal system. Adjust, as necessary, and regularly maintain the system throughout the period of restriction. Signal system to meet requirements of Provincial Standards.

3.8 Restoration of Roads

.1 Restore roads in accordance with the requirements of the Provincial Standards for roadways and public works. Place and compact aggregate sub-base over duct banks and excavation.

.2 Do not place frozen material.

.3 Place material only on clean unfrozen surfaces, free from snow and ice.

.4 Shape each layer to smooth contour and compact to density of not less than 98% corrected maximum dry density.

.5 Place and compact asphalt material on base surface in a layer of uniform depth and width. Compact to achieve the required density.

END OF SECTION

LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS
26 05 19

1 GENERAL

1.1 Scope

.1 Provide wires and cables for systems operating between 0 and 1000 Volts, including:

- .1 building wires,
- .2 armoured cables,
- .3 aluminium sheathed cables,
- .4 mineral insulated cables including fire rated cables,
- .5 instrumentation and control cabling.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	26 05 33	Conduits, Fastenings and Fittings
.2	26 05 37	Wireways and Auxiliary Gutters
.3	26 27 28	Wire and Box Connectors - 0 - 1000 V

1.3 Applicable Codes and Standards

.1 Product standards:

.1	CSA C22.2 No. 38	Thermoset-Insulated Wires and Cables
.2	CSA C22.2 No. 51	Armoured Cables
.3	CSA C22.2 No. 94.1	Enclosures for Electrical Equipment, Non-Environmental Considerations
.4	CSA C22.2 No. 123	Metal Sheathed Cables
.5	CSA C22.2 No. 124	Mineral-Insulated Cables
.6	CSA C22.2 No. 131	Type TECK 90 Cable
.7	CSA C22.2 No. 239	Control and Instrumentation Cables
.8	ULC S139	Standard for Fire Test for Circuit Integrity of Fire-Resistive Power, Instrumentation, Control, and Data Cables

1.4 Design Criteria

.1 Conductor sizes are based on connected equipment having a temperature marking of 75°C or higher. Where equipment does not have a temperature marking or it has a marking lower than 75°C, increase the size of the conductors accordingly, to the satisfaction of the consultant.

.2 For wires in conduit, conductor sizes are based on not more than 3 current carrying conductors in a conduit. Where more than 3 current carrying conductors are installed in a conduit increase the conductor size accordingly, to the satisfaction of the consultant.

.3 Do not reduce conductor sizes, conductors may have been oversized due to voltage drop constraints.

1.5 Submittals

.1 Submit product data sheets for materials specified herein.

2 PRODUCTS

2.1 Building Wires

.1 Conductors: copper conductors: size as indicated..

.2 Minimum wire size: No. 12 AWG.

.3 Stranded conductors for 10 AWG and larger.

.4 Insulation:

.1 chemically cross-linked thermosetting polyethylene material,

.2 RW90 or RWU90 to CSA C22.2 No. 38,

.3 RWU90 if run exterior to building,

.4 1000V and 600V ratings.

.5 Conductors to be colour coded. Conductors to have colour impregnated into insulation at time of manufacture. Phase conductors No. 8 AWG and larger, with black insulation, may be colour coded with adhesive colour coding tape.

Standard of Acceptance

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

2.2 Armoured Cables

.1 Type: AC90, 600V 90C to CSA C22.2 No. 51, FT4 rated.

.2 Conductors:

.1 copper, minimum size #12,

.2 bare copper bonding wire sized per the electrical code.

.3 Insulation: RW90 XLPE.

.4 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

2.3 Armoured Cables with Insulated Bonding Conductor

.1 Type: AC90 ISO-BX, 600V 90C to CSA C22.2 No. 51, FT4 rated.

.2 Conductors:

.1 copper, minimum size #12,

.2 green insulated copper bonding wire, same size as the phase conductors.

.3 Insulation: RW90 XLPE.

.4 Armour: interlocking type fabricated from galvanized steel or aluminum strip.

2.4 Armoured Cables ACWU

.1 Type: ACWU90, 600V to CSA C22.2 No. 51.

.2 Conductors: insulated [copper,][copper for sizes up to #1 AWG, aluminum for sizes #1/0 and larger,] quantity and size as indicated.

.3 Insulation: RW90 XLPE.

.4 Armour: interlocking aluminum.

.5 Bonding conductor:

.1 bare in multiconductor cables,

.2 bare concentric in single conductor cables,

.3 copper or same material as phase conductors.

.6 Jacket: FT-4 rating with rating permanently identified on jacket.

.7 Connectors:

.1 Watertight.

.2 Non-magnetic for single conductor cables.

2.5 Armoured Cables Teck

.1 Type: TECK90, 600V to CSA C22.2 No. 131.

.2 Conductors: insulated copper, quantity and size as indicated.

.3 Insulation: RW90 XLPE.

.4 Inner jacket; FT-4 rated PVC.

.5 Armour: interlocking steel for multiconductor cable, interlocking aluminum for single conductor cables

.6 Bonding conductor:

.1 bare in multiconductor cables,

.2 bare concentric in single conductor cables,

.3 same material as phase conductors,

.4 copper for feeders serving patient care areas,

.5 isolated from the armour by the inner jacket.

.7 Outer jacket: FT-4 rating with rating permanently identified on jacket.

.8 Connectors:

.1 Watertight,

.2 Equal to T&B Star Teck type,

.3 Non-magnetic connectors for single conductor cables.

Standard of Acceptance (armoured, aluminium sheathed and TECK cables)

- Aetna Insulated Wire
- General Cable
- Nexans Canada Inc.
- Northern Cables Inc.
- Prysmian Cables & Systems Ltd.
- Southwire

2.6 Fire Rated Mineral Insulated Cable

.1 Type: MI, 600V to CSA C22.2 No. 124.

.2 Conductors: solid annealed copper, quantity and size as indicated.

.3 Insulation: compacted magnesium oxide.

.4 Sheath: seamless annealed copper.

.5 Terminations: as supplied by the cable manufacturer.

.6 Polymer jacket on cables that are to be buried or embedded, or installed exterior or in environments corrosive to copper.

.7 Fire rating: listed 2 hour rating to ULC S139, cables labelled accordingly.

.8 Cables to be shipped with ends sealed.

Standard of Acceptance

- Pentair/Pyrotenax System 1850
- Vitalink MC

2.7 Instrumentation and Control Cabling

.1 Control cables to CSA C22.2 NO. 239.

.2 Control cables as follows:

Conductors	Quantity, arrangement and gauge shown on drawings or specified elsewhere.
Identification	Colour coded or numbered.
Insulation	XLPE
Armour	Steel (No armour required if installed in conduit or approved wireway).
Jacket	FT4 Flame Retardant, FT6 when installed in open style cable trays in ceiling spaces that are used as return air plenums.

.3 Shielded cables to provide 100% shield coverage complete with drain wire.

.4 Multipair twisted shielded cables to have individually shielded pairs, overall shield, drain wires and overall rated jacket.

Standard of Acceptance

- General Cable (Carol)
- Belden
- Nexans Canada Inc.

3 EXECUTION

3.1 General

.1 Conductor colour coding to be as follows:

.1 Phase A - Red

.2 Phase B - Black

.3 Phase C - Blue

.4 Neutral - White

.5 Ground - Green

.6 Control - Orange

.2 Where colour coding tape is utilized, apply at least 50 mm (2") at terminations, junction boxes and pull boxes. Do not paint conductors.

.3 Use:

.1 1000 V insulation for 600 Volt systems,

.2 600 V insulation for 347/600 V and 120/208 V systems.

.4 Wiring installed underground: RWU90.

.5 Store wire and cable in a clean, dry, well ventilated area.

.6 Protect white insulated wire from exposure to NOx gas (eg: exhaust from propane fuelled equipment) by wrapping with shrink wrap, by locating away from sources of NOx and by maintaining adequate ventilation to minimize NOx levels.

.7 Where white insulated wire has discoloured:

.1 do not install,

.2 dispose of the wire,

.3 remove and replace wire that has been installed.

.8 Neatly train circuit wiring in cabinets, panels, pullboxes and junction boxes and hold with nylon cable ties.

.9 Splice wires:

.1 up to and including No. 6 AWG: with nylon insulated expandable spring type connectors with moulded thermoplastic body and expandable square edge design spring.

.2 larger than #6 AWG: with compression sleeve connectors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.

.3 aluminum Conductors: with long barrel compression sleeve connectors approved for use with aluminum conductors and heat shrink insulating sleeves, voltage rating of sleeves equal to or greater than the cable.

.10 Do not splice conductors used in parallel runs.

.11 Where the Consultant agrees that splicing of conductors in a parallel run is unavoidable, connect the paralleled runs of the feeder together in a junction box at the splice location, using:

.1 copper bus bars of quantity and size to match the circuit,

.2 a two hole long barrel compression lug on each cable,

.3 two nuts and bolts on each lug,

.4 two oversized flat washers and a spring lock washer, or two Belleville washers, on each bolt,

.5 an oversized enclosure to house the above; CSA 22.2 No 94.1 Type [1][3R][4][12].

3.2 Installation of Building Wires

.1 Install wiring as follows:

.1 in conduit systems in accordance with Section 26 05 33.

.2 in wireways and auxiliary gutters in accordance with Section 26 05 37.

.2 Home runs, of 15 and 20 Ampere circuits to lighting and receptacle panels, which exceed:

.1 25 m (75') in length: No. 10 AWG or larger,

.2 40 m (120') in length: No. 8 AWG or larger,

.3 60 m (180') in length: No. 6 AWG or larger.

.3 Increase the size of branch circuit conductors and home runs as required so that the total voltage drop, from panelboards to loads, does not exceed 3% under load.

.4 For branch circuit wiring provide a dedicated neutral conductor for each phase conductor. Where the load does not produce harmonic currents a common neutral conductor may be used with two or three phase conductors, subject to prior approval by the Consultant.

.5 For branch wiring, common neutral conductors may be used in the following applications:

.1 lighting circuits, excluding dimming circuits,

.2 housekeeping receptacles,

.3 specific purpose receptacles for equipment that does not produce harmonic currents, such as resistance heating.

.6 Where wires are damaged or contaminated during installation, remove and dispose of wires, swab out conduits and pull in new, clean conductors.

3.3 Installation of Armoured Cables AC90(BX)

.1 May be used for drops to surface and recessed mounted fluorescent luminaires.

.2 [May be used for wiring concealed within walls provided that horizontal runs within the ceiling space do not exceed 3m.]

.3 Do not use in patient care areas.

.4 Terminate cables in accordance with Section 26 27 28.

3.4 Installation of Armoured Cables AC90 ISO-BX

.1 May be used for drops to surface and recessed mounted fluorescent luminaires in patient care areas.

.2 May be used for wiring to outlets, receptacles and light switches in patient care areas, provided that the wiring is concealed within walls and that horizontal runs within the ceiling space do not exceed 3m.

.3 [May be used for wiring to isolated ground receptacles, provided that the wiring is concealed within walls and that horizontal runs within the ceiling space do not exceed 3m.]

.4 Terminate cables in accordance with Section 26 27 28.

3.5 Installation of Armoured Cables ACWU and TECK

.1 Install and terminate cables in accordance with manufacturer's recommendations.

.2 Use non-magnetic connectors for single conductor cables.

.3 In systems that serve patient care loads, provide:

.1 cables with copper bonding conductors,

.2 bonding conductors isolated from the cable armour by an inner PVC jacket or by insulation on the bonding conductor.

.4 For single conductor cables in free air circuits rated up to and including 400Amperes:

.1 Space cables one cable diameter apart throughout the run.

.2 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained.

.3 Provide a 6mm thick aluminium termination plate at each end of the run.

.4 Size the termination plates to overlap the openings by at least 20mm on all sides.

.5 Seal the plates to the enclosures with silicone sealant and secure to the enclosures with nuts, bolts and lock washers every 150mm.

.6 Terminate all cables of the circuit on the same terminal plate.

.7 Connect the cable bonding conductors to the enclosure bonding lug or bus at each end of the run.

.8 Bond each aluminium termination plate to its associated enclosure.

.5 For single conductor cables in free air circuits rated greater than 400Amperes:

.1 Space cables one cable diameter apart throughout the run.

.2 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained.

.3 At the supply end of the run:

(a) provide a 6mm thick aluminium termination plate,

(b) size the termination plate to overlap the opening by at least 20mm on all sides,

(c) seal the plate to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,

(d) terminate all cables of the circuit on the terminal plate,

(e) connect the cable bonding conductors to the enclosure bonding lug or bus,

(f) bond the aluminium termination plate to the enclosure.

.4 At the load end of the run:

(a) provide a 6mm thick non-conductive fire-resistant FRP (Glastic) termination panel,

(b) size the termination panel to overlap the opening by at least 20mm on all sides,

(c) seal the panel to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,

(d) terminate all cables of the circuit on the terminal panel,

(e) cut off the cable bonding conductors at the connector and cover with insulating tape, ensure that the cable bonding conductors do not make any electrical contact.

(f) ensure that the cable connectors do not make electrical contact with the enclosure.

.5 Install a separate bonding conductor for the circuit:

(a) of copper wire,

(b) sized per the Electrical Safety Code,

(c) run from the bonding lug or bus in the supply end enclosure to the bonding lug or bus in the load end enclosure,

(d) separated from the phase cables throughout the run, by a distance of not less than the spacing between the phase cables,

(e) securely fastened throughout the run.

.6 For single conductor cables in direct buried circuits:

.1 Space cables apart per Diagram D8 of the electrical code.

.2 Maintain cable spacing throughout the run.

.3 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings of not less than one cable diameter.

.4 At the supply end of the run:

(a) provide a 6mm thick aluminium termination plate,

(b) size the termination plate to overlap the opening by at least 20mm on all sides,

(c) seal the plate to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,

(d) terminate all cables of the circuit on the terminal plate,

(e) connect the cable bonding conductors to the enclosure bonding lug or bus,

(f) bond the aluminium termination plate to the enclosure.

.5 At the load end of the run:

(a) provide a 6mm thick non-conductive fire-resistant FRP (Glastic) termination panel,

(b) size the termination panel to overlap the opening by at least 20mm on all sides,

(c) seal the panel to the enclosure with silicone sealant and secure to the enclosure with nuts, bolts and lock washers every 150mm,

(d) terminate all cables of the circuit on the terminal panel,

(e) cut off the cable bonding conductors at the connector and cover with insulating tape, ensure that the cable bonding conductors do not make any electrical contact,

(f) ensure that the cable connectors do not make electrical contact with the enclosure.

.6 Install a separate bonding conductor for the circuit:

(a) insulated RWU90 copper,

(b) sized per the Electrical Safety Code,

(c) run from the bonding lug or bus in the supply end enclosure to the bonding lug or bus in the load end enclosure,

(d) separated from the phase cables throughout the run, by a distance of not less than the spacing between the phase cables.

3.6 Installation of Mineral Insulated Cables

.1 Provide fire rated mineral insulated cables unless non-fire rated cables are indicated.

.2 Store cables under dry conditions.

.3 Handle cables with care to avoid cable kinks; it is recommended that cable be uncoiled from supply reel by rolling. Do not install kinked cables.

.4 Install and terminate cables in accordance with the manufacturer’s recommendations.

.5 Install fire rated cables in accordance with ULC S139 and in accordance with the manufacturer’s recommendations.

.6 Install cables in trays, on hangers or on channels secured to walls, beams or floor slabs, using clamps supplied by or recommended by the manufacturer.

.7 For cable tray installations:

.1 install fire rated cables in stainless steel trays only,

.2 non fire rated cables may be installed in galvanized, aluminium, fibreglass or stainless steel trays.

.8 Support cables with clamps, straps, clips of:

.1 copper,

.2 stainless steel,

.3 steel material,

.4 aluminum, for non fire rated cables only.

.9 Secure cables so that they cannot contact any dissimilar metals other than the approved supporting materials.

.10 In damp or wet areas wrap cables with electrical tape where the cable contacts the supporting materials unless the supporting materials are copper or stainless steel. For non-fire rated cables only, clamps with integral rubber insets may be used in lieu of tape.

.11 Support fire rated cables:

.1 directly from fire rated structure per ULC FHITC.1850 or, where ULC FHITC.1850 cannot be applied, support cables in accordance with written instructions from the Consultant,

.2 on centres not exceeding:

(a) 1219 mm (4') for cables less than or equal to 7.6mm (0.3”) in diameter,

(b) 1828 mm (6') for cables greater than 7.6mm (0.3”) in diameter,

.3 with stainless steel clamps or straps on cable groups midway between supports, for single conductor cables.

.12 For non-fire rated cables provide supports on centres not exceeding 2000mm (6.56’).

.13 Bend cables using a suitable hickey with a bending radius of not less than six times the cable diameter.

.14 Protect embedded cables from punctures and mechanical damage.

.15 For unjacketed single conductor cables that form a circuit or form one run of a feeder with parallel runs, install the cables with their sheaths in contact with one another throughout their length, excluding 1m at each point of connection to equipment or box.

.16 For single conductor cables in circuits rated 200 A and higher:

.1 Cut an opening in the enclosure at each end of the run, opening to be large enough for all cables of the circuit to pass through with spacings maintained.

.2 Provide a 6mm thick brass termination plate at each end of the run.

.3 Size the termination plates to overlap the openings by at least 20mm on all sides.

.4 Seal the plates to the enclosures with silicone sealant and secure to the enclosures with nuts, bolts and lock washers every 150mm.

.5 Terminate all cables of the circuit on the same termination plate.

.6 Provide a copper bonding conductor, sized per Table 16 of the ESC, from each brass termination plate to the equipment ground lug or bus in the associated enclosure.

.7 Connect to the termination plate and to the equipment ground lug or bus using Burndy YA compression connectors with 12mm stainless steel bolts and matching hardware.

.17 For parallel runs, install cable groups at least 2.15 cable diameters apart.

.18 Terminate cables using glands and seals as supplied by the cable manufacturer. Install gland and seal assemblies using tools specifically designed for the purpose.

.19 For fire rated feeders to fire pump controllers:

.1 terminate the mineral insulated cable in a type 3R junction box located adjacent to the fire pump controller,

.2 extend the feeder using RW90 in EMT, sized to match the ampacity rating of the mineral insulated cables,

.3 connect the EMT to the bottom of the fire pump controller enclosure, do not connect to the top or sides of the controller enclosure.

.20 Upon completion of cable terminations and prior to energization, test the insulation resistance of each cable with an insulation tester. Where measured values are not acceptable to the Consultant, rework or replace the cable until satisfactory results are obtained.

.21 For fire rated cables, provide the services of the cable manufacturer to inspect the cable installation and termination methods and provide a written report documenting that the cables have been installed in accordance with the requirements of the ULC standard and the ULC listing and in accordance with the manufacturer's recommendations. Submit the report to the Consultant.

3.7 Installation of Instrumentation, Communication and Control Cabling

.1 Install wiring as follows:

.1 in conduit systems in accordance with Section 26 05 33,

.2 in wireways and auxiliary gutters in accordance with Section 26 05 37,

.3 in open style cable trays in ceiling spaces, using FT6 plenum rated cable assemblies,

.4 in open style cable trays in ceiling spaces, using FT6 or FT4 rated cable where the ceiling space is not used as a return air plenum, as directed by the Consultant.

.2 Neatly train circuit wiring in cabinets, panels, pull boxes and junction boxes and hold with nylon cable ties.

.3 Run instrumentation, communication and control cabling point to point and terminate on terminal strips. Do not splice communication or control cabling. Where long runs make a continuous point to point installation impractical, make splices on labelled terminal blocks in an accessible labelled terminal cabinet, installed at 1200 mm (48") above floor, and indicate cabinet location, terminal and wire numbers on the As-built drawings.

.4 Terminate control cables in equipment with suitable connectors.

.5 Clearly identify cables at both ends, with permanent PVC wire markers, Weiland type Z or equal, indicating cable number and wire numbers.

3.8 Testing

.1 Insulation resistance testing;

.1 megger circuits, feeders and equipment up to 350 V with a 500 V instrument,

.2 megger 350-600 V circuits, feeders and equipment with a 1000 V instrument,

.3 check resistance to ground before energizing.

END OF SECTION

SECONDARY GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 05 26.16

1 GENERAL

1.1 Scope

.1 Provide grounding and bonding for electrical distribution at 750 V and lower, as shown.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	26 01 01	Electrical General Requirements.
.2	26 05 53	Identification for Electrical Systems.
.3	26 08 05	System Co-ordination, Verification and Testing.

1.3 Applicable Codes and Standards

.1 Installation codes and standards:

.1	ANSI/IEEE 142	IEEE Recommended Practice for Grounding of Industrial and Commercial Power Systems
.2	ANSI/IEEE 837	Standard for Qualifying Permanent Connections Used in Substation Grounding.
.3	ANSI/TIA 568A	General Telecommunications Cabling for Customer Premises
.4	ANSI/TIA 569	Telecommunications Pathways and Spaces
.5	ANSI/TIA 607	General Telecommunications Bonding and Grounding (Earthing) for Customer Premises
.6	CSA-Z32	Electrical Safety and Essential Electrical Systems in Health Care Facilities.]

.2 Product standards:

.1	CSA C22.2 No 41	Grounding and Bonding Equipment.

1.4 Submittals

.1 Submit product data sheets for materials specified herein.

.2 Submit list of nameplates.

.3 Operation and Maintenance Data:

.1 Provide operation and maintenance data for incorporation into operating and maintenance manuals.

2 PRODUCTS

2.1 Clamps

.1 Conductor to water main clamps suitable for grounding connections,

.2 Type and size as required to make electrically conductive connections to underground water pipe,

.3 Non-corroding copper, bronze and/or stainless steel construction.

2.2 Electrodes

.1 Rod electrodes:

.1 material: steel with a bonded copper cladding not less than 254 µm (10 mils) thick],

.2 size: 19 mm dia by 3 m long (¾" dia by 10' long),

.3 listed to C22.2 No 41.

.2 Plate Electrodes:

.1 material: copper

.2 size: 600 x 600,

.3 thickness: 3.2 mm,

.4 listed to C22.2 No 41.

2.3 Conductors

.1 Buried grounding conductors:

.1 bare, stranded, tinned, soft annealed copper,

.2 size #4/0 AWG unless indicated otherwise.

.2 Insulated grounding and bonding conductors:

.1 bare, stranded, soft annealed copper,

.2 type RW90 green insulation.

2.4 Accessories

.1 Accessories including but not limited to:

.1 grounding and bonding bushings,

.2 protective type clamps,

.3 bolted type conductor connectors,

.4 exothermic welded type conductor connectors,

.5 bonding jumpers, straps,

.6 pressure wire connectors,

to be of non-corroding copper, bronze and/or stainless steel construction.

3 EXECUTION

3.1 Installation

.1 Ground electrical systems in accordance with the Electrical Safety Code and the latest edition of ANSI/IEEE Standard 142.

.2 Bond electrical equipment in accordance with the Electrical Safety Code and the latest edition of ANSI/IEEE Standard 142.

.3 Install connectors in accordance with manufacturer's instructions.

.4 Protect exposed grounding and bonding conductors from mechanical injury.

.5 Make buried connections, and connections to conductive water main and electrodes, using copper welding by exothermic process.

.6 Use mechanical connectors for grounding and bonding connections to equipment provided with lugs.

.7 Soldered joints not permitted.

.8 Provide a bonding wire for flexible conduit, connected at both ends to bonding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.

.9 Provide a separate bonding conductor in each conduit:

.1 sized as per Table 16 of the ESC,

.2 not less than #12 AWG copper,

.3 with one bond conductor for every three line conductors.

.10 Bond building structural steel and metal siding to ground by welding copper to steel.

.11 Make grounding connections in radial configuration only, with connections terminating at a single grounding point. Avoid loop connections.

.12 Install grounding conductors outside electrical rooms and electrical closets in PVC conduit and conceal where possible. Where PVC conduit is not permitted use EMT and bond the EMT to the conductor at both ends.

3.2 Electrodes

.1 Make ground connections to continuously conductive underground water pipe on street side of water meter.

.2 Provide a 4/0 AWG copper water meter shunt.

.3 Install electrodes and make grounding connections.

.4 Bond grounding electrodes together with 4/0 AWG copper conductors.

.5 For main electrical rooms on grade, provide a rod electrode at each corner of the room and connect to perimeter ground bus.

.6 For main electrical rooms on a suspended slab, provide:

.1 two runs of 4/0 AWG copper conductor,

.2 connect runs to opposite corners of the perimeter ground bus,

.3 install in PVC conduit,

.4 run via separate routes,

.5 connect to opposite corners of the building ground grid.

.7 Where high resistivity soil conditions exist such as rock or sand, provide:

.1 additional electrodes,

.2 deeper electrodes,

.3 soil enhancement material or,

.4 chemically filled grounding rods,

as required to achieve an acceptable resistance to ground value.

3.3 System Grounding

.1 Provide system grounding connections to neutral point of secondary systems using not less than #6 copper conductor unless indicated otherwise.

.2 Install insulated copper grounding conductor for service raceways and service equipment as required by the electric utility company.

.3 Install grounding conductors in PVC conduit.

3.4 Equipment Bonding

.1 Install insulated copper bonding connections:

.1 sized not less than #12 AWG and not less than indicated in Table 16 of the electrical code,

.2 to typical equipment including, but not necessarily limited to the following list:

(a) service equipment,
(b) transformers,
(c) switchboards,
(d) panelboards,
(e) splitters,
(f) disconnect switches,
(g) junction and outlet boxes,
(h) receptacles,
(i) luminaires,
(j) transfer switches,
(k) UPS systems,
(l) battery enclosures,
(m) capacitor banks,
(n) frames of motors,
(o) frames of generators (alternators),
(p) motor control centres,
(q) starters,
(r) fire alarm systems,
(s) security systems,
(t) CCTV systems,
(u) audio systems,
(v) communications systems,
(w) control panels,
(x) outdoor lighting,
(y) elevators,
(z) other equipment that is supplied with electrical power.

.2 Where applicable, run bonding conductors as part of the feeder.

.3 Where bonding conductors are run separately, install in PVC conduit.

.4 In healthcare facilities, for circuits to patient care receptacles, oversize the bonding conductor as necessary to comply with the voltage drop criteria in CSA standard Z32.

3.5 Communications Systems

.1 Install bonding connections for telephone, sound, fire alarm, intercommunication systems as follows:

.1 telephones: make telephone bonding system in accordance with telephone company's requirements,

.2 communications system bonding: in accordance with ANSI/TIA 607, 568A, 569 standards,

.3 sound, fire alarm, intercommunication systems: as required by the electrical code except where indicated otherwise.

3.6 Bonding of Other Items

.1 Install insulated copper bonding connections:

.1 sized not less than #6 AWG,

.2 run in PVC conduit,

.3 to typical items including, but not necessarily limited to following list:

(a) metallic water piping systems,

(b) metallic waste water piping systems,

(c) metallic gas piping systems,

(d) metallic vacuum piping systems,

(e) metallic compressed air piping systems,

(f) building steel work.

.2 Review the design and installation of each piping system with the system installer and provide bonding jumpers where necessary to ensure that each piping system is electrically continuous.

3.7 Identification

.1 For the grounding of each electrical system, show the location and method of grounding on the single line electrical diagrams, in accordance with Section 26 05 53.

3.8 Field Quality Control

.1 Perform tests in accordance with:

.1 Section 26 01 01 - Electrical General Requirements.

.2 Section 26 08 05 - System Co-ordination, Verification and Testing.

.2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.

.3 Perform tests before energizing electrical system.

END OF SECTION

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 05 29

1 GENERAL

1.1 Scope

.1 Provide fasteners and supports for electrical services.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 01 61 00 Common Product Requirements.

.2 26 05 01 Electrical Basic Materials and Methods

.3 26 05 49.13 Seismic Restraint for Electrical Services

1.3 Submittals

.1 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.

.1 Shop drawing details:

(a) construction detail drawings for each loading condition,

(b) span deflection calculations,

(c) building attachment load calculations and type.

.2 Provide services of engineer who sealed the custom trapeze hanger shop drawings to conduct a general review of the completed installation on site.

2 PRODUCTS

2.1 Support Channels

.1 Hot dipped galvanized steel, U shape, size 41 mm x 41 mm x 2.5 mm (1-1/2" x 1-1.2" x 1/10") thick, surface mounted, suspended or set in poured concrete walls and ceilings.

2.2 Inserts

.1 Inserts for conduits and raceway hangers, for single, double and multiple runs: galvanized steel.

Standard of Acceptance

- Unistrut Canada
- Burndy (Canada) Ltd. - Flexibar
- Pilgrim Technical Products Ltd. - Tufstrut

2.3 Hangers

.1 Hangers for electrical conduit: hot-dipped galvanized after fabrication.

Standard of Acceptance

- Burndy Canada Ltd.
- Canstrut
- Electrovert Ltd.

- E. Myatt & Co. Ltd
- Steel City Electric Ltd.
- Pilgrim Technical Products Ltd.

2.4 Trapeze hangers

.1 Performance:

.1 Manufactured:

(a) to product load listings.

.2 Custom fabricated:

(a) maximum deflection between supports: 1/250 (0.4%) of span

(b) minimum factor of safety : 5 times load to ultimate tensile or compressive strength.

.2 Construction:

.1 Carbon steel shapes, to suit load application:

(a) hollow steel section,

(b) equal leg El section, or

(c) double C channel “strong-back”, with welded clips.

.2 Hanger rods:

(a) as specified above, and

(b) minimum two support rods,

(c) rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.

.3 Finish:

.1 hot dipped galvanized finish in mechanical rooms and outdoors.

.2 black steel finish in other areas.

Standard of Acceptance

- Anvil Fig 45, 46, 50

3 EXECUTION

3.1 Installation

.1 Supply and deliver inserts to site in ample time to be built into work of other trades. Provide necessary templates and adequate instructions to locate and install inserts.

.2 Secure equipment to masonry, tile and plaster surfaces with lead anchors.

.3 Secure equipment to poured concrete with expandable inserts.

.4 Secure surface mounted equipment with T-bar support hanger fastened to inverted T bar ceilings. Ensure that T bars are adequately supported to carry weight of equipment specified before installation.

Standard of Acceptance

- Caddy - fig. No. 512 c/w BHC clip

.5 Support equipment, conduit or cables using clips, spring loaded bolts, cable clamps designed as accessories to basic channel members.

.6 Fasten exposed conduit or cables to building construction or support system using straps.

.1 One-hole steel straps to secure surface conduits and cables 50 mm (2") and smaller.

.2 Two-hole steel straps for conduits and cables larger than 50 mm (2").

.3 Beam clamps to secure conduit to exposed steel work.

.7 Suspended support systems.

.1 Support individual cable or conduit runs with 6 mm (¼") dia threaded rods and spring clips.

.2 Support 2 or more cables or conduits on channels supported by 6 mm (¼") dia threaded rod hangers where direct fastening to building construction is impractical.

.8 For surface mounting of two or more conduits use channels.

.9 Provide galvanized after fabrication metal brackets, frames, hangers, clamps and related types of support structures where indicated or as required to support conduit and cable runs.

.10 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

.11 Do not use wire lashing or perforated strap to support or secure raceways or cables.

.12 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of [Engineer][Consultant].

.13 Install fastenings and supports as required for each type of equipment cables and conduits, and in accordance with manufacturer's installation recommendations.

.14 Supply and erect special structural work required for the installation of electrical equipment. Provide anchor bolts and fastenings unless noted otherwise. Mount equipment required to be suspended above floor level, where details are not shown, on a frame or platform bracketed from the wall or suspended from the ceiling. Carry supports to either the ceiling or the floor, or both as required, at locations where, because wall thickness is inadequate, it is not permitted to use such brackets.

.15 Electrical panels, switches or other electrical equipment shall be complete with suitable bases or mounting brackets. Install angle or channel iron supports to bear the equipment where it is shown in or on structural tile walls, or walls that are inadequate to bear the equipment.

.16 Provide channel iron or other metal supports where necessary to adequately support lighting fixtures. Do not use wood. Lighting fixtures shall be supported totally independent of ceiling and supported from structure above.

.17 Support hangers, in general, from inserts in concrete construction or from building structural steel beams, using beam clamps. Provide additional angle or channel steel members required between beams for supporting conduits.

.18 Do not use explosive drive pins in any section of work without obtaining prior written approval.

.19 Provide re-enforced concrete pads under switchboards, generators, and all other floor mounted electrical equipment. Pads are to formed with chamfered edges to prevent chipping. Pads are to be sealed and painted to prevent dust from entering and interfering with electrical equipment.

3.2 Housekeeping Pads

.1 Conform to Specification section 26 05 01.

END OF SECTION

SPLITTERS, JUNCTION AND PULL BOXES, CABINETS
26 05 32

1 GENERAL

1.1 Scope

.1 Provide splitters, junction boxes, pull boxes and cabinets.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 26 24 16.14 Panel Trim

1.3 Applicable Codes and Standards

.1 Product standards:

.1 CSA C22.2 No. 76 Splitters.

.2 CSA C22.2 No. 40 Junction and Pull Boxes.

1.4 Submittals

.1 Submit shop drawings and product data for cabinets in accordance with Section 26 05 01 Electrical General Requirements.

2 PRODUCTS

2.1 Splitters

.1 Sheet metal enclosure, welded corners and formed hinged cover suitable for locking in closed position.

.2 Main and branch lugs and connection bars to match required size and number of incoming and outgoing conductors as indicated.

.3 At least three spare terminals on each set of lugs in splitters.

.4 Distribution riser splitters shall be of special construction with hinged access door, copper bus bars predrilled to accept two hole compression connectors for all incoming and outgoing cables.

2.2 Junction and Pull Boxes

.1 Welded steel hot dipped galvanized construction with screw-on flat covers for surface mounting.

.2 Covers with 25 mm (1") minimum extension all around, for flush-mounted pull and junction boxes.

2.3 Cabinets

.1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.

.2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing sheet steel backboard for surface or flush mounting as indicated.

.3 Cabinet trim to conform to Specification section 26 24 16.14.

.4 Surface mounted cabinet finish colour: ASA 61 grey.

2.4 Instrumentation and Control Terminal Cabinets

.1 Surface mounted, gasketed, drip proof and dust tight, JIC enclosure, CEMA type 12 With hinged door, lock, 2 keys, white raised and removable internal mounting panel, diagram pocket, finished with ASA 61 grey.

Standard of Acceptance

- Hammond

.2 Panel wiring to be contained in PVC wiring ducts complete with cover strips, minimum 50 mm x 50 mm (2" x 2"). Wireway fill to be limited to 60%. Where there are a large number of door mounted devices, door wiring harnesses shall also be contained in wiring ducts at rear door. All door wiring devices to emanate from the control panel terminal strips. Wiring to panel face mounted devices to be bundled neatly on hinge side of panel, enclosed in flexible spiral wrap, and installed such that wiring will not be damaged when opening and closing door. Ground panel door to panel with a flexible copper bonding strap. Label all wiring with permanent PVC sleeve type markers.

.3 Phoenix contact terminal blocks with mounting rails, end covers, terminal markers, partition plates and accessories: UK 2.5 termination of wiring 22 to 12 AWG; UK 5 and UK 10 series for current transformers and other leads #10 AWG and #8 AWG; UDK or UK 5 twin for connecting two or more conductors to one terminal block; DIK 1.5 for three wire sensor device wiring; MTKD for thermocouple leads.

.4 Provide lamacoid nameplates for all panel mounted control and indicating devices, and all internal components such as terminal strips, control transformers, control devices, relays, etc. as per 26 05 01.

3 EXECUTION

3.1 Splitter Installation

.1 Install splitters and mount plumb, true and square to the building lines.

.2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 Junction, Pull Boxes and Cabinets Installation

.1 Install pull boxes in inconspicuous but accessible locations.

.2 Mount cabinets with top not higher than 2 m (6'-6") above finished floor.

.3 Install terminal block as indicated in Type T cabinets

.4 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m}[100'} of conduit run between pull boxes.

3.3 Identification

.1 Provide equipment identification in accordance with Section 26 05 01 - Electrical - General Requirements.

.2 Install size 2 identification labels indicating system name, voltage, phase and source of power.

.3 Provide a typed directory in cabinets showing following information: Nature, actual quantities and room number of device or devices connected to each terminal, as well as signal circuit number where applicable.

END OF SECTION

CONDUITS, FASTENINGS AND FITTINGS
26 05 33

1 GENERAL

1.1 Scope

.1 Provide conduits, fastenings and fittings for electrical conductors.

1.2 Submittals

.1 Submit shop drawings and product data for products specified herein.

1.3 Applicable Codes and Standards

.1 Product standards:

.1	CSA C22.2 No. 18.1	Metallic Outlet Boxes
.2	CSA C22.2 No. 45.1	Electrical Rigid Metal Conduit - Steel
.3	CSA C22.2 No. 83	Electrical Metallic Tubing
.4	CSA C22.2 No. 56	Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit
.5	CSA C22.2 No 211.2	Rigid PVC (unplasticized) Conduit

2 PRODUCTS

2.1 Conduits

.1 Rigid hot dipped galvanized steel threaded conduit to CSA C22.2 No. 45.1.

.1 epoxy coated rigid galvanized steel conduit: with zinc coating and corrosion resistant epoxy finish inside and outside equal to Columbex Green Guard II

.2 PVC coated hot dipped galvanized rigid steel conduit: with 40 mil PVC exterior coating, 2 mil urethane interior and thread coating equal to Rob Roy Plastibond RedHot

.2 Electrical metallic tubing (EMT), [hot dipped] galvanized: with couplings to CSA C22.2 No. 83

.3 Rigid PVC conduit to CSA C22.2 No 211.2.

.4 Flexible metal conduit and liquid-tight flexible metal conduit to CSA C22.2 No. 56.

.5 Size conduits sufficiently to allow easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

2.2 Conduit Fastenings

.1 One hole steel straps to secure surface conduits 50 mm (2 in.) and smaller. Two hole steel straps for conduits larger than 50 mm (2 in.).

.2 Beam clamps to secure conduits to exposed steel work.

.3 Channel type supports for two or more conduits.

.4 Six mm dia threaded rods to support suspended channels.

2.3 Conduit Fittings

.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

.2 Factory "ells" where 90 degree bends are required for 25 mm (1 in.) and larger conduits

.3 Insulated throat steel set screw or raintight insulated throat steel compression connectors and couplings for EMT.

.4 Threaded or compression type raintight/concrete tight insulated throat zinc plated steel connectors and couplings for rigid steel conduit.

.5 Raintight insulated throat steel connectors at all surface panelboards, switchboards and other electrical equipment in sprinklered areas for all conduit terminations.

2.4 Expansion Fittings

.1 Electrogalvanized steel with internal grounding for EMT suitable for 100mm (4 in.) linear conduit movement.

Standard of Acceptance

- Cooper Crouse Hinds XJG-EMT

.2 Weatherproof expansion fittings with internal bonding assembly suitable for 100mm (4 in.) linear expansion.

.3 Watertight expansion fittings with integral bonding jumper suitable for linear expansion and 19 mm (3/4 pm.) deflection in all directions.

.4 Concrete type, water tight, corrosion resistant for conduit installations embedded in concrete

.5 Weatherproof expansion fittings for linear expansion at entry to panel.

2.5 Fish Cord

.1 Polypropylene.

3 EXECUTION

3.1 Location of Conduit

.1 Drawings do not indicate all conduit runs. Those indicated are in diagrammatic form only.

3.2 Installation

.1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.

.2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.

.3 Use electrical metallic tubing (EMT) except: in cast concrete, underground or where installed exposed within 2.0m (6'-6") of floor.

.4 Use rigid galvanized steel conduit where installed surface mounted within 2.0m (6'-6") of floor.

.5 Use rigid PVC conduit in slab on grade cast concrete and underground. Do not use PVC conduits in slabs above grade. All conduits shall be surface mounted to minimize risks of future damage when core drilling during future renovations. Where localized congestion or circumstances forces the use of conduits in the floor slabs, they shall be epoxy coated rigid galvanized steel.

.6 Provide PVC conduit with bonding conductor as per Table 16A of Ontario Electrical Safety Code.

.7 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment

.8 Use explosion proof flexible connection for connection to explosion proof motors.

.9 Install conduit sealing fittings in hazardous areas. Fill with compound.

.10 Use raintight connectors or hubs for terminating conduits at all surface or floor mounted panelboards, switchboards, and other equipment located in sprinklered areas or where at risk of exposure to dripping liquids.

.11 Install wiring in conduit unless otherwise specified.

.12 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.

.13 Mechanically bend steel conduit over 19mm (3/4") dia.

.14 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

.15 Install fish cord in empty conduits.

.16 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.

.17 Dry conduits out before installing wire.

.18 Conduit manufacturer's touch up enamel shall be used to repair all scratches and gouges on epoxy-coated conduit.

.19 Install junction boxes or cable anchor boxes wherever necessary for proper pulling or anchoring of cables. Install so as to be accessible after building is completed and set to come within finished lines of building.

.20 Where EMT or rigid PVC is used, run green insulated bonding conductor in conduit, with minimum one bonding conductor per three ungrounded conductors.

.21 Provide expansion couplings, with bonding jumper and ground clamps where raceways cross building control joints.

.22 Where circuits are required in the vicinity of a steel roof deck:

.1 support the conduits, EMT or cables at least 38mm (1½”) below the underside of the deck,

.2 do not run conduits, EMT or cables on the top side of the roof deck,

.3 do not cut openings in the roof deck unless specifically indicated,

.4 where circuits must be located within 38mm (1½”) of the underside of a roof deck, use galvanized rigid steel conduit and cast fittings,

.5 where there is no option to running conduits on the top side of a roof deck, use epoxy or PVC coated galvanized rigid steel conduit with epoxy or PVC coated cast fittings.

.23 Where conduits or cables are installed under raised floors and are required to be fastened in place, use two hole inverted “U” straps. No sharp edges or corners will be permitted which may damage PVC jackets or cables.

.24 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass. They shall be installed as close to building structure as possible such that, where concealed, necessary furring can be kept to a minimum. Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

3.3 Wiring Methods

.1 Install wiring in surface mounted EMT conduit unless otherwise specified. In finished areas, conceal conduit in walls and ceiling spaces.

.2 In areas designated as Explosion Proof on Drawings, conduit and wiring shall be Class I, Group D, Division I.

.3 Where shown on drawings, armoured cable shall be Teck 90 type. Jackets of cable shall have FT-4 rating identified. Connectors shall be equal to ABB Installation Products Ltd. (T & B) - Star Teck Type.

.4 Rigid PVC conduit with ground wire as per Electrical Safety Code Table 16 shall be used throughout below grade areas and may be used in or under slab on grade areas. It shall not be used in above grade slabs.

.5 Epoxy enamel or PVC coated rigid galvanized steel conduit shall be used throughout basement; in damp locations including but not limited to intake and exhaust shafts and air handling units; for rigid metallic conduit underground or in floor slabs; for wiring outdoors and in unheated buildings; and where noted on Drawings.

.6 Runs of conduit and cables, where shown, are indicated only by general location and routing. Install conduits and cables so as to provide maximum head room and to interfere as little as possible with free use of spaces through which they pass.

.7 Use EMT conduit for branch circuit and signal wiring in ceilings, furred spaces, and in hollow walls and partitions.

.8 Use rigid galvanized steel conduit for wiring where conduits are exposed to possible mechanical damage.

.9 Use epoxy coated rigid galvanized steel conduit for wiring in poured concrete.

.10 Aluminum conduits shall not be used

.11 Flexible conduit and armoured cable will be accepted in parts of existing building, where furred spaces above ceilings are too congested to permit conduit to be installed, but only with [Engineer's] [Consultants] written permission. Terminate armoured cable, where shown, in accordance with the manufacturer's recommendations.

.12 Flexible steel conduit with integral insulated green ground wire is permitted for the final connection to luminaires mounted in suspended ceilings from the branch wiring junction box above, with flexible conduit length not to exceed 3 m (10'), and be neatly installed and attached to luminaire support chain

.13

.14 Conduit shall be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown, are minimum and shall not be reduced.

.15 Arrange conduits, installed in suspended ceilings, to provide minimum interference with removal of tiles.

.16 Where existing locations of flush mounted electrical devices (switches, receptacles, etc.) correspond to new devices shown, the existing downdrop conduit and outlet box may be re-used. Provide new devices, new coverplates, new home-run conduit and complete new wire.

.17 Vertical raceways to be provided with insulated cable support bushings or other approved method of supporting the weight of the cable, where vertical runs exceed those of Table 21 of the Electrical Code.

3.4 Surface Conduits

.1 Run parallel or perpendicular to building lines.

.2 Locate conduits behind infrared or gas fired heaters with 1.5m (5') clearance.

.3 Run conduits in flanged portion of structural steel.

.4 Group conduits wherever possible on suspended or surface channels.

.5 Do not pass conduits through structural members except as indicated.

.6 Do not locate conduits less than 75 mm (3") parallel to steam or hot water lines with minimum of 25 mm (1") at crossovers.

3.5 Concealed Conduit

.1 Do not install horizontal runs in masonry walls.

.2 Do not install conduits in terrazzo or concrete toppings.

3.6 Conduits in Cast-in-place Concrete

.1 Locate to suit reinforcing steel. Install in centre one third of slab.

.2 Protect conduits from damage where they stub out of concrete.

.3 Install sleeves where conduits pass through slab or wall.

.4 Where conduits pass through waterproof membrane provide oversized sleeve before membrane is installed. Use cold mastic between sleeve and conduit.

.5 Do not place conduits is slabs in which slab thickness is less than 4 times conduit diameter.

.6 Encase conduits completely in concrete with minimum 25 mm (1") concrete cover.

.7 Organize conduits in slab to minimize cross-overs.

3.7 Conduits in Cast-in-place Slabs on Grade

.1 Run conduits 25 mm (1") and larger below slab and encased in 75 mm (3") concrete envelope. Provide 50 mm (2") of sand over concrete envelope below floor slab.

3.8 Conduits Underground

.1 Slope conduits to provide drainage.

END OF SECTION

OUTLET BOXES, CONDUIT BOXES AND FITTINGS
26 05 35

1 GENERAL

1.1 Scope

.1 Provide outlet boxes, conduit boxes and fittings for electrical services.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 26 27 28 Wire and Box Connectors 0-1000V

1.3 Applicable Codes and Standards

.1 Product standards:

.1 CSA C22.2 No. 18. Outlet Boxes, Conduit Boxes, and Fittings

2 PRODUCTS

2.1 General

.1 Outlet boxes, conduit boxes, and fittings listed to CSA C22.2 No. 18.

2.2 Outlet and Conduit Boxes - General

.1 Size boxes in accordance with CSA C22.1

.2 102 mm (4") square or larger outlet boxes as required for special devices

.3 Gang boxes where wiring devices are grouped.

.4 Blank cover plates for boxes without wiring devices.

.5 Combination boxes with barriers where outlets for more than one system are grouped.

2.3 Sheet Steel Outlet Boxes

.1 Hot dipped galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 mm x 50 mm x 38 mm (3" x 2" x 1½") or as indicated. 102 mm (4") square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.

.2 102 mm (4") square or octagonal outlet boxes for lighting fixture outlets.

.3 102 mm (4") square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster or tile walls.

2.4 Masonry Boxes

.1 Hot dipped galvanized steel masonry single and multi-gang boxes for devices flush mounted in exposed block walls.

2.5 Concrete Boxes

.1 Hot dipped galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.6 Floor Boxes

.1 Concrete tight hot dipped galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brass or brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex single or receptacles. Minimum depth: 28 mm (1¼") for receptacles; 73 mm (3") for communication equipment.

.2 Adjustable, watertight, concrete tight, cast floor boxes with openings drilled and tapped for 12 mm (½") and 19 mm (¾") conduit. Minimum size: 73 mm (3") deep.

2.7 Conduit Boxes

.1 Cast FS boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacle, outside building and where weatherproof boxes are required.

.2 Explosion proof boxes in areas indicated on drawings.

2.8 Fittings - General

.1 Bushing and connectors with nylon insulated throats.

.2 Knock-out fillers to prevent entry of debris.

.3 Conduit outlet bodies for conduit up to 32 mm (1½") and pull boxes for larger conduits.

.4 Double locknuts and insulated bushings on sheet metal boxes.

2.9 Acoustical Putty Pads

.1 Moldable putty sheets:

.1 3mm (1/8”) thick,

.2 Sound Transmission Class (STC) rating of not less than 23 for one layer,

.3 self adhesive,

.4 non-combustible,

.5 non-hardening,

.6 non-shrinking,

.7 non-corrosive to:

(a) boxes,

(b) EMT,

(c) conduit,

(d) PVC,

.8 asbestos free.

Standard of Acceptance

- 3M - Fire Stop Moldable Putty Pads
- Hilti – Firestop Putty Pads
- Kinetics - IsoBacker

3 EXECUTION

3.1 Installation

.1 Support boxes independently of connecting conduits.

.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 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm (¼") of opening.

.4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

.5 Provide a suitable outlet box for each light, switch, receptacle or other outlet, approved for the particular area in which it is to be installed.

.6 Locate outlet boxes, mounted in hung ceiling space, so they do not obstruct or interfere with the removal of lay-in ceiling tiles.

.7 Offset outlet boxes, shown back to back in partitions, horizontally to minimize noise transmission between adjacent rooms.

.8 Box connectors to conform to Specification section 26 27 28.

.9 For outlet boxes installed in walls with a Sound Transmission Class (STC) rating:

.1 apply acoustical putty pads to the outlet box,

.2 cover all openings and EMT, conduit and cable entrances/exits,

.3 install putty pads on the outside of boxes,

.4 provide additional layers and/or provide other sound control measures, as necessary to maintain the STC rating of the wall assembly,

.5 install pads and other sound control measures, if applicable, in accordance with the manufacturers recommendations.

.10 Use gang boxes at locations where more than one device is to be mounted. Use combination boxes with suitable barriers where outlets for more than one system are shown.

.11 Where 100 mm (4") square boxes are installed in exposed concrete or cinder block in finished areas, blocks will be cut under masonry division as instructed under this section. Openings shall be cut to provide a close fit to boxes and covers so that edges of openings are not visible after installation of plates. Mortar shall not be used to patch up openings that are cut too large or to patch ragged edges.

.12 Where boxes are required for wiring and equipment on the underside of a steel roof deck:

.1 support the boxes at least 38mm (1½”) below the underside of the deck,

.2 do not cut openings in the roof deck unless specifically indicated,

.3 where boxes must be located within 38mm (1½”) of the underside of a roof deck, use cast conduit boxes.

END OF SECTION

Cable Tray for Electrical Systems
26 05 36

1 GENERAL

1.1 Scope

.1 Provide cable tray, associated support hangers and accessories as shown.

1.2 Related Sections

.1 26 05 49.13 Seismic Restraint for Electrical Services

1.3 Applicable Codes and Standards

.1 Product standards:

.1 CSA C22.2 No.126.1 Metal Cable Tray Systems.

1.4 Submittals

.1 Submit shop drawings and product data for each type and size of tray.

.2 Identify cable tray types with terminology used in Part 2.

.3 Show actual cable tray installation details and support systems.

2 PRODUCTS

2.1 Trough Type (Vented and Solid) Cable Tray

.1 Size as shown and as required.

.2 Vented or solid as shown.

.3 Load rating: Class C

.4 Material: stainless steel].

.5 Accessories and fittings as shown and as required for a complete system.

.6 Accessories and fittings of same manufacture and material as the tray, including:

.1 horizontal elbows,

.2 end plates,

.3 box connectors,

.4 vertical risers,

.5 drops,

.6 tees,

.7 wyes,

.8 expansion joints,

.9 reducers,

.10 barriers,

.11 covers (vented, solid),

.12 peaked covers (vented, solid),

.13 bonding jumpers (copper).

.7 Inside radius of bends, not less than: 600mm (24")]

.8 Hardware: stainless steel.

Standard of Acceptance

- Canadian Electrical Raceways
- Commercial Roll Formed Products - Comtray
- Cooper B-Line – Cable Tray
- Cope Trof
- Legrand
- MP Husky
- ABB Installation Products Ltd. (T & B)

2.2 Supports

.1 Hanger rods: stainless steel.

3 EXECUTION

3.1 Installation - General

.1 Install in accordance with the manufacturer's recommendations.

.2 Use tools as recommended by the manufacturer, in particular use offset blade cutters to cut wire mesh tray.

.3 Where the tray supports fire rated mineral insulated cables, use stainless steel tray.

.4 Install parallel or perpendicular to building lines. Where not possible, obtain instructions from the Consultant.

.5 Support on 3000mm (10') centers, except where indicated otherwise.

.6 Confirm with the Consultant, the ultimate cable loading for each run.

.7 Provide additional supports as required to suit the ultimate loading.

.8 Support both sides of tray using trapeze hangers, except where shown otherwise.

.9 Support center spine type cable tray using rods attached to the center spine.

.10 Provide supports on each side of an expansion fitting or gap.

.11 Attach supports directly to the building structure.

.12 To permit installation of rollers and cables, maintain a clear space above the tray of at least:

.1 150mm (6") for trays supporting cables up to 25mm outside diameter,

.2 225mm (9") for trays supporting cables larger than 25mm and up to but not including 50mm outside diameter,

.3 300mm (12") for trays supporting cables of 50mm or larger outside diameter,

.4 300mm (12") to ceilings, heating ducts and heating equipment.

.13 Install tray with side clearances of not less than:

.1 600mm (24") on one side, for tray up to 1000mm wide, mounted on wall brackets or trapeze hangers,

.2 600mm (24") on both sides, for tray wider than 1000mm, mounted on wall brackets or trapeze hangers,

.3 600mm (24”) on one side and 150mm (6”) on the other side, for center hung tray up to 1000mm wide.

.14 Ensure that no other services or hangers are installed through the web space of the tray.

.15 Brace to withstand loads due to pulling in of cables.

.16 Provide covers where indicated:

.1 secure with clips supplied by the tray manufacturer,

.2 for outdoor installations bolt covers to the tray using stainless steel hardware, provide sufficient attachment in accordance with the manufacturer’s recommendations to ensure that covers will remain in place when exposed to wind speeds of 160 km/hr. (100mph).

.17 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.

.18 File cuts smooth.

.19 For galvanized trays, coat cut edges with a galvanizing compound.

.20 Where other wiring methods are connected to cable tray:

.1 provide a mechanical attachment using tray manufacturer’s fittings,

.2 arrange the connection to prevent damage to conductors,

.3 provide effective bonding.

.21 Provide expansion fittings where tray:

.1 crosses a building expansion joint,

.2 where required to accommodate thermal expansion.

.22 For ladder and center spine type trays, a gap, bridged with a flexible bonding jumper, is acceptable as an expansion fitting.

.23 For center spine and wire mesh trays, provide cable bending radius protectors at bends, tees, wyes, crosses and dropouts.

.24 Use hardware of the same material as the tray. Where hardware must be of a different material, the material to have equivalent corrosion resistance as the tray. Obtain Consultant’s acceptance of hardware manufactured from materials different from the tray.

.25 Install tray as a bonding conductor with bonding continuity from end to end and with associated electrical equipment.

.26 Provide bonding jumpers at each joint in the tray and between tray and associated electrical equipment. Splice plates, fittings, clamps are acceptable as bonding jumpers if they are CSA listed for the purpose.

3.2 Installation of Cables in Tray

.1 Install cables individually.

.2 Lay cables into tray wherever possible.

.3 Use rollers when necessary to pull cables.

.4 Secure cables in tray at 1200mm (4') centers, with factory made non ferrous cable clamps.

.5 Use aluminum clamps to secure single conductor cables, do not use nylon ties.

.6 Nylon ties may be used for multiconductor cables where acceptable to the Consultant.

.7 Identify cables every 30m (100') and at each end of the run with size 2 nameplates.

.8 Do not exceed 80% of the load rating of the tray or the support system.

.9 Additional Requirements for Installation of Cable Tray for Communications Wiring

.1 Maintain separation of cable tray from sources of electromagnetic interference as follows:

Item	**Minimum Clearance**
Fluorescent ballasts	150mm (6”)
Conduit and cables used for electrical distribution less than 1kV	300mm (12”)
Conduit and cables used for electrical distribution greater than 1kV	1000mm (36”)
Motor	1200mm (48”)
Transformer	1200mm (48”)

.10 The above table provides a guideline. Where equipment produces particularly high levels of electric or magnetic fields, provide greater clearances acceptable to the Consultant.

.11 Wherever possible, install, tray so that communications conductors cross sources of interference at right angles. Where not possible obtain instructions from the Consultant.

END OF SECTION

VIBRATION ISOLATION FOR ELECTRICAL SYSTEMS
26 05 48

1 GENERAL

1.1 Scope

.1 Provide vibration and noise isolation for the following electrical equipment:

.1 engine driven equipment,

.2 motor driven equipment,

.3 transformers,

.4 and as shown..

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 26 05 49.13 Seismic Restraint for Electrical Services]

.2 26 05 49.23 Seismic Qualification for Electrical Equipment

1.3 Design Criteria

.1 Provide design, selection and provision of materials, installation instructions, installation and inspection of vibration isolation equipment and systems.

.2 Select vibration isolation equipment to maintain noise levels below the NC levels in the following schedule.

AREA	NOISE CRITERIA (NC level)
Offices - private	32 to 34
-open plan	36 to 38
-business machine areas	40 to 42
-conference/boardrooms	30 to 32
Operating Rooms	25 to 27
Private Bedrooms	26 to 28
Hospital Wards	30 to 32
Public Areas	38 to 40

.3 Coordinate the design and installation of vibration isolation with seismic restraint systems provided under:

.1 Section 26 05 49.13 Seismic Restraint for Electrical Services

.2 Section 26 05 49.23 Seismic Qualification for Electrical Equipment

.4 The requirements under this Section are in addition to the requirements for supports and vibration isolation specified in other Sections.

1.4 Manufacturer Responsibilities

.1 Manufacturer of vibration isolation components to:

.1 determine vibration isolation sizes and locations,

.2 supply suitable vibration isolation as required,

.3 supply installation instructions and drawings,

.4 provide trained field supervision personnel on site to insure proper installation,

.5 conduct site inspections of the Work in progress,

.6 conduct a final inspection of the Work,

.7 prepare a final inspection report of the installation.

1.5 Submittals

.1 Submit shop drawings:

.1 details of suspension and support for ceiling and wall hung equipment,

.2 details of vibration isolation for each piece of equipment hung from the structure or supported from the floor,

.3 product data sheets for isolation components,

.4 load deflection curves,

.5 calculations of the expected deflection and the natural frequency.

2 PRODUCTS

2.1 Resilient Isolator Type 1 (R1)

.1 Rubber waffle or ribbed pads:

.1 of 30 durometer natural rubber, not less than 13 mm (½") thick,

.2 suitable for loading up to 350 kPa. (50 psi).

.2 Rubber-steel-rubber pads:

.1 two layers of rubber waffle or ribbed pad, 13 mm (½") thick, as specified above,

.2 bonded to 6 mm (¼") steel plate with holes sleeved and fitted with isolation washers.

.3 Neoprene jacketed precompressed moulded fibreglass.

2.2 Resilient Isolator Type 2 (R2)

.1 Elastomer rubber with:

.1 threaded insert,

.2 hold down bolts.

.2 Neoprene, 50 mm (2") free height:

.1 natural frequency not to exceed 15 Hz at full load,

.2 capable of sustaining a load of 110 kg (250 lb),

.3 with deflection not exceeding 5 mm (0.19").

2.3 Elastomeric Mounts

.1 Neoprene in shear:

.1 colour coded,

.2 durometer not greater than 60,

.3 threaded insert,

.4 two bolt down holes,

.5 ribbed top and bottom surfaces.

2.4 Spring Mounts – General Requirements

.1 Isolator springs:

.1 designed so that ratio of lateral to axial stiffness is equal to or greater than 1.2 times ratio of static deflection to working height,

.2 selected for 50% travel beyond rated load,

.3 cadmium plated,

.4 colour coded.

.2 Mounts:

.1 zinc or cadmium plated hardware,

.2 rubber isolation washers,

.3 housings coated with rust resistant paint,

.4 levelling devices,

.5 6 mm (¼") thick ribbed rubber sound pad bonded to load plate.

.3 Clearance between metal parts to be not less than 6 mm (¼").

2.5 Spring Isolator Type 1 (S1)

.1 Open spring isolators:

.1 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

2.6 Spring Isolator Type 2 (S2)

.1 Controlled spring isolators:

.1 heavy rigid steel base frames,

.2 built-in vertical limit stops,

.3 removable spacers,

.4 extra stiff springs with ratio of lateral to axial stiffness of 1.0.

2.7 Isolation Hangers – General Requirements

.1 Isolation hangers to have swivel arrangement to permit hanger box or rod to move through 20° arc without metal to metal contact.

2.8 Hanger Type 1 (H1)

.1 Spring hanger:

.1 welded steel housing with one coat anti-rust paint,

.2 colour coded spring,

.3 retaining cups,

.4 elastomeric washers.

2.9 Hanger Type 2 (H2)

.1 Rubber hanger:

.1 welded steel housing with one coat anti-rust paint,

.2 25 mm (1") colour coded neoprene in shear with durometer of not more than 60,

.3 threaded insert.

2.10 Hanger Type 3 (H3)

.1 Horizontal thrust restraint:

.1 spring and elastomeric element,

.2 housed in box frame with rods and angle brackets to connect unit between isolated equipment and fixed object,

.3 fitted with means to adjust start-stop movement to not more than 9 mm (3/8”).

2.11 Acoustic Barriers for Anchors and Guides

.1 Manufactured from 25 mm (1") thick neoprene isolation with duck reinforcing material.

Standard of Acceptance

- Vibron / Kinetics
- BVA
- VMC / Korfund
- Mason
- Tecoustics
- Eaton B-Line

3 EXECUTION

3.1 General

.1 Install vibration isolation equipment and systems in accordance with the component manufacturer’s recommendations. Where a conflict occurs between the requirements of this Section and the manufacturer’s recommendations, apply the most stringent requirements.

.2 Install vibration isolation equipment in accordance with manufacturer's instructions.

.3 Locate isolation for equipment to provide stable support under saddles, frames and projections of equipment.

3.2 Application

.1 Provide additional steel in bases and rails to obtain rigidity and uniform load distribution.

.2 Make flexible connections to isolated equipment so as to maintain isolation system flexibility and to allow full range of movement of the isolated equipment.

3.3 Start-up and Set-up

.1 After installation of connections to resiliently mounted equipment:

.1 remove shims and blocking and adjust mountings to level equipment,

.2 adjust connections, hangers, snubbers and restraints,

.3 ensure that physical contact between isolated equipment and building structure cannot occur at limits of movement.

.2 On completion of installation and start-up of equipment:

.1 manufacturer/supplier of Vibration Isolation equipment to visit site, check performance of systems, inspect installation and submit written recommendations,

.2 make corrections to installation in accordance with manufacturer/suppliers recommendations,

.3 provide notice 24 hours in advance of this site visit.

.3 Provide a final inspection report signed by the manufacturer/supplier's representative, certifying that the vibration isolation equipment is suitable for the application and has been installed in accordance with the manufacturer's recommendations.

END OF SECTION

SEISMIC RESTRAINT FOR ELECTRICAL SERVICES
26 05 49.20

1 GENERAL

1.1 Scope

.1 Provide seismic restraint devices to limit movement of electrical equipment, conduit, bus duct, busway, cable, cable tray and wireway under seismic force and movement conditions.

.2 Provide engineering services for the design, selection of materials, installation instructions, and inspection of seismic restraint devices.

.3 The requirements under this Section are in addition to the requirements for support of electrical equipment, conduit, bus duct, busway, cable, cable tray and wireway, and vibration isolation specified in other Sections.

.4 Where specifications of materials of this Section differ from those in other Sections of Division 26, this Section governs.

1.2 Definitions

.1 The following definitions apply for the purpose of this section.

Conduit – means an electrical raceway that includes rigid galvanized steel conduit, electro-metallic tubing (EMT), PVC conduit, aluminium conduit.

Transverse restraint – means restraint(s) applied to limit motion perpendicular to the centerline of the conduit, bus duct, busway, cable, cable tray or wireway.

Longitudinal restraint – means restraint(s) applied to limit motion parallel to the centerline of the conduit, bus duct, busway, cable, cable tray or wireway.

Restraint: means a device which limits movement of object due to imposed seismic forces acting on the object.

Brace: a restraint directly connected to an object that reacts against both tension and compression seismic loads.

Cable restraint: a restraint consisting of cables that reacts against only tension seismic forces, and that may have a small amount of slack to prevent vibration isolation short-circuiting during normal operation.

Snubber (restraint): a restraint that does not come into contact with the object under normal operating conditions.

Seismically qualify (seismically qualified): means equipment which has been evaluated by testing to withstand defined forces in amplitude and frequency which simulate seismically-induced movement, after which the equipment continues to function for its intended purpose.

.2 The following abbreviations apply to this section:

"C_p" the horizontal seismic force coefficient as defined in NFPA 13.

"***K_s"*** horizontal seismic force coefficient (equal to 0.3 S (0.2) I_E S_p, as defined in the 2020 NationalBuilding Code of Canada and represents a multiply of gravitational acceleration.

"K_v" vertical seismic force coefficient and represents a multiple of gravitational acceleration.

"W_p" the weight of the component subject to a seismic force.

.3 Interpretation:

.1 In this specification, the parameter "S_s" (spectral response acceleration at 5 Hz) in NFPA 13, ASHRAE, SMACNA and MSS SP-127 used for estimating the horizontal seismic force, has the same meaning as the parameter "$S_a(0.2)$" for the spectral response acceleration value at 0.2 seconds as defined in the National Building Code of Canada.

1.3 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

1. 26 05 49.23 Seismic Qualifications for Electrical Equipment

1.4 Applicable Codes and Standards

.1 Legislation

.1 2020 National Building Code of Canada, as adopted in the jurisdiction of the Project.

.2 Installation standards and codes:

.1	ASHRAE D-90316	Practical Guide to Seismic Restraint
.2	ANSI/SMACNA	Seismic Restraint Manual Guidelines for Mechanical Systems, 3rd edition.

.3 Product standards:

.1	ACI 355.2	Qualification of Post-Installed Mechanical Anchors in Concrete
.2	ASTM A492	Standard Specification for Stainless Steel Rope Wire
.3	ASTM A1023	Standard Specification for Stranded Carbon Steel Wire Ropes for General Purpose
.4	ICC-ES AC01	Expansion Anchors in Masonry Elements
.5	ICC-ES AC106	Predrilled Fasteners (Screws) in Masonry
.6	ICC- ES AC156	Acceptance Criteria for Seismic Certification by Shake-Table Testing of Non-structural Components
.7	ICC-ES AC193	Mechanical Anchors in Concrete Elements
.8	ICC-ES AC308	Post-Installed Adhesive Anchors in Concrete Elements

.4 Other documents:

.1	ASCE 7	American Society of Civil Engineers, Minimum Design Loads and Associated Criteria for Buildings and Other Structures

1.5 Seismic Analysis, Design and Inspection Services

.1 Provide the services of a professional engineer, licensed in the province or territory of the Work and who specializes in seismic restraint of building services and equipment (the "Seismic Engineer"), for the design of seismic restraints and to provide inspection services of the completed installation.

.2 Seismic Engineer design services;

.1 Provide the design of seismic restraint systems, including seismic restraint calculations for all connections of equipment to the structure.

.2 Provide design drawings showing locations of restraints and details of construction and attachment of restraints. Mark-ups of Consultant drawing or Contractor installation drawings may be used for this purpose.

.3 Analysis dead loads, seismic loads and capacity of materials utilized for connections to equipment and structure. Analysis to detail anchoring methods, bolt diameter, embedment and/or welded length. Design seismic restraint devices to accept, without failure, the seismic forces acting on the equipment or components and their support and restraint attachments to the building structure.

.3 Seismic Engineer inspection services;

.1 At periods during installation and at completion of the installation of the seismic restraint devices, the Seismic Engineer shall inspect the installation, identify and report deficiencies (if any) which are observed, and re-inspect the installation after deficiencies have been corrected.

.2 Seismic Engineer to submit periodic inspection reports and a final inspection report after all work is completed and deficiencies have been corrected, confirming the installation conforms to the seismic design requirements. Prepare and submit any required declarations or similar document to this effect where required by local legislation.

.4 Shop drawings of custom restraints, supporting calculations, and reports shall be sealed by the Seismic Engineer.

.5 Prepare and submit reports of inspections of the installation and a final general review report of the completed seismic installation.

1.6 Manufacturer's Services – Seismic Restraints

.1 Manufacturer of seismic control equipment are responsible for:

.1 determining seismic restraint sizes and locations,

.2 provide calculations and supply materials for restraint of vibration isolated and non-isolated equipment,

.3 provide installation instructions, drawings and trained field supervision to ensure proper installation and performance including welding details,

.4 field inspection of manufactured support systems including roof curbs and other rooftop equipment supports at time of installation.

1.7 Design Criteria

.1 Design seismic restraint systems to conform to the provincial or territorial building code requirements for seismic forces and movement as applicable for the place of the Work. Seismic calculation and restraint methods as described in ASHRAE D-90316, and SMACNA seismic guideline are acceptable as the baseline requirement.

.2 Base the design of seismic restraints on actual equipment data (dimensions, weight, center of gravity, etc.,) obtained from submittals or the manufacturers of the equipment.

.3 Testing and calculations of seismic restraints shall include both shear and tensile loads as well as one test or analysis at 45° to the weakest mode.

.4 Site design parameters:

Item	Description	Abbrev.	Value
1	Site Class	--	C
2	Building Category	---	Post Disaster

Item	Description	Abbrev.	Value
3	Building Importance Factor	I_E	1.5
4	Design Spectral Response acceleration factor	S(0.2)	0.32
5	Interstorey displacement factor	---	0.01

.5 Building seismic force coefficient data;

.1 seismic horizontal force coefficients "K_s" and seismic vertical uplift force coefficient "K_v" for building service are listed in Schedule A attached to the end of this Section. These coefficients are the maximum values independent of the type of equipment or service being restrained. It is permitted to calculate a lower K_s coefficient where the Cp, Ar and Rp values, as defined in the building code specific to the actual equipment or service being restrained, are used.

.6 Seismic force;

.1 the horizontal seismic force "V_p" applied to a component is:

$$V_p = K_s \times W_p,$$

.2 the vertical seismic force "V_{PV}" applied to a component is:

$$V_{pv} = K_V \times W_p$$

.7 For suspended equipment, the building elevation height is measured to the level of the floor above the suspended equipment.

.8 For vibration isolated equipment, where the clearance distance (air gap) between the equipment support frame and the restraint (e.g. snubber or integral limit stop) exceeds 6 mm (1/4 in.), the seismic horizontal force V_p is to be increased by 100%.

.9 Where adhesive anchors for concrete are used, the seismic force for the restrained equipment is to be increased by multiplying the horizontal seismic force coefficient specified in Schedule A of this Specification section by the "R_p" equipment category as defined in article 4.1.8.18 of the National Building Code of Canada specific to the equipment being restrained.

$$K_{s,adhesives} = K_s \, x \, R_{p,applicable\ equipment}$$

.10 Where concrete inserts are used, the seismic force for the restrained equipment is to be increased by multiplying the horizontal seismic force coefficient specified in Schedule A of this Specification section by the "R_p" equipment category as defined in article 4.1.8.18 of the National Building Code of Canada specific to the equipment being restrained and divided by the value of 1.5.

$$K_{s,inserts} = K_s \, x \, \frac{R_{p,applicable\ equipment}}{1.5}$$

1.8 Seismic Qualification of Equipment

.1 Refer to 26 05 49.23 Seismic Qualifications for Electrical Equipment

1.9 Submittals

.1 Submit shop drawings in accordance with Division 1 and as follows.

.2 Submittals for design of seismic restraint systems shall be sealed by a Professional Engineer licensed in the province or territory of the jurisdiction of the Project.

.3 Seismic restraints:

.1 Provide test certificates for each seismic restraint device, identifying maximum tested load capacities.

.2 Provide calculations for each piece of restrained equipment, lengths of braced conduit bus duct, busway, cable, cable tray and wireway including seismic forces, restraint selection, and selection data.

.3 Provide seismic data in spreadsheet format for each piece of equipment, including the following information:

(a) Equipment ID,

(b) Building floor level,

(c) Horizontal seismic force factor,

(d) Equipment weight,

(e) Horizontal seismic force,-

(f) Vertical uplift seismic force (where applicable),

(g) Design condition (worst case) overturning moment,

(h) Number of restraint fastenings,

(i) Pull-out tension for worst case restraint,

(j) Compression for worst case restraint (vibration isolated equipment),

(k) Horizontal shear per fastener,

(l) Worst case simultaneous tension and shear loads at each restraint and snubber,

(m) Pull-out tension load rating per fastener,

(n) Horizontal shear rating per fastener.

.4 Provide drawings for each type of restraint assembly, including details for connections to building structure, and associated bill of materials, and (where applicable) full welding details of field welds to structural elements.

.5 For building connections in concrete, provide concrete anchor sizes and nominal and effective embedment depth.

.6 Provide floorplan layout drawings indicating location of each restraint, identifying each restraint type in a manner to identify the restraint detail.

.7 Provide layout and construction details for reinforced housekeeping pads based on actual equipment to be restrained and selected concrete anchors. Shop drawings to include:

(a) minimum housekeeping pad plan dimensions and height, including reinforcement,

(b) details for securing the housekeeping pad to the structural floor slab,

(c) dimensioned position of restraint devices or combination isolator/restraint devices,

(d) minimum distance from concrete anchors to edge of housekeeping pad.

.4 Shop drawings for seismically qualified equipment:

.1 Provide seismic test data sheets for seismically qualified equipment. Alternatively, provide seismic qualification listing from HCAI Special Seismic Certification Preapproval (OSP)".]

.5 Calculations and designs shall be sealed by a Professional Engineer licensed in the province or territory of the jurisdiction of the project.

.6 Electrical distribution riser support system:

.1 Provide engineered layout drawings of electrical distribution riser supports including support/restraints, with supporting load calculation including dead loads and static seismic loads, and reaction loads at building connection.

1.10 Quality Assurance

.1 Without limiting Contractor's responsibility for quality assurance of the Work, the following minimum quality control processes are required.

.2 Pre-Construction meeting;

.1 Request and arrange a meeting with the Seismic Engineer and Consultant to review seismic restraint approach, prior to any restraint installation. Obtain approval from the Consultant before commencing work.

.3 Initial installation and review;

.1 Install the first three transverse and three longitudinal braces for each conduit type, bus duct, busway and cable tray system.

.2 Request and arrange for a review of the installation by the Seismic Engineer and Consultant. Obtain approval of the installation before commencing the remainder of the work.

.4 Provide the services of the manufacturer's technical representative to conduct site inspections of the Work in progress, and to conduct a final inspection of the Work. Provide a copy of the final inspection report to the Consultant for review. For clarity, these inspections are separate from those performed by the Seismic Engineer.

.5 Provide services by the Seismic Engineer to conduct periodic reviews of the work in progress, and final review of the completed seismic restraint installation before any ceilings are installed or work is otherwise concealed.

.6 All deficiencies identified by the Seismic Engineer, manufacturer, or Consultant are to be rectified before equipment or services are concealed.

2 PRODUCTS

2.1 General

.1 Seismic restraint materials are to be provided by manufacturers specializing in the field of seismic restraint.

Standard of Acceptance

- Vibro-Acoustics (Swegon North America)
- Kinetics Noise Control Inc.
- B.V.A. Systems
- Korfund (VMC)
- Tecoustics
- Hilti
- nVent

.2 Manufactured seismic restraints, anchors, and related materials to be tested in accordance with ICC ES AC156 for loads meeting or exceeding the applied seismic forces of the Work.

.3 Demonstrate conformity of seismic restraint products by:

.1 approved by a government agency and indicate maximum restraint ratings, or

.2 provided with test results verified by an independent testing laboratory which state the maximum restrain ratings.

.4 Seismic restraints for equipment supported by vibration isolators to be either:

.1 vibration isolators provided with separate seismic snubbers, or

.2 combination vibration isolators with integral seismic snubbers.

.5 The following product articles describe the more common type of restraint devices. Other restraint devices are permissible provided they are qualified by 3rd party testing laboratories for seismic force restraint.

2.2 Seismic Snubbers

.1 Type "SS1" – Single-Axis/Single Direction Snubbers:

.1 ASHRAE Type "I", designed to restrict movement in one axis,

.2 carbon steel construction with epoxy or electrostatic paint finish, attached to floor or housekeeping pad with minimum of two bolts, faced with minimum 6.4 mm (1/4 in.) thick neoprene pad of compounded to bridge bearing quality,

.2 Type "SS2 / SS3" – Multi-Axis/Multi-Direction Snubber Assemblies:

.1 ASHRAE Type "G" and "F", designed to restrict movement in two (2) lateral ("SS2") or three (3) axis ("SS3"),

.2 interlocking steel construction, attached to equipment structure and equipment, maximum of 6 mm (¼ in) seismic movement,

.3 minimum 6 mm (¼ in) thick resilient neoprene pads compounded to bridge bearing specifications, to prevent metal-to-metal impact,

.4 minimum two bolt attachments to the floor,

2.3 Seismic Restraint Brackets

.1 Type "SRB" – Rigid Equipment Restraint Brackets:

.1 suitable for connection to equipment bases and tank bases,

.2 carbon steel "L" sections with epoxy or electrostatic paint finish, for fastening to both the floor structure/housekeeping pad and the equipment base,

.3 structure bolt opening equipped with neoprene bushing, compounded to bridge bearing quality,

.4 minimum two bolt fastening to equipment base using screws,

.5 suitable for equipment direct contact to floor with or without isolation pads,

2.4 Seismic Vibration Isolators

.1 Type "2-S" – All Direction Neoprene Isolator:

.1 ASHRAE Type "E", designed to restrict movement in all directions with no metal-to-metal contact.

.2 molded, oil resistant neoprene compounded to bridge bearing quality, with encapsulated cast-in-place top steel load plate, and steel base plate with anchor holes,

.2 Type "3-S" – Restrained Spring Isolator – Constant Load:

.1 ASHRAE Type "B", designed to restrict movement in all directions,

.2 colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm (¼ in.) neoprene pad,

.3 removable coil spring element without having to disturb supported equipment,

.4 lateral stiffness greater than 1.2 times rated vertical stiffness,

.5 minimum 50% overload capacity,

.6 non-welded spring elements: epoxy coated, with a minimum 1000-hour rating when tested in accordance with ASTM B-117,

.7 steel housing design to limit lateral and vertical movement of the supported equipment,

.8 neoprene snubber, to limit maximum equipment movement in any direction to 6 mm (¼ in.),

.9 location of snubbers designed to minimize prying action on floor bolts,

.10 adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

.3 Type “4-S” – Restrained Spring Isolator – Variable Load:

.1 colour coded seismic-controlled spring isolator, single or multiple spring coils, with minimum 6 mm (¼ in) neoprene pad mounted under spring(s),

.2 removable coil spring element without having to disturb supported equipment,

.3 lateral stiffness greater than 1.2 times rated vertical stiffness,

.4 minimum 50% overload capacity,

.5 non-welded spring elements: epoxy coated, with a minimum 1000-hour rating when tested in accordance with ASTM B-117,

.6 steel housing design to limit lateral and vertical movement of the supported equipment,

.7 top load plate with adjustable and leveling bolts,

.8 adjustable vertical restraints to allow unloading of water-bearing equipment,

.9 isolation washers,

.10 bottom load plate with anchor holes,

.11 hot dipped galvanized for outdoor installations,

.12 neoprene snubber compounded to bridge veering quality, to limit maximum equipment movement in any direction to 6 mm (¼ in),

.13 adaptor base suitable sized for larger anchors, when required to suit anchorage capacity.

2.5 Restrains and Braces for Distribution Services

.1 Type “SCR” – Cable Restraints:

.1 manufactured system consisting of cable, building attachment, and vertical hanger rod reinforcement assembly,

.2 field-built assemblies are not acceptable,

.3 steel wire strand cables:

(a) galvanized steel aircraft cable to ASTM A1023, or stainless steel to ASTM A492

(b) sized for seismic load with a safety factor of 2,

(c) arranged for restraint in both longitudinal and transverse directions under tension loads only,

(d) connector strength rating equal to 90% of cable breaking strength rating.

.4 building and equipment attachment brackets:

(a) carbon steel assemblies, designed to permit rotation to the final installation angle, or 45° bent steel plates with holes to allow attachment of cable loops,

(b) protective loop thimbles at contact with connectors,

(c) rope connections: overlap wire “U” clips with at least two (2) bolt fasteners, or tool-less wedge insert lock connectors,

(d) selected to exceed the cable working design load by 50%,

(e) single sided “C” beam clamps are not acceptable.

(f) fasteners to building structure designed to withstand simultaneous shear and tension loads, including prying action due to the bracket.

.2 Type “SSB” – Solid Braces:

.1 factory-built or field assembled solid braces, consisting of structural-shapes, building attachment, and vertical hanger rod reinforcement assembly.

.2 sized for seismic load with a safety factor of 2,

.3 arranged for restraint in both longitudinal and transverse directions.

.4 building and equipment attachment brackets:

(a) carbon steel assemblies, designed to permit rotation to the final installation angle, or 45° bent steel plates with holes to allow attachment of cable loops,

(b) selected to exceed the working design load by 50%,

(c) single sided “C” beam clamps are not acceptable.

(d) fasteners to building structure designed to withstand simultaneous shear and tension loads, including prying action due to the bracket.

.3 Bracing of vertical hanger rods for SCR restraints and SRB braces:

.1 hanger rods braced to avoid potential for buckling;

(a) structural steel angle or formed channel brace selected to prevent support rod buckling,

(b) brace attached to support rod with a series of adjustable clips, without the use of hand-tools.

.2 hanger rods are not required where two SRB braces are provided at each seismic restraint location and are installed at 180° opposition to each other.

2.6 Mechanical Anchors

.1 General:

.1 Post-installed mechanical anchors in concrete to be seismically qualified for installation in cracked concrete in accordance with ACI 355.2 by testing for seismic tension and shear loads in cracked concrete in accordance with ICC-EC AC193, and qualified by an ICC-ES seismic evaluation report.

.2 Anchors installed in concrete masonry units to be seismically qualified in accordance with TMS 402/602 by testing for seismic tension and shear loads in accordance with ICC-ES AC01 or AC106 and be qualified by an ICC-ES seismic evaluation report.

.3 Anchors to be selected for concurrent shear and tension loads with a safety factor not less than 2.0 times estimated load.

.2 Undercut anchors for post-concrete installation:

.1 zinc-plated carbon steel bolt, nut, washer, and cone-shape bearing-bell, with tungsten-tipped cutting radial edges, to create bearing force by keying into concrete,

(a) for outdoor use, all materials are to be stainless steel.

.2 special undercut stop-drill bit and installation setting tool,

.3 marking system to indicate when the anchor is completely installed,

.4 designed for pre-setting of anchors and/or fastening of anchors through the equipment attachment opening,

Standard of Acceptance

° Hilti - fig. HDA (indoor), HDA-R (outdoor)

.3 Expansion wedge anchors for post-concrete or masonry unit installation:

.1 zinc-plated carbon steel bolt, nut, washer, expanding segments and wedge mandrel, to create restraint force by friction and keying against/into adjacent concrete,

(a) for outdoor use, all materials are to be stainless steel.

.2 torque- loading to determine complete installation,

Standard of Acceptance

° Hilti - fig. KB-TZ2 (concrete and masonry)
° Hilti - fig. HSL-3 (concrete only)

.4 Screw anchors for masonry units:

.1 Zine-plated carbon steel masonry screw with hex washer head, to create restraint force by keying into concrete masonry units.

(a) for outdoor use, all materials to be stainless steel.

Standard of Acceptance

° Hilti - fig. KH-EZ series.

.5 Housekeeping pad anchors:

.1 for installation prior to pouring of the housekeeping pad and post-installation of the structural floor,

.2 tapered ductile iron body, with openings sized for two runs of Ø10mm (#3) reinforcing bar, and body NC threaded receiver for connection to undercut or expanding wedge anchors,

.3 two pieces of Ø10mm (#3) reinforcing bar, of sufficient length to tie into housekeeping pad reinforcement,

.4 undercut or expanding wedge anchor for connection to the structural floor slab.

Standard of Acceptance

° Mason Industries - fig. HPA

2.7 Adhesive Anchors

.1 Adhesive anchors for post-concrete installation:

.1 seismically qualified for installation in cracked concrete in accordance with ACI 355.2 by testing for seismic tension and shear loads in cracked concrete in accordance with ICC-EC AC308.

.2 to have an ICC-ES seismic evaluation report and be suitable for installation in cracked and uncracked normal- and light-weight concrete.

.3 anchors to be selected for concurrent shear and tension loads with a safety factor not less than 2.0 times estimated load.

.4 injectable, two-component hybrid adhesive, matching threaded rod and accessories.

Standard of Acceptance

° Hilti - fig. HIT-HY 200

3 EXECUTION

3.1 General Requirements

.1 Design and construct seismic restraints to;

.1 keep equipment and distribution services in place during and following seismic events,

.2 resist vertical loading simultaneously with transverse or longitudinal seismic loading.

.2 Give special consideration to design for adjacent connections, insulation treatment, thermal movement, vibration isolation, and relation to building seismic joints.

.3 Select restraint fastening systems so that full restraint will be provided assuming one failed fastener.

.4 Install seismic restraint devices in accordance with manufacturer's instructions and Seismic Engineer's installation shop drawings.

.5 Secure each transverse or longitudinal brace to the building structure, and not any other building service.

.6 Restraint installation;

.1 install cable restraints with cables snug.

.2 use solid braces only in rigidly supported situations,

.3 brace hanger rods forming a part of a seismic restraint to accept resulting compressive loads,

.4 install transverse and longitudinal braces at angles between 45 and 60° measured from the horizontal unless the seismic bracing details by the Seismic Engineer states otherwise.

.7 Trapeze supports may have the trapeze braced (transverse and longitudinally) provided each conduit (of all types) or cable is restrained to the trapeze.

3.2 Use of Pre-Engineered Bracing Details for Electrical Distribution Services

.1 Use of pre-engineered restraint and bracing details for conduit in accordance with SMACNA is permitted. Where the installation of these services exceeds the limits of the SMACNA guideline, provide specific engineering restraint devices and systems.

.1 for SMACNA details, refer to the seismic hazard level ("SHL") by floor level in Schedule A of this Specification Section.

.2 For the purpose of using SMACNA piping restraints, the following table may be used as a conversion for selected galvanized steel conduit and EMT sizes, where they are 40% filled with copper conductors. Use a similar conversion based on an equivalent weight per linear unit basis for other conduit materials and conductor fill quantity.

Galvanized steel conduit Size, I.D. (mm)	53	63	78	91	103	129	155
EMT Size, I.D. (mm)	63	78	91	103	-	-	-
Reference Pipe Size, Schedule 40, NPS (in)	2½	3	3½	4	5	6	8
Unit Weight of Reference Pipe Size Filled with Water Kg/m	11.7	15.9	19.8	24.2	34.6	46.8	74.6

.3 Provide cable restraints or bracing for transverse and longitudinal seismic restraints at spacing and locations as specified in the above referenced standards.

3.3 Exemptions from Seismic Restraint

.1 Except as required in paragraph .2 below, the following electrical distribution services are exempt from seismic restraint:

.1 exemption rules in SMACNA for piping apply to the equivalent weight per linear unit of conduit (of all types).

.2 conduit Ø60 mm (2.5 in. nominal) and smaller that are suspended, and wireways of similar cross-sectional area.

.3 suspended conduit where the length of support from the structure to the conduit does not exceed 305 mm (12 in.) and,

(a) the connection of the hanger rod to the building structure is fitted with a swivel to prevent bending of the rod,

(b) the free movement of the conduit will not come into contact with other building services or the building structure.

.4 conduit and cables fastened directly to the building structure (excluding partitions) using industry standard clips and concrete anchors as specified herein.

.2 These exemption rules do not apply to:

.1 fire alarm cables and conduit,

.2 emergency power cables and conduit,

3.4 Building Structural Connections

.1 Select building connection devices based on seismic loads for actual provided equipment.

.2 For connection to concrete structures;

.1 Select building structure anchors as follows:

(a) post-installed undercut anchors or wedge-expansion anchors,

(b) concrete inserts may be used in new construction but only where complete seismic design is completed and seismic forces are adjusted to suit,

.2 Spacing between anchors: not less than 3 x the effective embedment of the greatest embedment length.

.3 Where adhesive anchors or concrete inserts are used, the anchors are sized for an increased seismic force as described in article “Design Criteria”.

.4 For connection to steel structures:

.1 use double sided beam clamp, loaded to the centerline of the beam web, or

.2 were permitted by the building structural engineer, specifically designed welded or bolted connection may be used.

.3 the use of single sided “C” type beam clamps is not permitted for the connection to the building steel structure for hanger rods and seismic restraints.

3.5 Construction of Housekeeping Pads

.1 Do not construct housekeeping pads until equipment restraint and anchors are designed and selected by the Seismic Engineer and/or seismic restraint manufacturer, and housekeeping pads detailed design are provided by the Seismic Engineer.

.2 Provide housekeeping pads with integral reinforcement and structural anchors to the floor slab to withstand applied shear loads and anchor pull-out tension loads.

.1 provide reinforcing bar both directions on equal centers, and interior and perimeter floor anchors,

.2 in pre-installation construction, “Z-bar” shapes may only be used when housekeeping pad layouts are known prior to construction of the structural floor slab,

.3 in post-installations, use tapered housekeeping pad anchor assemblies,

.4 in post-installations, “L-rebar” shapes with adhesive anchors may be used, except the seismic forces in Schedule A of this Specification section must be increased as described above for adhesive anchors.

.3 Pre-engineered details of construction for housekeeping pads as shown in chapter 6 of ASHRAE *Practical Guide to Seismic Restraint* may be used within its defined limits of application including but not limited to:

.1 housekeeping pad sizes are limited to 37 m^2 (400 ft^2) or less,

.2 equipment center of gravity height does not exceed the width of the housekeeping pad,

.3 the ASHRAE maximum load rating includes the weight of the restrained equipment, vibration isolation equipment, support rails and bases, and the housekeeping pads,

.4 for values of “Fp” in ASHRAE, substitute the horizontal seismic force “Vp” as defined in the National Building Code of Canada for non-structural components (based on the seismic force coefficient “K_s” in Schedule A of this Specification section).

.4 Size the housekeeping pad so that the distance from the equipment anchors to the edge of the pad is not less than 1.5 times the effective embedment depth of the equipment anchor unless the anchor manufacturer requires greater separation distance.

3.6 Restraints for Bus Duct, Busway, Cable Tray - General Requirements

.1 Use braces for restraint of bus ducts and busways.

.2 Use braces or cable restraints for cable trays.

.3 Provide reinforcement of hanging rods to prevent buckling of the rod.

3.7 Conduit, Wireway Restraints - General Requirements

.1 Use cable restraints for suspended conduit and suspended wireway.

.2 Provide reinforcement of hanging rods to prevent buckling of the rod.

.3 For trapeze hangers, provide U-bolts over conduit to limit lateral and vertical movement.

.4 Attach restraints to conduit or conduit hangers, and trapezes.

.5 Where pre-engineering restraints in accordance with SMACNA are used, the spacing for transverse and longitudinal restraints are to be reduced to 50% of the stated spans for the following conduit materials:

.1 PVC conduit.

3.8 Floor Mounted Equipment Restraints

.1 Anchor floor mounted equipment with anchor bolts, with a minimum of four (4) anchors.

.1 friction due to gravity loads shall not be considered to provide resistance to seismic forces.

.2 Secure equipment directly using equipment base supports or SRB brackets. Alternatively, use type SS1, SS2, SS3 or SRB snubbers where equipment is not subject to overturning moments. Use only type SRB or SS3 snubbers where equipment is subject to overturning moments;

.1 for type SS1 snubbers, provide a minimum of eight (8) snubbers for each piece of equipment, with two units placed on each corner of the equipment base frame.

.2 for type SRB, SS2 and SS3 snubbers, provide a minimum of four (4) snubbers for each piece of equipment, with one unit placed on each face of the equipment base frame.

.3 Provide resilient neoprene bushings and washers between equipment and anchor bolts where equipment is secured rigidly to floor or housekeeping pad.

.4 Install snubber devices only after equipment is installed and operating, to ensure no metal-to-metal contact. Adjust snubbers so that any clearance gaps do not exceed 6 mm (1/4 in.).

.5 For floor mounted equipment with vibration isolators;

.1 select basic vibration isolator in accordance with Section 20 05 48.

.2 select seismic restraint for each piece of equipment of either:

(a) integrated seismic vibration restraint type 2-S, 3-S or 4-S, or

(b) vibration isolator in accordance with Section 20 05 48 combined with seismic snubbers SS1, SS2 or SS3 as applicable to suit overturning moment.

.3 Do not mix types of restraint on the same piece of equipment.

.4 Where the equipment is not provided with a structural base to transfer seismic forces, provide a structural-shape, or formed steel channel base as a complete steel frames suitably cross braced in both horizontal directions to withstand seismic induced shear force and bending moments.

3.9 Suspended Equipment Restraints

.1 Provide restraints for equipment independent of restraints provided on connecting conduit, bus duct, busway, or cable trays.

.2 Provide reinforcement of hanger rods to prevent buckling.

.3 Provide SCR type longitudinal and transverse restraints at each corner of the equipment (total of eight (8) cables). Alternatively, a single SCR cable can be installed at each corner of the equipment, positioned at 45° to both transverse and longitudinal direction and sized for concurrent transverse and longitudinal loads.

3.10 Equipment Restraints - Surface Wall-Mounted Equipment and Panels

.1 Application: for electrical panels, control panels, motor controllers, and other electrical distribution equipment.

.2 Attach equipment to horizontal galvanized steel channels and fasten with bolts equipped with neoprene isolation grommet washers. Channels to extend past the side of the equipment to allow anchoring to wall. Select bolts for concurrent shear dead-weight without deduction for uplift load, and tension restraint load.

.3 Attach channels to concrete or masonry walls with not less than four (4) anchors with each anchor having a not less than a 1.5 safety factor.

3.11 Equipment Restraints - Recessed Wall-Mounted Equipment

.1 Application: for electrical panels, control panels, motor controllers, and other electrical distribution equipment.

.2 Mount recessed equipment through the top, bottom and sides of the equipment housing to adjacent block wall or wall studs.

3.12 Inspection, Testing, Adjustment and Reporting

.1 For equipment supported on vibration isolators, field measure air gaps on each restraint and if necessary, adjust the restraint so that the clearance air gap does not exceed 6 mm (1/4 in.). Provide a written report identifying the results of each test and adjustment, to the Seismic Engineer and Consultant for review.

.2 Arrange for the seismic restraint manufacturer to inspect and report on the installation at completion of the work. Make corrections of deficiencies identified by the manufacturer. This work is to be performed prior to the final field review by the Seismic Engineer.

.3 Arrange for Seismic Engineer to conduct a final inspection prior to substantial performance of the Work. Make corrections of deficiencies identified by Seismic Engineer. This work is to be performed prior to the final field review by Consultant.

.4 Make corrections of deficiencies identified by Consultant.

.5 Submit the following reports prior to application for substantial performance of the Work, or where applicable, ready-for-takeover of the Work:

.1 Seismic Engineer periodic and final inspection reports,

.2 seismic restraint manufacturer inspection reports,

.3 Seismic Engineer declaration of general review.

3.13 Schedules

.1 The following schedules are attached to and form part of this Specification section.

.1 Schedule A Seismic Force Coefficients and SMACNA SHL Class

(a) Table 1 Horizontal Seismic Force Factor, K_s

(b) Table 2 Vertical Seismic Force Factor, K_v

Schedule A –Seismic Force Coefficients and SMACNA SHL Class

Table 1 – Horizontal Seismic Force Factors		
Building Level	Horizontal Seismic Force Coefficient (except fire protection)	SMACNA SHL Class
	K_s	---
Roof		
Ground Floor	0.10	D
Basement	0.17	D

Table 2 – Vertical Seismic Force Factors	
Building Level	Vertical Seismic Force Factor
	K_v
All Floors	0.07

END OF SECTION

SEISMIC QUALIFICATION FOR ELECTRICAL EQUIPMENT
26 05 49.23

1 GENERAL

1.1 Scope

.1 Provide seismic qualification (certification) of select electrical equipment where such requirement and method of qualification is specified in other technical Specification sections of Divisions 26, 27 and 28..

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 26 05 49.20 Seismic Restraint for Electrical Services

1.3 Definitions

.1 The following definitions apply for the purpose of this section.

Seismic Qualification: equipment which has been evaluated to withstand design lateral and vertical seismic induced forces:

Attachment seismic qualification (Level I qualification) - means the equipment is evaluated at the equipment's attachment point to the building structure to retain the position of the equipment during a design seismic event.

Structural seismic qualification (Level II qualification) - means the equipment's internal structural elements and components have been evaluated to remain in place and not be dislodged during a design seismic event and includes Level I qualification.

Functional seismic qualification (Level III qualification) - means the equipment is evaluated to continue its functional operation after being subjected to a design seismic event and includes a Level I and II qualification.

.2 Refer to Specification section 26 05 49.13 for other applicable definitions and abbreviations.

.3 Interpretation:

.1 In this specification, the parameter "S_{DS}" (5% damped spectral response acceleration parameter at short periods) in ASCE7, AHRI 1271, NFPA 13, ASHRAE, SMACNA and MSS SP-127 used for estimating the horizontal seismic force, has the same meaning as the parameter "S(0.2)" for the Project site-specific design spectral response acceleration value at 0.2 seconds as defined in article 4.1.8.18 of the 2020 National Building Code of Canada.

1.4 Applicable Codes and Standards

.1 Legislation

.1 2020 National Building Code of Canada, as adopted in the jurisdiction of the Project.

.2 Product standards:

.1 ICC- ES AC156 Acceptance Criteria for Seismic Certification by Shake-Table Testing of Non-structural Components

.3 Other documents:

.1 ASCE 7-10 American Society of Civil Engineers: Minimum Design Loads and Associated Criteria for Buildings and Other Structures

.2 NEMA EESCTG 1-2019: NEMA Seismic Guideline 1 – General Requirements for Seismic Qualification of Electrical Equipment for Commercial Building Loads

.3 NEMA BI 50010-2024: Seismic Certification Criteria for Nonstructural Electrical Components for Commercial Building Code Applications

1.5 Design Criteria

.1 Refer to Specification section 26 05 49.13 for general seismic force design criteria.

1.6 Seismic Qualification of Equipment

.1 Refer to each applicable equipment Specification section for the equipment-specific seismic qualification level and certification method.

.2 Where equipment is specified only for Attachment seismic qualification (Level I) or Structural seismic qualification (Level II), certify such equipment in accordance with either of the following:

.1 by static analysis or dynamic analysis in accordance with ASCE7 or by shake table test in accordance with ICC ES AC156.

.3 For equipment which is specified for Functional seismic qualification (Level III), certify such equipment in accordance with the following:

.1 by shake table test in accordance with ICC ES AC156.

.4 Site design parameters:

Item	Description	Abbrev.	Value
1	Site Class	X_s	C
2	Building Category	---	Post-Disaster
3	Building Importance Factor	I_E	1.5
4	Design Spectral Response acceleration factor	S(0.2)	0.32

.5 Shaker table test parameters in accordance with ICC EC AC156 are to comply with the following:

.1 calculate seismic forces in accordance with the building code at the place of the Work, or in its absence the 2020 National Building Code of Canada (“NBC”),

$$V_p = 0.3\, S(0.2) I_E\, C_p\, \frac{A_r}{R_p}\, (1 + 2\frac{h_x}{h_n})\, W_p$$

.2 the ASCE7 parameter “ S_{DS}” is equivalent to “S(0.2)” where S(0.2) is as defined in the NBC and is the maximum of S(0.2,X) and S(0.5,X),

.3 the ASCE7 parameter “a_p” is equivalent to the NBC “A_r” parameter.

.4 the ASCE7 parameter “R_p” is equivalent to the NBC “R_p” parameter.

.5 the ASCE 7 Component importance factor “I_p” is to be read as the NBC Building Importance Factor “I_E”.

.6 the ASCE7 parameter “z/h” is to be read as the NBC parameter “h_x/h_n”,

.7 the ASCE7 parameter “Ω_0” has no equivalent in the NBC and is not to be used,

.8 the NBC parameter "C_P" has no equivalent in ASCE7 but is to be included in the force calculation,

.9 the values of parameters "Ar", "Rp", and "Cp" are found in each equipment technical specification section.

.10 unless otherwise specified in the product technical Specification section, the value of "h_x/h_n" ratio is to be 1.0, representing the equipment under test being located anywhere in the building including at the top of a building,

.11 the test parameters are in accordance with the following table and as follows:

(a) parameters for test acceleration values A_{FLX-H}, A_{RIG-H}, A_{FLX-V}, and A_{RGD-V} are as defined in ICC-ES AC156.

Building Code	Test Criteria	Design S(T,X) (g)	S_{DS} (g)	z/h	Horizontal Acceleration		Vertical Acceleration	
					A_{FLX-H}	A_{RIG-H}	A_{FLX-V}	A_{RIG-V}
NBC 2020	ICC-ES AC156	0.32	0.32	0.0	0.320	0.128	.214	0.086

.12 other parameters as specified in accordance with Specification section 26 05 49.13.

.6 Where seismic qualification is by shake table test, equipment product line may be qualified by extrapolation or interpolation analysis from a suitable range of tested sample products of the same model by either:

.1 in accordance with ICC ES AC156 for equipment within the scope of that standard, or

.2 with equipment manufacturer's supporting calculations for such equipment which are prepared by an engineer licensed in the jurisdiction of the Project.

.7 Alternate compliance path:

.1 equipment which conforms with all the following is deemed to be seismically qualified:

(a) equipment which is certified and listed on the California Department of Health Care Access and Information "Special Seismic Certification Preapproval (OSP)", and

(b) the certification horizontal acceleration factor is equal to or greater than the Projects horizontal acceleration factor "Kv" as specified in Specification section 26 05 49.13.

1.7 Submittals

.1 Where equipment is specified to be seismically qualified, submit any of the following test certificates with the shop drawings for each applicable equipment:

.1 NEMA BI 500-01

.2 California HCAI OSP listing including data for design horizontal seismic forces,

.3 test reports by independent laboratories for conformance to ICC ES AC156,

.4 manufacturer's sealed calculation reports (seismic qualification Level I and Level II only).

2 PRODUCTS

.1 Not Used

3 EXECUTION

.1 Not used.

END OF SECTION

IDENTIFICATION FOR ELECTRICAL SYSTEMS
26 05 53

1 GENERAL

1.1 Scope

.1 Provide identification and warning signs for complete electrical systems as shown.

1.2 Applicable Codes and Standards

.1 Product standards:

.1 CSA C22.2 No. 197 PVC Insulating Tape

1.3 Submittals

.1 Shop drawings:

.1 Submit list of nameplates with proposed wording, prior to engraving.

.2 Submit list of labels with proposed wording, prior to printing.

.3 Submit representative samples of nameplates, labels and warning signs.

2 PRODUCTS

2.1 Warning Signs

.1 As required to meet requirements of the Electrical Safety Authority.

.2 Outdoor signs:

.1 fibreglass,

.2 minimum size 250 mm x 360 mm (10" x 14").

.3 Indoor signs;

.1 aluminum,

.2 baked enamel finish,

.3 minimum size 180 mm x 250 mm (7" x 10").

Standard of Acceptance

- Brady
- Seton

2.2 Equipment Identification

.1 Nameplates for panels and equipment:

.1 3 mm (⅛") thick laminated plastic plates,

.2 engraved lettering,

(a) first line: 11 mm (7/16 in.) high lettering,

(b) second line: 7mm (1/4 in.) high lettering,

(c) third line: 5mm (3/16 in.) high lettering,

.3 [colour coded as follows:

(a) black lettering on white background for panels and equipment on normal power,

(b) white lettering on orange background for panels and equipment on emergency power,

(c) white lettering on light blue background for panels and equipment on UPS power,

.4 with bevelled edges,

.5 mechanically attached with self-tapping stainless steel screws.

.2 Labels for warnings, instructions etc. on panels and equipment:

.1 printed on white polyester background,

.2 7 mm (¼") high letters unless specified otherwise,

.3 UV resistant inks,

.4 clear polyester over lamination,

.5 pressure sensitive adhesive.

Standard of Acceptance

- Brady
- Ideal Industries
- Safety Sign

.3 Do not commence manufacture of nameplates and labels until wording has been reviewed by the Consultant.

2.3 Wiring Identification

.1 Colour coded phasing tapes:

.1 7 mil poly vinyl chloride,

.2 pressure sensitive adhesive,

.3 compatible with wire insulation,

.4 permanent colour,

.5 electrically insulating,

.6 UV and moisture resistant,

.7 to CSA C22.2 No. 197

Standard of Acceptance

- 3M Scotch 35
- Electro Tape Specialties 103/103C Series

.2 Wire markers:

.1 adhesive

.2 self laminating,

.3 white vinyl print area,

.4 permanent thermal transfer printing.

Standard of Acceptance

- Brady
- Panduit

3 EXECUTION

3.1 Equipment Identification

.1 Identify electrical equipment with nameplates, directories and labels.

.2 Provide nameplates:

.1 secure to top exterior of equipment except where indicated otherwise,

.2 switchboards: indicate name, voltage and ampacity,

.3 rear of switchboard cubicles or cells: indicate name of cell or cubicle,

.4 panelboards: indicate name, voltage and source of power,

.5 terminal cabinets: indicate name, system and voltage,

.6 circuit breakers with fixed trip units: indicate load supplied, voltage and maximum allowable ampere rating of the breaker,

.7 circuit breakers with replaceable trip units: indicate load supplied, voltage and maximum allowable ampere rating of the trip unit,

.8 circuit breakers with adjustable trip units: indicate load supplied, voltage and maximum allowable ampere setting of the long time pick up,

.9 disconnects: indicate load supplied, voltage, type of fuses and maximum allowable ampere rating of fuses,

.10 starters: indicate equipment being controlled, voltage and maximum allowable setting of the overload device,

.11 contactors: indicate equipment being controlled and voltage,

.12 transformers: indicate name, capacity, primary and secondary voltages,

.13 pull boxes and junction boxes: indicate system, circuit numbers and voltage,

.14 cabinets for low voltage systems, such as signals and communications: indicate name and system,

.15 equipment not listed above, such as, instruments, fire alarm, clock and program equipment and control panels: identify in a similar manner showing name and number of the equipment, voltage and load information.

.16 typical identification standards:

(a) Lighting, Receptacle and Power Panels: each identified with an engraved lamicoid nameplate secured to top interior trim as follows:

LP-4NW-1EA	11 mm (7/16") high lettering
120/208 volts	7 mm (1/4") high lettering
Fed from PP-SBSW-EAA	5 mm (3/16") high lettering

.3 Directories:

.1 Supply each panelboard with a directory card holder welded to inside of door, complete with a neatly typewritten list showing information as follows:

Panelboard Name LP-4NW-1EA		
Panel Voltage 120/208 Volts		
Circuit Number	Description	Maximum Allowable Rating

1	Lighting Room #34	20 Amps
2	Receptacles Room #34	15 Amps
3	Ice Machine Room #17	30 Amps
4/6	Split Receptacle Room #26	20 Amps
5/7/9	Sub Feed to Receptacle Panel RP-4NW-1EA	60 Amps

.2 Cabinets for low voltage systems, such as signals and communications: as for panelboards with a directory showing circuit numbers and room locations plus a blank column for "Remarks".

.3 Cover directory list with a 0.8mm (1/32") minimum thick clear plastic sheet to protect it.

.4 Warning Labels:

.1 circuit breakers where the allowable maximum continuous load is less than the breaker rating or the breaker is not marked with a continuous load rating: provide a label stating:

Caution: maximum continuous load not to exceed XXX Amperes.

.2 disconnects where the allowable maximum continuous load is less than the switch rating or the switch is not marked with a continuous load rating: provide a label stating:

Caution: maximum continuous load not to exceed XXX Amperes.

.5 Pull Boxes and Junction Boxes

.1 Identify feeder pull boxes and junction boxes:

(a) lettering stamped on brass or aluminum tags,

(b) showing the name of the feeder or system,

(c) voltage involved,

(d) data for both termination points whether equipment or panel,

(e) secure tag under box lid screws using steel wire.

3.2 Service Rough-in Identification

.1 Apply a small dab of paint to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:

Red	Fire Alarm System and Emergency Voice Communication System
Dark Blue	Intercom and Public Address
Dark Green	Telephone and Data Systems
Black	Annunciator and Buzzer System
Grey	Clock System
White	Central Dictation
Orange	Nurse Call
Yellow	Alarm Systems

Pink	Computer Systems
Light Green	TV Systems

.2 Junction boxes in furred ceilings to have colour identification on both inside and outside.

.3 As an alternative to applying paint dabs, prepainted conduit/EMT may be used where applicable.

.4 Colour coding is not required for lighting and power circuits.

3.3 Wiring Identification

.1 Identify feeders and branch circuit wiring with wire markers;

.1 at each end of run,

.2 in each junction box,

.3 wherever they are introduced into ducts or equipment.

.2 Identify incoming utility service lines by Red - Phase "A", Black - Phase "B", Blue - Phase "C", with colour coded phasing tape.

.3 Band buswork in each;

.1 switchboard,

.2 unit substation cubicle,

.3 power panel,

.4 lighting and receptacle panel,

with colour coded phasing tape as follows:

Red	Phase A
Black	Phase B
Blue	Phase C
White	Neutral
Green	Bond/Ground

.4 Band feeder and sub-feeder bus and conductors as above.

.5 Maintain phase sequence and colour coding throughout.

.6 Connections in equipment to be Phase A, B, C from left to right when viewing from front or accessible direction.

.7 For control conductors for motors and equipment, schedule and chart marker numbers with corresponding machine numbers and locations and include with Record Drawings and Operation and Maintenance Data.

.8 Use colour coded wires in communication cables, matched throughout system. Schedule and chart, marker numbers and wire colours with corresponding equipment and include with Record Drawings and Operation and Maintenance Data.

3.4 Conduit and Cable Identification

.1 Label;

.1 incoming service cables,

.2 bus ducts,

.3 feeder conduits/EMT,

.4 feeder cables,

.5 communications cables.

.2 Locate labels as follows;

.1 at every end of every conduit, duct or cable run, adjacent to item of equipment serviced,

.2 on each exposed conduit, duct or cable passing through a wall, partition or floor (one on each side of such wall, partition or floor),

.3 at intervals of not more than 15 m (50') along every exposed conduit, EMT, duct or cable run exceeding 23 m (75') in length,

.4 at every access point on concealed conduit, EMT, duct or cable runs,

.1 visible from 1.5 m (5') above adjacent floor or platform.

3.5 Fire Stopping Identification

.1 Provide a warning card adjacent to each opening exceeding 25mm (1”) in diameter, indicating the following;

.1 a warning that the opening is protected by a fire stopping material,

.2 the fire stop system used, ULC or cUL,

.3 F rating or FT rating,

.4 specific fire stop product(s) used,

.5 name and telephone number of the contact person should any changes to the fire stopping be required.

.2 Provide warning labels for each fire stopped penetration as follows;

.1 permanently attached to walls, floors, underside of slabs, adjacent to the penetration,

.2 on each side of the penetration,

.3 vinyl panel, white and red background with black lettering,

.4 self adhesive with permanent pressure sensitive adhesive,

.5 stating:

WARNING
THROUGH PENETRATION FIRESTOP SYSTEM - DO NOT DISTURB
NOTIFY BUILDING MANAGEMENT OF ANY DAMAGE

3.6 Single Line Electrical Diagrams

.1 Provide a single line schematic diagram in each Electrical room to illustrate every component including;

.1 main service,

.2 transformers,

.3 grounding,

.4 switchgear,

.5 unit substations,

.6 generators,

.7 circuit breakers,

.8 fuses,

.9 capacitor banks,

.10 surge protective devices,

.11 disconnect switches,

.12 transfer switches,

.13 panelboards,

.14 major items of equipment such as chillers,

.15 feeders,

.16 key interlocks,

.17 interlocking schemes,

.18 protective relays,

.19 metering,

.20 transformer winding arrangements,

.21 voltage levels, including number of phases and wires,

.22 equipment ratings such as: Amperes, kW, kVA, kVAR.

.2 Diagram:

.1 print of an AutoCAD drawing using the latest version of AutoCAD,

.2 not less than 600 mm x 600 mm (2' x 2'),

.3 in a wood frame,

.4 plexiglass covered.

.3 Submit diagram to Electrical Inspection Authority and incorporate all requirements indicated in their comments.

.4 Submit diagram as shop drawing for review.

.5 Provide an electronic version of the drawing file to the Owner for the Owner’s future use.

END OF SECTION

INDEPENDENT POWER SYSTEM TESTING
26 05 73.15

1 GENERAL

1.1 Scope

.1 The Division 26 contractor shall retain and pay for the services of an Independent Testing Organization ("ITO") to provide Factory Acceptance Testing (FAT), Site Acceptance Testing (SAT) and On-Site Commissioning Service in accordance with the details specified herein.

.2 The Division 26 Contractor shall include in the Bid Amount the cost for the services of tradesmen to handle equipment, make temporary connections, operate equipment and make repairs and adjustments and assist the testing organization's on-site specialists during the site acceptance testing and supplementary Commissioning phase of the work and as required by the [Engineer][Consultant] until the equipment and systems are accepted by the Owner.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections. Refer to these sections for additional requirements for factory witness testing and for site acceptance testing:

.1 26 08 06 Electrical Systems Studies and Reports

.2 26 08 15 Electrical Commissioning

.3 26 05 26.16 Secondary Grounding and Bonding for Electrical Systems

.4 26 23 00 Low-Voltage Switchgear

.5 26 24 16.13 Panelboards

.6 26 32 13 Power Generation Diesel

1.3 Installation Codes and Standards

.1 ANSI/NETA ATS Standard for Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems

1.4 Independent Testing Organization

.1 In order to ensure the requirement for independence, the ITO must be retained directly by the Division 26 contractor or owner. The ITO must not be retained by an equipment manufacturer or their distributor as part of an equipment package.

1.5 Bidding Instructions to Vendors

.1 The Bidders for Division 26 work shall advise all equipment suppliers bidding for the equipment supply for this project prior to Tender close of the requirement for comprehensive factory and on-site testing and commissioning and the requirement for on-site services of technical representatives during the testing and extensive commissioning phase and ensure the services and associated costs are included in the suppliers' quotations for the equipment for the project and in the Bidder's Tender Price.

1.6 Approved Testing Organizations

Standard of Acceptance

- Haronitis & Associates Limited
- AC Tesla
- Spark Power

- Eaton Electric / Cutler Hammer Service
- Schneider Canada Service
- Siemens Service
- G. T. Wood
- Brosz and Associates
- Enkompass

.2

2 PRODUCTS

2.1 Not Used

3 EXECUTION.

3.1 Factory Acceptance Testing

.1 Provide in-plant inspection and factory witness testing at various manufacturing plants where the equipment and materials are made and/or assembled prior to shipment to the jobsite. Testing to suit delivery schedule of manufacturers.

.2 Include a contingency allowance in the cost to re-visit the manufacturers' plants and re-witness Factory Witness tests, should the initial tests fail and repairs and modifications cannot be done to correct deficiencies during the initial testing program.

.3 Certification shall be made that all required tests have been completed and that equipment conforms to standards, specifications and shop drawings and is suitable for shipment.

.4 Factory witness tests of equipment and HV cables shall be done after equipment have passed standard production tests and is free and clear of deficiencies and in the opinion of the manufacturers, the equipment is deemed suitable for shipment to the job-site.

.5 The supplementary factory witness tests by the Independent Testing Organization are required to certify on behalf of the contractor and owner that the equipment is compliant and free and clear of deficiencies and suitable for shipment to the job-site.

.6 Detailed testing requirements are identified in equipment specification sections.

.7 The following is list of equipment for the factory witness tests.

.1 High voltage switchgear.

.2 Main power transformers

.3 Diesel generators

.4 Low voltage switchboards

.5 Automatic Transfer Switches

.8 Provide a test report for each equipment item in each of above sections.

3.2 Site Acceptance Testing (SAT)

.1 Upon Completion of the installation and prior to energization of components and systems, perform a complete inspection and testing to verify phase and polarity match of feeders with equipment and the tightness of power wiring terminations.

.2 Detailed testing requirements are identified in equipment specification sections.

.3 In addition, perform site acceptance testing for the following equipment:

.1 Power Transformers

.2 Emergency Power System

.3 Low voltage switchboards

.4 Power Feeders

.5 Potential transformers (throughout all components and systems)

(a) Ratio, polarity and phase angle tests

(b) Insulation resistance tests

.6 Current transformers (throughout all components and systems)

(a) AC excitation test, (produce saturation curves)

(b) Polarity ratio and insulation resistance tests

.7 Metering and Instruments throughout all components and systems

(a) Verify correctness of wiring and operation

.8 Key Interlocking schemes

(a) Verify proper operation and identification of all key interlocking systems throughout all switchboards and panelboards

3.3 Testing, Adjusting and Verification

.1 Provide necessary test equipment, material, labour and miscellaneous services during the testing, adjusting, verification and commissioning procedure.

.2 Work normal to the electrical trade such as providing temporary feeders, jumpers and connections, and handling equipment shall be done by the contractor under Division 26.

.3 Work and technical supervision by manufacturers' technical representatives in the verification, testing and commissioning phase shall be provided and all costs for tradesmen and representatives shall be included in the tender price.

.4 Verify that all protective device schemes function properly. Conduct circuit breaker trip tests. Apply correct voltage and current to protective devices.

.5 Verify the performance of the ground fault alarm and protection systems

.6 Provide cross wattmeter readings or equivalent or any differential and/or directional relay schemes. Verify metering schemes.

.7 During the testing and verification procedure, conduct supplementary spot checks on selected protective devices in company with representative of the Owner and/or [Engineer][Consultant] to adjust and re-test protective devices so that final settings will result in performance in accordance with approved issue of respective co-ordination curve.

3.4 Performance Verification of the Entire System

.1 After the energization of the electrical systems have been satisfactorily completed and all testing and calibration work have been done and all reports submitted as shop drawings to the Consultant and all deficiencies noted to-dated have been corrected, the systems shall be subjected to supplementary dynamic simulation and verification of their operating performance characteristics in accordance with the Consultant Test Plans and in the presence of the Consultant and Owner's representative.

.2 The Contractor's forces and manufacturer's technicians shall also be present to start, stop and operate equipment and make adjustments as directed by the [Engineer][Consultant].

.3 The following is an abbreviated outline of the tasks to be undertaken:

.1 Dynamic phasing and polarity verification of HV & LV switchboards, automatic transfer switches, and APS systems.

.2 Verify the start signal from each ATS is received at the respective diesel generator control panels and that the DG's start and supply power to the ATS's in the prescribed sequence.

.3 Verify that APS system will operate automatically. Tripping of incoming power supplies will be required

.4 Verify operation of APS automatic load management system by removing generating units from the system and simulating other malfunctions in the system.

.5 Verify operation of all manual controls on APS system

.4 Upon completion of the Commissioning phase, prepare a comprehensive report summarizing the findings.

3.5 Reports

.1 Prepare and submit the following reports. Simultaneously submit one copy directly to the Consultant and one copy to the contractor to be processed as a shop drawing:

.1 Factory Witness test report for each item of equipment within 5 working days of the factory visit. Where deficiencies in the factory test have been noted, inform the engineer and contractor immediately to permit a decision to be made whether remedial action is required of the manufacturer prior to the equipment being accepted for shipment to site.

.2 Site Testing Report for each item of equipment within 5 working days of completion of site test.

.3 Site Performance verification report(s) to reflect each significant phase of system completion.

.4 Upon completion of the Commissioning phase, prepare a comprehensive report summarizing the findings.

.2 The final report and study shall include assurance for the following items:

.1 That the protective devices on the high voltage equipment co-ordinate with the Utility protective devices.

.2 That the protective devices within the parameters of the study conform to the results of the study.

.3 That the equipment has been tested and performs as per the settings of the approved co-ordination curves.

.4 That the "as left" condition of the protective devices corresponds to the record documents.

.3 Completed studies and reports shall be submitted simultaneously to the Consultant as well as part of the requirements of the Maintenance Manuals. Provide PDF of final reports plus one hard copy.

END OF SECTION

WIRING FOR MECHANICAL SERVICES
26 07 03

1 GENERAL

1.1 Scope

.1 Provide wiring for mechanical services and equipment which forms part of the Work under Divisions 20 to 25.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 20 05 12 Common Electrical Requirements for Mechanical Services

.2 20 05 14.13 Constant Speed Motor Controllers

.3 20 05 14.16 Variable Frequency Drive Motor Controllers

1.3 Definitions and Abbreviations

.1 The following definitions apply to this section.

.1 ***Control panels –*** an electrical device that controls or monitors mechanical equipment, or that interfaces with instrumentation devices.

.2 ***Control wiring*** - wiring for the purpose of communication or control of mechanical equipment and instrumentation.

.3 ***Mechanical breaker panel (MBP)*** - 120/208 V mechanical power panel with overcurrent protection circuit breakers provided as part of an MCC.

.4 ***Mechanical Services Panel (MSP) –*** panelboard with branch circuit overcurrent protection devices, provided by Division 26, and dedicated to supply power for equipment provided by mechanical trades work.

.5 ***Mechanical trades work -*** equipment and systems provided under Divisions 20 to 25.

.6 ***Motor controllers -*** constant speed motor controllers of the manual, magnetic or solid-state type in accordance with specification section 20 05 14.13.

.7 ***Motor Control Center (MCC) –*** has the meaning as specified in section 20 05 14.13.

.8 ***Packaged equipment –*** mechanical trades equipment containing some or all of: motor(s), controls and/or other electrically powered equipment, such as but not limited to: electric heating equipment, water treatment equipment, packaged HVAC equipment, electric boiler, electric domestic water heaters, etc.)

.9 ***Power Panel (PP)***: 208 up to 600 V, 3 phase, panelboard with branch circuit overcurrent protection devices, provided by Division 26, which serves general building loads and may also serve equipment provided by mechanical trades work.

.10 ***Power wiring*** means wiring that provides electrical power to mechanical equipment.

.11 ***Receptacle panel (RP)*** - a 120/208 V panelboard with branch circuit breakers, provided by Division 26.

.12 ***VFD***: variable frequency drives in accordance with specification section 20 05 14.16.

.13 ***Wiring*** means conductors, cable, conduit, fittings, supports and accessories.

.2 For clarity, any reference herein to Division 20 means Divisions 20 to 25 inclusive.

2 PRODUCTS

2.1 Not used

3 EXECUTION

3.1 Wiring of Mechanical Trades Motors and Equipment

.1 To limit responsibility and to specifically define the Work under this Division, use the following procedure with regard to motors and equipment provided under mechanical trades work.

.2 The contractor for the mechanical trades work will be responsible for installing equipment which they supply including motors, motor controllers, VFDs, disconnect switch, Motor Control Centres, mechanical breaker panels (MBP) and miscellaneous controls.

.3 For motorized equipment forming part of the mechanical trades work, wire to line side of the Motor Control Centre, motor controllers, VFDs, , or disconnect switch provided under the mechanical trades work, in reasonable proximity to equipment being controlled.

.4 From this point, unless otherwise shown, the cost of electrical material and labour will be borne by the particular trade whose work is involved. That trade will mount the motor controller or VFD and wire from it to the motor being controlled, together with control wiring, remote switches, and pilot lights.

.5 Except where a panelboard is shown to be provided by Division 26, where individual starters and controls are grouped together, provide a feeder, main fused disconnect switch, a splitter of adequate size and capacity, individual fused disconnect switches, and wire to line side of the Division 20 motor controllers.

.6 In the case of packaged equipment and control panels, provide a junction box adjacent to motor or device being electrically powered, and pull wire through with sufficient length to allow direct termination to the end device or equipment.

.7 Provide branch circuit wiring and an junction box for each motorized damper or heating control, with sufficient length to terminate at the motorized damper or heating control.

.1 Provision of conduit from these junction boxes to the mechanical equipment will be done under Mechanical Division 20.

.8 Ascertain locations of starters, Motor Control Centres, and motors from Mechanical Drawings.

3.2 Coordination and Division of Responsibility – Division 20 and Division 26

.1 Schedule A at the end of this Specification section specifies the division of responsibility between Division 20 and Division 26 for provision of electrical work for mechanical equipment, including termination of conductors.

.2 For clarity;

.1 the Division 20 electrical Work may be performed by the Division 26 contractor, but the work is managed and paid for by the Division 20 contractor.

.3 Coordinate with the Division 20 contractor to manage the Division 26 work. Coordination to include but is not limited to:

.1 reviewing a list of all planned and ordered mechanical trades equipment for motor horsepower ratings and electrical power requirements, prior to procuring power distribution equipment,

.2 periodically review this power requirements list as mechanical trades equipment is ordered, and revise and update branch circuit feeders and breaker ratings in a timely manner.

Schedule A – Coordination of Division 20 and 26 Scope of Work

Schedule A – Coordination of Division 20 and 26 Scope of Work			
Reference	**Work Element**	**Div. 20**	**Div. 26**
All	Motor Control Centers, motor controller racks, motor controllers, VFDs, Mechanical Breaker Panels (MBP), and disconnect switches	●	
General Mechanical Equipment fed from Dedicated Power Panels for Mechanical Equipment (Note 1)	Mechanical Service Panels (MSP), including branch overcurrent protection devices.		●
	Power wiring from MSPs and/or MCCs to: - motors, including between motors and motor controllers, VFDs and/or disconnect switches as applicable, - packaged equipment, including disconnect switches as applicable, - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc.)	●	
	Power wiring from RP and/or MBP to: - motors, including between motors and motor controllers, - packaged equipment, including disconnect switches as applicable, - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc.)	●	
General Mechanical Equipment fed from Non-dedicated Power Panels (Note 2)	Non-dedicated Power Panels (PP) and receptacle panels (RP), including branch overcurrent protection devices.		●
	Distribution splitters		●
	Power wiring from PPs and/or distribution splitters to: - motor controller, - disconnect switch ahead of VFD, - disconnect switch for package equipment, - packaged equipment (with integral disconnect switch) - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc.)		●
	Power wiring from RP to: - motor controller or disconnect switch, - disconnect switch for package equipment, - packaged equipment (with integral disconnect switch), - equipment not requiring motor controllers or disconnect switches (control panels, heat tracing, etc.)		●
	Power wiring from: - disconnect switch to a VFD, - motor controller or VFD to the motor, - disconnect switch to packaged equipment	●	
Terminal Units BAS Controllers	Power wiring for controllers at 120 V, single phase terminating in a junction box for each group of terminal boxes.		●

Schedule A – Coordination of Division 20 and 26 Scope of Work			
Reference	**Work Element**	**Div. 20**	**Div. 26**
	Power wiring for controllers at 120 or 24 VAC, from junction box provided by Division 26 to each terminal unit controller.	●	
	Power wiring for controllers at 24 VAC/DC, from building automation system control panels to terminal unit box controller.	●	
	3 phase, 208 V and higher voltage wiring direct to terminal unit box.		●
BAS Controls and OEM Controls	In service rooms: provision of 120/208 VAC mechanical service panels (MSP) complete with 15 A breakers in service rooms for use by Division 20 to 25.		●
	In service rooms: where MCC's are used, dedicated 120 VAC mechanical breaker panels (BP) complete with 15 A breakers for use by Division 20 to 25.	●	
	Power wiring for controls in service rooms: wiring from MSP or BP to the BAS and OEM control equipment.	●	
	Other than service rooms: Dedicated 120V 15A normal and emergency branch circuit breakers as indicated on the receptacle panel schedules.		●
	Power wiring for controls other than in service rooms: wiring from dedicated circuits in receptacle panels to control equipment.	●	
	120 V, single phase power supply with a junction box at specific control devices as shown.		●
	Breaker tamper-protection locks.	●	
	Instrumentation and actuator power and control wiring, for both BAS controls and OEM controls.	●	
	Control wiring to interlock motor controllers and to connect safety and operating controls.	●	
Equipment Service Lights	120 VAC, 15A power circuits for equipment service lights, terminated in the equipment service light.		●
	120 VAC, 15A power circuits for equipment convenience receptacles, terminated in the receptacle.		●
	Power wiring from adjacent junction boxes to light switches/service convenience receptacles and fixtures	●	
	Equipment service lights, switches and convenience receptacles.	●	
Fire and Smoke Dampers	Power wiring to damper interlock control panels for smoke dampers, motorized fire dampers, and combination smoke/fire dampers.		●

Schedule A – Coordination of Division 20 and 26 Scope of Work			
Reference	**Work Element**	**Div. 20**	**Div. 26**
	Wiring between damper interlock control panels (for smoke dampers, motorized fire dampers, and combination smoke/fire dampers), to their associated dampers.	●	
Life Safety Interface	[Fire Alarm System (“FAS”)control and monitoring modules located at BAS control interface panel.][Fire Alarm System (“FAS”) control and monitoring modules located at/near fan starter or damper actuator, and wiring between control module and damper motor and fan starter.]		●
	FAS control and monitoring modules located at/near sprinkler and standpipe supervised valves and flow switches including wiring between each module and the respective valve/flow switch.		●
	Wiring between FAS control and monitoring modules, and smoke control and smoke venting fans and dampers.		●
	Termination of FAS control and monitoring wiring in BAS panels	●	

Notes:
[1] MPP and MBP will be located in mechanical services rooms.
[2] PP and RP are not dedicated for mechanical equipment and may be located in any type of service room or space.

End of Section

ELECTRICAL SYSTEM STUDIES AND REPORTS
26 08 06

1 GENERAL

1.1 Scope

.1 The Division 26 contractor shall retain and pay for the services of a contractor to do the electrical systems studies and reports to provide a complete building Short Circuit Study, System Coordination Study, and Arc-Flash Study in accordance with the details specified herein.

.2 System analysis to be completed with one of the recommended software packages of EasyPower, ETAP, or SKM. Other software packages may be used but must be approved by consultant prior to use.

.3 The systems studies contractor doing the system studies may be the same company as the independent testing organization (ITO) but is not required to be.

.4 The systems studies contractor doing the studies to complete a systematic review of all existing building information where required. Including, with the assistance of the Division 26 contractor, site verification of the following:

.1 equipment ratings,

.2 existing protective device specifications and settings,

.3 conductor characteristics.

.5 The systems studies contractor shall obtain all information on the existing electrical equipment as part of the study and the Div 26 contractor shall provide all new information.

.6 Systems studies contractor to coordinate with relevant equipment manufacturers to obtain specific information pertaining to protection and coordination of the system prior to equipment release for production.

.7 Systems studies contractor to update coordination settings and arc flash labelling per Owner and Consultant approved study recommendations.

.8 Division 26 contractor to coordinate with systems study contractor, Owner, and Consultant and prepare specific methods of procedure for any site investigations, system adjustments, and related testing plans that may impact site operation.

.9 Division 26 contractor is responsible to coordinate with equipment manufacturers and project commissioning personnel regarding the implementation of the Owner and Consultant approved system studies findings and recommendations resulting from the studies.

.10 ITO, which may be the same contractor as the systems studies contractor, is responsible for setting, testing, validation, and reporting of all protective device setting adjustments.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 [26 05 73.05 Electrical System Studies and Reports

.2 26 08 11 Testing of Integrated Electrical Life Safety and Fire Protection Systems]

.3 [26 08 15 Electrical Commissioning]

.4 26 05 73.15 Independent Power System Testing

1.3 Definitions and Abbreviations

.1 The following definitions apply to this section;

.1 PCC – point of common coupling,

.2 LVPCB – low voltage power circuit breaker,

.3 MRM - Maintenance Reduction Mod

.4 High Voltage System – electrical distribution system with nominal voltages above 1000V,

.5 Low Voltage System – electrical distribution system with nominal voltages below or equal to 1000V.

1.4 Applicable Codes and Standards

.1 Installation codes and standards:

.1 OESC Ontario Electrical Safety Code,

.2 CSA Z32 Electrical safety and essential electrical systems in health care facilities,

.3 CSA Z462 Standard for electrical safety in the workplace,

.4 CSA Z460 Control of hazardous energy – lockout and other methods,

.5 IEEE Standard 242 Recommended practice for protection and coordination of industrial and commercial power systems.

.6 IEEE Standard 1584 Guide for performing arc-flash hazard calculations,

1.5 Qualified Tradesperson

.1 Work to be performed by a qualified, licensed, and recognized firm with an established reputation in this field, using tradesperson holding applicable certificates of competency.

1.6 Submittals

.1 Distinct report submissions must include:

.1 Preliminary Short Circuit and Coordination Study Report

(a) submission and approval of this report is a prerequisite for related equipment's shop drawing approval and release for production,
(b) submission of this report is required for review by the Consultant within 4 weeks of Contract award.

.2 Short Circuit and Coordination Study Report (review)

(a) proposed coordination settings for review,
(b) submission schedule must align with Contract commissioning and testing requirements.

.3 Preliminary Arc Flash Study Report,

(a) preliminary arc flash study report, intended to inform approval of coordination settings,
(b) submitted with Short Circuit and Coordination Study Report (review).

.4 Arc Flash Study Report (review)

(a) updated arc flash report with approved coordination settings,
(b) report must include all proposed labels,
(c) submission schedule must align with Contract commissioning and testing requirements.

.5 Short Circuit and Coordination Study Report (final)

.6 Arc Flash Study Report (final)

(a) report must include documentation of all labels, as installed.

.2 Each report, including final versions, must be submitted as a formal shop drawing for review and approval.

.3 Preliminary and review study submissions are permitted in PDF only.

.4 Final report submissions to be issued in PDF and hardcopy upon shop drawing approval.

.5 Single line and schematic diagrams included with reports must adhere to the following;

.1 acceptable paper sizes: ANSI A, ANSI B, or a standard US architectural size,

.2 project specific title blocks indicating project, drawing title, date, and revision number,

.3 include reference to a legend defining all symbols,

.4 text height must be scaled no less than 2mm.

.6 In addition to system study reports, the Division 26 contractor is responsible for preparing and submitting formal specific methods of procedure for review and approval a minimum of two weeks prior to any activities that may impact facility operation.

.7 An unlocked final soft copy of the master file from the systems studies analysis software must be submitted to the Owner upon final approval of all report submissions.

1.7 Approved Independent Testing Organizations

.1 To ensure the requirement for independence, the systems studies contractor must be retained directly by the Division 26 contractor. The systems studies contractor must not be retained by an equipment manufacturer or their distributor as part of an equipment package.

Standard of Acceptance

- AC Tesla
- Brosz and Associates
- C-INTECH
- Eastenghouse
- Enkompass
- G.T. Woods
- Haronitis & Associates Ltd.
- KRKA
- K-Tek Electro-Service Industries
- Spark Power

2 PRODUCTS

2.1 Preliminary Short Circuit and Coordination Study

.1 Immediately upon award of Contract liaison with the Supply Authority to obtain;

.1 incident utility fault energy at PCC,

.2 information pertaining to relays and other protective devices installed on Supply Authority system and substations which affect the co-ordination of the new equipment provided under this contract.

.2 Immediately upon award of Contract liaison with the equipment manufacturers to obtain;

.1 manufacturer specific information pertaining to protection and coordination of the system.

.3 Immediately upon award of Contract review existing and new building single line diagrams. Verify all relevant site conditions and identify all proposed equipment locations and routing as necessary to complete the preliminary report.

.4 Identify worst case short circuit energy levels at each new bus/device to identify minimum equipment/bus device interruption ratings and equipment withstand ratings.

.5 For high voltage systems:

.1 prepare preliminary high voltage phase and ground curves,

.2 recommend fuse and/or sensor sizes for protection devices,

.3 identify minimum short circuit interruption and withstand ratings.

.6 For low voltage systems:

.1 confirm long-time overcurrent settings,

.2 where applicable determine CT (sensor) sizes. If multitap CTs are available for LVPCBs, select CTs where the long-time setting is middle of the range.

.3 identify minimum short circuit interruption and withstand ratings.

.7 The recommended minimum short circuit interruption and withstand ratings, fuse ratings, relays, sensors and CTs should be documented in a report titled “Preliminary Short Circuit and Coordination Study Report”.

.8 Attend all necessary meetings as required by the Supply Authority, Consultant and manufacturer to resolve co-ordination details.

2.2 Short Circuit and Coordination Study

.1 Prepare a complete building model using approved software to facilitate short circuit and coordination and preliminary arc flash studies.

.2 All information included in the model should be site verified and include the entire building’s electrical distribution down to 120V/208V branch panel buses. Note: information related, but not limited to, motor, generator, photo-voltaic, DC system (telecom, UPS) ratings and contributions should be included in the analysis, and associated rating and settings site verified.

.3 When relevant equipment rating information is not verifiable on-site or in existing documentation the ITO is responsible for coordinating directly with equipment manufacturers for both new and existing equipment. Any assumptions must be explicitly identified and highlighted in the submitted reports.

.4 Short Circuit Study

.1 Prepare a complete building short circuit study using software.

.2 Short circuit study shall include segregated single line diagrams with appropriate information so that the Consultant’s single line diagrams can be updated with calculated symmetrical fault current data and submitted to the Electrical Safety Authority for review and approval.

.3 Short-circuit study should identify, at a minimum, the following for all distribution equipment/buses;

(a) Device/Bus ID,
(b) Voltage,
(c) Bus/Device Interruption and Withstand Ratings,
(d) Peak Three Phase Symmetrical and Asymmetrical Fault Levels,
(e) Peak Single Phase Symmetrical and Asymmetrical Fault Levels,
(f) X/R ratio.

.4 Scrutinize short circuit currents and fault levels under diverse operating scenarios, including but not limited to:

(a) various source configurations, where multiple sources are connected to the system,
(b) equipment and distribution maintenance bypass and tie configurations,
(c) peak non-generative equipment contributions.

.5 Any assumptions on operating configurations must be identified and confirmed prior to award of Contract.

.6 Verify onsite and with Div 20 contractor if motor starters have VFDs.

.5 Coordination Study

.1 Prepare a detailed co-ordination study of the complete building electrical system.

.2 The co-ordination study shall include the preparation of time-current characteristic curves of the protective devices in the system. Curves represented graphically with log-log axes; .01 to 10,000 seconds on the 'time' co-ordinate (vertical axis) and 5 ranges on the 'current' co-ordinate (horizontal axis). The system shall be sub-divided into portions so that the curve for each device clearly shows its relationship to associated upstream and downstream devices. Each set of curves on a single graph, for the portion of the system involved, shall include the following:

(a) appropriate section of single line diagram,
(b) electrical equipment and conductor damage curves,
(c) transformer inrush, damage, and overload curves,
(d) phase and ground time current curves characteristics on different graphs,
(e) three phase and ground fault levels when operating with normal utility power,
(f) generator decrement curves for the main emergency switchboard,
(g) protective devices identified with a unique label matching the Contract Drawings or alternatively, matching the single line diagram prepared for the study. Ambiguous names will not be accepted.

.3 Separate sets of time-current curves should be provided for each protective device feeding a specific bus. For example, double ended switchboards or switchboard/panelboards fed through a transfer-switch will have multiple time-current curve plots.

.4 Separate instances of a specific device's protection settings on multiple time-current curves must be consistent with each other.

.5 The coordination study must be comprehensive and include time-current curves identifying all adjustable device settings for the entire building and the largest associated downstream non-adjustable device (e.g. molded-case breaker or fuse). The coordination study should also include:

(a) Protective devices on the Supply Authority system,
(b) Distribution equipment at all voltage levels, their largest protective device, and all upstream devices feeding the equipment.
(c) Protection equipment on motors 75kW (100 HP) and larger.

.6 The coordination study must propose optimal device settings per the codes and standards referenced herein.

.7 All proposed protective device settings that deviate from the recommended practice of the codes and standards referenced herein must be explicitly identified and highlighted in the associated report submission labelled "Short Circuit and Coordination Study Report".

2.3 Arc Flash Study

.1 Prepare a detailed arc-flash study of the complete building electrical system using an incident energy analysis method.

.2 The study shall identify potential arc flash hazard sites, calculate incident energy levels (cal/cm^2) during arc-flash events, calculate arc flash boundaries and specify PPE requirements per the relevant standards referenced herein. Calculations shall take into consideration the characteristics of the overcurrent protective devices and their fault clearing time, including its condition of maintenance.

.3 The preliminary study should propose mitigative strategies for review and consider any specified arc reduction systems.

.4 Incident energy levels and PPE requirements should be calculated and reported with and without the activation of any arc reduction systems.

.5 The report should include detailed arc flash and shock hazard information for each electrical enclosure and propose an associated detailed label identifying:

.1 Arc Flash Protection

Working Distance: xx mm (yy in)
Incident Energy: xx cal/cm^2
Arc Flash Boundary: xx m (yy in)

.2 Shock Protection

Nominal Voltage: xx V
Limited Approach Boundary: xx m (yy in)
Restricted Approach Boundary: xx mm (yy in)

.3 Recommend Personal Protective Equipment

When an employee is working within the Arc Flash Boundary, they shall wear protective clothing and other personal protective equipment (PPE).

Refer to CSA Z462 for PPE Requirements
Glove Class: xx

.4 Equipment Name: xxx

.5 Analysis Details

Report Name/Version: xxx.pdf
Report Date: yyyy/mm/dd
Arc Flash Analysis by: Company Name
Analysis Standard: IEEE 1584-xxxx

.6 A schedule of Arc flash labels with this information shall be submitted for application by the manufacturer and/or contractor to all electrical enclosures in accordance with the study.

2.4 Model Data

.1 An output of the model data shall be provided in pdf as part of the shop drawing process in order to review the correctness of breaker types, cable types, cable lengths, and any other inputs into the system studies.

3 EXECUTION

3.1 Existing Electrical Site Data

.1 Division 26 contractor is ultimately responsible to perform and facilitate site investigations of all existing electrical distribution equipment as required for systems studies to verify:

.1 equipment ratings,

.2 existing protective device specifications and settings,

.3 conductor characteristics including length.

3.2 Equipment Manufacturer Coordination

.1 Systems Studies Contractor to coordinate with equipment manufacturers to obtain specific information pertaining to protection and coordination of the system prior to their release for production.

3.3 Commissioning Program

.1 Systems Studies contractor and Div 26 contractor to comply with the project commissioning requirements in accordance with specification section 26 08 15.

.2 The verification and testing requirements specified in this section may be concurrent with, or conducted separately from, the commissioning program, as coordinated with the Contractor and the commissioning agent.

3.4 Testing, Adjusting and Verification of Protective Devices

.1 Provide necessary test equipment, material, labor, and miscellaneous services during the testing, adjusting, verification and commissioning procedure.

.2 All modified settings are to be verified by secondary injection.

.3 Systems studies contractor to set all devices noted in the coordination study and apply all labels.

3.5 Methods of Procedure

.1 Division 26 contractor to coordinate with systems studies contractor, Owner, and Consultant and prepare specific methods of procedure for any site investigations, system adjustments, and related testing plans that may impact site operation.

.2 Specific methods of procedure must be submitted a minimum of two (2) weeks prior to the activity for review and approval by Owner and/or Consultant.

End of Section

TESTING OF INTEGRATED FIRE PROTECTION AND LIFE SAFETY SYSTEMS 26 08 11

1 GENERAL

1.1 Scope

.1 Provide testing of integrated fire protection and life safety systems and related equipment provided under Divisions 26 to 28 with those provided under other Divisions of the Work, in accordance with specification section [01 75 11].

.2 This specification is limited to testing of the interconnections between life safety and/or fire protection systems. Refer to separate technical specification sections for the individual testing and commissioning requirements for those systems.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 Section [01 75 11 Testing of Integrated Fire Protection and Life Safety Systems]

1.3 Definitions and Abbreviations

.1 Refer to section [01 75 11].

1.4 Applicable Codes and Standards

.1 Installation codes and standards:

.1 CAN/ULC-S1001 Integrated Systems Testing of Fire Protection and Life Safety Systems

1.5 Qualified Tradesperson

.1 Refer to section [01 75 11].

2 PRODUCTS

.1 Not used.

3 EXECUTION

3.1 General Requirements

.1 Conduct complete and thorough testing and documentation of the systems interface and integration between various FPLS systems provided under Divisions 26 to 28 and those provided under other Divisions of the Work.

.2 Include all labor and material as required to participate in and implement the integrated FPLS testing process for equipment and systems provided under Division 26 to 28.

3.2 Integrated Test Plan and Procedures - Development

.1 Participate in the development of the integrated FPLS test plan and procedures in accordance with the requirements of specification section [01 75 11].

.2 Supply manufacturer’s operating and testing instructions to the ITC prior to the development of the integration FPLS test plan.

3.3 Integration Test Plan – Implementation

.1 Complete related FPLS system testing in accordance with the applicable technical specification sections of Divisions 26 to 28, prior to implementation of integrated FPLS testing. Where testing of such systems inherently test the FPLS system interconnection(s), such testing is not required to be duplicated for the integrated FPLS testing provided the results of the integration test are recorded in accordance with the requirements of the integrated FPLS test plan.

.2 Prior to implementing any integrated FPLS test,

.1 provide written confirmation from each trade contractor under Divisions 26 to 28 of the Work, that their respective FPLS related equipment or systems, or parts thereof, have been installed in accordance with the design and are ready for integrated FPLS testing,

.2 where applicable, provide test verification reports from the organization that verified the installation of any FPLS system as required by referenced codes or standards, such as NFPA or ULC.

.3 provide a copy of inspection reports from an authority having jurisdiction governing a FPLS system.

.3 Coordinate with the ITC and provide all necessary resources to implement the integrated FPLS test plan.

3.4 Final Test Results Report

.1 The final test report will be prepared by the ITC.

END OF SECTION

ELECTRICAL COMMISSIONING
26 08 15

1 GENERAL

1.1 Scope

.1 Provide commissioning of electrical systems provided under Division 26.

.2 Electrical system installation, start-up, testing, preparation of O&M manuals and operator training are the responsibility of the Division 26 Contractors, with the coordination of the commissioning process the responsibility of the General Contractor/ Construction Manager.

.3 Include all labor and material as required to participate in the commissioning process, as outlined in this section, for equipment installed under Division 26.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

- .1 Section 01 91 13 General Commissioning Requirements
- .2 Section 26 05 73.05 Independent Power Testing
- .3 Section 26 08 06 Electrical System Studies and Reports
- .4 Section 26 08 13 Testing of Hospital Wiring
- .5 and as shown.

1.3 Commissioning Process

.1 Commissioning Mandate for Electrical Systems : to ensure that all project systems perform interactively and in strict accordance with the design intent and Owner's operational needs as set forth in the Contract Documents.

.2 Commissioning procedures are in accordance with this Section [and the Owner's Commissioning Plan and Procedures][].

.3 The Commissioning process develops, coordinates, and documents the following:

- .1 Equipment start-up
- .2 Control system calibration
- .3 Testing
- .4 Verification and Performance Testing
- .5 Operation documentation
- .6 Operator training

.4 The Commissioning Program is divided into the following parts:

- .1 Part 1 : Pre-Start and Start-Up testing
- .2 Part 2 : Installation Verification testing
- .3 Part 3 : Performance Validation testing
- .4 Part 4 : Systems Operating Manuals
- .5 Part 5 : Operator Training

1.4 Work Included

.1 Commissioning work of Division 16 includes, but is not limited to:

.1 Participation in regular construction meetings as well as separate Commissioning Meetings during the construction period associated with the scheduling, coordination, and implementation of the various commissioning activities within the overall construction program.

.2 Factory Testing of equipment as described under various equipment specifications

.3 Site Testing and start-up of equipment.

.4 Detailed acceptance testing as described under various equipment specifications including supplementary testing required by Commissioning Authority

.5 Cooperation with the Commissioning Authority in developing and implementation of the commissioning plan.

.6 Providing qualified personnel for participation in implementing commissioning test procedures.

.7 Providing equipment, materials, and labor as necessary to correct construction and/or equipment deficiencies found during the commissioning process.

.8 Providing operation and maintenance manuals, and as-built drawings to the Commissioning Authority for verification in a timely manner.

.9 Providing training and demonstrations for the systems specified in this Division prior to turnover to Owner.

.2 Conduct complete and thorough evaluation and documentation of the operation and performance of all components, systems, and sub-systems, including the following equipment and systems:

.1 Low Voltage Switchgear

.2 Power Generation Diesel

.3 Commission equipment supplied by the electrical contractor, as well as equipment which has been pre-tendered, pre-purchased, or pre-ordered by the Owner or their Agent, and the value of which has been assigned to the Electrical Contractor or their sub-trades and is included in the value of the Work. Provide skilled tradespeople to operate various related electrical equipment in support of the commissioning program.

.4 Commission services to equipment, but not the equipment itself, where the supply of the equipment does not form part of the electrical Work. Provide skilled tradespeople to operate various related electrical equipment in support of the commissioning activities of other trades.

.5 Provide the following commissioning documentation:

.1 recording completed Pre-start and Start-up procedures test results,

.2 recording completed Installation Verification and Performance Validation test results,

.3 As-built records.

.4 Operation and maintenance manuals

.6 The final commissioning report will be prepared by the Commissioning Consultant.

1.5 Excluded Work

.1 Unless otherwise specified, equipment which is not supplied by the electrical contractor or their sub-trades, where the value for the supply of equipment is not included as part of the Work, such as:

.1 Supplied by Owner (SBO) equipment,

.2 Equipment marked Not in Contract (NIC) or Not in Electrical Contract (NIEC).

1.6 Required Information and Commissioning Prerequisites Information:

.1 Provide:

.1 A complete set of accurate "as built" drawings must be transmitted to commissioning consultant a minimum of one (1) month prior to Substantial Performance.

.2 A copy of all equipment specifications must be transmitted to commissioning consultant a minimum of one (1) month prior to Substantial Performance.

.3 All "sequence of operation" narratives must be submitted to the commissioning consultant a minimum of one (1) month prior to Substantial Performance. Include all set points and timing sequences.

.4 A copy of all Factory Acceptance Test (FAT) reports must be completed, reviewed by the Consultant, and transmitted to commissioning consultant a minimum of one (1) month prior to Substantial Performance.

.5 A copy of all site startup reports must be transmitted to the commissioning consultant a minimum of five (5) business days prior to Substantial Performance.

1.7 Definitions

.1 ***Major deficiency*** – an item which if not corrected renders the equipment or system unsuitable or unsafe for use by the Owner. Major deficiencies must be corrected as a condition for achieving Substantial Performance.

.2 ***Minor deficiency*** – an item which does not impact on the operation of the equipment or system and will allow the Owner to use the system safely. Minor deficiencies may be corrected before or after Substantial Performance, but will not prevent certification of Substantial Performance of the Work.

1.8 Commissioning Schedule

.1 Provide a detailed commissioning schedule for consolidation into the main construction schedule.

.2 Include:

.1 equipment and systems start-up predecessors

.2 time periods for pre-start and start up testing, verification and validation testing for each equipment and system.

1.9 Documentation Deliverables

.1 Identify documents including test documents, binder covers, etc. using equipment ID numbers provided on equipment schedules.

.2 Scan original signed test reports, including verification and performance test reports, manufacturers service reports, etc. in Adobe Acrobat *.pdf version 8 format. For original document chapters, provide Adobe chapter referencing.

.3 Submit three (3) copies of each completed and accepted Verification and Functional Performance Test reports, both preliminary and final issues.

.4 Collate final, accepted and signed test results in separate binders as follows:

.1 Electrical Systems

.2 Communications Systems

.3 Fire Alarm and Security Systems

.5 Provide three (3) CD-R or DVD-R copies of commissioning documentation.

1.10 Substantial Performance

.1 Application for Substantial Performance of the Work is precedent on the Work being ready for Owner's use which includes completion of the following commissioning elements:

.1 Start-Up and testing.

.2 Commissioning Verification testing including submission of completed records,

.3 Commissioning Performance Validation testing including submission of completed records, except for alternate season tests,

.4 Commissioning Controls Validation testing,

.5 Training of Owner's operations personnel,

.6 As-built documentation issued for Consultant's review,

.7 Operations and Maintenance manuals which have been reviewed by the Consultant and accepted by the Owner.]

1.11 Test Equipment

.1 Furnish tools and equipment required during the various stages of pretesting, startup, and commissioning processes.

.2 Utilities (water, gas, fuel oil, electrical power) are provided by the Owner or as provided in the Contract documents.

.3 Provide any test equipment and software required for pretesting and start-up, whether specified or not.

.4 Manufacturer provides test equipment and personnel as required for the startup and testing of their equipment and assists in the commissioning process as needed.

.5 Manufacturer provides test equipment, demonstrate its use, and assists in the commissioning process as needed.

2 ORGANIZATION

2.1 General

.1 Complete all phases of work so that the systems can be started, tested, and verified for alarm or status monitoring by the BAS system and fire alarm systems as applicable, and the Commissioning procedures can be undertaken in a timely manner such that only one acceptance test is conducted at any one time. Provide supplementary testing as required to ensure all BAS and fire alarm system monitoring of electrical equipment status points are verified to demonstrate all operating status and alarm conditions.

.2 Participate and assist in the development of the Commissioning Schedule by the General Contractor, by providing necessary information pertaining to the equipment and installation. Provide commissioning schedule information to be incorporated into the overall Construction Plan schedule.

.3 Acceptance procedures may begin prior to completion of a system and/or sub-system. Start of acceptance procedures before system completion does not relieve the Contractor from completing those systems in accordance with the commissioning and construction schedule.

2.2 Participants

.1 Commissioning Team consists of multiple parties with separate responsibilities.

.2 Owner:

.1 establishes acceptance criteria,

.2 provides operations staff to receive training, and to witness any or all tests at their discretion,

.3 final acceptance of commissioning results.

.3 Design Consultant:

.1 responsible for the construction review activities in accordance with local building code requirements,

.2 may participate in development and / or review of commissioning procedures,

.3 reviews pre-startup, testing, and commissioning test results,

.4 Commissioning Authority:

.1 develops and/or approves the commissioning plan and procedures,

.2 coordinates Owner's commissioning team members who witnesses tests,

.3 accepts the commissioning test results on behalf of the Owner.

.5 Commissioning Consultant:

.1 develops or assists the Commissioning Authority to develop the commissioning plan and procedures,

.2 selectively witnesses commissioning tests on an audit basis to confirm compliance by the Contractor to the Commissioning Plan,

.3 reviews commissioning test results and makes recommendations to the Owner and/or Acceptance Authority for acceptance.

.4 monitors the progress of the commissioning work and reports to the Owner.

.6 General Contractor / Construction Manager:

.1 coordinates and manages commissioning activities,

.2 develops and integrates commissioning activities into the construction schedule,

.3 ensures commissioning procedures are completed and documented, and commissioning records including any required attachments are submitted.

.7 Electrical trades Contractors (“Commissioning Agent”) :

.1 Provide the services of qualified technician(s) who are familiar with the construction and operation of the system, to start-up and debug equipment and systems within the Division 16 scope of Work. Includes work of Independent Testing Agent subcontractor. Include for labour, materials, and subsistence costs for these same technicians to assist the Commissioning Authority in completing the commissioning program.

.2 Provide access to the contract plans, shop drawings, and equipment cut sheets of all installed equipment.

.3 Ensure the qualified technician(s) are available and present during commissioning testing to complete the tests, make adjustments and to assist in problem resolutions.

.4 Should any equipment or system experience performance problems and/or reconstruction or replacement of comments is required, include for additional technician time for subsequent retesting of systems until required system performance is achieved.

.5 The Commissioning Authority reserves the right to approve proposed technicians with regard to the technical skill level required for each type of equipment and/or system, and a willingness by the individual(s) to work within the Commissioning Group.

.6 provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with BAS, alarm, and life-safety systems. Provide access to the contract plans, and all as-built schematics of sub-systems, interfaces and interlocks.

.8 Equipment suppliers (“Commissioning Agent”) :

.1 provide the services of manufacturers' service personnel to provide assistance with pre-start and initial start-up of the equipment, and to undertake operation of equipment as part of the acceptance and commissioning testing program as required

3 EXECUTION

3.1 Commissioning Meetings

.1 Participate in periodic commissioning team meetings, and trade commissioning meetings.

.2 Pre-construction:

.1 participate in a pre-construction meeting of commissioning team members, to familiarize parties with the commissioning process, and to ensure that the responsibilities of each party are clearly understood.

.3 Construction and Post-Construction:

.1 participate in commissioning meetings as scheduled by the General Contractor.

.2 participate in trade commissioning meetings as required, in addition to the regular commissioning team meetings,

.3 identify to the commissioning group problems relating to the commissioning schedule, identification of start-up issues, etc, and participate in the resolution of these problems.

3.2 Commissioning Procedures

.1 The Owner's designated Commissioning Authority provides the commissioning procedures (checklists, etc) for use by the contractor.

.2 Each commissioning procedure tests the equipment and systems, and consists of the following elements:

.1 Document sign-off

.2 Pre-start and Initial test

.3 Installation Verification - Equipment

.4 Installation Verification - Systems

.5 Performance Validation

.6 Appendices.

.3 Document Sign-Off:

.1 each completed procedure is signed off by the following parties:

(a) Contractor, for testing,

(b) Commissioning Consultant, for review and witnessing,

(c) Owner, for test acceptance.

.4 Pre-Start and Initial Test:

.1 Checklists included: confirmation of authorities inspections, pre-start safety checks (where applicable), system cleaning and pressure testing, and confirmation of availability of supporting systems.

.5 Installation Verification - Equipment

.1 Checklists to verify the installation of equipment, including: design specification requirements, drawing requirements, manufacturer installation requirements, and other experience-related items.

.2 Use of pre-printed manufacturer installation and start-up checklists are permitted and encouraged; however, the commissioning procedure checklists may contain supplemental items.

.6 Installation Verification - System:

.1 Checklists to verify the installation of the system associated with the equipment.

.7 Performance Validation:

.1 Specific test procedures and record documentation requirements for performance measurements of the various systems.

.8 Appendices:

.1 Collate test reports from authorities having jurisdiction, manufacturer start-up and test reports, balancing reports, etc.

3.3 Commissioning test methodology

.1 Step 1 : Notify the Commissioning Consultant in accordance with an agreed schedule and notification period when testing will begin on each procedure type. The Commissioning Consultant will witness the testing on an audit basis, including the first instance, the last instance, and at random during other times.

.2 Step 2 : complete the commissioning procedures including recording results, and sign-off and date separately the completion of Part “A” Verification, and Part “B” Validation. Any deficiencies discovered during this testing are to be corrected prior to sign-off of the test.

.3 Step 3 : on completion of systems which do not require witness demonstration, finalize the report and submit to the Commissioning Consultant and the Consultant for review.

.4 Step 4 : on completion of systems which have been witnessed by the Commissioning Consultant, the Commissioning Consultant is to sign-off the completed procedure document as being witnessed.

3.4 Commissioning implementation

.1 Conduct operating tests and checks to verify that all components, equipment, systems, and interfaces between systems, operate in accordance with contract documents.

.2 Demonstrate and verify operating modes, interlocks, specified control sequences, specific responses to abnormal or emergency conditions, and verification of the proper response to the Building Automation System, security system, and fire alarm system as applicable.

.3 Roles and Responsibilities:

Organized by:	General Contractor
Test sheets provided by:	Commissioning Authority
Testing Conducted by:	Div 16 Contractors Equipment Suppliers Technical Personnel as appropriate Independent Testing Agent as specified
Testing recorded by:	Div 16 Contractors Equipment Suppliers Technical Personnel as appropriate Independent Testing Agent as specified Commissioning Authority
Tests witnessed by:	Commissioning Consultant Owner (selected tests)

Organized by:	General Contractor
Reports reviewed by:	General Contractor Commissioning Consultant Design Consultant Owner / Commissioning Authority
Reports Accepted by:	Owner

3.5 Operating checks

.1 The Commissioning Consultant witnesses selected equipment and system tests on an audit basis.

.2 Set the system equipment into operating mode to be tested including but not limited to:

- .1 Normal start up, operation, and shut-down
- .2 Normal auto position
- .3 Normal manual position
- .4 Unoccupied cycle
- .5 Emergency power operation, including transition states.
- .6 Status and Alarm conditions

.3 Inspect and verify the position of each device and interlock identified on the checklist.

.4 Repeat the above tests for each operating mode that applies to the system being tested.

.5 For failed test items, provide appropriate comments to the checklist data sheet and classify whether it is a “Major” or “Minor” deficiency.

- .1 The Consultant retains the right to make the final decision regarding classifications of deficiencies.

.6 Test failure is defined as:

- .1 Refer to relevant specification sections.

.7 Acceptance

- .1 The final reports will be reviewed by the Commissioning Consultant and the Consultant, to determine if verification is complete and the operating systems are functioning in accordance with the contract documents.
- .2 The Commissioning Consultant, in conjunction with the Consultant, reviews and makes final classification of all noted deficiencies. Correct deficiencies classified as “Major” before acceptance of the Verification stage.
- .3 The Owner will make the final acceptance of test results.

3.6 Performance Validation Testing

.1 Conduct performance tests and checks to validate that equipment and system components are providing the required performance (capacity) for each equipment and system.

.2 Special testing requirements:

- .1 Conduct acoustic measurement tests outside the building when generators are running, in accordance with local noise by-law procedures.
- .2 Conduct acoustic measurement tests inside of generator room when generators are running.

3.7 Problem Resolution

.1 In the event that additional work is required to either correct systems, misapplied or improperly installed equipment, and/or deficient performance under varying load conditions, assist the Owner and Commissioning Consultant in developing an acceptable resolution to the problem, including the resources of equipment suppliers.

.2 The Owner has final approval over any additional work required to achieve the required level of performance.

.3 Complete corrective work in a timely fashion to permit the completion of the commissioning process.

3.8 Acceptance

.1 Any identified deficiencies will be reviewed by the Consultant in conjunction with the General Contractor/Construction Manager to determine if correction of the deficiency is as a result of a defect in the equipment or installation.

.2 If it is determined the performance deficiency is as a result of a defect in the equipment or its installation, rectify the deficiency and repeat the performance test until the required performance levels are achieved.

.3 If it is determined the equipment or system has been constructed in accordance with the contract documents, the Owner will decide whether to accept the performance as is, or, direct the installation contractor to make changes to the system as required to obtain performance levels which meet the design intent, and retest the system.

3.9 Post-Substantial Performance Commissioning

.1 Provide commissioning after Substantial Performance:

.1 Performance testing which is weather or live-load dependent;

.2 For out-of-season system performance testing, conduct initial performance tests to demonstrate off-peak load performance. Schedule peak load performance testing over the succeeding nine (9) months to ensure all equipment is tested at peak load prior to the expiry of the warranty period.

.3 Infra-red thermal imaging of equipment under peak building live-load conditions,

.4 90 day security system testing,

.5 Alternatively, provide temporary equipment (load banks, etc) to simulate full load conditions. Submit proposed methodology for review by the Commissioning Authority and Consultant.

3.10 Additional Commissioning

.1 Additional commissioning activities may be required after completion of system performance testing. Include in the tender cost a reasonable reserve to complete this work, including assistance from manufacturers' service technicians.

3.11 Systems Operating Manuals

.1 Provide Operating and Maintenance Manuals in accordance with the requirements of section16010.

.2 The Systems Operating Manuals (SOM) are in addition to the Operating and Maintenance Manuals (OMM) required under Section 16010.

.1 Provided by Commissioning Authority and/or Consultant.

3.12 Training

.1 Equipment Training:

.1 Provide equipment training in accordance with Section 26 05 01 and the relevant equipment specification sections. The manufacturer's representative training will emphasize operating instructions and preventative maintenance.[][

.2 Systems Training:

.1 In addition to the equipment training described above, provide additional training to describe the operational requirements and design intent of each system.

.2 Include classroom instruction, delivered by competent instructors. Place emphasis on overall systems diagrams and descriptions, and design criteria and conditions.

.3 If required, obtain and pay for the services of the Design Consultant to provide the instructor services and to provide lecture material for inclusion in the training manual.

.4 Training topics to include:

(a) Types of installed systems

(b) Design intent and design criteria

(c) Design constraints

(d) Different operating modes – occupied, unoccupied, emergency conditions, etc.

(e) Seasonal operating modes

(f) Energy efficiency

(g) System operation

(h) Automatic controls

(i) Service, maintenance, diagnostics and repairs

(j) Use of reports and logs

(k) Troubleshooting

.5 Structure each session to start with the classroom instruction for the overall system, followed by hands-on instruction for each equipment, with the services of the manufacturers' representative as required. Demonstrate the start-up and shut-down of each system.

.6 Organize and schedule each training session to deliver the required instruction in an efficient and effective manner on a schedule agreed upon with the Owner. Allow for two (2) training sessions for each topic, separated by approximately one week each, to allow for shift coverage.

.7 Structure each training session based on type of maintenance personnel attending the training session, ie. Plumbers, fitters, general maintenance, controls technicians, etc. Develop the proposed training plan and obtain approval from the Owner before commencing the training.

.8 Complete the training as close to Substantial Performance as possible, so that the Owner's operations staff are prepared to operate the system after Substantial Performance is certified.

.3 Training Manuals

.1 Provide training material hand-outs for each session.

.2 Collect training material and bind into separate binders.]

END OF SECTION

LOW-VOLTAGE DISTRIBUTION TRANSFORMERS
26 22 13

1 GENERAL

1.1 Scope

.1 Provide dry type transformers with primary voltages up to 600 V, as shown.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

- .1 26 05 48 Vibration Isolation for Electrical Systems
- .2 26 05 49.20 Seismic Restraint for Electrical Services
- .3 26 05 09.23 Seismic Qualification for Electrical Equipment

1.3 Seismic Qualification

.1 Seismically qualify (certify) the following equipment specified herein:

- .1 Transformer

.2 The seismic qualification of the above-listed equipment is to conform to Specification section 26 05 49.23 for the following seismic qualification level and certification method:

- .1 Functional seismic qualification (Level III): by shake table testing,

.3 The following equipment specific seismic force parameters are to be used:

C_p	A_r	R_p	h_x/h_n
1.00	1.00	1.25	1.0

1.4 Applicable Codes and Standards

.1 Legislation:

- .1 NRCan 2019 — Natural Resources Canada Energy Efficiency Regulations (Dry-Type Transformers)

.2 Product Standards:

- .1 CAN/CSA C22.2 No. 47 — Air-Cooled Transformers (Dry Type),
- .2 CSA C22.2 No. 94.1 — Enclosures for Electrical Equipment, Non-environmental Considerations,
- .3 CSA C22.2 No. 94.2 — Enclosures for Electrical Equipment, Environmental Considerations,
- .4 CSA C9 — Dry-Type Transformers,
- .5 CAN/CSA C802.2-18 — Test Method and Minimum Efficiency Values for Dry-Type Transformers.
- .6 UL 1561 — Standard for Dry-Type General Purpose and Power Transformers

1.5 Submittals

.1 Shop drawings:

.1 Submit shop drawings and product data for each type and rating of transformer.

.2 Operation and Maintenance Data:

.1 Provide operation and maintenance data for incorporation into the Operating and Maintenance Manual.

.2 Provide operating and maintenance instructions.

1.6 Quality Control

.1 Type tests:

.1 Conduct factory tests in accordance with CSA C9 for the following:

(a) temperature rise,

(b) sound level.

.2 Production tests:

.1 Conduct in accordance with CSA C9 for the following:

(a) voltage ratio, including all taps,

(b) polarity or angular displacement,

(c) dielectric, applied potential and induced potential,

(d) partial discharge (cast-coil transformers only).

.3 Energy efficiency:

.1 Submit the energy efficiency reports to show compliance with the specified efficiency values.

2 PRODUCTS

2.1 General

.1 Listed to CSA C22.2 No. 47 and UL 1561.

.2 Transformers constructed in accordance with the referenced standards except where indicated otherwise.

.3 Self-contained, free-standing units suitable for floor mounting.

.4 Up to and including 75 kVA to also be suitable for wall mounting.

.5 Supply wall mounting brackets for transformers shown to be wall mounted.

.6 Vacuum impregnated epoxy or polyester resin construction.

.7 Type ANN.

.8 Efficiency to meet or exceed CSA C802.2-18 and NRCan 2019.

.9 Windings: [copper [.

.10 Buswork and all current carrying parts, other than the windings: [copper.

.11 Primary and secondary voltages and kVA ratings as indicated on drawings.

.12 Delta connected primary and 120/208 volt wye or, where indicated, a Zigzag connected secondary.

.13 Secondary neutral terminals, suitable for the connection of:

.1 [the neutral conductor,

.2 #6 AWG copper grounding conductor and

.3 bonding conductor.

.14 Primary-to-secondary phase shift of -30 degrees, except where indicated otherwise.

.15 Taps: four (4) @ 2.5% full capacity primary taps, two above and two below nominal voltage.

.16 Provisions for incoming and outgoing conductor entry of sizes shown.

.17 Front accessible connections, unless indicated otherwise.

.18 System bonding lugs, connected to the enclosure for:

.1 primary feeder bonding conductor,

.2 secondary feeder bonding conductor and

.3 bonding conductor to the secondary neutral terminal.

.19 System bonding lugs sized to accommodate cables sizes in accordance with Table 16 of the electrical code.

.20 Core bonded to the enclosure, either inherently by design or by a bonding strap.

.21 Seismic certified to withstand the ground acceleration criteria and seismic demand requirements for non-structural equipment as specified in the Building Code for the geographic location of the installation.

.22 Labelled to warn of an arc flash potential in accordance with the electrical code.

Standard of Acceptance

- ABB
- Atlas Transformer Inc.
- Bemag
- Delta Transformers Inc.
- Hammond Power Solutions Inc.
- STI Power

2.2 Ratings

.1 kVA capacity based on Class 220] degree C insulation, with 150degree C rise.

.2 Impedance:

.1 per Table 7 of CSA C9, except where indicated otherwise,

.2 not less than 3% up to and including 225kVA,

.3 Full load voltage regulation at 80% power factor:

.1 ≤ 45 kVA: ≤3.4%,

.4 Noise levels:

.1 Per Table 8 of CSA C9 for ratings ≤300 kVA, unless noted otherwise.

2.3 Support and Isolation

.1 Support core and coil assemblies on in-shear vibration isolation mounting pads. Pads to:

.1 provide a uniform deflection underweight and weight distribution of supported equipment,

.2 consist of 2 layers of 9mm (3/8") ribbed or waffle pattern neoprene pads of not more than 50 durometer,

.3 include a galvanized steel plate separating and bonded to the layers of elastomer,

.4 [equal to Kinetics Noise Control Model "NGD", with a static deflection ≥ 4.5mm,]

.5 include a thru bolt with extra thick extra-large washers, tightened for shipping purposes.

.2 In addition to the vibration isolation mounting pads, provide external vibration isolation mounts in accordance with Specification section 26 05 48 [on each of the following transformers:

.1 floor and bracket mounted transformers: neoprene floor mounts.

Standard of Acceptance

° Kinetics - fig. RD Series.

.2 suspended transformers: steel spring isolation hangers.

Standard of Acceptance

° Kinetics - fig. SH Series.][]

.3 [Vibration isolation mounts to be seismically rated in accordance with Specification section and 26 05 49.

2.4 Enclosure and Finish

.1 Electrical enclosure: to CSA C22.2 No. 94.1 Type 3R], except where indicated otherwise.

.2 Finish:

.1 rust-inhibiting metal treatment process,

.2 powder coat finish to UL50 3R,

.3 colour: ANSI #61 grey.

.4 colour as follows (colour numbers are for Sherwin Williams paint):

(a) Normal power: ANSI #61 grey,

(b) Emergency power: International Orange #SW4082,

.3 Provide 2 pressurized spray cans of matching paint to touch-up small areas marred during installation.

2.5 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 53 – Identification for Electrical Systems.

.2 Label size: 7.

.3 In addition, provide a nameplate on the transformer bearing the following:

.1 markings per electrical code clause 26-262,

.2 markings per CSA C9, section 6.1,

.3 “Efficiency per CSA C802.2-18 / NRCan 2019” or equivalent wording for transformers meeting these efficiency requirements.

.4 Submit nameplate wording.

3 EXECUTION

3.1 Installation

.1 Mount transformers:

.1 ≤ 75 kVA suspended, on wall brackets or on floor as indicated,

.2 Provide, under this division, a 100mm (4") reinforced concrete pad with beveled edges for each floor mounted transformer. Seal with paint or concrete sealer to prevent concrete dust from entering equipment.

.3 Anchor the concrete pad to the building structure in accordance with Section 26 05 48 and 26 05 49.

.4 Install transformers in level upright position.

.5 Provide suitable mounting hardware.

.6 Where specified, install the external vibration isolation mounts for both floor mounted (between enclosure and pad) and bracket (wall) mounted transformers (between enclosure and brackets).

.7 Where specified, install the external spring isolation hangers in the support rods of suspended transformers.

.8 Install seismically rated vibration isolation mountings in accordance with Section 26 05 48 and 26 05 49.

.9 Position transformers to provide:

.1 adequate clearance for ventilation,

.2 adequate clearance to access connections,

.3 adequate clearance to access taps.

.10 Remove shipping supports only after transformer is installed and just before putting into service.

.11 Loosen isolation pad bolts until no compression is visible.

.12 Make final primary and secondary connections using flexible steel conduits.

.13 Make primary and secondary connections in accordance with wiring diagram.

.14 Provide a #6 AWG green insulated copper ground conductor in rigid PVC conduit from transformer secondary neutral to the building grounding system.

.15 Connect the bonding conductors from the primary and secondary feeders to the transformer bonding lugs.

.16 Provide a bonding conductor, sized not less than the secondary feeder bonding conductor, from the transformer bonding lugs to the transformer secondary neutral terminal.

.17 Provide 4#12 control wiring in EMT from each pair of alarm contacts to the BMS.

.18 Provide a compatible communications cable in EMT between each temperature monitoring device and the BMS.

.19 Program the temperature monitoring devices for correct operation.

.20 Provide nameplates in accordance with Article "Equipment Identification”.

.21 Energize transformers after installation is complete.

.22 Adjust transformer taps as required to achieve suitable secondary voltage at loads, with the transformer operating under its typical load.

.23 Touch up small areas marred in transit or during installation with touch up paint.

.24 Repaint entire enclosure using electrostatic process where significant damage to factory finish has occurred.

END OF SECTION

LOW-VOLTAGE SWITCHGEAR
26 23 00

1 GENERAL

1.1 Scope

.1 Provide low-voltage switchgear as shown.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

- .1 26 01 01 Electrical General Requirements
- .2 26 05 01 Electrical Basic Materials and Methods
- .3 26 05 49.13 Seismic Restraint for Electrical Service
- .4 26 05 49.23 Seismic Qualification for Electrical Equipment
- .5 26 05 53 Equipment Identification
- .6 26 28 16.19 Low Voltage Power Circuit Breakers
- .7 26 43 13 Surge Protection devices for Low-Voltage Electrical Power Circuits

1.3 Applicable Codes and Standards

.1 Product standards:

- .1 CSA C22.2 No. 31.18 (R2022) Switchgear Assemblies
- .2 UL 1558 Standard for Metal-Enclosed Low-Voltage Power Circuit Breaker Switchgear
- .3 IEEE C37.13-2015 Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
- .4 IEEE C37.17-2022 Standard for Trip Systems for Low-Voltage (1000 V and Below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers
- .5 IEEE C37.20.1-2015 IEEE Standard for Metal Enclosed Low-Voltage Power Circuit Switchgear
- .6 IEEE C37.27-2008 Guide for Low-Voltage AC (635 V and below) Power Circuit Breakers Applied with Separately-Mounted Current-Limiting Fuses
- .7 IEEE C57.13-2016 Standard Requirements for Instrumentation Transformers

1.4 Seismic Qualification

.1 Seismically qualify (certify) the following equipment specified herein:

- .1 Switchgear.

.2 The seismic qualification of the above-listed equipment is to conform to Specification section 26 05 49.23 for the following seismic qualification level and certification method:

- .1 Functional seismic qualification (Level III): by shake table testing,

.3 The following equipment specific seismic force parameters are to be used:

C_p	A_r	R_p	h_x/h_n
1.00	1.00	1.25	1.0

1.5 Submittals

.1 Submit shop Drawings and product data for products specified herein.

.2 All drawing and product data provided for the equipment to show equipment as specified and ordered.

.3 Typical drawings are not acceptable. Reproducible drawings for approval to be supplied.

.4 Physical Construction Drawings, completely dimensioned, showing:

.1 arrangement,

.2 plan, front view, and elevation views,

.3 required clearances for opening doors and for removing breakers,

.4 conduit or cable trays entrance locations and dimensions for both top and bottom entrance,

.5 bus bar locations and configurations,

.6 incoming and outgoing power cable terminator positions,

.7 field wiring terminal block locations, and all other terminal block locations,

.8 anchor bolt locations,

.9 grounding connections,

.10 weight of equipment.

.5 Three line diagrams, with ANSI device function numbers used throughout, to show all:

.1 instrument transformers,

.2 relays,

.3 meters and meter switches,

.4 other pertinent devices.

.6 Elementary Diagrams:

.1 Elementary (schematic) wiring diagrams to be furnished for the electrically-operated breaker control scheme.

.2 Each elementary diagram to show all control devices and device contact, each of which to be labelled with its proper ANSI device function number.

.3 Each elementary diagram to show device and terminal block terminal numbers.

.7 Control Switches

.1 Provide control switch development tables.

.8 Detailed connection (wiring) diagrams showing:

.1 detailed connection (wiring) diagrams showing:

(a) all wiring within each unit,

(b) all interconnecting wiring between units,

(c) identification of all terminals, terminal blocks, and wires.

.2 clear identification, by some distinguishing method, of all interface wiring to remote devices including but not limited to:

(a) leads from external current transformers,

(b) trip circuits from remote devices,

(c) auxiliary contacts to remote devices,

(d) AC control power,

(e) separate incoming AC power,

(f) spare auxiliary contacts and relay contacts which are to be wired to terminal blocks for future use.

.9 Provide one additional set of drawings shipped with the switchgear for maintenance use, installed in a suitable permanent drawing pocket inside one of the control cubicle doors.

.10 Provide nameplates in accordance with "Equipment Identification"; submit nameplate designations for approval.

.11 Submit co-ordination curves for review.

.12 Spare parts list:

.1 complete spare part list, including parts location diagrams or drawings to be included with the manufacturer's quotation.

.2 list of priced spare parts which manufacturer recommends should be on hand during start-up and the two year's operation.

.13 Material List

.1 A material list to be furnished listing the quantity, rating, type, and manufacturer's catalogue number of all equipment on each unit.

.14 Installation, Operating, and Maintenance Instructions

.1 Installation, operating, and maintenance instructions to cover all the equipment furnished including all protective relays, power fuses, auxiliary relays, etc., and to include characteristic curves of each different protective relay and power fuse.

1.6 Factory Acceptance Test (FAT)

.1 Factory verification tests to be performed in the presence of the Consultant, Independent Testing Agent, and the Owner’s representative, after completion of assembly in factory and following standard factory testing procedures, in accordance with NEMA and EEMAC Specifications, and as described herein.

.2 Certified copies of standard production tests to be submitted upon request.

.3 As part of the FAT, perform the following inspections and test procedures on each switchgear lineup in accordance with ANSI/NETA ATS-2025 Acceptance Testing Specifications (NETA ATS):

.1 Switchgear Assemblies per NETA ATS, with the exclusion of primary injection testing

.2 *Low Voltage Power Circuit Breakers* per NETA ATS, with the exclusion of primary injection testing.

.3 Low Voltage Ground Fault Protection Systems per NETA ATS

.4 *Instrument Transformers* per NETA ATS

.5 *Metering Devices* per NETA ATS

.6 Verification of key-interlock scheme

.4 Tests to include hi-pot testing, operation of breakers, operation of relays, meters and switches.

.5 Completed switchboard to be connected to a power supply (or multiple power supplies as required) to permit operation of all electrically operated devices including but not limited to switches and pushbuttons, indicating lights, meters, and automatic transfer and breaker interlock schemes to prove that they are wired correctly, that contacts make and break and that all devices and meters perform satisfactorily before shipment of switchboard.

.6 Test the overcurrent and other protective devices on each breaker to prove that trip unit and breaker function satisfactorily.

.7 Undertake primary current injection testing of each switchboard for verification of protective schemes. Double ended switchboards to be interconnected at factory to permit complete testing.

.8 Racking in and out of breakers and manual operation of equipment to be tested to prove that items work freely.

.9 Verification of key interlock schemes.

.10 Correct deficiencies noted during the factory test prior to shipment.

.11 Submit certified copies of successful completion of the above tests prior to shipment of the equipment.

1.7 Approvals and Information

.1 Manufacturer to not commence final fabrication or erection of equipment until receipt of:

.1 reviewed or "Reviewed as Noted" shop drawings from Consultant.

.2 Manufacturer to supply:

.1 information to install and test equipment for complete installation,

.2 shop drawings for review, as specified in "Submittals",

.3 information for Owner, as specified in "Instruction Manuals".

1.8 Provisions for Handling and Field Erection

.1 Each shipping split of stationary structures to be furnished with removable lifting angles and/or plates suitable for crane hooks or slings.

.2 Each shipping split to also be furnished with removable steel channel base plates which will permit using pipe rollers or dollies without damaging the frame steel of the equipment.

1.9 Shipping

.1 If shipped separately, the power circuit breaker to be individually crated and tagged with its proper unit number and the equipment number of the assembly to which it belongs.

.2 Relays to be shipped installed in the stationary structures and to be securely blocked and braced to prevent damage during shipment if required.

.3 Each "shipping section" of stationary structures to be provided with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

1.10 Preparation for Shipment

.1 Preparation for Shipment to be in accordance with manufacturer's standards, unless otherwise noted. The manufacturer to be solely responsible for the adequacy of the Preparation for Shipment provision employed in respect of materials and application, to provide materials and their destination in ex-works condition when handled by commercial carrier systems.

1.11 Operation and Maintenance Data

.1 Provide operation and maintenance data for incorporation into manual specified in Section 26 01 01 Electrical General Requirements.

1.12 Maintenance Materials

.1 Provide maintenance materials as required and as specified in Section 26 01 01 Electrical General Requirements.

1.13 Operating and Maintenance Instructions

.1 Provide operating and maintenance instructions as specified in Section 26 01 01 Electrical General Requirements.

2 PRODUCTS

2.1 General

.1 Switchboard and Components manufacturers:

Standard of Acceptance

- Eaton (Magnum DS Series)
- Schneider Canada Limited (PZ4 Series)
- Siemens Canada Limited (WLSeries)
- Bibico

2.2 Materials

.1 Low voltage switchgear to be of type, rating and arrangement shown. Rearrangement of components will not be permitted. Equipment to be constructed to fit space allocated and to be a free standing assembly mounted on a concrete pad.

.2 Prepare fully prepared spaces where future breakers are indicated. Include racking mechanism, bus, stationary element, secondary contacts, control and metering wiring such that, at a future date, a circuit breaker of correct frame size can be installed with no modifications required to switchgear lineup..

.3 Main bus and switchboard to be drilled and plated and have provision for future extension of additional vertical cells at each end of switchboard.

2.3 Structure and Components

.1 Free standing, rigid, dead-front enclosure

.2 Indoor construction of non-walk-in type conforming to CSA Type-2 suitable for use in a sprinklered area, including additional drip hoods.

.3 Switchboard to consist of the required number of vertical sections bolted together to form a rigid and self-supporting assembly. Vertical sections to be designed for bolting together without misalignment or distortion.

.4 Each vertical section to be divided into three compartments from front to rear:

.1 Front compartment containing circuit breakers and/or auxiliary equipment.

.2 Bus compartment in the middle

.3 Cable compartment at rear containing the bus extensions from breaker load terminals to cable terminals.

.5 Provide fire retardant and non-hygroscopic internal separation barriers:

.1 between vertical sections, full depth and from top to bottom, to isolate contiguous sections

.2 between circuit breaker compartments and bus compartment.

.3 between circuit breaker compartments and instrument/control compartment.

.6 Each circuit breaker shall be mounted in an individual metal-enclosed compartment ventilated as necessary. Ventilation openings between compartments within the LV switchgear to be such that the gases produced by circuit breaker interruption do not impair the operation of adjacent compartments.

.7 Provide ventilation openings, with overhanging drip-proof louvers, to maintain internal air temperatures below limits required by CSA and ANSI C37.20.1.

.8 Design to accommodate feeder circuit breakers to be stacked 3 high in a vertical section with additional top compartment reserved for control equipment. Feeder circuit breakers up to 2000A to be capable of being mounted in the uppermost compartment without de-rating.

.9 Circuit breakers of like rating and secondary connections to be interchangeable. Circuit breaker compartments including prepared space compartments to have mechanical interlocks to allow only a breaker with the correct rating, frame size, secondary control voltage and connections to be inserted.

.10 Provide a hinged front door for each circuit breaker compartment or metering compartment. The door design for breaker compartments shall be such that the following functions can be performed with the door closed: manual or remote racking the circuit breaker between the connect, test and disconnect positions; manually operate the breaker spring-charging system; close and open circuit breaker; examine and adjust trip unit; and read circuit breaker rating nameplate. Meters and instruments to be mounted in the upper compartment on a suitably braced hinged door. Doors to be secured with ¼ turn latches. A door more than 1.22m (48 inches) high is to be fastened at minimum two latch points.

.11 Each vertical section to have a hinged full-height rear door to allow access into the cabling compartment. Rear doors to have minimum 3 captive bolts and be able to open 135°.

.12 Bolted connections, lugs for cable connections, terminations for power and control wiring and any other items requiring torquing, infra-red thermal scanning, maintenance, or replacement shall be visible and accessible from the front or rear when respective hinged door is opened.

.13 Vertical sections to be of sufficient depth to accommodate bending radii of mains and feeder cables shown. Section depth to also be adequate to accommodate the quantities of conduit terminations and bus-duct entrances as shown on the drawings.

.14 Vertical sections to be configured for top entry/exit of all cables and bus-duct ties. Provide removable top plates for ease of installation.

.15 Individual breaker compartments to be provided with primary and secondary contacts of silver plated copper. Also provide rails, stationary disconnecting mechanism parts and cell interlocks. The drawout mechanism to hold the circuit breaker rigidly in the fully connected, test, and fully disconnected positions. Interlocks to be provided which will prevent moving the circuit breaker from the fully connected, test, and fully disconnected positions, unless the breaker is open. Interlocks to prevent closing the breaker between any of these positions. Provisions to be made for padlocking the breaker open in any of the positions noted above. Mechanisms to be ruggedly constructed and close tolerances maintained to assure interlocks will not fail due to binding, misalignment or susceptibility to distortion.

.16 Lifting angles or channels to be provided on each shipping section.

.17 Two channels across bottom of each section, to permit rolling or jacking of board.

.18 Provisions to accommodate seismic bracing on site.

2.4 Busses

.1 Bus work to be plated copper throughout.

.2 Buses and bus connections to be sized for a temperature rise of 65°C above 40°C ambient.

.3 Main bus to extend through all sections. Ampacity rating of main bus to equal the main breaker frame rating.

.4 Busing to be braced to withstand stresses resulting from fault current equal to the interrupting rating of the main breaker. Busing to be tested to withstand fault current equal to the interrupting rating of the main breaker for the short-time current duty cycle (2 periods of 30 cycle fault current flow separated by 15 seconds).

.5 Vertical section busses to be rated for the total maximum ampacity of the vertical section. Branch bus connections from the section bus to the breakers to be fully rated for the maximum frame size breaker which may be inserted.

.6 Provide plated bus extensions from the load side fixed terminals of each feeder breaker into the rear cable compartment for connection to load conductors.

.7 Compression type terminal lugs, cable supports, bus supports and necessary space to be provided in the rear section of the switchboard assembly for the proper termination of incoming and outgoing cable or bus.

.8 Continuous copper ground bus of adequate cross-sectional area to be provided, 6 mm x 50 mm (¼" x 2") minimum, extending the full length of the switchboard assembly and securely bolted to the structural members of the enclosure. Equipment requiring ground connections to be connected to this bus using approved pressure indent type solderless connectors. Ground bus to be readily accessible. Ground bus to be continuous without joints except at shipping splits, where joint to be made with not less than two bolts. The frame of each housing to be grounded to this bus.

.9 Provide lugs for ground conductors run with outgoing feeders.

.10 Joints for busses, interconnections and disconnecting devices to have plating and contact arrangement as per manufacturer's standard unless otherwise noted. Bus connections to be bolted with at least two high strength bolts per lap properly torqued and locked into place.

.11 All busbar connections to be secured using Grade 5 bolts and Belleville Grade 5 conical spring washers. All bolts to be tightened with a calibrated torque wrench to manufacturer's standard.

.12 Where the busbars are drilled the cross section through the bars at the point of drilling the cross-sectional area to be capable of taking the full rated current.

.13 For switchboard lineups that are close coupled to transformers, provide flexible braided connectors and interconnect the switchboard main bus to the transformer secondary terminals.

.14 Provision for bus extensions for future units to be drilled and plated.

.15 Bus supports of high strength, flame retardant, track resistant, inorganic, non-hygroscopic insulation material which to be standoff or fully compartmented type to eliminate flat horizontal surfaces and provide extra creepage such that contamination buildup does not compromise phase to phase and phase to ground insulation integrity.

.16 Busduct connections to be designed with the same integrity as the switchboard bus. Phase collection and provision of necessary bolts, nuts, and washers for bus duct connection.

.17 Phase designations for all phases to suit CSA and NEMA Standards.

2.5 Low Voltage Power Circuit Breakers

.1 To 26 28 16.01 Low Voltage Power Circuit Breakers

.2 LVPCB section to be fabricated and assembled as part of switchboard in an arrangement shown.

2.6 Equipment Identification

.1 Provide equipment identification in accordance with Section 26 05 53 – Identification for Electrical Systems.

.2 Engraved, high quality plastic nameplates with black letters suitably inscribed on white background for cubicle and circuit identification to be provided on front and rear sections.

.3 Engraved letters to be 12 mm (½ in.) minimum, except 6 mm (¼ in.) minimum height may be provided for meters, relays, switches, signal lights, keys and key blocks, and all other devices.

.4 Circuit identification inscription data will be furnished to the manufacturer as required.

2.7 Phase Designation

.1 Coloured phase designations or numbering markings to be readily visible in each bus compartment, current transformer compartment, circuit breaker compartment and line and feeder cable compartment.

2.8 Mimic Bus

.1 A white mimic bus single line diagram to be rivetted on front of switchboard.

.2 Run bus through breaker handles and show every piece of equipment on board.

.3 Symbols used to be industry standards for each device.

2.9 Finish

.1 Finish equipment as follows:

.1 basic rust-inhibiting metal process

.2 interior in white

.2 Exterior to be finished with paint equal to Sherwin Williams, as follows:

.1 Emergency power - F65E37 International Orange

.3 Manufacturer to provide quart of touch-up paint or several pressurized spray cans to touch-up small areas marred during installation.

2.10 Control and Secondary Wiring (Breaker Element and Cubicle)

.1 Control and secondary wiring to be enclosed in metallic raceway insofar as practical. Wiring to outgoing circuits, at shipping splits and devices mounted in hinged instrument panels, to terminate at terminal blocks.

.2 Terminal blocks to have numbered points for circuit identification. Terminal blocks to be General Electric Type EB or equal. Terminal blocks for current circuits to be shorting block type.

.3 Wiring to be type 'TA', 'TBS', or 'SIS', flame retardant #14 AWG size single conductor minimum, stranded, tinned copper, extra flexible type throughout. Wires to be tagged at both ends with permanent plastic sleeve type markers. Insulation to be 600 V, working and 1500 V test.

.4 Secondary and control wiring within the rear bus compartment to be completely shielded in a protective metal covering as far as practical.

.5 Cable openings between sections to be protected with bushings to prevent abrasion to cable jackets

.6 Wiring from bus differential and transformer differential CT's to be minimum #10 AWG.

.7 Fuse and terminal blocks to be easily accessible. Fuses of the proper type and rating to be supplied by the switchgear manufacturer.

.8 Provisions to be made for the installation of control conduits to the switchboard and connections to be brought to a terminal board furnished and installed by the switchboard manufacturer. Fuses to be Class J HRC.

.9 Auxiliary wiring checks to be made throughout the manufacture and assembly of the equipment to assure wiring correctness and continuity.

.10 Final checkout of wiring to be made with the complete switchgear lineup assembly to assure wiring correctness and continuity. Polarity of current and potential transformers and devices to be checked to assure proper functioning of all protective devices and instrumentation.

2.11 Zone Selective Interlocking

.1 Preserve desired selective coordination between main(s), tie(s) and feeder(s) protective devices.

.2 Wired connection between relays or protective devices.

.3 If a feeder detects an overcurrent condition it sends a restraining signal to upstream breaker(s). The main (and tie) then follows its normal time-current characteristics and serves as a backup. However, if the main breaker detects an overcurrent condition above its short-time (or ground fault) pickup setting, but the feeders do not (e.g., main bus fault), then the main breaker does not receive a restraint signal and trips with no intentional time delay.

2.12 Instrument Transformers

.1 Potential transformers and current transformers required to operate relays, meters and other devices indicated in the drawings and specifications to be coordinated so that the ratio and accuracy are suitable for each individual application, taking into account the burdens imposed. Construction of transformers to conform to ANSI Standards. All terminals to have permanent polarity designations and to be wired accordingly. All applicable requirements of IEEE C57.13 to apply.

.2 Primary potential bus or cable tap leads to be designed with the same design integrity as the primary bus.

.3 Both current and potential transformers to be wired through test switches to provide quick and easy multi-circuit testing of switchboard relays, meters and instruments.

2.13 Potential Transformers

.1 Potential transformers to be housed in a separate compartment in the circuit breaker cubicle or superstructure.

.2 Potential transformers to be of the 0.3 accuracy class, per ANSI Standards and of sufficient capacity to serve the maximum burden imposed.

.3 Each potential transformer to be protected with current limiting primary fuses, and to be designed to withstand the basic impulse level of the switchboard.

2.14 Current Transformers

.1 Current transformers to be easily removable and accessible and of the ring or bar-type.

.2 Ring-type current transformers to be used where burden and accuracy permit. Primary terminals on bar-type current transformers to be silver plated and rigidly (2 bolt minimum) connected to the bus structure.

.3 Secondary connections of all current transformers to have provisions for short circuiting when not connected to instruments and to be solidly grounded.

.4 Current transformers to be capable of carrying at least 125% of CT rating continuously and have a short time rating at least equivalent to that of the switchgear bus. Accuracy class: C100/ 0.6 B-1.

2.15 Operation of the Automatic Transfer Scheme

.1 Switchboard EPA-2 is to be equipped with an automatic transfer scheme. Refer to 26 32 13.33 Emergency Power Control System for details.

2.16

2.17 Arc Flash Mitigation

.1 Arc Flash Protection Relay

.1 Provide dual-sensing arc flash protection relay with optical sensing and supervising current sensors to prevent false trips.

.2 Provide optical sensors in each breaker compartment, bus compartment and cable compartment, and at the line side of each main breaker, that will provide a trip signal to the LV main breaker and/or tie breaker within 8 milliseconds of detecting an arc flash. Provide a second, concurrent trip signal wired to trip the corresponding upstream MV breaker feeding the main transformer close-coupled to the switchgear.

.3 Utilize point type and/or fibre optic loop type optical sensors to ensure proper coverage within compartments.

.4 Standard of Acceptance

(a) Schneider VAMP 321

(b) ABB REA

(c) Siemens equal

.2 Zone Selective Interlocking

.1 Preserve desired selective coordination between main(s), tie(s) and feeder(s) protective devices.

.2 Wired connection between relays or protective devices.

.3 If a feeder detects an overcurrent condition it sends a restraining signal to its upstream breaker(s). The main (and tie) then follows its normal time-current characteristics and serves as a backup. However, if the main breaker detects an overcurrent condition above its short-time pickup setting, but the feeders do not (e.g., main bus fault), then the main breaker shall not receive a restraint signal and it shall trip with no intentional time delay.

.4 Connect ZSI from switchgear feeder power circuit breaker trip unit to downstream panelboard molded case breaker trip units.

.5 Energy Reduction Maintenance Setting Switch (ERMS)

.6 For each Main, Tie or Feeder circuit breaker, provide a Maintenance OFF ON selector switch on the compartment door to switch the circuit breaker instantaneous tripping characteristics to an alternate setting temporarily during maintenance activity.

.7 Provide a lock feature for the ERMS switch so that it may be locked in either the OFF or ON maintenance mode position.

.8 Provide a blue LED indicating light to indicate trip unit is in the ERMS mode.

(a) Wire contacts on all ERMS switches to a common alarm input to plant control system.

2.18 Surge Protection Devices

.1 Where indicated on drawings, Surge Protective Devices (SPD) to be provided and mounted internal to the switchboard they are protecting.

.2 Refer to specification 26 43 13 – Surge Protective Devices for Low-Voltage Electrical Power Circuits for further details.

2.19 Meters on Main Breakers

.1 All meters to be a maximum of {2 m (6'-0"} above floor level with switchboard on {100 mm (4"} pad.

.2 Provide metering as follows for main breakers:

.1 three (3) current transformers and 3 HRC fused potential transformers, metering accuracy, frequency response 10 - 10,000 Hz,

.2 digital microprocessor based metering system to be as follows; Eaton IQ Analyzer (or Eaton Power Xpert 468K) or Square D Power Logic:

(a) the digital metering to consist of a single microprocessor based unit capable of monitoring and displaying,

(b) AC amperes, AC voltage, Watts, Vars, Power Factor, Frequency, Watt Demand, Watt Hours, power quality, harmonics, waveform capture,

(c) the digital metering to have an accuracy of 0.5% of the read values,

(d) communications with central electrical monitoring system,

(e) the digital meter to have a membrane type display face suitable for EEMAC 3R and 12 mounting,

(f) the digital meter to be provided with an addressable communication card capable of transmitting all data, including trip data over a compatible two wire local area network to a central personal computer for storage and/or print out,

(g) include a centralized monitoring unit, Cutler Hammer “Breaker Interface Module”, or Siemens or Square D equivalent in each switchboard, factory connected to monitor the complete status of each breaker in the switchboard,

(h) digital meters and monitoring units to be completely programmed and made operational by the Switchgear manufacturer.

2.20 Meters on Feeder Breakers

.1 Provide metering as follows:

.1 each feeder breaker to be equipped with a 3 phase true RMS digital meter with local LCD display to indicate phase current for each phase, present and peak demand, and power consumption as part of the circuit breaker protective relay unit. Metering functions to be completely programmed and made operational by the Switchgear manufacturer,

2.21

2.22 Miscellaneous

.1 Provide the following:

.1 one set of spare fuses per switchboard of each type used in each switchboard,

.2 redundant power supplies of suitable capacity complete with transfer control relay to provide 120 VAC power to shunt trip operators on feeder breakers.

2.23 Co-ordination

.1 Manufacturer to review line and load side equipment connected to switchboard, as well as equipment enclosed and provide trip devices to co-ordinate with line side and load side equipment. Allowance will not be made, after Contract award, to change trip devices to provide satisfactory co-ordination.

3 EXECUTION

3.1 Installation

.1 Provide low voltage switchboards of type, rating and arrangement as shown.

.2 Provide a 100 mm (4") reinforced concrete pad with bevelled edges. Seal with paint or concrete sealer to prevent concrete dust from entering equipment. Pads to be provided under this division.

.3 Grout a minimum of two steel plates with anchor bolts into pad, for levelling purposes, for full length of switchboard.

.4 Assemble all shipping sections and level switchboard on pad.

.5 Provide interconnecting, incoming and outgoing cable, bus duct, and control wiring connections as shown and as required.

.6 Terminate all power cables with two hole long barrel compression connectors equal to Burndy YA-2N.

Standard of Acceptance

- Burndy
- Ilsco
- Thomas & Betts
- Hubbell

.7 Provide grounding of each switchboard to ground bus with green insulated copper in conduit. Terminate with Burndy YA-2N lugs.

.8 Touch up small areas marred in transit or during installation with touch up paint. Repaint entire switchboard using electrostatic process where large areas of significant damage to factory finish has occurred.

.9 Provide and install new rubber mats 3' wide 1/4" thick 17,000 volt rating, American Biltrite Canada Ltd., in front and rear of Switchboards for a continuous and neat appearance. Do not place mats until work is completed and room has been thoroughly cleaned. Clean or replace any existing mats dirtied or damaged during the installation.

.10 Provide connection from Neutral Grounding Resistor relay to open Main Breaker as required by OESC 10-302 and OESC Table 17 – Conditions for Initiation of Automatic Alarm and De-energization of System

3.2 Manufacturers Service Representation on Site

.1 Manufacturer to supply factory trained service representative to perform the following field services

.1 Check the installation of the equipment;

.2 Check or supervise the installation contractor in the start-up of the equipment;

.3 Calibrate controls;

.4 Conduct Site Acceptance Testing (SAT);

.5 Participate in the commissioning program;

.6 Demonstrate the operation of safety controls to the Owner's representatives;

.7 Demonstrate the operation of the equipment over its entire performance range to the Owner's representatives; and

.8 Provide training of the facility maintenance operations staff.

3.3 Site Acceptance Test (SAT)

.1 Conduct an acceptance test in presence of and to satisfaction of Consultant, after completion of installation, but before switchboard is permanently put into service.

.2 SAT to include the following:

.1 Thorough physical inspection and verification of the installation including wiring and interconnections.

.2 Inspection and test procedures in accordance with ANSI/NETA ATS-2025 for:

(a) SWITCHGEAR AND SWITCHBOARD ASSEMBLIES, with the exception of primary current-injection testing.

(b) *LOW-VOLTAGE POWER CIRCUIT BREAKERS* with the requirement that trip units' LSIG pick-up and delays to be verified by secondary current-injection in-lieu of primary injection.

.3 Function testing of each breaker's remote open/close control from the generator master control system.

.4 Function testing of each breaker's status monitoring on the remote generator master control system for each of the following: breaker identification, open, closed, tripped, and withdrawn.

.5 Function testing of monitoring of each breaker trip unit's metering information via the gateway-server on the Building Management System.

.6 Function testing of high-resistance grounding system's fault indication on all three phases.

i) Record the results of SAT and submit completed report to the Owner.

.7 Correct defects at no additional cost to Owner. Replace defective equipment immediately with new factory equipment

END OF SECTION

WIRE AND BOX CONNECTORS 0-1000 V
26 27 28

1 GENERAL

1.1 Scope

.1 Provide wire and box connectors for wiring 1000 V and less, as shown.

1.2 Applicable Codes and Standards

.1 Product standards:

.1 CSA C22.2 No.65 Wire Connectors.

.2 CSA C22.2 No.188 Splicing Wire Connectors.

2 PRODUCTS

2.1 Materials

.1 Mechanical pressure type wire connectors:

.1 for copper conductors: current carrying parts of copper or tin plated aluminum,

.2 for aluminum conductors: current carrying parts of aluminum.

Standard of Acceptance

- Burndy
- Ilsco
- Thomas & Betts

.2 Compression type pressure wire connectors:

.1 long barrel

.2 tin plated copper for copper conductors

.3 aluminum for aluminum conductors

Standard of Acceptance

- Burndy
- Ilsco
- Thomas & Betts

.3 Twist on wire connectors:

.1 for copper wire up to and including #6 AWG,

.2 “live” spring construction,

.3 corrosion resistant spring,

.4 square wire spring construction,

.5 polypropylene cap rated for 105°C

Standard of Acceptance

- T&B Marette
- Ideal
- 3M

.6 For damp, wet, outdoor and submersible locations: filled with silicone gel.

.4 Fixture type splicing connectors:

.1 current carrying parts of copper,

.2 sized to fit copper conductors 10 AWG or less,

.3 temperature rating of not less than 105°C

Standard of Acceptance

- Burndy
- Hubbell
- Thomas & Betts

3 EXECUTION

3.1 Installation

.1 Provide connectors in accordance with the manufacturer's recommendation for the size, quantity and type of wires.

.2 Install connectors in accordance with the manufacturer's recommendations.

.3 Remove insulation carefully from ends of conductors:

.1 where the conductor is damaged, remove the damaged portion and strip the insulation back further as necessary,

.2 where the conductor is too short, replace the conductor.

.4 For aluminum conductors, clean the conductors and immediately coat with electrical joint compound.

.5 Tighten screws of mechanical pressure type connectors in accordance with the manufacturer's recommendations. Installation to meet secureness tests in accordance with CSA C22.2 No.65.

.6 Install compression type connectors using the appropriate compression tool and die as recommended by the manufacturer. Make two crimps on each wire. Installation to meet secureness tests in accordance with CSA C22.2 No.65.

.7 Remove all traces of electrical joint compound after each connection has been made.

.8 Install fixture type connectors and tighten. Replace insulating cap.

END OF SECTION

DISCONNECT SWITCHES UP TO 1000 V
26 28 16.16

1 GENERAL

1.1 Scope

.1 Provide enclosed disconnect switches for wiring systems of 1000 V or less, as shown.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 26 28 13 Fuses

.2 26 05 49.13 Seismic Restraint for Electrical Service

.3 26 05 49.23 Seismic Qualification for Electrical Equipment

1.3 Seismic

1.4 Applicable Codes and Standards

.1 Product standards:

.1 CSA C22.2 No. 4 Enclosed and Dead Front Switches.

.2 CSA C22.2 No. 39 Fuseholder Assemblies.

1.5 Seismic Qualification

.1 Seismically qualify (certify) the following equipment specified herein:

.1 Enclosed disconnect switches.

.2 The seismic qualification of the above-listed equipment is to conform to Specification section 26 05 49.23 for the following seismic qualification level and certification method:

.1 Functional seismic qualification (Level III): by shake table testing,

.3 The following equipment specific seismic force parameters are to be used:

C_p	A_r	R_p	h_x/h_n
1.00	1.00	1.25	1.0

1.6 Submittals

.1 Submit shop drawings for each type and size of switch.

2 PRODUCTS

2.1 Disconnect Switches

.1 Listed to CSA C22. 2 No. 4.

.2 Electrical enclosure: fusible and non-fusible disconnect switch in CSA C22.2 No. 94.1 Type 1 sprinkler proof or Type 3R enclosure, sizes as indicated.

.3 2 pole or 3 pole as required for single phase or three phase circuits.

.4 2 pole with solid neutral for three wire circuits with neutral.

.5 3 pole with solid neutral for four wire circuits with neutral.

.6 6 pole for two speed motor applications.

.7 HP rated where used in motor circuits, with rating not less than the largest motor in the circuit.

.8 Provision for padlocking switch in OFF position.

.9 Mechanically interlocked door to prevent opening when handle in ON position.

.10 Fuses: size as indicated, and to conform to Specification section 26 28 13.

.11 Fuse holders:

.1 listed to CSA C22. 2 No. 39.,

.2 suitable without adaptors, for type and size of fuse indicated.

.12 Heavy Duty, quick-make, quick-break action, rated for load breaking operation.

.13 ON-OFF switch position indication on switch enclosure cover.

.14 Auxiliary NO/NC contact in switches used for hydraulic elevator motors.

.15 Rust inhibiting process to enclosures prior to finishing.

.16 Finish enclosures using manufacturer’s standard process, colour to be grey ASA No.49 or 61.

3 EXECUTION

3.1 Installation

.1 For sprinklerproof and CSA Type 3R enclosures use watertight connectors complete with O rings for conduit connections.

.2 Provide fuses in disconnect switches, sizes as shown.

END OF SECTION

LOW- VOLTAGE POWER CIRCUIT BREAKERS
26 28 16.19

1 GENERAL

1.1 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 26 01 01 Electrical General Requirements

.2 26 23 00 Low-Voltage Switchgear

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 [][26 05 49.13 Seismic Restraint for Electrical Service

.2 26 05 49.23 Seismic Qualification for Electrical Equipment]

1.3 Applicable Codes and Standards

.1 Product standards:

.1	CSA C22.2 No. 31	Switchgear Assemblies
.2	IEEE C37.13	Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures
.3	IEEE C37.17	Standard for Trip Systems for Low-Voltage (1000 V and Below) AC and General Purpose (1500 V and below) DC Power Circuit Breakers
.4	IEEE C37.20	Switchgear Assemblies – Including Metal Enclosed Bus
.5	IEEE C37.27	Guide for Low-Voltage AC (635 V and below) Power Circuit Breakers Applied with Separately-Mounted Current-Limiting Fuses
.6	IEEE C57.13	Standard Requirements for Instrumentation Transformers
.7	NEMA SG-5	Power Switchgear Assemblies

.2 Where requirements of this Specification exceed those of above mentioned standards, this Specification to govern.

1.4 [Seismic Qualification

.1 Seismically qualify (certify) the following equipment specified herein:

.1 Low-voltage power circuit breaker assemblies.

.2 The seismic qualification of the above-listed equipment is to conform to Specification section 26 05 49.23 for the following seismic qualification level and certification method:

.1 Functional seismic qualification (Level III): by shake table testing,

.3 The following equipment specific seismic force parameters are to be used:

C_p	A_r	R_p	h_x/h_n
1.00	1.00	1.25	1.0

1.5 Submittals

.1 Submit shop Drawings and product data for products specified herein.

.2 All drawing and product data provided for the equipment to show equipment as specified and ordered.

.3 Typical drawings are not acceptable. Reproducible drawings for approval to be supplied.

.4 Physical Construction Drawings, completely dimensioned, showing:

.1 arrangement,

.2 plan, front view, and elevation views,

.3 required clearances for opening doors and for removing breakers,

.4 field wiring terminal block locations, and all other terminal block locations,

.5 grounding connections,

.6 weight of equipment.

.5 Three line diagrams, with ANSI device function numbers used throughout, to show all:

.1 instrument transformers,

.2 relays,

.3 meters and meter switches,

.4 other pertinent devices.

.6 Elementary Diagrams:

.1 Elementary (schematic) wiring diagrams to be furnished for the electrically-operated breaker control scheme.

.2 Each elementary diagram to show all control devices and device contact, each of which to be labelled with its proper ANSI device function number.

.3 Each elementary diagram to show device and terminal block terminal numbers.

.4

.7 Detailed connection (wiring) diagrams showing:

.1 detailed connection (wiring) diagrams showing:

(a) all wiring within each unit,

(b) all interconnecting wiring between units,

(c) identification of all terminals, terminal blocks, and wires.

.2 clear identification, by some distinguishing method, of all interface wiring to remote devices including but not limited to:

(a) leads from external current transformers,

(b) trip circuits from remote devices,

(c) auxiliary contacts to remote devices,

(d) AC control power,

(e) separate incoming AC power,

(f) spare auxiliary contacts and relay contacts which are to be wired to terminal blocks for future use.

.8 Provide one additional set of drawings shipped with the switchgear for maintenance use, installed in a suitable permanent drawing pocket inside one of the control cubicle doors.

.9 Provide nameplates in accordance with "Equipment Identification"; submit nameplate designations for approval.

.10 Submit co-ordination curves for review.

.11 Spare parts list:

.1 complete spare part list, including parts location diagrams or drawings to be included with the manufacturer's quotation.

.2 list of priced spare parts which manufacturer recommends should be on hand during start-up and the two year's operation.

.12 Material List

.1 A material list to be furnished listing the quantity, rating, type, and manufacturer's catalogue number of all equipment on each unit.

.13 Installation, Operating, and Maintenance Instructions

.1 Installation, operating, and maintenance instructions to cover all the equipment furnished including all protective relays, power fuses, auxiliary relays, etc., and to include characteristic curves of each different protective relay and power fuse.

1.6 Factory Test and Inspection

.1 Factory verification tests to be performed in the presence of the [Engineer] [Consultant], Independent Testing Agent, and the Owner’s representative, after completion of assembly in factory and following standard factory testing procedures, in accordance with NEMA and EEMAC Specifications, and as described herein.

.2 Certified copies of standard production tests to be submitted upon request.

.3 Tests to include operation of breakers, operation of relays, meters and switches.

.4 Completed switchboard to be connected to a power supply (or multiple power supplies as required) to permit operation of all electrically operated devices including but not limited to switches and pushbuttons, indicating lights, meters, and automatic transfer and breaker interlock schemes to prove that they are wired correctly, that contacts make and break and that all devices and meters perform satisfactorily before shipment of switchboard.

.5 Test the overcurrent and other protective devices on each breaker to prove that trip unit and breaker function satisfactorily.

.6 Racking in and out of breakers and manual operation of equipment to be tested to prove that items work freely.

.7 Verification of key interlock schemes.

.8 Correct deficiencies noted during the factory test prior to shipment.

.9 Submit certified copies of successful completion of the above tests prior to shipment of the equipment.

.10 As part of the FAT, perform the following inspections and test procedures on each switchgear lineup in accordance with ANSI/NETA ATS-2021 Acceptance Testing Specifications (NETA ATS):

.1 *Low Voltage Power Circuit Breakers* per NETA ATS, with the [exclusion][inclusion] of primary injection testing.

.2 Low Voltage Ground Fault Protection Systems per NETA ATS

.3 *Instrument Transformers* per NETA ATS

.4 *Metering Devices* per NETA ATS

.5 Verification of key-interlock scheme

1.7 Approvals and Information

.1 Manufacturer to not commence final fabrication or erection of equipment until receipt of:

.1 reviewed or "Reviewed as Noted" shop drawings from Consultant.

.2 Manufacturer to supply:

.1 information to install and test equipment for complete installation,

.2 shop drawings for review, as specified in "Submittals",

.3 information for Owner, as specified in "Instruction Manuals".

1.8 Shipping

.1 If shipped separately, the power circuit breaker to be individually crated and tagged with its proper unit number and the equipment number of the assembly to which it belongs.

.2 Relays to be shipped installed in the stationary structures and to be securely blocked and braced to prevent damage during shipment if required.

.3 Each "shipping section" of stationary structures to be provided with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

1.9 Preparation for Shipment

.1 Preparation for Shipment to be in accordance with manufacturer's standards, unless otherwise noted. The manufacturer to be solely responsible for the adequacy of the Preparation for Shipment provision employed in respect of materials and application, to provide materials and their destination in ex-works condition when handled by commercial carrier systems.

2 PRODUCTS

2.1 General

.1 Switchboard and Components manufacturers:

Standard of Acceptance

- Cutler Hammer Ltd.
- Schneider Canada Ltd.
- Siemens Canada Ltd.
- Bibico

2.2 Air Circuit Breakers

.1 Air circuit breakers to be designed, assembled, tested and to comply with the following standards complete with their latest revisions:

.1 power circuit breakers in enclosures to comply with IEEE C37.13,

.2 fused power circuit breakers to comply with IEEE C37.13/IEEE 538,

.3 trip devices to comply with IEEE C37.17,

.4 power circuit breakers with separately mounted fuses to comply with IEEE C37.27/IEEE 331.

.2 Type tests of circuit breakers to have been conducted by the manufacturer as specified in the above standards. Proof of same with certification that the equipment meets or exceeds these standards to be supplied upon request.

.3 Short time current ratings of circuit breakers to be as follows:

.1 unfused circuit breakers; one half second at the current level equal to the interrupting rating,

.2 fused circuit breakers; same as for unfused circuit breakers, exclusive of fuses."

.4 Air circuit breakers to include the following:

.1 draw out construction,

.2 manual operation for breakers up to 1600 A frame size, electric operation for breakers 2000 A frame size and larger,

.3 Plexiglass bubble covers over power circuit breakers

.4 isolation of adjacent breaker compartments by steel panels, top to bottom and front to rear,

.5 isolation of front breaker section and rear bus section by steel panels,

.6 Solid state selective trips with:

(a) True RMS sensing

(b) Adjustable long time pick-up and adjustable time delays including I^2t and I^4t

(c) Adjustable short time pick up and adjustable time delays including flat response and I^2t

(d) Adjustable instantaneous pick up with “off” position

(e) Zone Selective Interlocking (ZSI)

(f) Arc-flash reduction feature, for maintenance mode, wired to a manual switch located on the corresponding breaker control compartment.

(g) Integral digital meter with local display of the following:

i) Current: present and peak individual phase currents and ground current

ii) Voltage

iii) Power: present and peak values for kW, kVA and kVAR

iv) Energy

v) Power factor

vi) In addition to all of the above functions, main breaker trip units to display current and voltage total harmonic distortion, individual current and voltage harmonic components up to 31^{st} harmonic, and be capable of waveform capture at a resolution of at least 58 points per cycle.

(h) Auxiliary modules, power supplies and wiring for the breaker to communicate the following information to an external electrical power monitoring system via external Ethernet local area network.

i) circuit-breaker identification and status (open/closed/tripped)

ii) present and peak values of current, voltage, power, energy, power factor and waveforms

iii) causes of tripping

iv) alarms

v) historical files and maintenance records

vi) view and set protection function parameters remotely

.7 Wiring to control (open/close) the breaker remotely from the Load Control and Transfer System.

.8 Integral ground fault protection on all breakers. Adjustable up to sizes shown. Provide interposing CT as required to obtain ground fault pick-up settings shown in the schedules. Individual breakers to be equipped with a visual indication of ground fault indication. The integral ground fault protection specified for each breaker to include three coordinated time settings, with the minimum time setting to be 0.20 - 0.25 seconds. Two other, longer term, settings to be included, identified as intermediate and long term. The associated current and time ratings to be applied to the breakers as shown.

.9 Six auxiliary contacts for remote annunciation, two for "open", two for "closed" and two for "tripped".

.10 Indicating lights to be provided on breakers to indicate the following conditions:

(a) Red Light: Breaker closed

(b) Green Light: Breaker open

.11 ability to remain closed during power outage on supply.

.12 breakers to be horizontal drawout type, equipped with a stored energy spring mechanism for quick make, quick break, trip free operation. The breaker stored-energy spring mechanism to be designed so that the closing speed is independent of both control voltage and the operator. Breakers to be 3 pole, single throw with a continuous current trip rating as specified and shown on drawings, complete with three independent arc quenchers, closing mechanism, mechanical push trip button, interpole barriers and positive position indicator, so that the position of the breaker is indicated at the front of the compartment. Breakers of like rating to be completely interchangeable. A mechanical interlock to allow only the correct rating breaker to be inserted into the cubicle.

.13 breakers, where required, to have the spring charging device operating at 120 V AC. 120 VAC shunt trip from a power supply internal to the switchboard to be provided for remote tripping applications, on manual and electrically operated breakers. Power supplies for all breakers to be redundant.

.14 the breaker levering mechanism to be arranged to prevent racking the breaker between the Connected - Test - Disconnected positions unless the breaker is in the tripped position.

.15 breakers to be dead front construction, which provides a steel barrier between the operator and live parts when racking the breaker - between the Connected - Test - Disconnected positions, and to be capable of being padlocked in any of these positions, such that it cannot be closed or moved to any other position.

.16 breakers to be positively grounded to the enclosure prior to being inserted into the 'Test' and 'Connected' positions. In the 'Test' position the primary breaker disconnect contacts to be separated by a safe distance from the line and load contacts. The primary disconnect contacts to be self-aligning and to be positively and securely engaged in the 'connected' position. The contacts to be silver to silver and accessible for inspection.

.17 the secondary disconnecting contacts, as required, to consist of a rugged self-aligning constant pressure device, with smooth silver plated copper contacts, which supply control circuit connections to the moveable element. It to be fully engaged when the circuit breaker is in the 'connected' and 'test' positions. The contacts to be suitably protected from physical damage and designed so that positive contact pressure is assured during the life of the breaker. Control wiring to be harnessed, protected and kept away from moving parts. Wiring to devices to be provided with sufficient slack to prevent breakage from movement or vibration.

.18 each breaker to be provided with mounting brackets for installing an electrically operated remote-racking device.

.19 current limiting fuses, on line or load side of breaker as shown complete with interlocks to prevent fuse withdrawal unless associated breaker is tripped and to prevent breaker from being closed if one or more current limiting fuses or control fuses are blown. Fuses for breakers larger than 2000 A frame size to be contained in a separate draw-out compartment.

.20 key interlocks, in an arrangement as shown, complete with lamacoid nameplate at key block and on key with key designation inscribed with 12 mm (½") letters.

.21 cable and/or bus duct terminations as required and as indicated on Drawings.

.22 power supplies of suitable capacity for operation of such items as electrically operated breakers and meters, using HRC fuses for protection of small wiring

.23 redundant power supplies in each switchboard, of suitable capacity complete with transfer control relay to provide 120 VAC power to operator breakers.

.5 additional redundant power supply in each switchboard, complete with transfer control relay scheme, to provide 120V control power from each switchboard to a common control bus, to provide redundant back up control power to each switchboard for operation of digital metering systems and communications devices forming part of the Electrical Monitoring system. Wiring is to be terminated at suitable labelled terminal blocks, for field wiring between switchboards by the installing contractor. External power supply to be provided from facilities UPS distribution system.

2.3 Equipment Identification

.1 Provide coloured phase designations for all phases to suit CSA, NEMA and Supply Authority Standards.

.2 Engraved, high quality plastic nameplates with black letters suitably inscribed on white background for cubicle and circuit identification to be provided on front and rear sections.

.3 Engraved letters to be 12 mm (½ in.) minimum, except 6 mm (¼ in.) minimum height may be provided for meters, relays, switches, signal lights, keys and key blocks, and all other devices.

.4 Circuit identification inscription data will be furnished to the manufacturer as required.

2.4 Mimic Bus

.1 A white mimic bus single line diagram to be rivetted on front of switchboard.

.2 Run bus through breaker handles and show every piece of equipment on board.

.3 Symbols used to be industry standards for each device.

2.5 Control and Secondary Wiring (Breaker Element and Cubicle)

.1 Control and secondary wiring to be enclosed in metallic raceway insofar as practical. Wiring to outgoing circuits, at shipping splits and devices mounted in hinged instrument panels, to terminate at terminal blocks.

.2 Terminal blocks to have numbered points for circuit identification. Terminal blocks to be General Electric Type EB or equal. Terminal blocks for current circuits to be shorting block type.

.3 Wiring to be type 'TA', 'TBS', or 'SIS', flame retardant #14 AWG size single conductor minimum, stranded, tinned copper, extra flexible type throughout. Wires to be tagged at both ends with permanent plastic sleeve type markers. Insulation to be 600 V, working and 1500 V test.

.4 Cable openings between sections to be protected with bushings to prevent abrasion to cable jackets

.5 Fuse and terminal blocks to be easily accessible. Fuses of the proper type and rating to be supplied by the switchgear manufacturer. Fuses to be Class J HRC.

.6 Provisions to be made for the installation of control wiring conduits to the switchgear and connections to be brought to terminal blocks furnished and installed by the switchgear manufacturer. Auxiliary wiring checks to be made throughout the manufacture and assembly of the equipment to assure wiring correctness and continuity.

.7 Final checkout of wiring to be made with the complete switchgear lineup assembly to assure wiring correctness and continuity. Polarity of current and potential transformers and devices to be checked to assure proper functioning of all protective devices and instrumentation.

2.6 Energy Reduction Maintenance Setting Switch (ERMS)

.1 For each Main, Tie or Feeder circuit breaker, provide a Maintenance OFF ON selector switch on the compartment door to switch the circuit breaker instantaneous tripping characteristics to an alternate setting temporarily during maintenance activity.

.2 Provide a lock feature for the ERMS switch so that it may be locked in either the OFF or ON maintenance mode position.

.3 Provide a blue LED indicating light to indicate trip unit is in the ERMS mode.

.4 Wire contacts on all ERMS switches to a common alarm input to plant control system.

2.7 Instrument Transformers

.1 Potential transformers and current transformers required to operate relays, meters and other devices indicated in the drawings and specifications to be coordinated so that the ratio and accuracy are suitable for each individual application, taking into account the burdens imposed. Construction of transformers to conform to ANSI Standards. All terminals to have permanent polarity designations and to be wired accordingly. All applicable requirements of IEEE C57.13 to apply.

.2 Primary potential bus or cable tap leads to be designed with the same design integrity as the primary bus.

.3 Both current and potential transformers to be wired through test switches to provide quick and easy multi-circuit testing of switchboard relays, meters and instruments.

2.8 Potential Transformers

.1 Potential transformers to be housed in a separate compartment in the circuit breaker cubicle or superstructure.

.2 Potential transformers to be of the 0.3 accuracy class, per ANSI Standards and of sufficient capacity to serve the maximum burden imposed.

.3 Each potential transformer to be protected with current limiting primary fuses, and to be designed to withstand the basic impulse level of the switchboard.

2.9 Current Transformers

.1 Current transformers to be easily removable and accessible and of the ring or bar-type.

.2 Ring-type current transformers to be used where burden and accuracy permit. Primary terminals on bar-type current transformers to be silver plated and rigidly (2 bolt minimum) connected to the bus structure.

.3 Secondary connections of all current transformers to have provisions for short circuiting when not connected to instruments and to be solidly grounded.

.4 Current transformers to be capable of carrying at least 125% of CT rating continuously and have a short time rating at least equivalent to that of the switchgear bus. Accuracy class: C100/ 0.6 B-1.

3 EXECUTION

3.1 Installation

.1 Install air circuit breakers as indicated.

3.2 Site Acceptance Testing

.1 Conduct an acceptance test in presence of and to satisfaction of Consultant, after completion of installation, but before switchboard is permanently put into service.

.2 SAT to include the following:

.1 Thorough physical inspection and verification of the installation including wiring and interconnections.

.2 Inspection and test procedures in accordance with ANSI/NETA ATS-2021 for:

(a) SWITCHGEAR AND SWITCHBOARD ASSEMBLIES, with the exception of primary current-injection testing.

(b) *LOW-VOLTAGE POWER CIRCUIT BREAKERS* with the requirement that trip units' LSIG pick-up and delays to be verified by secondary current-injection in-lieu of primary injection.

.3 Function testing of each breaker's remote open/close control from the generator master control system.

.4 Function testing of each breaker's status monitoring on the remote generator master control system for each of the following: breaker identification, open, closed, tripped, and withdrawn.

.5 Function testing of monitoring of each breaker trip unit's metering information via the gateway-server on the Building Management System.

.6 Correct defects at no additional cost to Owner. Replace defective equipment immediately with new factory equipment

END OF SECTION

POWER GENERATION DIESEL
26 32 13

1 GENERAL

1.1 General Requirements

.1 Conform to Sections of Division 1 as applicable.

.2 Conform to Section 26 01 01, Electrical General Requirements.

.3 Refer to Section 26 08 05, System Coordination, Verification and Testing

.4 Refer to Section 26 24 13, Low Voltage Switchboard.

1.2 Work Included

.1 Work to be done under this Section shall include furnishing of labour, materials, and equipment required for installation, testing and putting into proper operation complete systems as shown as specified and as otherwise required.

.2 General Schedule of equipment to be provided:

.1 2000kW prime rated, 347/600 volt, 3 phase, 4 wire, meeting CSA C282-15 and CSA Z32-15 and additional requirements as noted herein. System shall comprise a fully automatic emergency generating plant capable of automatic starting, and producing rated power in the event of failure of normal supply.

.2 Engine generator control panels, with monitor alarm and control system.

.3 Starting battery and charger per diesel generator.

.4 Control battery and charger per diesel generator.

.5 Engine exhaust silencers and associated components.

.6 Generator output circuit breaker

.3 The services to be provided by the supplier under this section shall include but shall not be limited to the following for a complete and satisfactory operating system.

.1 Shop drawings, fabrication and assembly as per "reviewed" shop drawings.

.2 Interface control wiring diagrams, schedules and wire running lists between all components supplied and to all external devices identified in the contract documents.

.3 Factory testing and supplementary witness testing. Witness testing procedure to be submitted as a shop drawing for review by the Engineer, Independent Testing Organization and Owner appointed Commissioning Agent.

.4 Delivery schedule and delivery DDP (Incoterms) – Kingston General Hospital – 76 Stuart St, Kingston, Ontario.

.5 Technical supervision of unloading, site assembly, installation of power and control cable connections, battery installation and connections, and all other work normal to the electrical trade.

.6 Commissioning, site testing including witness testing with temporary load banks. Witness testing procedure shall be submitted as a shop drawing for review by the Consultant. Rental cost of full capacity multi step load bank shall be included in Tender Price. Handling, installation, temporary wiring and removal shall be by the Contractor. Site testing procedure to be submitted as a shop drawing in accordance with the testing requirements of the contract documents and Owner

appointed Commissioning Agents requirements. These shall be reviewed by the Engineer, Independent Testing Organization and Owner appointed Commissioning Agent.

.7 Providing technical staff and manuals for factory and field training of Owner's staff in the complete operation of the system.

.8 Warranty service on a priority basis (within 4 hours).

.9 Data book including schematic diagrams of all circuit boards.

.10 Check out of system one month prior to expiry of warranty period.

.11 Services of a technical representative as required by the Owners to review production schedule, delivery dates, shop drawing changes, shop and field testing and training programs.

.12 Unloading, hoisting and setting into place, and work normal to the electrical, mechanical and millwright trades such as providing interface power and control wiring to terminals within the equipment components and installation of major components shall be done by the Installation Contractor.

.4 Include for the services of qualified factory trained technicians and service representatives to be on site for commissioning of systems and components and during the on-site "witness" testing program as long as necessary to make final adjustment for acceptance of the system.

.5 Include for the services of qualified factory trained technicians and service representatives to conduct training of the facility operating staff in the operation and maintenance of the overall emergency power system. Should equipment fail during a training session, conduct a repeat session.

.6 All on-site testing/commissioning, and site work requiring interruptions to Owner’s existing systems, shall be performed at Owner approved times. Assume premium time, between the hours of 23:00 to 06:00 or on weekends exclusive of Owner imposed embargo dates. A list of presently known Owner embargo dates can be made available upon written request during the tender period.

.7 Complete systems shall be left ready for continuous and efficient satisfactory operation.

1.3 Warrantee

.1 All equipment furnished under this contract shall be guaranteed by the Supplier for a period of 2 year following final site acceptance against:

.1 Faulty or inadequate design, manufacture or operation. improper assembly.

.2 Defective material or workmanship, or both.

.3 Leakage, breakage or other failure that might occur under normal and proper operation of the equipment.

.2 The complete emergency power system, including all accessories specified herein, shall be guaranteed against faulty and improper material and workmanship for a period of two (2) years from the date of final acceptance by the owner. All system parts and component assemblies shall be guaranteed for two (2) years after acceptance.

.3 The manufacturer shall correct any deficiencies in his equipment which occur during the two (2) year warranty period at no additional cost to the Owner. This shall include all costs for material and labour. The manufacturers technical representative shall be available on site on a priority basis i.e., within four (4) hours of being notified of a deficiency to repair the system.

.4 Prior to the expiry of the warranty period, i.e. during the last month of the period, provide technical staff on a weekend to conduct an in depth checkout of the total emergency power system. Replace

any components which have become degraded to the point where their long term performance is questionable. The cost of this service shall be included in the bid price.

.5 Cost for service calls made necessary to maintain the total emergency power system in optimal operating conditions during the two year warranty period shall be included in the bid price.

1.4 References

.1 Diesel-generator performance and accessories shall conform to latest CAN/CSA Standard C282.

1.5 Seismic Qualification

.1 Seismically qualify (certify) the following equipment specified herein:

.1 Power generators.

.2 Control panels, both generator mounted and free-standing.

.2 The seismic qualification of the above-listed equipment is to conform to Specification section 26 05 49.23 for the following seismic qualification level and certification method:

.1 Functional seismic qualification (Level III) for electrical control equipment: by shake table testing,

.2 Functional seismic qualification (Level III) for vibration isolated equipment: by shake table testing.

.3 The following equipment specific seismic force parameters are to be used:

Equipment	C_p	A_r	R_p	h_x/h_n
Generators, included generator mounted control panels	1.00	2.50	2.50	1.0
Control Panels - freestanding	1.00	1.00	1.25	1.0

1.6 Shop Drawings and Product Data

.1 Submit shop drawings and product data

.2 Submit the following information, contained in a binder, for approval indicating make, model, type, dimensions, ratings, etc...:

.1 list of components

.2 engine

.3 alternator

.4 voltage regulator

.5 governor

.6 battery charger

.7 battery

.8 best battery selector units

.9 cooling system

.10 engine and generator mounting, including vibration isolators

.11 silencer

.12 location of fuel and lube oil filters

.13 lube oil and coolant drain valves

.14 air cleaners

.15 engine instrument panel

.16 main control panel

.17 starting motor

.18 block heaters

.19 spares storage cabinets

.20 radiator sizing calculations

.21 power and control junction boxes

.22 weights of all components

.23 dimensioned outline of unit

.24 confirmation of Diesel exhaust pipe diameter

.25 brake horsepower versus rated speed curves

.26 diesel fuel consumption and cooling water data

.27 performance curves for local conditions and multipliers for ambient temperatures

.28 generator decrement curves against generator breaker in switchgear

.29 efficiency of generator

.30 confirmation of diesel exhaust back pressure and water coolant requirements.

.31 flow diagrams for fuel, lubricating oil, and cooling systems

.32 engine and generator control wiring diagrams

.33 muffler/silencer including back pressure calculations

.3 Submit decrement and generator damage curves to show fault current sustaining ability of generator as outlined.

.4 Submit description of set operation including

.1 automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.

.2 manual starting

.3 manual emergency stop

.4 interfaces with external connections including, but not limited to, intake air dampers, exhaust dampers, combustion dampers, fuel systems, building automation system, DC starting battery systems, Generator Switchboard and Automatic Transfer Switchboard.

.5 submit description of automatic shutdown and alarms on

.1 over cranking

.2 over speed

.3 high engine temperature

.4 low lube oil pressure

.5 short circuit

.6 alternator over voltage

.7 lube oil high temperature

.8 thermistor over temperature on alternator

.6 Physical Construction Drawings, completely dimensioned, showing:

.1 Arrangement.

.2 Plan, front view, and elevation views.

.3 Required clearances for opening doors and for removing breakers.

.4 Conduit or cable trays entrance locations and dimensions for both top and bottom entrance.

.5 Bus bar locations and configurations.

.6 Incoming and outgoing power cable terminator positions.

.7 Field wiring terminal block locations, and all other terminal block locations.

.8 Anchor bolt locations.

.9 Grounding connections.

.10 Weight of equipment.

.7 Three line diagrams, with ANSI device function numbers used throughout, shall show all:

.1 Instrument transformers.

.2 Relays.

.3 Meters and meter switches.

.4 Other pertinent devices.

.8 Elementary Diagrams

.1 Elementary (schematic) wiring diagrams shall be furnished for the electrically-operated breaker control scheme.

.2 Each elementary diagram shall show all control devices and device contact, each of which shall be labelled with its proper ANSI device function number.

.3 Each elementary diagram shall show device and terminal block terminal numbers.

.9 Control Switches

.1 Provide control switch development tables.

.10 Detailed Connection (Wiring) Diagrams showing:

.1 Approximate physical location of all items in each unit.

.2 All wiring within each unit.

.3 All interconnecting wiring between units.

.4 Identification of all terminals, terminal blocks, and wires.

.5 Clear identification, by some distinguishing method, of all interface wiring to remote devices. This shall include, but not be limited to, leads from external current transformers, trip circuits from remote devices, auxiliary contacts to remote devices, AC control power, and separate incoming AC power. This shall also include spare auxiliary contacts and relay contacts which shall be wired to terminal blocks for future use.

1.7 Operation and Maintenance Data

.1 Provide operation and maintenance data for diesel generator for incorporation into Operation and Maintenance Manual.

.2 Include in Operation and Maintenance Manual instructions for particular unit supplied and not general description of units manufactured by supplier. Include all nameplate/sizing information.

.3 Operating manual shall include fully detailed software program, documentation including descriptive sequence of operations and referenced to accompanying ladder logic diagrams. This material shall be used in training Owner's staff in the system operation, maintenance and diagnostics. Include the cost of the services of a technical representative for instructing the commissioning team in the system operation.

.4 Five (5) complete sets of operation and maintenance manuals shall be provided for the system. Turn over one set to the Engineer. These manuals shall be applicable to the engine, generator, battery and charger, control panel including the circuit breakers, controls instrumentation and all other components of the assembly. The manuals shall include circuit and wiring diagrams, safety precautions, operating and maintenance instructions, including drawings, illustrations and identification of wiring. Coordinate breaker details and information with switchgear manufacturer.

.5 Operation and maintenance instructions for engine and accessories, alternator and accessories, control panel, battery charger, battery, fuel system, engine room ventilation system, exhaust system and accessories, to permit effective operation, maintenance and repair.

.6 Illustrated parts lists with parts catalogue numbers.

.7 As Built schematic diagrams of electrical power, control, and logic circuits.

.8 Flow diagrams for:

- .1 Fuel system.
- .2 Lubricating oil.
- .3 Cooling system.

.9 Certified copy of factory test results.

.10 Maintenance and overhaul instructions and schedules.

.11 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.

1.8 Maintenance Materials

.1 Provide maintenance materials. Include:

- .1 2 sets of fuel filter replacement elements.
- .2 2 sets of lube oil filter replacement elements.
- .3 2 sets of air cleaner filter elements.
- .4 2 sets of fuses for control panel.

.2 Provide one complete set of all special tools required for unit servicing.

.3 Provide one battery service safety kit including:

.1 Full face shield

.2 Acid resistant gloves

.3 Acid resistant apron

.4 Acid neutralizing compound

.5 Eye wash bottle

.6 Battery top up bottle

.7 Acid resistant wall mount rack to support the above

.8 Hydrometer with wall mount bracket and acid resistant drip cup

.9 10 Litres of distilled water.

.4 Provide one heavy duty free standing spares storage cabinet of painted steel construction, approximately 40” wide by 18” deep, with not less than six heavy duty adjustable shelves each capable of supporting 175 kg. and with two hinged lockable doors. Cabinet to house the maintenance materials, special tools, Operation and Maintenance Manual plus a log book.

1.9 Training program

.1 Include in the services of a qualified technical representative at the factory and at the site to conduct "hands-on" training programs for the Owner's staff.

.2 The amount of time to be included in the tender is three (3) days at the site for a total of 24 hours.

.3 The training shall include identification of components and diagnostic alarms as well as basic inspection, housekeeping and logging procedures.

.4 Submit an outline of the training program for review, adjustment and approval by the engineer. Training will occur in three (3) separate one (1) day sessions, at a time convenient to the Owner, over the construction and warranty period.

.5 Sessions may be videotaped by the Owner or Contractor as an aid to ongoing training of Owners staff.

1.10 Provisions For Handling And Field Erection

.1 Each shipping split of stationary structures shall be furnished with removable lifting angles and/or plates suitable for crane hooks or slings.

.2 Each shipping split shall also be furnished with removable steel channel base plates which will permit using pipe rollers or dollies without damaging the frame steel of the equipment.

1.11 Preparation For Shipment

.1 Preparation for Shipment shall be in accordance with manufacturer's standards, unless otherwise noted.

.2 The manufacturer shall be solely responsible for the adequacy of the Preparation for Shipment provision employed in respect of materials and application, to provide materials and their destination in ex-works condition when handled by commercial carrier systems.

1.12 Shipping

.1 The engine generator set assembly shall be capable of withstanding normal shipping and handling shocks and vibration without damage or deterioration.

.2 If shipped separately, any components shall be individually crated and tagged with its proper unit number and the equipment number of the assembly to which it belongs.

.3 Each "shipping section" shall be provided with a permanently-attached, readily-visible identification tag bearing the equipment number of the assembly of which it is a part.

.4 Cost associated with transportation, insurance and road permits for delivery of equipment to job site shall be included in the bid price.

1.13 Installation

.1 Installation of the diesel generator equipment shall be in full accordance with, and under the technical supervision of the supplier. Provide drawings showing general arrangement of all components including batteries, interconnecting wiring drawings and schedules suitable for use by the successful contractor.

.2 Equipment shall be arranged or crated with features which make it easy for hoisting, rolling and jacking into place without damage to the equipment.

.3 Include in the bid, the cost of a factory engineer or technician to supervise the site assembly and to commission, test, and certify the installation on site.

1.14 Submittals with Bid

.1 The following drawings and information are to be submitted with the bidders tender:

.1 Location of nearest local office staffed with regularly employed engineers and/or technicians who have been factory trained in the installation and service of the proposed equipment.

.2 Number of Professional Engineers on staff, licensed in the Province of Ontario.

.3 Name and location of factory trained engineers and technicians in regular employment with the system supplier qualified to service the proposed equipment, and their areas of expertise.

.4 Resumes for key project personnel and the project manager assigned to the project, and their areas of expertise. Include information on key personnel from sub-suppliers (paralleling and synchronization controls and switchgear).

.5 A list of similar installations in Canada (high voltage diesel generators and switchgear, critical facilities (data centers etc.)).

.6 Typical response time for a qualified factory trained service engineer or technician to be on site following an "emergency" service call.

.7 A document of compliance indicating compliance with each article of the specification, where compliance is not possible the article shall be noted and an explanation given, the document of compliance shall be signed by an officer of the company supplying the system.

.8 Failure to provide the above information will result, at the discretion of the engineer and Owner, in the rejection of the RFP submission.

.2 Submit the following information, contained in a binder, for approval indicating make, model, type, dimensions, ratings, etc...:

.1 engine

.2 alternator

.3 voltage regulator

.4 governor

.5 control panel

.6 weights of all components

.7 Dimensioned outline of unit

.8 Confirmation of Diesel exhaust pipe diameter

.9 Brake horsepower versus rated speed curves

.10 Diesel fuel consumption and cooling water data

.11 Performance curves for local conditions and multipliers for ambient temperatures

.12 List of components

.13 Confirmation of diesel exhaust back pressure and water coolant requirements.

.14 Confirmation of transient frequency and voltage performance under specified step load conditions, including 0-100%, 0-50%, 25 - 75%, and 50-100% load steps.

.3 Preliminary Physical Construction Drawings, completely dimensioned, showing:

.1 Arrangement.

.2 Plan, front view, and elevation views.

1.15 Source Quality Control

.1 Factory test each generator set including engine, alternator, control panels, and accessories in presence of Engineer and Independent Testing Agent.

.2 Notify Engineer ten (10) working days in advance of date of factory test.

.3 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:

.1 Date

.2 Generator set serial no.

.3 Engine, make, model, serial no.

.4 Alternator, make, model, serial no.

.5 Voltage regulator, make and model.

.6 Rating of generator set, kW, kVA, V, A, r/min, Hz.

.4 Mark check sheet and record data on forms in duplicate as test proceeds.

.5 Demonstration of automatic start system

.6 With 100% rated full load, operate set for 4 h, taking readings at 30 min intervals, and record following:

.1 Time of reading.

.2 Running time.

.3 Ambient temp in °C.

.4 Fuel consumption

.5 Lube oil pressure in kPa.

.6 Lube oil temp in °C.

.7 Engine coolant temp in °C.

.8 Exhaust stack temp in °C.

.9 Alternator voltage:

.10 Alternator current:

.11 Power in kW.

.12 Frequency in Hz.

.13 Power Factor.

.14 Battery charger current in A.

.15 Alternator cooling air outlet temp.

.7 After completion of 4 h run, demonstrate following features, shut down devices and alarms: Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.

.1 Cycle crank test

.2 Over cranking.

.3 Over speed.

.4 High engine temp.

.5 Low lube oil pressure.

.6 Simulated Short circuit, to verify operation of differential protection.

.7 Alternator over voltage.

.8 Low battery voltage, or no battery charge.

.9 Manual remote emergency stop.

.10 High alternator temperature.

.11 All other safety features

.8 Next install continuous electronic power quality meter with sufficient storage capacity and of sufficient sampling rate to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:

.1 No load to full load to no load.

.2 No load to 75% load to no load.

.3 No load to 50% load to no load.

.4 25% load to 100% load to 25%.

.5 50% load to 100% load to 50%.

.9 Emergency Switchboard and Synchronization System

.10 Demonstrate

.1 Automatic starting of set on failure of normal power.

.2 Operation of manual control switch.

.3 That battery charger reverts to high rate charge after cranking.

1.16 Temporary and Trial Usage

.1 Temporary and trial usage by Owner of equipment or any other work or materials supplied before final completion and written acceptance shall not be construed as evidence of acceptance by Engineer.

.2 Owner shall have the privilege of such temporary and trial usage, as soon as supplier shall claim that said work is completed and in accordance with specifications, for such reasonable length of time as is deemed to be sufficient for making a complete and thorough test of same.

.3 Claims for damage shall not be made by supplier for the injury to or breaking of any parts of such work which may be used, whether caused by weakness or inaccuracy of structural parts or by defective materials or workmanship of any kind whatsoever.

1.17 Final Acceptance

.1 Request for acceptance shall be submitted in writing. Written request shall not be submitted until:

.1 Deficiencies noted during job inspections have been completed.

.2 Systems have been pre-commissioned and tested and are ready for on-line operation.

.3 Completed data books have been submitted and approved.

.4 Diagrams have been submitted and approved, and equipment identification is completed.

.5 The cleaning up is finished in every respect.

.6 Spare parts and replacement parts specified have been provided and receipt of same acknowledged.

.7 Record drawings are completed and approved.

.8 Owner's operating personnel have been instructed in operation of systems.

2 PRODUCTS

2.1 Procurement Package

.1 Generator complete with enclosure and fuel tank have been specified, bid and pre-selected. Procurement package is identified as RFP_10434805-ME-02. Refer to project reference manual for details of this material to be assigned to the successful general contractor. The generator supplier identified is Total Power - Generac, package is part of the project reference manual.

.2 Electrical contractor to coordinate and provide all connections indicated below.

2.2 Nominal Size and Rating

.1 Unit shall meet the requirements of CAN/CSA Standard C282 for the supply of emergency power and have a minimum nameplate prime power rating of 2000 kW at 40°C ambient. 2000kW standby generator is acceptable if the generator is capable of delivery full load for a minimum of 500 hours of operation per year per CAN/CSA Standard C282 requirements.

.2 The unit shall accommodate identified power transformer in-rush currents, motor starting, 100% step loads without stalling, fault current duties and exhaust stack back pressure limitations all within the tolerances specified herein.

.3 The unit shall be sized and set to provide 100% load in a 40°C ambient without exceeding the limits specified herein.

.4 The engine provided shall have additional BHP capacity for power requirements to drive engine driven components and accessories such as: radiator fan, fuel pump, water pump, as well as additional BHP allowances for power transformer in-rush currents, motor starting duties, step loading changes, stack back pressure levels at 40°C ambient, all within CSA specified tolerances for voltage, frequency and temperature, and the tolerances specified herein.

.5 The engine manufacturer's catalogued BHP curves for Standby Rating shall be based on continuous duty conforming to or exceeding the following standards:

.1 SAE J816b (US)

.2 BS5514 (British)

.3 DIN "B" 6270 (European)

.4 ISO 3046/1

2.3 Performance Characteristics

.1 The equipment shall be suitable for operation and providing full output power as per the manufacturers guaranteed performance profile under the following conditions:

.1 Altitude 100 meters above sea level

.2 Outside ambient -40°C to 35°C nominal

.3 Room ambient 10°C to 40°C nominal

.4 The engine and generator units shall be capable of being synchronized and operated in parallel under all load conditions within the total capacity of the units.

.2 Frequency Control - Governor control on each unit shall maintain output frequency within the following limits:

.1 Frequency drift - with any constant load between no load and rated load, the change in regulated frequency shall be +/- 0.25% from rated.

.2 Steady-state - frequency control shall be within +/- 0.25% from rated when the load is varied from no load to rated load and all transients have decayed.

.3 Frequency variations during steady-state conditions shall show a random nature (as opposed to cyclic variations).

.3 Voltage Regulation - voltage control of generator output shall be within the following limits:

.1 Voltage drift - with any constant load between no load and rated kVA, the change in regulated output voltage shall not exceed +/- 0.5% within one-half hour and a constant ambient temperature.

.2 Steady-state voltage regulation - voltage regulation shall be +/- 1% of rated voltage when the load is varied from no load to rated kVA and all transients have decayed.

.4 Transient voltage and frequency deviation and recovery time upon addition and deletion of a 100% step load shall not exceed

.1 25% voltage deviation

.2 10% frequency deviation

.3 5 second recovery time to reach normal stability requirements

.4 Addition of a 100% step load shall not cause the engine to stall.

.5 Removal of a 100% step load shall not cause the engine to shutdown.

2.4 Diesel Engine

.1 Engine shall be a four stroke, single acting, full compression ignition type with a maximum crankshaft speed of 1800 rpm.

.2 Engine shall be a low emissions type certified to meet the requirements of the U.S. Environmental Protection Agency Tier 2 limits for a stationary emergency application

.3 Engine shall operate on commercial grades of diesel fuel oil readily available locally and shall give satisfactory performance on No. 2 Grade domestic fuel oil in an emergency.

.4 A special operating condition is that the set be capable of operating at light loads for an extended period of time as normal power failure may occur when only part of the full output of the generator set is required.

.5 Engine shall incorporate dry vortex type air cleaners equipped with service indicators, of replaceable element type, with an efficiency of at least 99.8%. Service indicators are not to be mounted in rubber hose.

.6 Diesel engine shall be suitable for a stack back pressure of 6.70 kPa.

.7 Flex connection at engine exhaust complete with gaskets, nuts, bolts and miscellaneous hardware.

.8 All moving parts such as flywheels, pulleys, belts, etc., shall be enclosed with suitable guards to protect the engine operator from accidental injury. All guards shall be easily removable for servicing the equipment.

.9 Engine shall be complete with inter-changeable cylinder heads, exhaust valves constructed of special alloy steel, and satellite faced exhaust valve inserts.

.10 Provide with the engine a flexible 100mm diameter hose of proper diameter and sufficient length to reach from the engine crankcase vent connection to the atmosphere side of the radiator exhaust plenum, for venting of crankcase fumes to atmosphere.

.11 Provide a crankcase emissions absorption system with a flexible 4" diameter hose of sufficient length to reach from the system to the atmosphere side of the radiator exhaust plenum, for venting of crankcase fumes to atmosphere. System to be Nelson-Winslow or equal.

.12 Engine shall be equipped with 24 volt D.C. electric starting motors, and the starting pinion shall be arranged to disengage automatically when the engine starts.

.13 Engine shall also be equipped with individual safety devices to shut-down the engine and to sound an alarm in the event of conditions specified later in this Section, and equipped with contacts to pre-alarm for conditions specified later in this Section.

.14 Each engine flywheel housing shall be connected rigidly to the generator housing with an SAE adaptor. Each unit shall be mounted on a common, heavy duty, stress relieved, fabricated steel

baseplate. Torsional approval of each entire assembly must be obtained and submitted in duplicate to the Consultant for review. Each report shall also outline the critical speeds of the assembly.

.15 Removable guards shall be provided around all moving parts and high temperature areas to protect operating personnel.

2.5 Governor

.1 Governor to be manufacturer's current OEM electronic high performance standard system for load sharing and speed control of the units. Governor package to be complete with magnetic pickup and synchronizing and load control modules.

.2 The governor control system to include filtering of harmonics to provide true RMS electrical inputs to the speed control system.

.3 Governor shall be capable of isochronous operation, no load to full load and capable, under any steady state condition, of maintaining engine speed within ±0.25%.

.4 The governor shall operate in an isochronous and shall provide load sharing functions when in parallel with similar units in isochronous.

.5 Input voltage and current signals shall be fed into the governor from current and potential transformers supplied with the governor and installed in the switchboard as supplied as part of this Contract.

.6 The governor shall be capable of the following performance:

.1 Operating the engine isochronously under steady state conditions from no load to full load.

.2 Transient regulation response as specified.

.3 Frequency drift as specified.

.4 Steady state speed regulation as specified.

.5 The governor control system shall include filtering of harmonics to provide true RMS electrical inputs to the speed control system.

.6 Parallel operation so the sets operate isochronously.

.7 Load sharing so that each engine generator set assumes an equal percentage of the total load while maintaining specified steady-state speed regulation.

.8 Adjustable load sharing so that each engine can be selected to assume more or less load, up to 100% (for annual load testing purposes).

2.6 Engine Cooling System

.1 Engine cooling system shall include built-in centrifugal type water circulating pump and thermostat to maintain proper jacket water temperature under each load condition.

.2 Cooling system components and seals with flexible water hose connections.

.3 Engine shall be cooled by an integral radiator and blower fan cooling system including permanent anti-freeze to -40°C as recommended by engine manufacturer.

.4 Radiator fan to be sized to provide radiator design air flow rates at minimum static pressure of 1.0" WC (generator external air flow resistance) plus air flow resistance by generator radiator and air flow resistance by any other generator components.

.5 Radiator shall have sufficient capacity for cooling the engine under full load conditions in an ambient temperature up to 40°C. Include for sizing to accommodate static pressure loss through louvres, silencers and dampers. Manufacturer shall verify this pressure drop and oversize as required to deliver full rated load under 40°C ambient temperature. At a minimum, unit shall be designed for 0.75" external static pressure drop. Division 20 contractor to supply flexible duct adapter, manufacturer shall coordinate requirements with installation contractor.

.6 Radiator to be equipped with a coolant liquid level indicator.

.7 Fan shall be pusher type, with ample means for adjustment to allow for belt stretching and shall be enclosed in an easily removable cage.

.8 Engine shall be complete with thermostatically controlled engine coolant pre-heater, Kim Hotstart to maintain coolant around combustion chamber of approximately 10°C. Heater shall be rated 208 Volts, 1 phase. Preheater water circuit to be equipped with position indicating ball type shut off valves to permit removal of heater without draining of coolant from the system. Include heavy duty thermostat equal to United Electric Model #120 complete with heavy duty engine mounted relay to shut off heater when engine is running.

.9 Ball drain valves shall be provided for draining coolant from each engine block, radiator and jacket heater.

2.7 Engine Monitoring Panel

.1 The following gauges shall be supplied and shall be flexibly mounted on engine:

.1 Coolant in and out temperature gauges

.2 Engine water temperature gauge

.3 Lube oil pressure gauge

.4 Lube oil temperature

.5 Tachometer

.6 Run Hour meter

.7 Exhaust temperature thermometer

.2 Panel shall be equipped with an integral shrouded emergency stop pushbutton

2.8 Lube Oil System

.1 Engine shall be provided with full pressure lubrication with high capacity positive displacement type gear driven pumps, with adjustable pressure regulators, replaceable element filter with bypass valve arrangement, supplying filtered lubricating oil under pressure to main bearings, crank pin bearings, piston pins, timing gears, camshaft bearings, valve rocker mechanism, governor and turbocharger. Full pressure lubrication shall be provided to all main bearings, connecting rod bearings and camshaft bearings.

.2 Readily accessible ball valves with suitable piping shall be provided for convenient draining of complete lubricating oil system.

.3 An air-cooled lubricating oil cooler shall be included.

.4 Engine shall be complete with thermostatically controlled oil sump heater, rated 120 volts, single phase, complete with heavy duty engine mounted relay to shut off heater when engine is running.

2.9 Fuel System

.1 Engine mounted high performance fuel transfer pump with filter assembly.

.2 Fuel filter shall have replaceable elements that can be easily removed without disturbing other parts of engine. Equip engine with primary and secondary fuel filters.

.3 Auxiliary Tuthill gear driven high lift fuel transfer pump (approximately 6 metre lift not including filter and line restrictions), complete with primary and secondary filter assemblies and check valve, hand operated priming pump with bypass valve, and fuel pressure switch to provide engine shutdown.

.4 Equip engine with a fuel to water or fuel to air heat exchanger type fuel cooler to dissipate all waste heat transferred from engine to recirculated fuel. Size fuel cooler to ensure fuel returned to the fuel storage tank from the engine is maintained at a temperature below 38°C with a room ambient air temperature of up to 40°C, with allowances made for temperature rise as the air is heated by the machine before it reaches the heat exchanger. Submit calculations as a shop drawing.

.5 Equip engine with a ULC listed fuel filter/water separator. Racor Fuel Filter/Water Separator, Model 79/1000 FG. Include a control panel mounted #18-1551 vacuum pressure gauge connected between engine and filter.

.6 Provide braided stainless steel aircraft quality flexible fuel oil connections, supply and return, from engine to filters, between filter components, and from filters to valved connections left by Division 20. Flexible fuel lines shall be supplied by Diesel manufacturer and shall comply with the requirements of the Authority Having Jurisdiction and shall be ULC listed.

Standard of Acceptance
- Aeroquip
- OPW
- OEM

2.10 Generator

.1 Three phase brushless, self-ventilating, revolving field synchronous machine of salient pole construction with amortisseur windings with permanent magnet pilot exciter, IP23 drip-proof construction, single bearing type connected to the engine through a flexible coupling with shear bolts.

.2 Diesel-driven alternator shall be complete with necessary controls and accessories, to comprise a fully automatic standby generating plant capable of producing power in event of failure of normal supply. Generator shall be capable of operating on system voltage shown, 80% power factor and maximum 1800 rpm.

.3 Generator enclosure shall be CSA Type 2 Drip-proof as per CSA C22.2 No. 100-M 1982 modified with air inlet and outlet louvres arranged in such a way as to prevent the sprinkler liquid from entering the equipment and/or interfering with its operation as per Electrical Safety Code Rule 26-008, equal to IP23 housing.

.4 Generator shall include fully connected damper windings and stator windings shall be 2/3 pitch to provide low reactance at the 5^{th} and 7^{th} harmonics for three phase non-linear loads. Total harmonic distortion shall not exceed 4% on a 3 phase balanced harmonic free load. Telephone interference factor for harmonic content shall not exceed 50.

.5 Generator insulation shall be Class H. When operating continuously at full load the average winding temperature in °C measured by rise of resistance method shall not exceed 130°C at an ambient of 40°C.

.6 Generator shall be of rotating field type with permanent magnet pilot exciter and shall be capable of maintaining at an ambient of 40°C the following: 100% of full load continuously; 110% of full load for 1 hour; 150% of full load for 1 minute; and 300% of full load for 10 seconds, at terminals of generator, without damage to generator, for the following fault conditions:

.1 3 phase symmetrical fault,

.2 phase to phase fault,

.3 phase to ground fault.

.7 Generator shall be complete with automatic voltage regulators, Stamford Series MX321 or equal (3 phase RMS voltage sensing) acting on each phase and capable of controlling voltage within ±½% of rated voltage, no load to full load, during steady state conditions.

.8 Set shall be oversized as required, to accommodate motor in-rush duty, and 100% block loading.

.9 Identify alternator windings with permanent tags.

.10 Bring windings to insulated terminals in an oversized metal junction box mounted on the alternator. Size junction box to permit mounting of engine and alternator low voltage controls and wiring terminal blocks, and to provide adequate space for terminating outgoing power cables with 2 hole long barrel compression connectors exiting from the top with adequate allowance for cable bending radius. Provide barrier in junction box to separate control voltage and line voltage wiring.

.11 Provide a tinned copper termination plate drilled to accept multiple 2-hole compression connector terminated cables per phase, and necessary bus bar extensions to generator winding terminals.

.12 Thermistors shall be embedded in stator winding and connected to alternator control circuitry.

2.11 Generator Excitation System

.1 Exciter shall be a brushless type using a rotating 3 phase full wave rectifier bridge circuit and a 3 phase rotating armature type alternating current generator mounted on the rotor shaft rated to provide excitation current necessary to operate alternator at rated output continuously for all overload conditions and to maintain specified voltage regulation under transient conditions.

.2 Voltage regulator system to have frequency dependent circuitry with adjustable voltage roll-off feature to aid engine speed recovery for step loads. Include for fine tuning at the engine supplier's plant and at the site for optimization of the settings.

.3 Voltage regulator to be solid state silicon controlled rectifiers with phase controlled sensing circuit, regulation ±½% no load to full load. Provide auto/manual control module, and individual hand trimmer adjustment located at control cubicle.

.4 The voltage regulator circuitry shall include:

.1 Control to adjust the stabilizing or anti-hunt circuit which controls overshoot or undershoot of the alternator voltage or load changes.

.2 Current forcing circuit to supply a minimum of 300% of nominal alternator output for at least 10 seconds to allow proper co-ordination of system protective devices.

.3 Manual control for adjustment of the automatically regulated generator voltage by ± 5%.

.5 Excitation system for each unit shall be complete with permanent magnet generator (PMG) pilot excitation system with a 3 phase RMS voltage sensing unit to provide +/- 0.5% voltage regulation. The AVR shall be immune to RIF and shall include built-in solid state overvoltage protection and adjustable short circuit current forcing controls and a separate trimmer unit mounted on the switchboard.

.6 The voltage regulator shall have the following performance features:

.1 Regulating the output voltage of the generator when it is disconnected from the load, supplying load alone, supplying load in parallel with the other sets.

.2 Steady state voltage regulation as specified.

.3 Voltage drift as specified.

.7 Mount the generator voltage regulator system in the generator control panel and provide suitable terminal blocks at each end to permit field interconnection to the generator terminal box with 8 #12 in 1" steel conduit. Components shall be protected against dust and moisture.

2.12 Safety and Alarm Devices

.1 One set of temperature and pressure switches shall be included for coolant system and lube oil system to provide instant shut-down action. Settings of these switches shall be as recommended by Engine manufacturer. Over speed shall cause instant shut-down.

2.13 Starting System

.1 Each engine shall be supplied with a complete and independent starting system.

.2 Electric starting system, minimum 24 volts, shall include dual starting motors, one (1) battery charger, cutout, regulator and two (2) sets of lead acid batteries.

.3 Batteries shall be capable of providing six consecutive 30 second cranking attempts without recharging, with terminal voltage not to fall below 75% of nominal voltage. Provide cranking limiter for one or more cranking cycles

Standard of Acceptance
- Surrette 8NS-23P
- Deka East Penn DL Series
- GNB KDZ Series
- OEM

.4 Provide a steel battery rack with a 3/4" plywood base both painted with acid resistant paint

.5 Provide a hydrometer with wall mounting bracket

.6 Batteries shall come complete with extra flexible 4/0AWG EPR insulated battery cables and compression connectors with battery rack with 3/4" painter plywood base.

.7 Fully automatic dual rate battery charger capable of recharging batteries in 30 minutes following one normal start.

.8 When battery voltage falls below a level suitable for starting, a contact on a secondary relay shall close to cause an alarm signal to be sounded at the Control Panel.

.9 Battery charger shall be a dual rate silicon rectifier battery charger for automatic float charge operating from 208 volts, single phase, 60 Hz having the following accessories and capacities:

.1 Wall mounted sprinkler proof enclosure

.2 Silicon controlled rectifier assembly with DC protection, suitable for dual charging rates

.3 AC power on indication

.4 AC power failure indication

.5 Float voltage adjustment

.6 Equalize circuit and timer

.7 Overload protected input switch

.8 DC output breaker complete with normally closed auxiliary contacts

.9 DC ammeter, 3" semi-flush, 250° scale taut band suspension

.10 DC voltmeter, 3" semi-flush, 250° scale taut band suspension

.11 Short circuit current limit

.12 Low voltage alarm with 60 second time delay (relay contacts which open for alarm, close normally wired out to terminal strip with appropriate connection) for supervisory control.

.13 DC output breaker trip alarm (wire out auxiliary contacts on DC output breaker as for low voltage alarm).

.14 Minimum charge rate to be 30 amps for battery charging and maximum charging time for fully discharged battery to 90% full charge shall not exceed six (6) hours.

.15 Enclosure to be finished and painted to match generator set enclosure; interior to be white.

Standard of Acceptance
- Mechron
- Vulcan
- OEM

2.14 Mounting Base

.1 Diesel-generator package shall be mounted on a structural steel base with suitable adjustable steel, restrained spring vibration isolators with 50 mm static deflection levelling bolts, oil proof snubbers, and 6mm thick sound pads mounted between steel base and concrete housekeeping pad. Isolation efficiency shall not be less than 95%. Isolators shall be suitable for noted seismic requirements.

Standard of Acceptance
- Mason Model
- Vibro-Acoustics
- Korfund
- OEM

.2 Vibration isolators to be anchored to the concrete floor with 5/8"anchors equal to Simpson Strong Tie Wedge All anchors with a minimum of 2 - 3/4' concrete cover

.3 The alternator set shall be complete with hooks and hubs for the attachment of slings suitable for moving the unit.

.4 Baseplates shall be of sufficient rigidity to maintain alignment of engine generator shafts and frames under all conditions during shipping, installation and service and shall be of all welded construction without bolt-on components.

.5 Engine generator feet and baseplate sole plates shall be machined parallel and true. Shimming shall be of the steel type and shall only be permitted underneath the generator feet.

.6 Provide all necessary piping, couplings, fittings, wiring and connections between all components mounted commonly on the steel base.

.7 Provide full size galvanized steel drip pan under engine and a separate pan under the Racor fuel filter assembly.

2.15 Outdoor Weather-Protective Walk-In Sound Attenuating Housing

.1 The generator set shall be provided within a sound-attenuated housing which allows the generator set to operate at full rated load in the ambient conditions previously specified. The enclosure shall reduce the sound level of the generator set while operating at full rated load to a maximum of 60 dBA at any location 7 meters/23 feet from the generator set in a free field environment. Housing configuration and materials used may be of any suitable design which meets application needs, except that acoustical materials used shall be oil and water resistant.

.2 The enclosure shall include hinged doors for access to both sides of the engine and alternator, and the control equipment. Key-locking and pad-lockable door latches shall be provided for all doors. Door hinges shall be stainless steel.

.3 The enclosure shall be provided with an exhaust silencer Super Critical grade, which is mounted inside of the enclosure, and allows the generator, set package to meet specified sound level requirements. Silencer and exhaust shall include a rain-cap and rain-shield. Secondary silencer shall be on the roof of the enclosure to attain the sound level as required.

.4 All sheet metal shall be primed for corrosion protection and finish painted with the manufacturer's standard color. All surfaces of all metal parts shall be primed and painted.

.5 Painting of hoses, clamps, wiring harnesses, and other non-metallic service parts shall not be acceptable. Fasteners used shall be corrosion resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.

.6 Space heater and adequately sized service switchboard for block heater, battery charger, internal lights, anti-condensation heater and receptacle shall be provided inside the enclosure.

.7 Enclosure base shall have a double wall construction sub-base fuel tank, UL listed with 72 hours capacity at full load. Level gauge, low level switch, vent cap, fill cap, leak alarm switch shall be provided in the fuel tank.

.8 The enclosure shall have a dedicated frame under the generator to allow the generator enclosure to be lifted off the belly tank for future service or replacement of the belly tank.

.9 Properly sized three phase electrical service panel shall be provided with pre-wired engine block heater, oil pan heater, alternator anti-condensation heater, battery charger and internal lights and space heater.

.10 External GFI receptacle shall be provided for electrical service connection.

.11 T-slot receptacles shall be provided inside enclosure. Minimum 2 receptacles to be provided.

.12 Enclosure shall be provided with motorized louvers/dampers for ventilation to meet CSA-282 requirement for maintaining 10Deg.C internal temperature.

.13 Provide interior lighting to average value of 300 lux.

.14 Provide one (1) exterior LED wall-pack luminaire at each entrance door to enclosure. Luminaire to be full cut-off with integral photocell.

.15

.16 Units shall include battery operated emergency lighting to average value of 50 lux for 30 minutes.

.17 Provide LED exit signs inside enclosure above exit doors. Provide dedicated circuit from shore power panelboard to power emergency lighting and exit signs.

.18 Provide addressable heat detectors inside enclosure.

.19 Provide Carbon Monoxide (CO) and Nox Detection System including controllers and sensors for possible flue gas leakage inside the enclosure. Exact number and location of sensors to be determined by equipment supplier.

2.16 Engine Alternator Finish

.1 Finish and paint the complete engine generator assembly, base, and all accessories with one coat of primer followed by two coats of high temperature machinery enamel with color equal to manufacturer standard color.

2.17 Diesel Exhaust Silencer

.1 Provide an exhaust silencer to meet the requirements of MOE and local noise ordinances. Muffler to possess as high an insertion loss as possible consistent with maximum allowable pressure drop and exhaust pipe dimensions and configuration.

.2 Verify required inlet and exhaust port positions and the required flange dimensions for connections to the exhaust piping system with the Division 20 contractor prior to manufacturing silencer.

.3 Attenuation to be a minimum of 35 dB in the 125 to 4000 Hz frequency range and consistent with that below. The diesel exhaust muffler/silencer system shall provide the following minimum attenuation requirements:.

Octave Band (Hz)	Silencer Insertion Loss (dB)
31.5	33
63	40
125	49
250	51
500	48
1000	47
2000	46

4000	47
8000	49

.4 Provide flexible hose connections of stainless steel at diesel engines. Hoses shall have close pitch corrugations and flanged ends and be capable of taking up the movement of the diesel engines plus expansion of the exhaust mufflers and piping in the axial direction of the flexible hose.

.5 Supply nuts, bolts, gaskets and all miscellaneous hardware required to complete the installation of the exhaust systems from the engines up to and including the flanged outlets of the silencers. The exhaust system components and hardware shall be delivered to the job-sit, inspected and turned over to the Division 20 contractor for installation.

.6 If engine has two outlet exhaust connections, provide two flexible hose connections and either a two inlet type muffler or an inverted “Y” type pipe fittings to transition from two to one exhaust connections.

.7 Exhaust silencer shall be standard wall thickness, seamless welded steel pipe to A-53-63T Grade “B” Specifications. Exhaust silencer, flanges and hardware shall be manufactured from Type 316 stainless steel.

.8 Expansion joints shall be provided.

Standard of Acceptance
- JP Environmental
- Silex
- York
- OEM

2.18 Recirculator

.1 Provide a recirculator for removing the oil mist form the engine crankcase breather vent.

.2 Recirculator is to be mounted in a horizontal position and above the crackcase oil level. A connection using rigid piping to be made between the recirculator and the engine crackcase breather.

.3 The exhaust from the recirculator is to be piped so that the engine air flow provides a 0" to 0.3" positive pressure reading during normal engine operation. Provide a U-Tube manometer for measurement of pressure difference and a control valve to adjust the pressure difference.

.4 Oil collected by the recirculator is to be returned to the engine with a tube from the bottom of the recirculator to the engine oil sump. Position oil drain tube below the oil level line of the engine oil sump.

.5 Provide two (2) spare filters for each recirculator.

.6 If recirculator is integral to the engine and meets the requirements of this section an external recirculator is not required.

2.19 Engine Control Panel Elements

.1 The generator set shall have a dedicated Engine Control Panel section..

.2 Section to include engine and generator monitoring, instrumentation, controls, and starting systems.

.3 Provide digital information screen capable of displaying the following information:

.1 Coolant in and out temperatures

.2 Engine water temperature

.3 Lube oil pressure

.4 Lube oil temperature

.5 Tachometer reading

.6 Run Hour meter reading

.4 All engine control panel elements are to be completely accessible with all terminations for power and control wiring and any other items requiring torquing, infra-red thermal scanning, maintenance, or replacement all visible and accessible from the front, when respective hinged door is opened.

.5 Provide two (2) Form C dry contacts, for each generator set, wired to a separate terminal strip in the panel for connection to the BAS by Division 20 for monitoring of the following conditions.

.1 Diesel Generator Set Summary Idle Trouble

.2 Diesel Generator Set Summary Running Trouble

.3 Diesel Generator Set Shutdown Alarm

.4 Diesel Generator Set Running Status

.6 Provide two (2) Form C dry contacts, for each generator set, wired to a separate terminal strip in the panel for connection to the Fire Alarm System by Division 26 for monitoring of the following conditions.

.1 Diesel Generator Set Summary Idle Trouble

.2 Diesel Generator Set Summary Running Trouble

.3 Diesel Generator Set Shutdown Alarm

.4 Diesel Generator Set Running Status

.7 Each engine control panel to include a programmable logic controller or a purpose built microprocessor based controller and is to include, but not be limited to, the following components:

.1 control system to initiate the diesel starting and stopping sequence, and annunciate any fault condition (local or remote indication);

.2 all required secondary and control wiring, type 'TEW' 105'C rated, extra flexible wire with thermoplastic insulation and an overall flame retarding cotton braid, neatly harnessed, suitably secured and identified with slip-on identification markers; Wiring shall be colour coded to suit application and standards; Note that wiring for the DC supply to control panel, wiring for cranking circuits and wiring for air box damper to be stranded minimum 10 AWG; wiring within control panel shall be stranded minimum16 AWG; and wiring between control panel and engine generator set shall be stranded minimum 14 AWG

.3 Each cell to be complete with all required control wiring and terminal blocks. Control wiring to be neatly harnessed and suitably secured. Wiring to outgoing circuits and to door mounted equipment shall terminate on terminal blocks.

.8 The designer/manufacturers of the entire control system will be required to:

.1 supply complete design, erection and layout drawings for the system, clearly indicating to all wiring requirements, interfacing or interconnection provisions required to completely integrate the controls with all remote apparatus;

.2 assemble, wire and pretest the system components in their factory prior to shipment to the engine supplier for factory testing.

.3 assist in the installation and oversee the work to ensure that it meets with the generator supplier's requirements;

.4 carry out a site test of the system in conjunction with the other components in the standby power system and demonstrate its proper operation to the satisfaction of the Owner and Consultant.

.9 Selector and Control Switches per Engine

.1 Provide the following devices on the front panel of the engine control section external to the HMI display panel:

(a) Engine Mode Operation Selector Switch with Manual, Off, Auto and Reset options.
- Switch in 'OFF' position shall cause an alarm to occur.

(b) Generator Start/Stop Momentary Contact Selector Switch with middle rest position
(c) Generator Breaker Open/Close Momentary Contact Selector Switch with middle rest position (with interlock to synchronization check protection scheme)
(d) Synchronization Auto/Manual Selector Switch
(e) Engine Speed Control
(f) Generator Voltage Adjust
(g) Alarm and Trouble audible notification
(h) Red Alarm Lamp
(i) Yellow Idle Trouble Lamp
(j) Yellow Running Trouble Lamp
(k) Illuminated White Alarm Silence Pushbutton
(l) Lamp Test Pushbutton
(m) Blue Engine Emergency Stop Shrouded mushroom type Pushbutton
(n) Synchroscope

.10 Metering and Instrumentation per engine

.1 automatic voltage regulator with provision for automatic voltage adjustment as specified

.2 radio suppression module (unless suppression with alternator meets Commercial Standards);

.3 digital governor and speed control system

.4 Provide the capabilities to monitor the following parameters through the engine HMI display:

(a) Generator Phase Currents
(b) Generator Voltage (L-L, L-N) at line side of generator breaker
(c) Bus Voltage (L-L, L-N) at load side of generator breaker
(d) Line-to-Load Voltage Difference between line and load side of generator breaker for all three (3) phases
(e) Power Factor (Average, Phase)
(f) kW, KVAR, kVA (Average, Phase, %)
(g) kW-hr, kVAR-hr (Total)
(h) Frequency
(i) Engine Speed
(j) Generator Elapsed Time
(k) Oil temperature
(l) Oil pressure
(m) Oil level
(n) Engine Coolant In Temperature

(o) Engine Coolant Out Temperature
(p) Fuel Pressure
(q) Fuel In Temperature
(r) Fuel Out Temperature
(s) Fuel Oil/Water separator vacuum pressure
(t) Excitation Voltage and Current
(u) Generator Stator and bearing temperature

.5 Note that current transformers and potential transformers for metering and protective relays are to be located in the switchgear. Individual engine information shall be accessible on the synchronizing control panel section HMI displays. Information shall be provided to the main control panel via modbus communication.

.11 Synchronization (“Dead Bus” Operation)

.1 A synchronization monitor, one per diesel generator set, shall sense voltage, frequency and phase angle of the unit to be paralleled. The monitor shall:

(a) Compare the voltage of an oncoming diesel generator set with the load voltage and initiate a correction signal to cause any voltage difference to be reduced to within that specified.
(b) Compare the frequency of an oncoming diesel generator set with the bus frequency and initiate a correction signal to the governor of the oncoming diesel generator set until the frequency difference is within that specified.
(c) Cause the phase angle of an oncoming diesel generator set with respect to the load voltage to be within that specified.

.2 The monitor shall permit a diesel generator set to be held in synchronization when both sources are available.

.3 When the above conditions have been satisfied, the monitor shall initiate a signal to close the circuit breaker of the incoming diesel generator set to the bus.

.4 The synchroscope shall be complete with an auto/manual selector switch.

.5 In the "auto" position the DG sets shall be automatically synchronized and paralleled to the bus. In the "manual" position the synchroscope shall allow the closing of the respective circuit breaker from the individual diesel generator control panel.

.12 The system shall be designed to start and parallel two (2) diesel generator diesel generator sets.

.13 The first diesel generator set to achieve 90% of nominal voltage and frequency shall be connected to the emergency bus. Monitor the switchgear for dead bus, lock-out other generator set (to avoid a race condition) and provide an instant connection.

.14 As the second diesel generator set reaches nominal output it shall be automatically synchronized, paralleled and connected to the bus.

.15 Prior to being paralleled to the bus, the oncoming unit shall be compared to the bus in frequency, voltage and phase angle. The set shall not be connected to the bus unless and until the following conditions have been satisfied:

.1 Frequency difference less than 0.3 Hz

.2 Voltage difference less than 5%

.3 Phase angle less than 5^{o} (electrical) with respect to the bus

.16 The paralleling of a diesel generator set shall not cause a voltage fluctuation exceeding 8% or a frequency fluctuation exceeding +/- 0.3%.

.17 Manual Control

.1 Controls shall allow manual start and paralleling from respective generator control panel. Controls shall include:

(a) A positive means of inhibiting out-of-phase paralleling.
(b) Means to operate diesel generator sets without connecting them to the main bus (Generator Start/Stop Selector Switch)
(c) Means to operate (trip/close) generator breakers that allow connection and disconnection of generators on the Generator Switchgear main bus (Generator Breaker Open/Close Selector Switch).

.18 Automatic synchronizers shall be of unit chassis construction, utilizing solid state circuitry for all sensing and control functions. Necessary interface circuits for control of voltage adjustment and circuit breaker shall be through enclosed electro-magnetic relays with isolated output contacts rated 5A at 230 volts A.C. Control of the governor for frequency adjustment shall be through direct solid state circuitry.

.19 Each synchronizer shall include a "check" selector switch to permit each diesel generator set to be held in synchronization when both normal and emergency sources are available.

.20 Automatic synchronizers shall be part of the Engine Control Panel section.

.21 Provide Remote monitoring software complete with all necessary licenses. Remote monitoring software shall be capable of running on Windows XP Professional or Windows 7 (64-Bit).

.22 Event logging with time and date stamps.

.23 Provision for exporting event logs/storing event logs on a personal computer. Include all necessary allowances for onsite set-up for remote storing of events.

.24 Provide annunciation of the following Status, Alarm and Trip conditions for each engine through the associated engine HMI display (trouble idle = function included in summary trouble idle output contacts and annunciation lamps; trouble running = function included in summary trouble running output contacts and annunciation lamps; alarm = function to be included in summary alarm output contacts)

Function	Shutdown or Warning Condition	Summary Trouble Condition (Idle)	Summary Trouble Condition (Running)	Summary Alarm Condition
Emergency Stop Activated (Local and Remote)	Shutdown			X
Overcrank	Shutdown			X
High Engine Temperature Pre-alarm	Warning		X	
High Engine Temperature Alarm	Shutdown			X
Low Lube Oil Pressure Pre-alarm	Warning		X	
Low Lube Oil Pressure Alarm	Shutdown			X
High Lube Oil Temperature	Warning		X	
Low Lube Oil Level	Warming	X		

Function	Shutdown or Warning Condition	Summary Trouble Condition (Idle)	Summary Trouble Condition (Running)	Summary Alarm Condition
Over Frequency	Shutdown			X
Under Frequency	Shutdown			X
Low Coolant Level	Warning	X		
SCR System Trouble	Warning		X	
Low Coolant Temperature	Warning	X		
Under Voltage	Shutdown			X
Over Voltage	Shutdown			X
Damper Breaker Open	Warning	X		
Alternator Over Temperature	Warning		X	
Exciter Diode Failure	Warning		X	
Engine Control Switch Not in Auto	Warning	X		
Low DC Voltage (Starting Batteries)	Warning	X		
Battery Charger Failure (contact wired from battery charger by Division 26)	Warning	X		
Fuel System Trouble (contact wired from fuel system controls by Division 26)	Warning	X		
Fuel Leakage Detection (contact wired from leakage detection panel by Division 26)	Warning	X		
Breaker Fail to Close	Warning		X	
Cool Down Cycle				
Fuel oil filter clogged	Warning		X	
Ground Fault Alarm	Shutdown			X
Reverse Power Relay	Shutdown			X
Generator Fault (Differential Protection)	Shutdown			X
Low DC Voltage (Control Power)	Warning	X		

.25 Deleted

.26 Instrument Transformers are to be provided by the switchgear supplier. A number of current transformers and potential transformers are to be located in the Generator Switchgear. Provide additional current transformers or potential transformers, if required, per engine, for:

.1 Voltage regulation

.2 Exciter power

.3 Governor circuits

.4 Generator VAR/Pf control or cross current compensation control circuitry

.5 Current transformers for differential protection are to be provided by the switchgear supplier and installed by the generator supplier.

.27 All instrumentation transformers shall have final ratios, burden and other characteristics selected by the Independent Testing Agent preparing the protection and coordination study. Coordinate final selections with Independent Testing Agent.

.28 Current transformers to have positive action automatic short circuiting devices in secondary terminals.

.29 Color coding wiring (D.C. - Blue, A.C. - Black, Dry Contact - Yellow), and necessary instrument transformers, nameplates, bus and terminal blocks.

.30 One (1) remote Emergency Stop mushroom head pushbutton stations per engine with lift type guard, with size 6 label, wired to shut down the associated engine immediately. Turn over to Division 26 contractor for mounting near generator room exits, and wiring to control panel.

2.20 Equipment Identification

.1 Provide equipment identification on generator, control panel, and all indication and control devices consisting of engraved, high quality plastic nameplates with black letters suitably inscribed on white background.

.2 Engraved letters shall be ½" minimum, except 6mm minimum height may be provided for meters, relays, switches, signal lights, keys and key blocks, and all other devices.

.3 All terminal blocks to have permanent lables

.4 All control cables shall be clearly identified, at both ends, with permanent PVC wire markers, indicating Cable Number and wire numbers.

.5 Also provide on generator connection, nameplate with red letters suitably inscribed on white background, reading "DANGER – 600VOLTS", and "DO NOT ENTER" as per Canadian Electrical Code. Engraved letters to be ½" minimum except "DANGER" which to be ¾" minimum.

2.21 Main Control Panel Finish

.1 Finish control panel as follows:

.1 basic rust-inhibiting metal process

.2 2 coats of powder coat finishing paint.

.2 Exterior shall be finished with manufacturer standard color.

.3 Manufacturer to provide quart of touch-up paint or several pressurized spray cans to touch-up small areas marred during installation.

2.22 Control and Wiring

.1 Terminal blocks shall have numbered points for circuit identification. Terminal blocks to be General Electric Type EB or equal. Terminal blocks for current circuits to be shorting block type.

.2 Wiring shall be type 'TA', 'TBS', or 'SIS', flame retardant #14 AWG size single conductor minimum, stranded, tinned copper, extra flexible type throughout. Wires shall be tagged at both ends with permanent plastic sleeve type markers. Insulation shall be 600 V, working and 1500 V test.

.3 Secondary and control wiring within the rear bus compartment shall be completely shielded in a protective metal covering as far as practical.

.4 Wiring from differential CT's shall be minimum #10 AWG.

.5 Fuse and terminal blocks shall be easily accessible. Fuses shall be Class J HRC. DC fuses (one per pole) shall be in dead front enclosure.

.6 Auxiliary wiring checks shall be made throughout the manufacture and assembly of the equipment to assure wiring correctness and continuity.

.7 Final checkout of wiring shall be made with the complete switchgear lineup assembly to assure wiring correctness and continuity. Polarity of current and potential transformers and devices shall be checked to assure proper functioning of all protective devices and instrumentation.

2.23 Instrument Transformers

.1 Potential transformers and current transformers required to operate relays, meters and other devices indicated in the drawings and specifications shall be coordinated so that the ratio and accuracy are suitable for each individual application, taking into account the burdens imposed. Construction of transformers shall conform to ANSI Standards. All terminals shall have permanent polarity designations and shall be wired accordingly. All applicable requirements of ANSI Standard C57.13 shall apply.

.2 Primary potential bus or cable tap leads shall be designed with the same design integrity as the primary bus.

.3 Both current and potential transformers shall be wired through test switches to provide quick and easy multi-circuit testing of switchboard relays, meters and instruments.

2.24 Potential Transformers

.1 Potential transformers shall be housed in a separate compartment in the circuit breaker cubicle or superstructure.

.2 Potential transformers shall be of the 0.3 accuracy class, per ANSI Standards and of sufficient capacity to serve the maximum burden imposed.

.3 Each potential transformer shall be protected with current limiting primary fuses, and shall be designed to withstand the basic impulse level of the switchboard.

2.25 Current Transformers

.1 Current transformers shall be easily removable and accessible and of the ring or bar-type.

.2 Ring-type current transformers shall be used where burden and accuracy permit. Primary terminals on bar-type current transformers shall be silver plated and rigidly (2 bolt minimum) connected to the bus structure.

.3 Secondary connections of all current transformers shall have provisions for short circuiting when not connected to instruments and shall be solidly grounded.

.4 Current transformers shall be capable of carrying at least 125% of CT rating continuously and have a short time rating at least equivalent to that of the switchgear bus. Accuracy class: C100/ 0.6 B-1.

2.26 Synchronizing Protection and Control Panel Sections

.1 General Operation

.1 The generator will normally operate in parallel with existing units. The controls shall be arranged to ensure the generator is automatically isolated under fault conditions.

.2 Control Panel Components

.1 Deleted

.2 Horn complete with silencing button.

.3 Total kW load indicator

.4 Automatic Load Monitors

.5 Automatic Synchronizers

.3 Metering and Instrumentation

.1 kW/kWHr meter

.2 Analogue Power Factor Meter (.5 lead to .5 lag)

.3 Analogue Ammeter and selector switch for 3 phases.

.4 Analogue Voltmeter and selector switch for 3 phases.

.5 Analogue Frequency meter.

.6 Analogue kVAr meter.

.4 Status, Alarm and Trip Indication

.1 Lamp test button for all indicating lamps

.2 Alarm horn and silencing switch

.3 Controls not in auto

.4 Control battery alarm

.5 Ground fault alarm

.6 PLC failure

.7 System Overvoltage

.8 System Undervoltage

.9 Running, On line, Lock Out indication for each engine

.10 Bus over/under frequency

.5 Synchronization

.1 A synchronization monitor, one per DG set, shall sense voltage, frequency and phase angle of the unit to be paralleled. The monitor shall:

(a) Compare the voltage of an oncoming DG set with the load voltage and initiate a correction signal to cause any voltage difference to be reduced to within that specified.
(b) Compare the frequency of an oncoming DG set with the bus frequency and initiate a correction signal to the governor of the oncoming DG set until the frequency difference is within that specified.
(c) Cause the phase angle of an oncoming DG set with respect to the load voltage to be within that specified.

.2 The monitor shall permit a DG set to be held in synchronization when both sources are available.

.3 When the above conditions have been satisfied, the monitor shall initiate a signal to close the circuit breaker of the incoming DG set to the bus.

.6 The system shall be designed to start and parallel all diesel generator (DG) sets

.7 The first DG set to achieve 90% of nominal voltage and frequency shall be connected to the emergency bus.

.8 As additional DG sets reach nominal output they shall be automatically synchronized, paralleled and connected to the bus in the sequence in which they achieve synchronization.

.9 Prior to being paralleled to the bus, the oncoming unit shall be compared to the bus in frequency, voltage and phase angle. The set shall not be connected to the bus unless and until the following conditions have been satisfied:

.1 Frequency difference less than 0.3 Hz

.2 Voltage difference less than 5%

.3 Phase angle less than 5^{o} (electrical) with respect to the bus

.10 The paralleling of a DG set shall not cause a voltage fluctuation exceeding 8% or a frequency fluctuation exceeding +/- 0.3%.

.11 Automatic synchronizers shall be of unit chassis construction, utilizing solid state circuitry for all sensing and control functions. Necessary interface circuits for control of voltage adjustment and circuit breaker shall be through enclosed electro-magnetic relays with isolated output contacts rated 5A at 230 volts A.C. Control of the governor for frequency adjustment shall be through direct solid state circuitry.

.12 Each synchronizer shall include a "check" selector switch to permit each DG set to be held in synchronization when both normal and emergency sources are available.

.13 Automatic synchronizers shall be part of the Load Management Control assembly and shall be complete with a sync check relay.

2.27 Generator Output Cables

.1 Power cables interconnecting the generator to the generator control panel, and interconnecting the starting batteries to the engine, shall be extra-flexible locomotive cables installed in cable tray [per Section 12-2202 of the Electrical Safety Code] with the following characteristics:

(a) Type DLO & UL listed as Marine Shipboard Cable
(b) CSA Type TC listed
(c) CSA FT-4 rated
(d) Stranded coated copper, size as indicated, with EPR insulation, and thermoset jacket

.2 Final connections of all control wiring terminating at the engine or generator to be installed in FT4 jacketed liquid tight flexible conduit.

2.28 Factory Test Procedure

.1 Supplier shall conduct performance and full load tests in his factory, to be witnessed by Engineer and Independent Testing Organization (ITO) upon completion of assembly at factory and prior to shipping to prove that unit will start automatically, pick up load and operate as required, in accordance with the article “Source Quality Control” at the beginning of this specification.

.2 Notification of factory test shall be given a minimum of ten (10) working days in advance. Dismantling and shipment from factory test bay shall not occur until deficiencies have been corrected and the system retested to the satisfaction of the Engineer and certified as being acceptable for shipment.

.3 The test shall include:

.1 Demonstration of automatic start system

.2 A 4-hour full load test, utilizing an adjustable load at rated power factor

.3 Demonstration of safety features

.4 Demonstration of cycle crank tests.

.5 Block loading tests from cold start: 0%-25%, 0%-50%, 50%-100% and 0%-100%

.4 During test, the following parameters shall be recorded at 30 minute intervals:

.1 Speed and frequency at steady state and step load changes

.2 Phase volts and amps at steady state and step load changes

.3 Load

.4 Coolant temperature

.5 Lubricating oil pressure

.6 Exhaust temperature

.5 Fuel consumption for duration of test shall be stated.

.6 Provide a photograph of an oscilloscope trace of the sine wave generator output 60 cycle.

.7 Deleted

.8 Synchronization and Automatic Transfer Tests

(a) Demonstrate the emergency start and synchronizing and paralleling features of all generators as a system
(b) Simulate utility power outages and demonstrate automatic operation of the system.
(c) Demonstrate the functioning of all transfer control and synchronization safety devices by creating the actual conditions or simulating these conditions if the actual conditions cause deterioration or damage to the emergency system.

(d) Demonstrate synchronization system, automatic transfer system and load management system with loadbanks, with a minimum capacity of 1350Kw. Tests shall include load steps to verify synchronization and load pick-up following simulated loss of utility power.

2.29 Acceptance Test (Final On-site Testing)

.1 A competent Diesel-generator expert shall be supplied for as long as is necessary for commissioning and witness testing and for two working days, at a time convenient to Owners, to instruct Owners' staff in maintenance and operation, and in addition shall be present during on-site commissioning and acceptance test.

3 EXECUTION

3.1 Pre-selected equipment

.1 Coordinate execution with the scope provided by Total Power as identified in Project reference manual and through discussions with them.

3.2 Installation General

.1 Prior to project completion, revise all wiring diagrams submitted as Shop Drawings to "As-Built" condition, prepare photo reductions of same and include them in the Operation and Maintenance Manual.

3.3 Installation of Engine Generator Set

.1 Mount Diesel-generator package on structural steel base with suitable adjustable steel spring vibration isolators with sound pads mounted between steel base and concrete base pad. Division 26 to provide concrete base pad and paint with oil resistant paint. Touch-up areas marred in transit or installation.

.2 Install complete starting system including batteries, jumpers and cables and battery charger. Provide 2#4/0 EPR extra flex copper cable connections from starting battery to [each] starter.

.3 Provide flexible fuel connections to fuel system isolating valves provided by Division 20, complete with all necessary flexible fuel connections between various filter components and engine.

.4 Mount and assemble Racor water separator and provide flexible fuel connection to engine.

.5 Provide full size galvanized steel drip pan under engine and a separate pan under the Racor fuel filter assembly.

.6 Ground generator frame to building ground and/or perimeter ground system.

.7 Install the flexible hose supplied by the engine manufacturer between the engine crankcase vent connection over to the atmosphere side of the radiator exhaust plenum, for venting of crankcase fumes to atmosphere. Provide necessary cutting and patching, and sleeve through plenum, with final connections of hose.

.8 Install the engine exhaust silencer, flexible connection at engine, and miscellaneous nuts, bolts, gaskets and all miscellaneous hardware required to complete the installation of the exhaust system from the engine up to and including the flanged outlets of the silencers

3.4 Installation of Engine Control Panel

.1 Provide incoming and outgoing cable connections.

.2 Provide interconnecting power and control wiring between Diesel-generator and control panel.

.3 Terminate all power cables with two-hole long barrel compression connectors equal to Burndy YA-2N.

.4 Provide interconnecting control wiring connections as shown and as required.

.5 Provide grounding of each control panel to building ground bus with two separate runs of a #4/O green insulated copper in conduit. Terminate with Burndy YA-2N lugs.

.6 Install complete DC control power system including batteries, jumpers and cables and battery charger and connect to control panel with 2#8 + ground in conduit.

.7 Extend DC control wiring 2#8+ ground in conduit to engine starting battery for control power

.8 Touch up small areas marred in transit or during installation with touch up paint. Repaint entire switchboard using electrostatic process where large areas of significant damage to factory finish has occurred.

.9 Provide and install new rubber mats 3' wide 1/4" thick 17,000 volt rating, American Biltrite Canada Ltd., in front and rear of control panels for a continuous and neat appearance. Do not place mats until work is completed and room has been thoroughly cleaned. Clean or replace any existing mats dirtied or damaged during the installation.

3.5 Installation of Miscellaneous Components

.1 Provide power and control wiring between engine control panel and diesel combustion air dampers and ventilation dampers. Division 26 to provide 120 V secondary power source from local120V emergency panel to the control panel switching relay to permit dampers to close when engine shuts down.

.2 Division 26 to provide 8 conductor #12 MICC cable from each Automatic Transfer Switch to the diesel generator control panel for engine start contact, ATS in normal position status, ATS in emergency position status, and ATS in bypass position status.

.3 Division 26 to provide 4 conductor #12 MICC cable from each Fire Pump ATS/Control Panel, and each Sprinkler Pump ATS/Control panel to the engine generator control panel for engine start contact and ATS in emergency position status.

.4 Supply one per engine Remote Emergency Stop mushroom head pushbutton station with lift type guard, with size 6 label, wired to shut down the engine immediately. Contractor to mount outside of room, and wire to control panel.

.5 Division 26 to provide connection from control panel to fire alarm panel to indicate engine running and trouble condition on fire alarm annunciator.

.6 Provide power and control wiring between engine control panel and the diesel fuel tank level controller to obtain “Fuel Low Level” alarm contact.

.7 Provide control wiring connection between engine control panel and fuel leakage detection system panel.

.8 Provide control wiring to battery charger and automatic transfer switches for remote monitoring indication on the centralized electrical monitoring system.

.9 Install 2- #10 AWG in 19 mm conduit interconnection the normal, emergency, and generator control switchboards for control power interconnection, for proper operation of centralized electrical monitoring system devices.

.10 Provide control wiring connection between engine control panel and fuel leakage detection system panel.

3.6 Testing

.1 Conduct an acceptance test of the complete emergency power system after preliminary runs and test have been made. Conduct this test on site after completion of installation. This acceptance test shall be as described under the article Site Tests in Section 2 above. In the event of equipment or component failures interrupting completion of test, correct the deficiency and repeat test until satisfactorily completed without failure.

.2 Demonstrate functioning of safety devices, pilot lights, controls, remote monitoring on the Building Automation System and Fire Alarm system, operation of any remote controls and indicators on the remote annunciator, and operation of all interconnections and alarms to battery charger, fuel system, leak detection panel, dampers, Automatic Transfer Systems, etc...

.3 Immediately following the load test a sample of lubricating oil shall be taken for lab analysis.

.4 After completion of tests replace all air, fuel and lubricating oil filters with new elements and change the lube oil.

.5 Provide temporary cables and temporary load bank for on-site testing, complete with terminal lugs on cables.

3.7 Site Tests

.1 General

.1 Upon completion of the installation of the emergency power supply system, the installation shall be tested to ensure conformity to the requirements of Standard C282. Provide Engineer and ITO with a minimum of ten (10) working days written notification of the proposed test date

.2 All construction within the diesel generator room is to be completed and the room is to be thoroughly cleaned prior to starting the engine for the first time.

.2 The generator manufacturer will be required to participate in the complete commissioning process including sub-systems affecting the operation of the diesel generators.

.1 The diesel generator manufacturer shall provide an initial review and start-up of the generators prior to any sub-system test requiring the use of the diesel generators. Provide documentation that sub-system pre-functional testing can be completed with the use of the diesel generators.

.2 There is no requirement for the presence of the diesel generator manufacturer at sub-system equipment non-running pre-functional verifications.

.3 The diesel generator manufacturer shall be present during the following sub-system equipment running and measurement functional tests:

(a) Fuel Pumps and associated controls.
(b) Day Tank Fuel Sensors and Alarms
(c) Main Tank Fuel Sensors and Alarms
(d) Fuel Inventory System
(e) Dampers
(f) Generator Sound Measurements
(g) Generator Emission Measurements
(h) Generator Switchboard
(i) Automatic Transfer Switchboard including load management verification
(j) Connections to Building Automatic System
(k) Connections to Fire Alarm System
(l) 125VDC Power Plant
(m) Neutral Grounding Resistors (at Generators and at Generator Switchboard)

.4 The diesel generator manufacturer shall include for a minimum of two (2) full day integrated system tests required to demonstrate that the complete emergency power system functions per the contract documents when all sub-systems and components have been installed and inter-connected.

.3 Operational Test

.1 Provide temporary loadbreak switch connected to the new loadbank quick connect

.2 Prior to any system testing, individually perform the following tests on each diesel generators using the connected load banks through the Automatic Transfer Switchboard and Generators Switchboard:

(a) Demonstration of automatic start system
(b) With 100% rated full load, operate set for four (4) hours, taking readings at 30 min intervals, and record following:
- Time of reading.
- Running time.
- Ambient temp in °C.
- Fuel consumption
- Lube oil pressure in kPa.
- Lube oil temp in °C.
- Engine coolant temp in °C.
- Exhaust stack temp in °C.
- Alternator voltage.
- Alternator current:
- Power in kW.
- Frequency in Hz.
- Power Factor.
- Battery charger current in A.
- Alternator cooling air outlet temp.

(c) After completion of four (4) hour run, demonstrate following features, shut down devices and alarms: Demonstrate low oil pressure and high engine temperature shutdown devices operation without subjecting engine to these excesses.
- Cycle crank test
- Over cranking.
- Over speed.
- High engine temp.
- Low lube oil pressure.
- Simulated Short circuit, to verify operation of differential protection.
- Alternator over voltage.

- Low battery voltage, or no battery charge.
- Manual remote emergency stop.
- High alternator temperature.
- All other safety features

(d) Next install continuous electronic power quality meter with sufficient storage capacity and of sufficient sampling rate to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
- No load to full load to no load.
- No load to 75% load to no load.
- No load to 50% load to no load.
- 25% load to 100% load to 25%.
- 50% load to 100% load to 50%.

.3 With the engine in a "cold start" condition and the test load banks connected, power failures will be simulated by opening switch LIS-9 supplying the normal power to the normal terminals of the Automatic Transfer Switchboard.

.4 On-site tests shall be completed to demonstrate all emergency power system sequences of operation, including:

(a) Normal power failure scenario
(b) Failure of one (1) generator to start following a utility failure. Repeat tests such that both generators are set as the failing generator.
- With loading on the highest priority breaker below the rating of one (1) generator
- With loading on the highest priority breaker above the rating of one (1) generator

(c) Failure of one (1) generator while the emergency power system is running on generator power supplied by two (2) generators. Repeat tests such that both generators are set as the failing generator.
- With loading on the highest priority breaker below the rating of one (1) generator
- With loading on the highest priority breaker above the rating of one (1) generator

(d) No Load Testing Mode
(e) Transfer Test Mode
- With both generators available.
- With failure of one (1) generator following the transfer to emergency power.

(f) Demonstration of ADD and SHED load management system.

.5 The following data shall be observed and recorded for each testing scenario:

(a) time delay on start
(b) cranking time until the engine starts and runs
(c) time required to come up to operating speed
(d) time until first generator is connected to the bus
(e) time until second generator is paralleled with the bus
(f) time required to achieve steady-state condition with the Automatic Transfer Switchboard transferred to the emergency position
(g) voltage, frequency, and amperes at start-up and at any observed change in load
(h) Engine oil pressure, water temperature where applicable, and battery charge rate at 5 min intervals for the first 15 minutes, and at 15 minute intervals thereafter
(i) time delay on retransfer for Automatic Transfer Switchboard
(j) time delay on engine cooldown and shutdown.

.6 Following the operational test prescribed above each the emergency generator system shall be subjected to an additional four (4) hour 100% load test (3300kW), using the temporary portable test load banks.

.7 The building load shall not be used as part of the test load. Unity power factor is acceptable for on-site testing,

.8 Demonstrate all alarm connections to remote systems including the fire alarm and building automation system.

.4 Pull the Plug Tests

.1 At the conclusion of the migration activities, a Pull the Plug Test shall be completed using migrated Owner building load.

.2 With the engine in a "cold start" condition, a power failure shall be simulated by opening switches supplying the normal power to the building.

.3 The emergency power system shall support the load for one hour after which normal power shall be restored to the normal main breakers of the Automatic Transfer Switchboard.

3.8 Installation by Generator Supplier

.1 Provide a complete Diesel-generator set and control panel power system. Deliver FOB job site on a flat bed tractor trailer, suitable protected during shipping from the environment.

.2 Verify power and control wiring connections between engine generator, engine control panel and diesel combustion air dampers and ventilation dampers, battery charger and automatic transfer system, building automation system and fire alarm system.

.3 Provide temporary cables and temporary load bank for on-site testing, complete with terminal lugs on cables.

.4 Conduct an acceptance test after preliminary runs and set up / calibration tests have been made. Conduct this test on site after completion of installation. This acceptance test shall be a minimum of four hours duration with full rated load plus verification of the system performance. In the event of equipment or component failures interrupting completion of test, correct the deficiency and repeat test until satisfactorily completed without failure.

.5 After completion of above test, perform tests to demonstrate overheat protection, low oil pressure protection and over-speed protection. Demonstrate functioning of safety devices.

.6 After completion of tests replace all air, fuel and lubricating oil filters with new elements and change the lube oil.

.7 Include costs of 1st year routine maintenance (with all filters) in bid price).

.8 Revise all wiring diagrams submitted as Shop Drawings to "As-Built" condition, prepare photo reductions of same and include them in the Operation and Maintenance Manual.

END OF SECTION

EMERGENCY POWER CONTROL SYSTEM
26 32 13.33

1 GENERAL

1.1 Scope

.1 Provide emergency power control system for new and existing generators.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	26 08 11	Testing of Integrated Electrical Life Safety and Fire Protection Systems
.2	26 08 15	Electrical Commissioning
.3	26 23 00	Low-Voltage Switchgear
.4	26 32 13.13	Power Generation Diesel

1.3 Qualified Tradesperson

.1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradesperson holding applicable certificates of competency.

1.4 Submittals

.1 Submit shop Drawings and product data in accordance with Section 26 01 01 - Electrical General Requirements.

.2 All drawing and product data provided for the equipment to show equipment as specified and ordered.

.3 Typical drawings are not acceptable. Reproducible drawings for approval to be supplied.

.4 Physical Construction Drawings, completely dimensioned, showing:

.1 Arrangement.

.2 Plan, front view, and elevation views.

.3 Required clearances for opening doors.

.4 Conduit entrance locations and dimensions for both top and bottom entrance.

.5 Incoming and outgoing cable terminator positions.

.6 Field wiring terminal block locations, and all other terminal block locations.

.7 Grounding connections.

.5 Detailed Connection (Wiring) Diagrams showing:

.1 All wiring within each unit.

.2 All interconnecting wiring between units.

.3 Identification of all terminals, terminal blocks, and wires.

.6 Detailed sequences for all load control scenarios

.7 Installation, Operating, and Maintenance Instructions

.1 Installation, operating, and maintenance instructions to cover all the equipment furnished

1.5 Quality Control

.1 Site Acceptance Testing

.1 Manufacturer to provide services of manufacturer's authorized service personnel to in accordance with the requirements of Part 3 of this specification.

1.6 Warranty

.1 In addition to the warranty provisions of Division 01, provide a written warranty for parts and labour to repair or replace any part of the equipment which may fail due to defective material or workmanship within a period of two years from the date of substantial performance.

2 PRODUCTS

2.1 Emergency Power Control System

.1 One master system level controller shall be provided, arranged to control the three (3) engine generator units (2 existing generator units and 1 new generator unit).

.2 Enclosure Type: CSA Type 1 with drip shield

.3 Control Panel Components

.1 Programmable Logic Controller (PLC).

.2 Colour touchscreen operator interface panel (HMI).

.3 Audible alarm complete with silencing button.

.4 BACnet network connection for remote monitoring

.4 The system shall be designed to ensure continuity of power in the event of a utility power failure by initiating the start-up and shutdown of diesel generator sets automatically with a manual override. The generating sets will be automatically started through direct-wired ATS engine start contacts. Generators will synchronise through on-board engine controllers and parallel. The addition and removal of sets from the bus shall be completely automatic with a manual override.

.5 The control panel shall contain the components necessary to make the system operate as specified. All wiring shall be terminated on easily accessible and identified screw type terminals. Room shall be allowed to permit external interconnecting wiring to be readily terminated.

.6 Overall system shall contain necessary control and interface relays to co-ordinate system operation with DG control panels and to provide for specified system operation.

.7 There shall be the following modes of operation:

.1 Manual control

.2 Normal starting sequence

.3 Normal stopping sequence

.4 Power transfer control sequencing

(a) Utility Power Failure

(b) Return to Utility Power

(c) Load Test- Blackout Test

(d) Load Test – Building Load

(e) Load Test – Load Bank

(f) Failure of a unit to start or synchronize

.8 The entire cabinet shall be fully wired up for a total of three DG sets.

.9 Nameplates shall comprise white lettering on red lamacoid, fastened to panel with rivets or self-tapping screws.

.10 All wiring to outgoing circuits and devices shall terminate at terminal blocks. Terminal blocks shall have numbered points for circuit identification.

.11 Auxiliary wiring checks shall be made throughout the manufacture and assembly of the equipment to assure wiring correctness and continuity.

2.2 Colour touchscreen operator interface panel (HMI).

.1 A full color high-resolution touchscreen, minimum 19” diagonal, operator interface panel (HMI) allowing the operator to monitor and control the on-site power system.

.2 Each screen to include navigation buttons to allow quick access to other screens that are logically connected with the screen being displayed. Access to screens that impact on system settings or sequence of operation to be controlled by a multi-level password system.

.3 Alarms and Indications

.1 Any alarm on any generator set or in the system will cause an alarm bar and warning condition display to appear on the touchscreen. Touching the bar displays a pop-up screen describing the equipment where the fault has occurred, and the name of the fault. The screen allows the operator to attempt to reset warning conditions from the HMI.

.2 Indications shall be provided to show:

(a) Normal supply available.

(b) Emergency supply available.

(c) Red flashing light assembly to indicate any piece of equipment not in the "auto" mode.

.3 Provide annunciation of the following system Status, Alarm and Trip conditions:

(a) Controls Not in Auto (System Idle Trouble)

(b) Control Voltage Alarm (System Idle Trouble)

(c) Ground Fault alarm (System Running Trouble)

(d) PLC failure (System Idle Trouble)

(e) System Overvoltage (System Alarm)

(f) System Undervoltage (System Alarm)

(g) Running, On Line, Lock Out indication for each engine

(h) Bus over/under frequency (System Alarm)

(i) Fuel System Trouble (System Idle Trouble)

.4 On-line diagram screen to display system status by a combination of animation, changing screen color, text messages, and pop-up indicators. Conditions visible on the screen to include:

.1 Depiction of main electrical single line diagram including G1, G2 and G3 and associated breakers; Generator Switchgear EPA, Generator Switchgear EPA-2

.2 Breaker status of generator output breakers, Switchgear EPA breakers and Switchgear EPA-2 breakers (open, closed, test, ERMS active)

.3 Bus energized/de-energized indication (red indicating energized, green indicating de-energized).

.4 Generator set designation, with control data, and performance summary screens accessible through hot keys (links) located on or adjacent to the generator set icon.

.5 Generator set mode (run/off/auto)

.6 Generator set status (normal/warning/shutdown/load demand stop).

(a) Depiction of the ATS in the one line indicating switch status (normal, emergency, test, bypass, remote override)

.5 System Control Screen(s)

.1 This screen is password-protected to prevent access to the configuration functions by unauthorized users

.2 The system control screen provides the operator with the ability to

(a) view timer values;

(b) initiate test (with or without load);

(c) control the shutdown sequence for the generator sets;

.3 The screen also allows setting of the source availability settings and sequence timing for power transfer.

.4 Ability to manually initiate load test sequences.

.5 An easily accessible timer shall be provided to initiate DG set shutdown sequencing. Initial time period shall be set at 5 minutes.

.6 System alarm history screen

.1 The emergency power control system to records the date, time and nature of all alarm and shutdown conditions reported on the system. This log to include all alarms reported on the generator set and all master control and network connected functions.

.2 Generator set will retain a detailed independent log of their perspective operating histories, allowing the user to not only understand system level operation conditions, but also view details of operation of any component in the system

.7 Generator set status and control screen

.1 The generator set status summary screen to provide a graphical display of critical generator set operating parameters for each generator set in the system.

.2 The screen to include:

(a) generator set state display (stopped, time delay start, idle speed state, rated volts/hertz, synchronizing, load share or load govern);

(b) AC metering for generator set (3-phase, AC volts and current, frequency, kW and power factor); and three-phase AC bus voltage and frequency.

(c) a complete display of engine and alternator data present in the generator set control.

(d) status of the generator set breakers.

.8 Trending screen

.1 real-time trend charts for AC output parameters and continuously monitors average voltage, frequency, total kilowatts, and average amperage.

.2 Scales of values displayed are field configurable

2.3 Input Signals to the Emergency Power Control Panel:

.1 Full integration with each generator engine controller

2.4 Output Signals from the Emergency Power Control Panel:

.1 Provide Form C dry contacts wired to a separate terminal strip for connection to the Fire Alarm system to indicate:

(a) Generator trouble

(b) Generator running

(c) Generator not in auto

2.5 Emergency Power Control Power

.1 Two external 120V power sources will be provided to the Emergency Power Control Panel to accept redundant 120V control power inputs.

.2 Panel to include barriered section to accept input AC power feeders from each source, such that power is available from either at all times.

2.6 Sequence of Operation

.1 Utility power failure

.1 Existing ATS sends engine start signal to each generator controller

.2 Existing G1/G2: First generator breaker to close when associated generator reaches rated frequency and voltage. Switchgear EPA bus is powered.

.3 G3: Generator breaker to close when generator reaches rated frequency and voltage. Switchgear EPA-2 bus is powered.

.4 Existing ATSs transfer to alternate source

.5 Existing G1/G2: Generator breaker to close when associated generator reaches rated frequency and voltage and synchronizes to bus EPA.

.6 EPA-EPA2 tie to close when all three generators are synchronized.

.2 Return to utility power

.1 Utility power is re-energized

.2 Existing ATSs transfer to preferred source

.3 Generator breakers open, EPA-EPA2 tie opens.

.4 Generator cool down initiated, generators shut down

.3 Utility power failure – G1 or G2 failure or out of service.

.1 Existing ATS sends engine start signal to each generator controller

.2 Existing G1/G2: First generator breaker to close when associated generator reaches rated frequency and voltage. Switchgear EPA bus is powered.

.3 G3: Generator breaker to close when generator reaches rated frequency and voltage. Switchgear EPA-2 bus is powered.

.4 Existing ATSs transfer to alternate source

.5 Existing G1/G2: Fails to start.

.6 EPA-EPA2 tie to close when two generators are synchronized.

.4 Utility power failure – G3 failure or out of service.

.1 Existing ATS sends engine start signal to each generator controller

.2 Existing G1/G2: First generator breaker to close when associated generator reaches rated frequency and voltage. Switchgear EPA bus is powered.

.3 G3: Fails to start. Switchgear EPA-2 bus is not powered.

.4 Existing ATSs transfer to alternate source.

.5 Existing G1/G2: Generator breaker to close when associated generator reaches rated frequency and voltage and synchronizes to bus EPA.

.6 EPA-EPA2 tie to close when two generators are synchronized. Switchgear EPA and EPA-2 bus are powered.

3 EXECUTION

3.1 Installation of Control Panel

.1 Coordinate the provision of a 4" reinforced concrete pad with bevelled edges for control panel. Seal with paint or concrete sealer to prevent concrete dust from entering equipment.

3.2 Installation of Field Installed interconnecting wiring

.1 Provide incoming and outgoing cable connections.

.2 Provide interconnecting power and control wiring between Diesel-generator and control panel.

.3 Provide interconnecting control wiring connections as shown and as required.

.4 Provide connection from control panel to fire alarm panel to indicate:

.1 Generator trouble

.2 Generator running

.3 Generator not in auto

.5 Provide connection from control panel to elevator control panel to indicate:

.1 Emergency power

.2 Elevator pre-transfer signals

.6 Provide output of all required information from control panel to BMS.

3.3 Manufacturers' Service Representation on Site

.1 Manufacturer to supply factory trained service representative to perform the following field services:

.1 inspect the installation of the equipment,

.2 conduct or supervise the installation contractor in the start-up of the equipment,

.3 calibrate controls,

.4 conduct site acceptance testing as described herein,

.5 participate in the commissioning program described herein,

.6 demonstrate and provide training on the operation of the equipment to the Owner's facility operations staff, including functional operating controls, operating performance range, and safety controls,

3.4 Site Acceptance Testing

.1 Conduct Site Acceptance Testing ("SAT") in the presence of and to the satisfaction of the Owner's representative(s), after completion of the installation but before equipment is permanently placed into service.

.1 Refer to 26 32 13.13

3.5 Integrated Testing of Life Safety and Fire Protection Systems

.1 Participate as required in the integrated system testing of the standpipe system in accordance with specification section 26 08 11.

3.6 Commissioning Program

.1 Comply with the project commissioning requirements in accordance with specification section 26 08 15.

.2 The verification and testing requirements specified in this section may be concurrent with, or conducted separately from, the commissioning program, as coordinated with the Contractor and the commissioning agent.

.3 In addition to the manufacturer Site Acceptance Testing, Contractor to provide field service personnel to participate in the system integration commissioning of the equipment and/or system including:

.1 review of equipment and system commissioning procedures,

.2 to have control and provide operation of equipment during testing and commissioning,

.3 adjusting of equipment controls as required to simulate load and/or fault conditions, and

.4 assist with record keeping of test results, and

.5 as further identified in specification section 26 08 15.

3.7 Demonstration and Training

.1 Demonstrate the operation of, and provide training on, the equipment and system, as applicable, in accordance with section 26 05 01.

End of Section

LIGHTING
26 50 00

1 GENERAL

1.1 Scope

.1 Provide lighting fixtures as shown.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 00 26 13 Procurement Substitution Procedure during Bidding

.2 [00 43 21 Cash Allowances]

.3 26 01 01 Electrical General Requirements.

1.3 Definitions and Abbreviations

.1 The following definitions and abbreviations apply to this section.

.1 ***CIE***: Commission Internationale de l'Eclairage (International Commission on Illumination).

.2 ***CRI***: Colour Rendering Index.

.3 ***Driver***: a control device that converts the AC source to a DC voltage suitable for the lamp, regulates the current flow and protects the lamp from excessive temperature.

.4 ***IESNA***: the Illuminating Engineering Society of North America

.5 ***LED***: a solid state light source using Light Emitting Diodes

1.4 Applicable Codes and Standards

.1 Product standards:

.1	CSA 22.2 No. 141	Emergency Lighting Equipment
.2	ISO 3864-1	Graphical Symbols – Safety Colours and Safety Signs: Part 1: Design Principles for Safety Signs in Workplaces and Public Areas.
.3	ISO 7010	Graphical Symbols – Safety Colours and Safety Signs: Safety Signs Used in Workplaces and Public Areas.

1.5 Qualified Tradesperson

.1 Work to be performed by qualified, licensed and recognized firm with an established reputation in this field, using tradesperson holding applicable certificates of competency.

1.6 Submittals

.1 Submit complete photometric data prepared by independent testing laboratory for luminaires where specified, for review by Consultant.

.2 Photometric data to be in accordance with IESNA testing procedures and to include:

.1 total input watts,

.2 candlepower summary,

.3 candela distribution zonal lumen summary,

.4 luminaire efficacy,

.5 CIE type,

.6 coefficient of utilization,

.7 lamp type and lumen rating in accordance with IESNA testing procedures.

.3 Submit samples of luminaires, which are not catalogue items, for review by Consultant. Do not manufacture additional luminaires until sample has been reviewed and all comments addressed to the satisfaction of the Consultant. Retain each reviewed sample on job site until final completion of project. Replace luminaires which do not match quality and workmanship of reviewed sample with new luminaires that do.

1.7 Shipping and Storage Requirements

.1 Do not deliver luminaires to building or stored therein until dry and protected space is available for proper storage of luminaires.

1.8 Substitutions

.1 Luminaires included under this Specification section are specified by manufacturer and type. Provide equipment, as specified, unless substitutions requests are approved by the Owner.

.2 Proposed substitutions will only be considered during the bidding period.

.3 Proposed substitutions are to conform to specification section 00 26 13 and as specified herein;

.1 submit proposed substitutions to the Consultant not less than two weeks prior to the tender close date and time.,

.2 proposed substitution submission to include:

(a) samples named as per the specifications,

(b) catalogue cuts,

(c) complete photometric reports,

(d) complete descriptive and technical data, and

(e) cost savings.

.3 Substitution submission are to be presented as an alternative price showing the amount to be deducted from or added to the base bid.

.4 where proposed substitutions alter functional or visual design, or change the space requirements or mounting details indicated, detail such changes in the submission and include costs for revised design and construction for trades involved.

.4 After award of the contract, substitutions will not be considered unless compelling reasons are given such as inability to meet delivery schedule; however, this reason will not be considered if the delay is caused by the Contractor's failure to order luminaires in accordance with the project schedule. In such cases, it remains the Contractor's responsibility to provide luminaires as specified without delay to the project and without additional cost to the Owner.

2 PRODUCTS

2.1 General

.1 Similar luminaires to be products of the same manufacturer.

.2 Maintain finishes of luminaires, as specified in the "Luminaire List", with colours to be consistent and finishes protected from damage.

.3 Where the description of the luminaire directs a "colour/ finish to suit Consultant" or similar language, it is to be understood that during construction the final colour/finish will be selected by Consultant at

that time. The Consultant shall be permitted to make their choice from a standard colour/finish range and the selected colour to apply to all of the particular type of luminaire, unless otherwise specified.

.4 Luminaires:

.1 completely assembled in factory,

.2 delivered to building in cartons or in palletized form, as directed.

.3 suitable for individual or continuous row mounting.

.5 Recessed luminaires, to include plaster trim frame or ring and mounting brackets to match ceiling type.

.6 Troffers: equipped with adjustable mounting brackets.

.7 For luminaires that will be supplied with power from two sources, provide:

.1 separate ballasts or drivers, as appropriate for each source,

.2 a grounded metal barrier:

(a) between the two sources,

(b) between the ballasts/drivers fed from different sources,

(c) between the wiring from the ballasts/drivers, fed from different sources and the lamps,

.3 a warning label indicating that the luminaire is fed from multiple sources.

.8 Ballasts and drivers to be free of polychlorinated biphenyls (PCB's).

.9 Ballasts and drivers to have a sound rating of "A".

.10 Ballasts to be certified in an accredited laboratory for efficiency, performance with the specified lamps, and for safety to the applicable standards.

2.2 Drivers

.1 LED Drivers:

.1 rated input voltage: 120V through 277V or 347V through 480V, as applicable,

.2 voltage input range: sustained variations of ± 10% with no damage to the driver,

.3 power factor greater than 90% from 20% to 100% rated load,

.4 total harmonic current distortion: less than 20%, from 20% to 100% rated load,

.5 in-rush current limits: per NEMA 410,

.6 output current regulated to ± 5% across published load range,

.7 output ripple current at maximum output:

(a) less than 15% measured (peak-average)/average,

(b) less than 5% low frequency content (< 120 Hz.),

.8 integral means of limiting surges to the LED's, per IEEE/ANSI C62.41.2 surge characteristics:

(a) for interior applications: common mode and differential mode surge protection of 2.5kV (100kHz, 30 Ohm ring wave),

(b) for exterior applications: common mode and differential mode surge protection of 3kV (1.2/50µs, 2 Ohm combination wave),

.9 able to tolerate sustained open circuit and short circuit output conditions without failure, without need for external fuses or trip devices,

.10 auto resetting protection,

.11 no visible flicker when tested with flicker wheel,

.12 for dimming systems: no visible flicker, when tested with flicker wheel, across the full dimming range,

.13 operating temperature, down to and including:

(a) -20˚C (-4˚F) for interior applications,

(b) -40˚C (-40˚F) for exterior applications,

.14 metallic heat dissipating enclosure,

.15 integral thermal foldback to reduce driver power if case temperature exceeds rated maximum temperature,

.16 rated for UL Damp and Dry locations,

.17 for downlights: compact enclosure with integral studs allowing the driver to be mounted on the outside of the luminaire or on a junction box, without the need for an additional enclosure,

.18 for linear luminaires: slim profile with height ≤ 25 mm (1 inch) and width ≤ 30 mm (1.2 inch),

.19 integral colour-coded connectors,

.20 labelled compliant with the latest edition of the following standards:

(a) [CSA-C22.2 No. 223, Power Supplies with Extra-Low Voltage Class 2 Outputs,

(b) CSA C22.2 No 250-13, Light Emitting Diode (LED) Equipment for use in Lighting Applications,]

.21 RFI and EMI: per FCC regulations, Title 47 CFR Part 15. Non-consumer,

.22 5 year warranty.

Standard of Acceptance

- Advance
- Litetech
- Universal
- VLM (Italy)
- Lumi-Drives (UK)
- Osram
- AC Electronics
- EldoLED

2.3 Lamps

.1 Light Emitting Diodes:

.1 1.2 or 3 watts per LED,

.2 available in 2700K, 3000K, 3500K and 4000K correlated colour temperature (CCT) packages,

.3 CCT tolerances to remain within a 3-step MacAdam ellipse and to maintain a CRI of ≥80, and an $R_9 > 50$,

.4 colour temperature and lumen output for each luminaire per luminaire schedule, using IESNA LM-79 testing procedures,

.5 maximum temperature at the base of the “LED cap” mounted to the substrate to be controlled to ensure full lamp life,

.6 lumen maintenance of not less than L_{70} @ 50,000 hours, using IESNA LM-80 and LM-21 testing procedures,

.7 LED’s of the same type to be from the same manufacturing batch,

.8 capable of continuous dimming, from 10-100% lumen output, flicker and noise free,

.9 provide certified test results for each type of LED used on the project,

.10 5 year warranty.

Standard of Acceptance- Lamp Acceptance:

- Cree
- Lumileds
- Nichia
- Osram
- GE
- Samsung
- Bridgelux
- Seoul Semiconductor
- Toyoda Gosei

3 EXECUTION

3.1 Installation

.1 Locate and install luminaires as indicated.

.2 Locate hangers on tile centres or intersections.

.3 Mount recessed down lights, troffers and surface mounted luminaires in or on full tiles.

.4 Verify quantity of luminaires before ordering.

.5 Verify colour temperature of lamps before ordering.

.6 Verify ceiling types with the latest revised Architectural Drawings and order luminaires to suit the correct ceiling.

.7 Check luminaires and mountings for their electrical and physical characteristics in relation to conditions due to building construction and mechanical equipment. Make necessary adjustments to luminaires or hanging arrangement without expense to Owners. Give notification at time of shop drawings and before construction if decision on necessary changes is required.

.8 Co-operate with other trades to ensure proper installation of luminaires.

.9 Carefully align luminaires, shown in continuous lines or rows, so that rows appear as straight lines.

.10 Mount luminaires perfectly level or plumb.

.11 Luminaires to fit tightly to ceiling without showing a space or light leak between frame and ceiling.

.12 Take down any improperly installed luminaires and re-install without expense to Owner.

.13 Standard octagonal boxes may be supplied where conduits feeding luminaires in finished areas are exposed on ceiling if hanger canopies entirely cover outlet boxes and are neatly notched for conduit. Otherwise, provide cast conduit outlet boxes with a diameter larger than canopies.

.14 Where luminaires are suspended directly from concrete slabs, attach boxes or hickies directly to poured concrete with 6mm (¼") or larger diameter bolts and lead expansion anchors.

.15 Where luminaires are suspended directly from precast slabs, use 8mm (5/16") or larger bolts through slabs, welded to 100mm x 100mm (4" x 4") or larger 3.5mm (10 gauge) plate located above slabs.

.16 Do not mount luminaires above pipes, ducts or equipment. In event of unavoidably tight locations, provide hangers to clear obstructions. Check layouts of other trades on job and plan co-operatively.

.17 Hang luminaires in the same room at the same height.

.18 Obtain approval before any changes are made to layouts shown.

.19 Support luminaires mounted in or on ceilings independently of ceiling by means of chains.

.20 Where luminaires are suspended or mounted on furred ceilings, provide continuous 12mm x 38mm (½" x 1½") channel above the ceiling, fasten each luminaire to channel with not less than two 6mm (¼") or larger diameter studs not more than 1220mm (4'- 0") on centre.

.21 Where luminaires are installed in or on "T" bar ceilings provide each luminaire with two safety chains anchored in an approved manner to the floor slab or roof structure above. Each chain to support two corners of the luminaire. For safety chains, use #10 Tensile jack chain, installed as noted below.

.22 Where luminaires are to be chain hung, use No. 10 Tensile jack chain, bright zinc coated, with a strength of 180 kg (400 lbs.). Make attachments using No.10 "S" hooks and close "S" hooks after installation. Caddy fasteners may be used where applicable.

.23 Suspend industrial luminaires using 12mm (½") conduit hangers and ARB ball aligners. Select location and length of hangers to clear equipment, ducts and pipes. Metal strut (Flexibar, Unistrut, Eaton B-Line strut, T&B Superstrut) may be used for mounting of luminaires in mechanical areas and electrical rooms.

3.2 Luminaires

.1 Luminaires:

.1 exactly as shown and as specified in the following schedule,

.2 complete with necessary accessories and lamps at time of acceptance,

.3 ULC or CSA certified,

.4 Each luminaire installed on a branch circuit operating at more than150 volts-to-ground:

(a) provided with a disconnecting means integral to the luminaire,

(b) disconnecting means that simultaneously opens circuit conductors between the branch circuit conductors and the ballast(s)/driver(s),

(c) conspicuous, legible and permanent signage adjacent to the disconnecting means, identifying the specific purpose in accordance with the Electrical Code.

3.3 Lamps

.1 Provide new lamps in luminaires.

3.4 Standard Sheets

.1 Comply with the requirement indicated in the H. H. Angus standard sheets listed below, as if described in full herein.

16501	Luminaire Type Mounting Detail

3.5 Equipment Schedules

.1 The following equipment schedules form part of this specification section.

.1 Schedule A: Lighting Fixtures

(a) luminaire types are listed in alphabetical order and not in order of preference.

SCHEDULE A – Lighting Fixtures

Title	Description	Lamp Schedule
LW1	Exterior LED wall mounted luminaire. Nominal dimensions of 3.5” depth x 8” height x 9” width. Luminaire housing in die-cast aluminum with durable powder coat finish. Luminaire is IP66 rated for exterior use. Luminaire to be photocell controlled. Luminaire to be complete with all necessary mounting brackets, etc. for a complete working installation. Luminaire to be wall mounted. • Driver: 0-10V • Rated life shall be 60,000 hrs. @ 70% lumen output. • Warranty: 5 years and meet L70, IES LM-80 and IES LM-79 testing. • Voltage: 120V *Manufacturer:* *Lithonia Lighting*: #WDGE1LED-P2-30K-80CRI-VW-MVOLT-SRM-PE *Lumenpulse Lighting* *Signify Lighting*	15W 1809 lumens 3000K LED 80+ CRI

END OF SECTION

CLOSEOUT REQUIREMENTS FOR ELECTRICAL WORK
26 77 19.20

1 GENERAL

1.1 Scope

.1 Provide documentation deliverables at completion of the Work for the following milestone events:

.1 Occupancy permit (where applicable) (Form OP1E),

.2 Substantial Performance of the Work (Form SP1E),

.3 Ready for take-over by Owner (Form RFT1E),

.4 Total Performance of the Work (Form TP1E).

1.2 Definitions

.1 The following definitions apply to this section.

.1 ***Occupancy permit*** – means either: (i) a permit issued by a regulatory authority to allow the Owner to occupy the building subject to the building permit, or (ii) a building permit close-out procedure where documentation must be submitted to the building authority for that purpose.

1.3 General

.1 The prerequisites and submittal of supporting documentation for the aforementioned milestone events may be combined as a single submission at one point in time for the following combination of events:

.1 Occupancy Permit, and Substantial Performance.

.2 Where a prerequisite is listed in more than one milestone event, it shall be included in the earliest-occurring milestone event unless expressly specified otherwise.

1.4 Occupancy Permit

.1 Submit the reviewed final record of the Testing of Integrated Life Safety and Fire Protection Commissioning report two weeks prior to application for occupancy permit, where such a report is required.

.2 Complete the Occupancy Permit Checklist and submit with required documentation to support the Owner's application for occupancy.

1.5 Substantial Performance

.1 Complete the Substantial Performance Checklist and submit with required documentation when applying for Substantial Performance of the Work.

.2 Where the work is sub-divided into separate scopes of Work, each requiring a separate Substantial Performance application, provide a separate checklist for each application.

.3 Within five working days of the Consultant's review report which indicates that Substantial Performance of the Work has been achieved, provide a detailed schedule for completion and/or correction of the Work of all items described in the Contractors' and the Consultants' deficiency list.

1.6 Ready-for-Takeover by Owner

.1 The basic prerequisites to attaining Ready-for-Takeover of the Work are described in the General Conditions and Supplementary General Conditions of the Contract.

.2 Complete the Ready-for-Takeover Checklist and submit with required documentation when applying for Ready-For Takeover of the Work.

1.7 Total Performance

.1 Complete the Total Performance Checklist and submit with required documentation when applying for Total Performance of the Work.

Form OP1E: OCCUPANCY PERMIT CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Building department inspection reports.
- ☐ AHJ electrical systems inspection reports.
- ☐ Fire Alarm Installation and Verification certificate to CAN/ULC-S524,
- ☐ Independent testing company, coordination study and testing reports submitted.
- ☐ Integrated Fire Protection and Life Safety test report to ULC-S1001.
- ☐ Equipment start-up reports (Interim).
- ☐ Electrical system testing reports.

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

Form SP1E: SUBSTANTIAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

☐ Occupancy permit has been issued by the AHJ (where applicable).
☐ Systems have been started-up, tested, and demonstrated to Owner or Consultant (final)
☐ Equipment and wiring identification completed
☐ Spare parts and replacement parts turned over to Owner, transmittal attached.

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

Form RFT1E: READY-FOR-TAKEOVER APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and documentation included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ Substantial Performance has been certified or verified.
- ☐ Occupancy permit has been issued by the AHJ (where applicable).
- ☐ Final cleaning and waste removal completed.
- ☐ Delivery to Owner of Operating and Maintenance documents for systems being taken-over by Owner.
- ☐ Submit copies of up-to-date as-built drawings.
- ☐ Final start-up, testing and balancing reports completed and submitted to Owner, including any items requiring corrections identified by Consultant.
- ☐ The portions of the building being turned over to the Owner can be secured by Owner.
- ☐ Demonstration and training are completed, or Contractor and Owner has agreed to a schedule to provide such training to be completed within one month after the date of Ready-for-Takeover.
- ☐ All commissioning activities except for those activities that are identified or otherwise agreed by the Owner to be deferred commission activities which may be completed after Ready-for-Takeover of the Work.
- ☐ Integrated systems testing of fire protection and life safety systems.
- ☐ All warranties have been submitted to the Owner.
- ☐ A comprehensive list of items to be completed or corrected is provided to Owner and Consultant and included in the application for Ready-for-Takeover, and includes a schedule of when such work will be completed.

Consultant Review		
Status:	☐ Reviewed	☐ Incomplete or deficient - resubmit
Signed:		
Date:		

Form TP1M: TOTAL PERFORMANCE APPLICATION CHECKLIST	
Project Name:	
Contract:	
Contract Scope:	
Application Date:	
Signed:	

The following requirements are completed and included in this application. Where documentation has been issued directly to the Owner, a copy of the transmittal is enclosed.

- ☐ All final Operating and Maintenance documents have been delivered to Owner.
- ☐ All final up-to-date as-built drawings have been delivered to Owner.
- ☐ All demonstration and training are completed.
- ☐ All commissioning activities are completed, including deferred alternate season commissioning activities.
- ☐ All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- ☐ All inspections and tests required to be performed by Contractor or manufacturer's prior to expiry of the warranty period have been completed, and documentation for those inspections and tests are included in this application.

Consultant Review		
Status:	□ Reviewed	□ Incomplete or deficient - resubmit
Signed:		
Date:		

End of Section

FIRE ALARM INITIATING AND INPUT DEVICES
28 46 11

1 GENERAL

1.1 Scope

.1 Provide fire alarm system addressable initiating devices as shown.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	28 46 21.11	Addressable Fire Alarm System

1.3 Definitions

.1 Terminology used in this specification is based upon CAN/ULC S524 definitions. Refer to S524 for a complete glossary of terms.

1.4 Applicable Codes and Standards

.1 Installation codes and standards:

.1 Refer to Specification section 28 46 21.11

.2 Product Standards:

.1	CAN/ULC-S528	Standard for Manual Stations for Fire Alarm Systems, Including Accessories
.2	CAN/ULC-S529	Smoke Detectors for Fire Alarm Systems
.3	CAN/ULC-S530	Standard for Heat Actuated Fire Detectors for Fire Alarm Systems

1.5 Submittals

.1 Submit product data sheets for materials specified herein.

.2 Submit shop drawings for engineered detection solutions (air aspiration, linear heat, beam detectors) including:

.1 Site specific floor plan drawings showing all system components.

.2 support details,

.3 temperature/smoke activation ratings.]

2 PRODUCTS

2.1 General

.1 All Fire Alarm System components shall be listed to applicable ULC and/or CSA standards for use with the proposed fire alarm system.

.2 Fire initiating devices shall be of the fire alarm system manufacturer product line or their approved products except where specified herein.

2.2 Addressable Manual (Pull) Stations

.1 Listed to ULC-S528.

.2 Manual stations:

.1 rigid construction, open circuit, pull lever type and finished in red enamel,

.2 Operating method: Two stage fire alarm suitable for insertion of an evacuation key.

.3 to be suitable for mounting in a 103 mm (4 in.) square recessed box with plaster ring in finished areas and surface mounted in unfinished areas,

.4 provided with an additional auxiliary contact(s).

.3 Manual stations to create an address on an identifiable loop.

2.3 Addressable Heat Detectors

.1 Listed to CAN/ULC-S530.

.2 Automatic detectors to be of the following types:

.1 addressable type,

.2 93°C (200°F), fixed temperature only (if not available as addressable device, provide conventional device with monitoring module),

.3 as otherwise indicated on drawings.

.3 Detectors to have suitable mounting plates with finish ring.

.4 Provide conventional non-addressable heat detectors in unheated areas with an individual addressable module mounted in a heated part of the building.

2.4 Addressable Smoke Detectors

.1 Listed to CAN/ULC-S529.

.2 Multi-criteria detector:

.1 addressable type,

.2 smoke detection: multi-criteria photoelectric smoke sensing,

.3 heat detection: 8.3°C (15°F) per minute rate-of-rise with 57°C (135°F) fixed detection.

.3 Remote adjustable sensitivity, with environmental condition monitoring function (“dirty”, “excessive dirty” messages),

.4 Incorporate an LED or lamp latched circuit to indicate the signal operation of the unit.

.5 Power requirement: operate on 24 volts DC and be protected against electrical transients and electromagnetic interference.

.6 Detectors to be equipped with NO/NC contacts to operate ancillary devices, where applicable.

.7 Detectors to be equipped with a fine mesh insect screen to prevent contamination of the detection chamber by insects.

.8 Recessed smoke detector to be complete with necessary shroud and flush mounting hardware.

2.5 Addressable Monitor Modules

.1 Supervision of Class B normally-open dry contact initiating device circuits with end-of-line resistor.

.2 Mount to standard 1-gang box.

.3 Include wall plate with LED viewing ports.

3 EXECUTION

3.1 General

.1 Installation of the Fire Alarm system components to be in accordance with the current applicable edition and all amendments of CAN/ULC-S524 and as specified herein.

END OF SECTION

ADDRESSABLE FIRE ALARM SYSTEM
28 46 21.11

1 GENERAL

1.1 Scope

.1 Update existing fire alarm system to meet the requirements of the new generator and outdoor enclosure as shown, and as otherwise required.

.2 Include for all costs associated with up-dating all the existing fire alarm system computer floor-plan graphics, and all existing facility or campus fire alarm annunciator graphic displays as required by the changes created by the Work.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1	[][26 05 49.13	Seismic Restraint for Electrical Services
.2	26 05 49.23	Seismic Qualification for Electrical Equipment]
.3	26 07 03	Wiring for Mechanical Services
.4	26 08 11	Testing of Integrated Fire Protection and Life Safety Systems
.5	[26 08 15	Electrical Commissioning]
.6	28 46 11	Fire Alarm Initiating and Input Devices
.7	28 46 23	Fire Alarm Notification and Output Devices
.8	28 46 90	Fire Alarm System Sequence of Operation.

1.3 Definitions and Abbreviations

.1 Terminology used in this specification is based upon CAN/ULC S524 definitions. Refer to CAN/ULC-S524 for a complete glossary of terms.

.1 ***Building Automation System*** – the control system which controls and monitors building systems other than a fire alarm system.

.2 ***Local Authority (Authorities)*** – means a regulatory authority for building safety and/or fire safety.

.2 The following abbreviations apply to this section:

.1 ***AHJ*** - Authority Having Jurisdiction

.2 ***CACF*** - Central Alarm and Control Facility

.3 ***DCL*** - Data Communication Link

.4 ***DCC*** - Display and Control Centre

.5 ***FAC*** - Fire Alarm Computer

.6 ***FAS*** - Fire Alarm System

1.4 Applicable Codes and Standards

.1 Installation codes and standards:

.1	CSA C22.1	Electrical Safety Code, as amended in the jurisdiction of the Work,
.2	CSA C282	Emergency Electrical Power Supply for Buildings

.3	CSA Z32	Electrical Safety and Essential Electrical Systems in Health Care Facilities
.4	CAN/ULC-S524	Installation of Fire Alarm Systems
.5	CAN/ULC-S536	Inspection and Testing of Fire Alarm Systems
.6	CAN/ULC-S537	Verification of Fire Alarm Systems
.7	CAN/ULC-S573	Installation of Ancillary Devices Connected to Fire Alarm Systems
.8	CAN/ULC-S1001	Integrated Systems Testing of Fire Protection and Life Safety Systems
.9	NFPA 13	Installation of Sprinkler Systems
.10	NFPA 20	Installation of Stationary Pumps for Fire Protection

.2 Product standards:

.1	CAN/ULC-S527	Standard for Control Units for Fire Alarm Systems
.2	CAN/ULC-S533	Egress Door Securing and Releasing Devices
.3	CAN/ULC-S548	Devices and Accessories for Water Type Extinguishing Systems
.4	ULC-S139	Standard Method of Fire Test for Evaluation of Integrity of Electrical Cables

1.5 Qualified Tradesperson

.1 Installing electricians to be qualified, licensed, and from a recognized firm with an established reputation in this field.

.2 Fire alarm technicians to be CFAA Registered.

1.6 System Requirements

.1 All system components to be listed by a Standards Counsel of Canada accredited testing laboratory to applicable standards adopted for Canada for use with the Fire Alarm System.

.2 All system components to comply with applicable provisions of the building code applicable to the location of the Work, CAN/ULC-S524, and meet the requirements of the local AHJ for building safety.

.3 General design and performance requirements:

.1 FAS to comply with ULC and as specified herein.

.2 FAS to be an integrated Fire Alarm and Voice Communication system.

.3 Existing FAS is two-stage, addressable, fully supervised, and microprocessor based.

.4 Provide Class A detection loops on a per zone basis

.5 FAS to be programmed to initiate a series of predefined control actions in accordance with Specification section 28 46 90.

1.7 Submittals

.1 Submit shop drawings to include:

.1 product data sheets for system components highlighted to indicate the specific products, features, and functions,

.2 fire alarm system sequence of operation,

.3 fire alarm graphic drawing,

.4 system power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods and under all voltage conditions per ULC Standards and applicable Building Code.

1.8 Operation and Maintenance Data

.1 Provide operation and maintenance data in accordance with the requirements of Division 01 and as follows.

.2 Operation and maintenance data to include:

.1 a copy of reviewed shop drawings with corrections completed and marks removed except review stamps,

.2 instructions for complete fire alarm system to permit effective operation and maintenance,

.3 a list of spare parts for system,

.4 detailed maintenance instructions for control equipment and each device type, maintenance schedule in accordance with CAN/ULC-S536,

.5 troubleshooting guide for control panels and devices,

.6 a copy of the fire alarm verification certificate and verification report

.7 warranty certificates for fire alarm system, batteries, ancillary devices, and other similar items, including battery suppliers date coding for batteries.

.8 the name, address, and telephone number of service representative of manufacturer to be contacted during warranty period,

.9 any additional fire alarm equipment information required for the facility Fire Safety Plan.

.3 Update shop drawing riser diagram to “As-Built” condition at the completion of the project. Submit both a printed drawing, a PDF file, and an AutoCAD file.

.4 Documentation required by CAN/ULC S573 to be maintained on site for ancillary device installations:

.1 A completed and detailed description for all ancillary device installations including, but not limited to the following:

(a) description and function of the ancillary device(s);

(b) sequence of operation;

(c) installation instructions;

(d) operating instructions; and

(e) maintenance and testing instructions.

.2 The plans of the building showing the location and identification of each ancillary device.

.3 Documentation showing the interconnection of each ancillary device or system connections to field devices, control units, transponders, and external power supplies.

.4 Documentation for ancillary devices and circuits serving smoke control and venting systems including building plans that indicate the type and location of all smoke control and venting equipment (fans, dampers, etc.)

2 PRODUCTS

2.1 General

.1 All Fire Alarm System components shall be listed to applicable ULC and/or CSA for use with the proposed fire alarm system.

.2 The system is to include all necessary output signals to connect to the Owner's designated monitoring company.

.3 Peer to peer network interface hardware and software components to enable data exchange and direct communications with the Building Automation System.

.1 The vendor to include for all costs for making the software data stream available at a RS232 port or RS485 port as necessary for use by the Building Automation System. The port to be configured to provide all output activity on a device-by-device basis.

.2 Coordinate protocol and data interpretation from the fire alarm to the Building Automation System.

Standard of Acceptance
° Siemens (Desigo Fire Safety Modular)

2.2 EXISTING SYSTEM

.1 It is the intent to maintain the operation of the existing FAS

.2 The existing FAS is Siemens Desigo Modular

.3 A fire alarm annunciator panel with LCD display fire alarm zone, active graphic plan, and telephone is located in the Building CACF.

2.3 Voice Communication - Voice Paging System

.1 Function;

.1 to give the firefighters the capability of providing intelligible evacuation instructions to all or selected areas of the building from the DCC.

.2 General;

.1 The system is to:

(a) incorporate a complete arrangement of speakers, microphones, amplifiers, control module and power supplies,

(b) provide [floor by floor, and each stairwell][as per drawings] evacuation switches in addition to "All-Call".

(c) be integral to the fire alarm system.

.3 Requirements;

.1 ULC listed hand-held microphone and hook switch assembly. The microphone to be a background noise-cancelling hand-held unit designed for close talking operation.

.2 Speaker zone selector switches and visual trouble indication for zones as shown on drawings, and evacuation switches for emergency voice announcements in specific areas.

.3 The voice communication system will have the following features:

(a) sound pre-announce tone,

(b) silence fire alarm signaling devices during pre-announce tone and emergency broadcasting,

(c) ability to connect remote telephone handset to the voice communication system,

(d) "Call-in" light assembly for each selector switch.

.4 Supervision:

(a) supervision of all audio circuits to pre-amplifier, amplifier, handset power supply, speakers, and handsets,

(b) supervision of open or short circuits will cause the appropriate trouble light to be illuminated and will sound a trouble signal on the fire alarm system,

(c) supervision of standby power supply system including loss of power with connection to separate fire alarm trouble signal.

.5 The system to be tri-channel to provide simultaneous Alert tone, Alarm tone and Voice messages.

2.4 Voice Communication – Amplifiers

.1 General:

.1 provide a separate amplifier for each voice paging zone.

.2 Amplifier type:

.1 solid state type compatible with the pre-amplifier,

.2 to be adequately sized to provide the sound pressure level specified for speakers.

.3 Amplifier features:

.1 adequate RMS power rating. Initial amplifier loading to not exceed 80% in order to allow for future system expansion. Calculations to assume each speaker is connected at 0.5 watt,

.2 frequency response with 1 dB from 200 - 15,000 Hz,

.3 noise level minimum of 80 dB below rated output,

.4 each audio power amplifier to have integral audio signal de-multiplexers, allowing the amplifier to select any one of eight (8) digitized audio channels as directed by system programming,

.5 audio amplifiers to be power limited and protected from short circuits conditions on the audio circuit wiring. Each amplifier output to provide a selectable 25/70 Vrms output, suitable for connection to emergency speakers.

2.5 Voice Communication Circuits

.1 Provide a minimum of two voice communication circuits for each voice paging zone.

.2 All communication circuits to be supervised for open, short, or ground fault conditions.

2.6 Input (Alarm Initiating) Circuits

.1 Alarm receiving circuits and addressable line cards for alarm initiating devices, such as manual pull stations, smoke detectors, combination smoke detectors/ heat detectors (Intelligent type), heat detectors, and water flow switches as shown on schedules and drawings.

2.7 Output Alarm Circuits

.1 Alarm output circuits for audible signals such as speakers, horns and visual indicators as shown.

.2 Alarm output circuit:

.1 includes necessary amplifiers and tone generator modules for electronic audible alarm devices as required.

.2 capable of being manually tested on a circuit-by-circuit basis by the CPU using a keypad or a keyboard.

.3 capable of being manually disconnected on a circuit-by-circuit basis at the transponder for testing purposes.

.4 a trouble signal is to sound when any output circuit is manually disconnected.

2.8 Fire Alarm Wires and Cables

.1 General requirements:

.1 wiring sizing and type to be as recommended by fire alarm system manufacturer,

.2 type: copper, not less than #18 AWG,

.3 wiring for speaker circuits to be twisted pair. Shielded or as recommended by manufacturer.

.2 Non-fire rated:

.1 fire alarm wiring:

(a) type FAS, 300V, 105°C,

(b) to be installed in conduit.

Standard of Acceptance

° Nexans
° General Cable
° Belden
° Southwire

.2 Armoured fire alarm cable:

(a) type FAS, 300V, 105°C,

(b) aluminum interlocked armour

Standard of Acceptance

° Securex II FAS 105

.3 Fire rated:

.1 fire rated armored cables:

(a) 2-hour fire rating with hose stream, listed to CAN/ULC S139,

(b) type FAS, 300V, 90°C.

Standard of Acceptance

° VITALink (Marmon, Comtram)

.2 fire rated mineral Insulated cables:

(a) 600V mineral insulated cable, as recommended by fire alarm manufacturer.

Standard of Acceptance

° Pyrotenax (nVent)

3 EXECUTION

3.1 General

.1 Install all control panels, graphics, and equipment required for a fully operational system as shown on drawings or as otherwise required.

.2 FAS to be installed under the supervision of manufacturer.

.3 At the completion of the Work, the building is to be left with a complete fire alarm and voice communication system accepted by the Local Authorities and meeting all applicable codes. System will be left ready for continuous and satisfactory operation.

3.2 Wiring

.1 Wiring material selection:

.1 wiring between transponder to the first initiating device or output device: 2-hour fire rated, or utilize isolators as outlined in CAN/ULC-S524 if the transponder is in a different fire alarm zone than the device it is serving.

.2 wiring for annunciators: solid copper 2-hour fire rated, serial link communication conductor as recommended by the manufacturer.

.3 all other wiring: non-fire rated or fire rated.

.2 Connect wiring for input alarm initiating circuits and output alarm circuits corresponding to the same fire alarm zone to the same transponder to ensure stand-alone operation is maintained.

.3 Align alarm devices and signals, where grouped together, one above the other.

.4 Provide fire alarm monitoring from each emergency generator control panel for “generator trouble”, “generator running” and “Generator not in auto” signals.

.5 Equip raceways with a separate ground conductor and connect to nearest ground bus.

.6 Wire and annunciate signals from fire pumps or sprinkler pumps as required by the building code and its references to NFPA 13 and NFPA 20.

.7 Wire signal circuits alternatively such that no two adjacent signal devices are on the same circuit.

.8 Provide a minimum of two speaker circuits per voice paging zone.

.9 Provide line isolators (on both sides) when crossing fire alarm zone boundaries.

3.3 Installation of Input Circuits and Initiating Devices

.1 Initiating devices to conform to Specification section 28 46 11.

.2 Protect smoke detectors during construction with a dust cover which is be removed at the time of verification.

.3 Wire alarm receiving circuits in a Class A, 2 wire configuration with the loop returning to the control panel via a separate conduit. Provide a conduit run from the respective control panel to the first and last device on the loop.

.4 Supervise all alarm receiving circuits for open, short, or ground fault conditions.

.5 Do not load circuits above 80% of capacity to allow for future additions.

.6 Install manual pull-stations as shown and in accordance with the following:

.1 1200 mm above the finished floor level, measured from the centre of the manual pull station,

.2 be adjacent to and centered on either the length or the width of a clear floor area of 1350 x 800 mm,

.3 install the manual pull station on the latch side of a single door at a maximum lateral distance of 1500 mm from the door opening, except where installed adjacent to an electromagnetically locked door or a door utilized for crossover access, install within 500mm.

.7 Provide a Lamacoid label for all monitoring modules indicating address and device monitored.

3.4 Installation of Output Circuits and Devices

.1 Notification and output devices to conform to Specification section 28 46 23.

.2 Wire alarm output circuits in a class B, 2 wire configuration.

.3 Supervise all alarm output circuits for open, short, or ground fault conditions by the use of an end of line resistor.

.4 Do not load circuits above 80% of capacity to allow for future additions.

.5 In finished areas, install speakers flush with the ceiling. Secure the back box to the runners above the ceiling. Install adequate supports for the speaker back boxes covered by the covers.

.6 In stairways and equipment spaces, surface-mount speakers and/or horns.

.7 Install wall-mounted audible signal devices at least 150 mm (6 in) below the ceiling, measured to the top of the device.

.8 Provide Lamacoid label for all control modules indicating address.

3.5 Installation of End of Line Resistors

.1 Where Class B wiring is specified or permitted, install the end-of-line resistors in an outlet box with stainless steel cover plate.

3.6 Sprinkler/Standpipe System Connections

.1 Provide addressable monitoring modules to each sprinkler flow, supervisory, and standpipe system switches and connect to fire alarm zones indicated. Connect to nearest associated transponder.

.2 Connect relay of sprinkler pump, auxiliary booster or special service pump to fire alarm zone indicated, for trouble condition.

.1 .

.3 .

3.7 Control of ancillary devices

.1 Where power to an ancillary device is provided from the fire alarm system, the power supply equipment and wiring shall be installed in accordance with CAN/ULC S573 and CAN/ULC-S524.

.2 Where power to an ancillary device or system is provided independent of the fire alarm system, the power supply equipment and wiring shall be installed in accordance with CAN/ULC S573 and CSA C22.1.

.3 Where control of an ancillary device is from multiple sources (ex. BMS and fire alarm), a warning label is to be installed at the ancillary device with the following wording:

.1 “THIS DEVICE IS CONTROLLED BY MORE THAN ONE SOURCE”

.4 Relays used for elevator recall are to be labelled “ELEVATOR RECALL RELAY” and note the specific recall function provided.

.5 Where ancillary devices or systems connect to an electrically supervised circuit and the devices or systems are not provided with dual input and output wire leads or terminals, the connection shall be made with a soldered joint or non removable crimped ring tongue connector. Except:

.1 This requirement does not apply to end-of-line devices, and

.2 it is permitted to have a non-supervised portion of the circuit, provided it is limited to the following lengths:

(a) 3 m when the non-supervised portion of the circuit is located outside of a service room; or

(b) 18 m when the non-supervised portion of the circuit is located entirely within the same service room.

3.8 System Verification

.1 Verify the fire alarm system in accordance with CAN/ULC-S537. Verification is to be performed by the FAS manufacturer/vendor and the electrical installers.

.2 Provide any necessary equipment, test apparatus, ladders and scaffolding as required.

.3 Adjust system and components as required to ensure system fully operating as intended.

3.9 Testing of Integrated Fire Protection and Life Safety Systems

.1 Comply with the requirements of specification section 26 08 11 for the testing of the integration of the FAS with other life safety and fire protection systems.

.2 All verification and testing requirements specified in this section must be complete and free of deficiencies prior to commencing Testing of Integrated Fire Protection and Life Safety Systems.

3.10 Local Authorities Demonstration

.1 Only after the testing and verification task is completed, and all deficiencies rectified, notify the Owner, Consultant and representatives of the Local Authority and demonstrate the proper functioning of the system. This will include, but not be limited to:

.1 detailed demonstration of each operable device,

.2 removal of individual speakers from their wiring connections to prove that adjacent speakers operate properly and subsequent reinstallation of speakers on selected floors,

.3 interfacing of voice communication and fire alarm systems,

.4 operation of individual handsets,

.5 operation of ceiling speakers.

End of Section

FIRE ALARM NOTIFICATION AND OUTPUT DEVICES
28 46 23

1 GENERAL

1.1 Scope

.1 Provide fire alarm system notification and output control devices as shown.

1.2 Related Sections

.1 Without limiting the scope of work or applicability of other specification sections, the work under this section directly integrates with or refers to the following specification sections:

.1 28 46 21.11 Addressable Fire Alarm System

1.3 Definitions

.1 Terminology used in this specification is based upon CAN/ULC S524 definitions. Refer to S524 for a complete glossary of terms.

1.4 Applicable Codes and Standards

.1 Product standards:

.1 CAN/ULC-S525 Audible Signal Devices for Fire Alarm System and Signaling Systems, Including Accessories

.2 CAN/ULC-S526 Visible Signal Devices for Fire Alarm Systems and Signaling Systems, Including Accessories

.3 CAN/ULC-S541 Speakers for Fire Alarm Systems, Including Accessories

1.5 Submittals

.1 Submit product data sheets for materials specified herein.

2 PRODUCTS

2.1 General

.1 All Fire Alarm System components shall be listed to applicable ULC and/or CSA for use with the proposed fire alarm system.

.2 Annunciation and output control devices to be of the fire alarm system manufacturer product line or their approved products except where specified herein.

2.2 Speakers

.1 Listed to CAN/ULC-S541.

.2 Speakers for the fire alarm system to have the following features:

.1 acoustically treated enclosure,

.2 line matching transformer with ¼, ½, 1, and 2 Watt taps,

.3 permanent magnet type speaker,

.4 wide dispersion bandwidth in hemispherical pattern, in both horizontal and vertical planes,

.5 minimum frequency response of 400 to 4000 Hz,

.6 high fidelity type speaker, 520 Hz type.

.3 For flush-mounting as shown, and provided with speaker enclosures where shown as surface mounted.

.4 Unit to be complete with hook-up terminals with screw-type connection.

2.3 Horn Speakers

.1 Listed to CAN/ULC-S541.

.2 Surface mounted with a weatherproof gland connection.

.3 Dispersion angle of 120°H x 80°V.

.4 Selectable weather protected taps of 1, 2, 4, & 7.5 watts.

.5 Finish colour: fire alarm red.

.6 Power supply: Powered by fire alarm output circuit.

2.4 Fire Alarm Bell

.1 Listed to CAN/ULC-S525.

.2 150 mm (6 in) in diameter.

.3 Surface mounted.

.4 Finish colour: fire alarm red.

Power supply: Powered by fire alarm output circuit.

2.5 Visible Signal Devices (Strobe Lights)

.1 Listed to CAN/ULC-S526.

.2 Performance:

.1 flash rate: one flash per second in alarm mode,

.2 the words "FIRE" to appear on the lens or attached nameplate.

.3 effective luminous intensity in a sleeping room or bed space: not less than 175 candela (cd).

.4 effective luminous intensity in all other areas: not less than 15 candela (cd) and selected to meet ULC S524 for the installed location.

2.6 Combination Signal Appliances

.1 Combination audible and visual signaling devices to conform to individual articles specified herein.

2.7 Addressable Control Relay Modules

.1 Form “C” dry relay contact to control external appliances.

.2 Contact rating: 2A @ 24V, 0.5A @ 120V.

.3 Designed to be installed in a standard 1-gang box.

.4 Include wall plate with LED viewing ports.

2.8 Alarm Signal Appliances

.1 For remote indication of alarm condition.

.2 Alarm lamp fixtures: high intensity (200 mcd) LED lamps, with screw-type terminals.

.3 Mounting plate: single gang-box plate.

2.9 Fire Do Not Enter Signs

.1 Listed to CAN/ULC-S526

.2 Extruded aluminum body and aluminum faceplate, with LED bulbs.

.3 Warning message:

.1 “FIRE DO NOT ENTER”

.2 red in colour,

.3 to be visible only when the sign is illuminated.

.4 Power supply: from fire alarm system.

3 EXECUTION

3.1 General

.1 Provide notification and output devices as shown.

.2 Installation of the fire alarm system components to be in accordance with the current applicable edition and all amendments of CAN/ULC-S524 and as specified herein.

3.2 Speaker Installation

.1 Initially set speaker taps to be ½ W. Verify suitability of sound levels in each area and adjust tap to suit.

.2 Speaker baffles to be held in place with approved fasteners.

.3 Speakers to be flush mounted unless otherwise noted.

.4 Speaker enclosures in stairwells to be suitable for surface mounting.

3.3 Visible Signal Devices Installation

.1 Where there are more than two strobe lights in a corridors or room in the same field of view, adjust units to flash in synchronization regardless of whether the strobe light is served from one or more control units / transponders.

.2 Suspend or mount ceiling-mounted strobe lights at not more than 9000mm above the finished floor.

.3 Mount wall-mounted strobe lights such that the entire lens is not less than 2000mm and not more than 2400 mm above the finished floor.

3.4 Addressable Control Relay Module Installation

.1 Mount control relay modules in a standard 1-gang box.

END OF SECTION

Special Provision No. 1

TEMPORARY TRAFFIC CONTROL

ITEM – TEMPORARY TRAFFIC CONTROL

SCOPE

The Contractor shall communicate with Kingston Health Sciences Centre - Kingston General Hospital to determine supply schedules and facilitate all deliveries during construction.

The provisions of OPSS.PROV 706 shall apply except as amended hereafter.

706.07 CONSTRUCTION

Section 706.07 is amended by the addition of the following;

Traffic Control Person's (TCP's) used on this project shall be assigned for such duties in accordance with the requirement of section 4.4 of Book 7 of the OTM. If in the opinion of the *Contractor Administrator*, the *Contractor's* TCP's have not been adequately trained, the *Contractor Administrator* can immediately exclude the TCP's from the site for the remainder of work on this *Contract*. TCP's so excluded will be replaced with properly trained personnel.

706.09 MEASUREMENT FOR PAYMENT

Section 706.09.01 is deleted and replaced by the following;

706.09.01 Lump Sum

Payment at the *Contract* price for the above tender item shall be full compensation for all labour, equipment, and material required to do the work.

706.10 BASIS OF PAYMENT

Sections 706.10.01, 706.10.02 and 706.10.03 are deleted and replaced by the following;

706.10.01 Temporary Traffic Control - Item

Payment at the *Contract* price for the above tender item shall be full compensation for all labour, equipment, and material required to do the work, which shall include any and all as required detour postings, advance signage notifications and any other traffic control implementations as required under OTM Book 7. All signage shall be monitored on a daily basis, and corrected / replaced as required. Additional signage and or requirements may be indicated by the *Owner / Contract Administrator* which shall be provided for and completed by the *Contractor* at no additional cost to the Contract.

This Special Provision applies to all components of the *Contract*.

Special Provision No. 2

REMOVALS

ITEM - REMOVALS (ALL ITEM COMPONENTS)

SCOPE

The provisions of OPSS.PROV 510 shall apply except as amended hereafter.

510.07 CONSTRUCTION

Section 510.07.01 is amended by the addition of the following;

510.07.01 General

The work shall include saw cutting. Cuts shall be made square and neat.

Stockpiling of material within the project limits shall not be permitted without written authorization from the *Contract Administrator*.

Tree removals shall be inclusive of the root mass and disposal of the tree in it's entirety off site.

510.07.06.01 General

Section 510.07.06.01 is amended by the addition of the following;

For all areas subject to asphalt removal;

- Temporary ramping shall be an asphalt ramp with a minimum dimension of 1.0m across the width of the asphalt prior to be opened to traffic.
- The *Contractor* shall maintain the temporary asphalt ramp, to the satisfaction of the *Contract Administrator* until surface course asphalt work has been completed.

510.07.06.02 Cutting Existing Pavement

Section 510.07.06.02 is amended by the addition of the following;

All pavement shall be cut the full depth of the pavement.

All cut edges with a depth greater than 60mm shall have a 1.0m lap joint. Depth of milling for the lap joints shall be 40mm for the entire width of the joint.

510.07.08.02 Removal of Driveways, Sidewalks, and Curbs

Section 510.07.08.02 is amended by the addition of the following;

Collective work to remove sidewalks, and curbing shall include the removal of all asphalt, concrete, stone or brick driveways, sidewalks, and curbing not otherwise noted in the Contract Documents.

510.09 MEASUREMENT FOR PAYMENT

510.09.01 Basis of Payment – Lump Sum

Section 510.09.01 is amended by the addition of the following;

Payment at the *Contract* price for the as noted and above tender items shall be full compensation for all labour, equipment, and material required to do the work.

Special Provision No. 3
EARTHWORKS

ITEM - EARTH EXCAVATION / GRADING / STRIPPING

SCOPE

It is the responsibility of the Contractor to make himself aware of site conditions through onsite inspections, and all other means as they feel necessary.

The provisions of OPSS. PROV 206 shall apply except as amended hereafter.

206.03 DEFINITIONS

Section 206.03 is amended by the addition of the following;

Rock means natural beds or massive fragments of hard, stable, cemented part of the earth's crust, either igneous, metamorphic or sedimentary in origin, which may or may not be weathered and includes boulders having a volume of 1 m^3 or greater.

Regardless of the foregoing, any material that can be removed without the use of drilling, blasting and/or hoe ramming shall not be considered rock for payment purposes.

206.07.03.01.02 Stripping

Section 206.07.03.01.02 is amended by the addition of the following;

Areas to be stripped shall be within the site property boundaries restricted only to areas as required to facilitate the proposed construction.

206.07.03.01.03 Excavation Below Subgrade

Section 206.07.03.01.03 is amended by the addition of the following;

Unsuitable material below subgrade will be determined during construction.

206.07.03.02 Rock Excavation - General

Section 206.07.03.02 is amended by the addition of the following;

The use of explosives for rock excavation shall not be permitted.

206.07.03.04 Excavation for Pavement Widening

Section 206.07.03.04 is amended by the addition of the following;

Suitable excavated material shall be incorporated into the *Work* at locations specified in the *Contract Documents*.

206.07.03.05 Management of Excavated Materials

Section 206.07.03.05 is amended by the addition of the following;

Suitable excavated material removed under the *Work* shall be incorporated into the *Work* as subgrade material at locations specified in the *Contract Documents* and as directed by the

Contract Administrator. Suitable material shall be determined by the *Contract Administrator, which may require sorting, temporary stockpiling, or other temporary measures prior to re-use.*

All material removed under the *Work* that cannot be incorporated into the *Work* shall be considered excess material.

206.09 MEASUREMENT FOR PAYMENT

206.09.01 Basis of Payment – Lump Sum

Special Provision No. 4

DISPOSAL

ITEM - DISPOSAL AND MANAGEMENT OF EXCESS CONSTRUCTION MATERIALS

SCOPE

The provision of OPSS. PROV 180 shall apply except as amended hereafter.

The Contractor is made aware that management of excess material as disposable fill shall be in accordance with Ministry of the Environment Conservation and Parks Guidelines as well as the recommended disposal options as identified within the site soils management report.

The *Contractor* shall be responsible for the proper management of all material removed under the Work. As much suitable excavated material as possible shall be incorporated into the Work in accordance with the *Contract Documents*.

Excess soil is soil that has been excavated, mainly during construction activities, that cannot or will not be reused at the site where the soil was excavated and must be moved off site. In some cases, excess soil may be temporarily stored at another location before the excess soil is brought back to be used for a beneficial reuse at the site where the soil was originally excavated.

The Contractor shall provide all information related to the management of material removed under the Work in a Material Management Plan prior to mobilizing to the site.

The Material Management Plan shall consider geotechnical investigation results provided in the Geotechnical Investigation Report by Malroz Engineering Inc. included in the Appendix A in Section 32 00 00. The report indicates contaminated soils that require disposal at a licensed waste disposal facility.

The Material Management Plan shall include, but not be limited to;

- Material to be incorporated into the Work,
- Information on proposed re-use including;
    - Locations for temporary stockpiled material,
    - OPSF 180-1 forms as required,
- Management of Excess Material including;
    - Location(s) for disposable fill,
    - required soils/fill management plans for the disposal / receiving site(s),
    - required soil testing analysis of the receiving site(s)
    - Written report and form of authorization from a qualified soils professional / engineer indicating that the receiving site(s) is capable of accepting such construction excess soils, inclusive of post construction reporting,
    - OPSF 180-2 forms as required,
    - Securement of Disposal site(s)
    - Tracking and Record Keeping of all disposed and haulage of excess material

- Quality Personal (third party qualified) management of the disposed materials complete with testing requirements as per O.Reg 406/19, and final report confirming the disposal procedures and summary of results

The *Contractor* shall not deviate from any component of his Material Management Plan without written authorization from the *Contract Administrator*.

180.04.01.01 Notification of Site Selection and Property Owner Release

Section 180.04.01.01 is amended by the addition of the following;

Management of excess material as disposable fill shall be permitted in accordance with O.Reg. 406/19, the "Rules for Soil Management and Excess Soil Quality Standards" and in consideration of the recommendations of the Geotechnical /Soils Reports.

180.04.01.02 Verification of Management by Disposal as Non-Hazardous Solid Industrial or Commercial Waste

Section 180.04.01.02 is deleted in its entirety and replaced by the following;

When excess material is managed by disposal as non-hazardous solid industrial or commercial waste, a copy of the weigh ticket or receipt provided by the disposal site operator shall be submitted to the Contract Administrator on a daily basis.

Within three weeks of the completion of all disposal activities associated with the work, a completed copy of the form OPSF 180-5, Waste Quantity Report, shall be provided to the Contract Administrator and shall account for all excess material managed by disposal as solid non-hazardous industrial or commercial waste.

180.04.01.03 Notification of Forest Resource Licensees

Section 180.04.01.03 is amended by the addition of the following;

No Forest Resource licensees have been identified within the project limits.

180.07.01 Conditions on Management of Excess Material - General

Section 180.07.01 is amended by the addition of the following;

The Contractor shall provide a management of excess material plan to the Contract Administrator two (2) weeks prior to mobilizing to the site.

180.07.02 Conditions on Management by Re-Use

Section 180.07.02 is amended by the addition of the following;

As much suitable excavated material as possible shall be incorporated into the Work in accordance with the *Contract Documents*. All other material shall be considered excess unless the Contractor has written authorization from the *Contract Administrator* to reprocess the material for another use.

If the Contractor intends to process, re-process or recycle excess material into a construction material or other useful product, he shall provide a material re-use plan for such activities two (2) weeks prior to mobilizing to the site.

180.07.03 Conditions on Management as Disposable Fill

Section 180.07.03 is amended by the addition of the following;

If the Contractor intends to manage excess material as disposable fill, he shall be responsible for locating a suitable location to do so, complete with all site testing and verification of the site to confirm acceptance of such excess material. The receiving sites(s) shall be capable of

accepting materials with acknowledgement of test results from the as completed soils management report and as appended to this Contract.

180.07.04 Conditions on Management by Open Burning

Section 180.07.04 is amended by the addition of the following;

Management of excess material by open burning is not permitted.

180.07.06 Conditions on Management by Stockpiling

Section 180.07.06 is amended by the addition of the following;

Management of excess material by stockpiling is permitted with an OPSF 180-1 form and written authorization from the *Contract Administrator*. Only suitable excavated material to be incorporated into the *Work* can be stockpiled.

That *Contractor* shall only stockpile enough material as can be reasonably foreseen as being required.

Material stockpiled within the project works area must be incorporated into the *Work* by the end of the week. If the material cannot be incorporated into the *Work* by the end of the day, it shall be removed to the approved stockpiling location or managed as excess material as specified in the *Contract Documents*.

Material stockpiled at the location identified on the an approved OPSF 180-1 must be incorporated into the *Work* within fourteen (14) working days unless identified as being for re-use in the *Contractor's* material re-use plan.

Stockpiled material that cannot be incorporated into the *Work* within fourteen (14) working days and that has not been identified as being for re-use in the *Contractor's* material re-use plan, shall be managed as excess material as specified in the *Contractor's* excess material management plan.

Regardless of the above, any location as chosen for temporary stockpiling of excess material must be confirmed by written acceptance from the Contractor's Quality Personal team member.

180.10 MEASUREMENT FOR PAYMENT

180.10 Basis of Payment – Lump Sum

Measurement for payment of Management of Excess Material shall be by the Lump Sum, which shall include all management oversight of the disposal operations inclusive but not limited to QP oversight and guidance, testing, tracking, reporting, registrations, fill management plans as may be required.

Special Provision No. 5

ASPHALT PARKING LOT STRUCTURE

ITEM - GRANULAR MATERIALS

SCOPE

The provision of OPSS. PROV 1010 shall apply except as amended hereafter.

Only quarried materials shall be utilized.

Prior to the placement of the first layer of granular, the existing subgrade surface shall be proof rolled, and subject to visual inspection to identify any areas of rutting and/or deflection.

All granular materials utilized for repair shall be approved by the Contract Administrator, of which shall conform to OPSS specifications as confirmed by appropriate certified materials testing.

Minimum depths of Granular materials shall be as per the following;

- Granular 'B' (Type II) shall be a minimum of 300mm compacted depth.
- Granular 'A' (Quarried Limestone) shall be a minimum compacted depth of 150mm.

Compaction of granular materials shall be 100% SPD.

The Contractor shall provide to the Owner the source site for granular materials to be utilized on this project complete with the submittal and approval of lab testing confirming OPSS conformance.

MEASUREMENT FOR PAYMENT

Basis of Payment – Lump Sum

Payment at the *Contract* price for the as noted and above tender items shall be full compensation for all labour, equipment, and material required to do the wor

Special Provision No. 6

HOT MIX ASPHALT

ITEM - HOT MIX ASPHALT

SCOPE

The provision of OPSS. MUNI 310 shall apply except as amended hereafter.

Section 310.07.01 is amended by the addition of the following;

310.07.01 Quality Control

Hot mix asphalt shall be HL-3, compacted to a minimum depth of 60mm.

Performance graded asphalt cement shall be 58-28 and shall conform to SHRP specifications.

Minimum % asphalt cement content shall be as follows;

- HL3 mix designs shall have 5.2% AC with a minimum stability of 11,500 (n)
- The Contractor is advised that they shall ensure that an adequate supply of trucks are made available as to avoid lag / delay between loads as to prevent cold joints and a provide for a continuous supply of hot mix asphalt.

Section 310.07.01 is amended by the addition of the following;

310.07.03.01 Application of Tack Coat

Application rate for tack coat shall be 0.35 kg/m^2.

Tack coat shall be applied to all vertical surfaces (curbs, structures, centerline and end joints etc.) coming into contact with HMA.

Tack coat shall be applied to all surfaces coming into contact with HMA that have been subject to partial depth removal.

No separate payment shall be made for tack coat used for edging and vertical faces. (i.e. curbs, structures).

Section 310.07.05.01.01 is amended by the addition of the following;

310.07.05.01.01 General

The *Contractor* shall obtain asphalt cement samples in accordance with OPSS 1101 for QA testing.

Section 310.07.05.01.02 is amended by the addition of the following;

310.07.05.01.02 Frequency and Location

The *Contractor* shall obtain a minimum of two (2) asphalt cement samples, at random test intervals when requested by the Contract Administrator. One (1) sample shall be for the use of

the Contractor, One (1) sample for the Contract Administrator, and One (1) referee sample which shall be kept at the offices of the Contract Administrator or geotechnical lab completing such testing.

Samples shall be taken at the asphalt plant.

Section 310.07.05.01.04 is amended by the addition of the following;

310.07.05.01.04 Delivery

Asphalt cement samples shall be delivered to a testing lab in Kingston. The lab will be confirmed by the Owner prior to construction.

Section 310.07.05.01.02 is amended by the addition of the following;

310.07.05.02.01 General

QA / QC samples shall be taken at random test intervals as directed by the *Contract Administrator*. Regardless samples shall be taken each day of paving operations, for each type of asphalt used on the *Contract*.

The *Contractor* shall obtain a minimum of three (3) asphalt samples, at each random test interval when requested by the Contract Administrator. One (1) sample shall be for the use of the Contractor, One (1) sample for the Contract Administrator, and One (1) referee sample, which shall be kept at the offices of the Contract Administrator or geotechnical lab completing

Section 310.07.05.02.05 is amended by the addition of the following;

310.07.05.02.05 Delivery

Asphalt samples shall be delivered to a testing lab in Kingston. The lab will be confirmed by the *Owner* prior to construction.

Cores samples shall not be required.

MEASUREMENT FOR PAYMENT

Basis of Payment – Lump Sum

Payment at the *Contract* price for the as noted and above tender items shall be full compensation for all labour, equipment, and material required to do the work.

Removal and replacement of defective areas such as flushing, bleeding, segregation, fat spots, surface damage and surface contamination shall be at the Contractor's expense.

Removal and replacement of rejected HMA due to aggregate gradation or non-compliance due to the asphalt cement content shall be at the Contractor's expense.

Removal and replacement of HMA that does not meet the acceptance criteria for Marshall or Superpave HMA shall be at the Contractor's expense.

Removal and replacement of HMA pavement that does not meet the average percent compaction shall be at the Contractor's expense.

No additional payment shall be made for any delays or costs attributed to verification of the gross mass and tare mass of trucks requested by the Contract Administrator.

Appendix 310-B is hereby invoked for Payment Adjustment for Changes in the MTO Performance Graded Asphalt Cement Price Index. Payment adjustments shall be paid under the *Asphalt Indexing (Provisional)* item and calculated using the formula in Appendix 310-B.

Appendix 1101-B is hereby invoked for this Contract.

The Contractor may opt out of Asphalt Indexing on this Contract by notifying the Owner in writing within ten (10) business days of receiving the Notice of Award.

Special Provision No. 7

LINE PAINTING

ITEM - LINE PAINTING

SCOPE

This specification covers the requirements for the removal and application of new parking lot pavement markings onto bituminous or concrete pavement.

The provisions of OPSS. PROV 710 shall apply except as amended herein.

CONSTRUCTION

Pavement markings shall include 10cm wide white parking stall lineage and other area markings as shown on the Contract drawings.

710.07.03 Pavement Marking Obliterating

Section 710.07.03 is amended by the addition of the following;

Black out paint shall not be permitted to remove existing parking lot lineage..

710.07.04 Premarking

Section 710.07.04 is amended by the addition of the following;

The Contractor shall premark all pavement marking 48 hours in advance of completing the pavement marking for review by the *Contractor Administrator.*

MEASUREMENT FOR PAYMENT

Basis of Payment – Lump Sum

Payment at the *Contract* price for the as noted and above tender items shall be full compensation for all labour, equipment, and material required to do the work.

Special Provision No. 8
CONCRETE WORKS

ITEM - CONCRETE SIDEWALK

SCOPE

The provisions of OPSS. PROV 351 shall apply except as amended hereafter.

353.09 MEASUREMENT FOR PAYMENT

353.09.01 Basis of Payment – Lump Sum

Payment at the *Contract* price for the above tender items shall be full compensation for all labour, equipment, and material required to do the work.

Special Provision No. 9

SEWERS

ITEM – 450 mm dia RCP STM SEWER
ITEM - 525 mm dia RCP SAN SEWER
ITEM – 914 mm (OD) STEEL CASING PIPE
ITEM – 965 mm (OD) STEEL CASING PIPE
ITEM - CONNECTION TO EXISTING SEWER SYSTEM
ITEM - 1200 mm CONCRETE MAINTENANCE HOLE
ITEM – TEMPORARY BYPASS

SCOPE

This specification covers the requirements for the installation of storm sewer, sanitary sewers, sanitary sewer maintenance hole, and corresponding connections to existing storm and sanitary sewer systems.

Work for installation of storm and sanitary sewers shall be completed as per OPSS.PROV 410 except as amended herein.

410.05 MATERIALS

410.05.08 Steel Casing Pipe

Steel casing pipe shall be in accordance with OPSS.PROV 1802.

Steel casing pipe nominal wall thickness shall be as following:

- 12.9 mm wall thickness for a 914 mm outside diameter steel casing pipe
- 12.7 mm wall thickness for a 965 mm outside diameter steel casing pipe

410.07 CONSTRUCTION

410.07.16 Pipe Installation in Casing

Sewer pipes under generator foundation footprint shall be installed in casing as shown on construction drawings.

410.07.17 Temporary Bypass

Contractor shall install and maintain the temporary bypass system for sanitary and storm sewers during construction.

Contractor shall provide the temporary bypass pumping documents (drawings, details, calculations, product specifications, etc.) signed by the professional engineer licensed in Ontario for consultant's review prior to construction start.

The bypass system shall have sufficient capacity to accommodate sanitary and storm flows under full-flow conditions in the existing sewers.

Contractor shall develop a plan of maintaining hospital entrance open during construction to ensure

that occupants can safely exist the building and provide this plan for consultant's review prior to construction start.

410.10 BASIS OF PAYMENT

410.10.04 Connection to Existing Sewer System – Lump Sum

Payment at the *Contract* price for this item shall be full compensation for all labour, equipment, and material required to do the work.

410.10.05 Steel Casing Pipe – Lump Sum

Payment at the *Contract* price for this item shall be full compensation for all labour, equipment, and material required to do the work.
Work for installation of sanitary sewer maintenance hole shall be completed as per OPSS.PROV 407.

Special Provision No. 10

CCTV INSPECTION

ITEM - CCTV INSPECTION

SCOPE

The provisions of OPSS. PROV 409 shall apply except as amended hereafter.

409.05 MATERIALS

409.05.01 General

Section 409.05.01 is amended by the addition of the following;

Media storage shall be a USB mass storage device.

The media storage device shall have a tag affixed to it with the required information.

409.07.01 Pipeline Cleaning

Section 409.07.01 is amended by the addition of the following;

All pipe sewers shall be cleaned and flushed just prior to inspection.

409.07.04 CCTV Inspection

409.07.04.01 General

Section 409.07.04.01 is amended by the addition of the following;

The *Contractor* shall implement flow control measures to ensure 100% of the pipe is visible. Flow control measures shall be approved by the *Contract Administrator*.

Main line and services shall be required.

409.07.05 Final Documentation

409.07.05.01 Inspection Reporting

Section 409.07.05.01 is amended by the addition of the following;

The inspection report shall include photographs of all major defects as well as a complete video of the works. All video and photos shall be completed in colour format. Reporting shall also include map references to coincide with the CCTV video footage.

409.09 MEASUREMENT FOR PAYMENT

Basis of Payment – Lump Sum

Payment at the *Contract* price for the as noted and above tender items shall be full compensation for all labour, equipment, and material required to do the work.

Non-compliant submissions returned for correction shall be corrected and resubmitted at no expense to the Owner.

APPENDIX A

Geotechnical Report

Geotechnical Investigation Report

Foundation Pad for New 2 kW Generator and Fuel Storage
Kingston General Hospital Site, Kingston, ON

Prepared for: Kingston Health Sciences Centre

June 19, 2026
File: 2021.00-101

Prepared by:
Malroz Engineering Inc.
308 Wellington St, 2nd Floor
Kingston, ON K7K 7A8

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Geotechnical Investigation Report

Foundation Pad for New 2 kW Generator and Fuel Storage
Kingston General Hospital Site, Kingston, ON

Prepared for:

Kingston Health Sciences Centre

File: 2021.00-101

Kingston Health Sciences Centre – 1 PDF copy
Malroz Engineering Inc. – 1 PDF copy

Notice to Reader

This document contains the professional opinion of Malroz Engineering Inc. (Malroz), as to the matters set out herein, based on professional judgement and reasonable care. It is to be read in the context of the agreement (the Agreement) between Malroz and Kingston Health Sciences Centre (the Client), the methodology, procedures and techniques used, Malroz's assumptions, and the circumstances and constraints under which its mandate was performed. This document is written solely for the purpose stated in the Agreement, and for the sole and exclusive benefit of the Client, whose remedies are limited to those set out in the Agreement. This document is meant to be read as a whole, and sections or parts thereof should not be read or relied upon out of context.

Malroz has, in preparing the geotechnical parameters and recommendations, followed accepted methodology and procedures, and exercised due care consistent with the intended level of accuracy, using its professional judgement and reasonable care, and is thus of the opinion that there is a high probability that actual geotechnical conditions will fall within the predicted range. However, no warranty should be implied as to the accuracy of estimates. Unless expressly stated otherwise, assumptions, data and information supplied by, or gathered from other sources (including the Client, other consultants, testing laboratories, equipment suppliers, etc.) upon which Malroz's opinions are based, have not been verified by Malroz; Malroz makes no representation as to their accuracy and disclaims all liability with respect thereto.

Malroz disclaims any liability to third parties in respect of the publication, reference, quotation, or distribution of this report or any of its contents and reliance thereon by any third party.

This page forms an integral part of this document and must remain with it at all times.

Respectfully submitted,

Malroz Engineering Inc.

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Figure 1 Borehole Location Plan

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1.0 Introduction

Malroz Engineering Inc. (Malroz) was retained by Kingston Health Sciences Centre (the Client) to conduct a geotechnical investigation in support of the construction of a proposed 2 kW generator with integrated fuel storage, located on the south side of Kingston General Hospital adjacent to King Street West in Kingston, ON (the Site).

This report summarizes the results of the geotechnical investigation, which was completed in general accordance with Malroz's approved proposal (ref. 2021.00-101-R01, dated February 24, 2026). The scope of work consisted of the following:

1. Advancement of a total of two boreholes at the Site, to a depth of 3.0 m or practical auger refusal, as specified by the Client;
2. Further advancement of each borehole by approximately 3 m to confirm the presence of rock, where refusal was encountered, to retrieve samples for further characterization and testing in the laboratory;
3. Installation of one monitoring well to make static groundwater observations;
4. Unconfined compressive strength tests on up to two recovered bedrock samples;
5. Analysis of four soil samples for environmental quality parameters; and
6. Reporting of field and laboratory results.

The recommendations and comments contained herein are based on factual information obtained during the investigation and are intended only for the use of project designers and engineers. They have been prepared with the understanding that the design will be carried out in accordance with applicable codes and standards. No investigations into environmental aspects of groundwater were included as a part of this scope of work. The General Conditions and Limitations (Section 7.0 of this report) form an integral part of this report.

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2.0 Site Description

The Site consists of a small asphalt parking lot and landscaped area located on the south side of Kingston general Hospital, adjacent to King Street West. The entrance ramp to the emergency department (including concrete retaining wall) was observed adjacent to the eastern limit of the work area. A concrete sidewalk was observed south of the work area.

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Photograph 1 – Site, south of BH101 looking north (March 2026)

Topography in the immediate area of the project area was generally flat. Regional topography around the Site slopes downwards southwest towards Lake Ontario.

3.0 Method of Investigation

3.1 Drilling Fieldwork

Two boreholes, identified as BH101 and BH102, were advanced on March 23 and March 24, 2026 at locations within the approximate anticipated area of excavation for the generator foundation. Boreholes were advanced using a Geoprobe 420M (a man-portable drilling rig) at both borehole locations due to site access constraints. Borehole locations are depicted in Figure 1 (Appendix A). Both borings were advanced to practical auger refusal, and were further advanced into bedrock using 'N' sized coring advanced with hand held core drilling equipment to confirm the presence of bedrock and recover samples for further description and testing in the laboratory.

Locations and ground surface elevations at each borehole (presented in metres above mean sea level (mASL), North American Datum 1983 (NAD83), zone 18 north) were surveyed by Malroz with Trimble R10 global navigation satellite system survey equipment, connected to the Can-Net virtual reference station network. Survey data is presented in the following table and assumed to be accurate to within the limits of the device.

Table 1 – Borehole Locations and Ground Surface Elevations

Test Location	Easting	Northing	Elevation (mASL)
BH101	380754.7	4897718.4	76.6
BH102	380753.5	4897730.7	77.0

Input By: TB
Validated By: DPH

Soil samples were collected while performing the Standard Penetration Test (SPT) in general accordance with the procedure as described in ASTM D1586. This consisted of freely dropping a 63.5 kg (140 lb) hammer from a vertical distance of 0.76 m (30 in), to drive a 51 mm (2 in) outer diameter split-barrel (split spoon) sampler into the ground. The number of blows of the hammer required to drive the sampler into the relatively undisturbed ground a distance of 300 mm (12 in) was recorded as the SPT 'N' value, which correlates to the relative density of non-cohesive soils and is, in certain cases, indicative of the consistency of cohesive soils. Each retrieved sample was placed in a resealable plastic bag.

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Samples collected for soil quality analytical testing were placed in laboratory provided containers, including field preservation using methanol vials, where applicable. Samples were kept cool until submittal to the analytical laboratory. Each sample was screened for headspace vapours from resealable plastic bags using an RKI Eagle combustible gas indicator (CGI) and photoionization detector (PID). Vapours were screened from the headspace of the Ziploc bags once the samples had equilibrated to room temperature and are summarized in Table D1, Appendix D.

Borehole BH101 was outfitted with a 50 mm diameter PVC monitoring well with flush-to-grade protective cover upon completion, as described in the borehole log in Appendix B.

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4.0 Subsurface Assessment

Details of the subsurface conditions encountered are presented in the borehole records presented in Appendix B of this report. We strongly emphasize, however, that the soil types, their sequence, thickness, and physical properties may vary between test boreholes, sample and test locations, both vertically and horizontally. This information is solely for general planning purposes and should not be used for detailed quantity take-offs.

4.1 Local Geology / Physiography

Bedrock geology at the Site is mapped as buff and green siltstone, dolomitic siltstone and lithographic limestone of the Gull River formation (Armstrong and Dodge, 2007; Carson, 1982). Surficial and quaternary geological mapping identify the area of the Site as Paleozoic bedrock exposed at surface or covered by a discontinuous, thin layer of drift (OGS, 2010, 2011).

4.2 Surficial Coverings

4.2.1 Asphaltic Concrete

Surficial asphaltic concrete was observed at both boreholes. The thickness of this material was measured to be approximately 50 mm at both locations.

4.3 Sandy Gravel Fill

A light grey sandy gravel fill with traces of silt was observed at both boreholes underlying the asphaltic concrete. This material was visually described as being generally moist. Moisture contents measured on recovered samples of this material ranged from 3 to 11% by dry weight. SPT ‘N’ values of 6 to 70 blows per 300 mm of penetration were measured in this material, which is indicative of a relative density ranging from loose to very dense.

4.4 Native Silty Clay

A dark brown silty clay with traces of sand was observed at borehole BH101 underlying the fill soil. This material was visually described as being generally moist. Moisture

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contents measured on recovered samples of this material ranged from 28 to 38% by dry weight. An SPT 'N' value of 5 blows per 300 mm of penetration were measured in this material, which is an estimate of a firm consistency.

4.5 Limestone Bedrock

Limestone bedrock was confirmed by core drilling at both borings as summarized in the following table. Core information and material descriptions are reported on the respective records of boreholes.

Table 2 – Bedrock Core Information Summary

Borehole / Core Run ID	Depth to Rock Surface (mbg/mASL)	Total Core Recovery, TCR (%)	Solid Core Recovery, SCR (%)	Rock Quality Designation, RQD (%)
BH101/RC1		100	94	83
BH101/RC2		95	95	90
BH101/RC3	2.2 / 74.4	98	85	85
BH102/RC1		100	8	0
BH102/RC2		100	31	11
BH102/RC3		100	7	0
BH102/RC4		100	36	19
BH102/RC5	2.0 / 75.0	100	39	23

Input By: TB
Validated By: DPH

Bedrock cores were described as grey limestone. A core log is attached in Appendix C.

Total core recovery (TCR) of the obtained cores was found to be between 95 and 100% and solid core recovery (SCR) was found to be between 7 and 95%. The solid core recovery is generally influenced by the orientations of joints and is low when joints oblique to the axis are intercepted. The rock quality designation (RQD) is highly dependent on the frequency of joints/bedding plane partings in the retrieved cores. On the basis of the recorded RQD values of between 0 and 90%, the rock quality is estimated to be very poor to excellent within the depths investigated.

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4.6 Groundwater

A detailed hydrogeological investigation was not included as a part of this work. However, water levels were recorded from a 50 mm diameter PVC monitoring well installed at borehole BH101.

Water level observations were made from the monitoring well on a subsequent visit to the Site on April 14, 2026, summarized in the following table.

Table 3 – Groundwater Observation (April 14, 2026)

Borehole ID	Groundwater Observation (mbg/mASL)
BH101	1.5 / 75.1

Input By: TB
Validated By: DPH

Groundwater levels can fluctuate greatly and vary based on the prevailing seasonal and atmospheric conditions (e.g., heavy rains, spring thaw, dry spells).

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5.0 Laboratory Testing

5.1 Geotechnical Laboratory

Samples recovered during drilling were transported to Malroz's geotechnical laboratory in Kingston, Ontario. Moisture contents were measured for most of the recovered soil samples with sufficient available quantity to test.

Laboratory test reports are included in Appendix C of this report, and summarized in the table below. Moisture contents are also summarized in borehole records in Appendix B.

In addition, unconfined compressive strength testing was conducted on two recovered samples of bedrock.

Table 4 – Summary of Unconfined Compressive Strength

Sample ID	Unconfined Compressive Strength (MPa)
BH101-RC1	140.8
BH102-RC2	138.9

Input By: TB
Validated By: DPH

Bedrock cores were described as grey limestone. Core photographs are attached in Appendix C.

5.2 Analytical Laboratory

Three soil samples (including one duplicate) were selected for laboratory analysis to provide characterization of environmental soil quality. The duplicate sample was collected for quality assurance/quality control (QA/QC).

Samples were submitted to an external analytical laboratory, Paracel Laboratories Ltd., for selective analyses of metals and hydride-forming metals; electrical conductivity (EC); sodium adsorption ratio (SAR); polycyclic aromatic hydrocarbons (PAHs); petroleum hydrocarbons (PHC F1-F4); benzene, toluene, ethylbenzene, and xylenes (BTEX); and pH. Soil analytical results for the Site are presented in Table D1 and discussed further in Section 6.4. Laboratory certificates of analysis are provided in Appendix E.

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Samples were submitted to an external analytical laboratory, Paracel Laboratories Ltd., for selective analyses of petroleum hydrocarbons (PHC F1-F4), and benzene, toluene, ethylbenzene, and xylenes (collectively known as BTEX), polycyclic aromatic hydrocarbons (PAHs), metals, electrical conductivity (EC), and sodium adsorption ratio (SAR). Select samples were assessed for pH for the purpose of confirming applicable reference standards. Soil analytical results for the Site are presented in Table D1, Appendix D, and discussed further in Section 6.5. Laboratory certificates of analysis are provided in Appendix E.

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6.0 Discussion and Recommendations

6.1 Excavations and Shoring

Excavations to a minimum of 2 to 2.5 m from existing site grades are expected to be required to reach a uniform bedrock subgrade for the placement of foundations and/or subgrade for the integrated below grade fuel tank. The use of shoring will likely be required as there may be insufficient lateral distance available to prevent impact to adjacent infrastructure, without the provision of proper supports. No excavations should extend within a zone extending 10 horizontal to 7 vertical from the bottom outside edge of any new or existing foundations or infrastructure (e.g. utilities) without the provision of proper support, to prevent them from becoming undermined.

All excavations and construction of any shoring should be carried out in accordance with the latest edition of the OHSA and Regulations for Construction Projects. The OHSA regulations require that if workers must enter an excavation deeper than 1.2 m, the excavation must be suitably sloped and/or braced in accordance with OHSA requirements. OHSA specifies the maximum slope of excavations into four broad soil types, summarized as follows:

Table 5 – OHSA Soil Types

Soil Type	Maximum Slope Inclination	Base of Slope Location
Type 1	1 horizontal to 1 vertical	Within 1.2 m of base of excavation
Type 2	1 horizontal to 1 vertical	Within 1.2 m of base of excavation
Type 3	1 horizontal to 1 vertical	From bottom of excavation
Type 4	3 horizontal to 1 vertical	From bottom of excavation

Both fill and native soils at this Site can be considered Type 3 at BH101, however fill soils at BH102 were found to be loose and should be considered as Type 4. However, any soils affected by seepage must be considered as Type 4. The highest soil type in any given excavation shall govern its sideslopes, therefore it is recommended that Type 4 be considered for this excavation.

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Excavations into overburden soils should be relatively easy using conventional excavating equipment; however, contractors should be prepared to manage erratic large particles up to boulder sized material. The use of breakers or blasting techniques would be necessary for rock at this Site. Use of rippers in this formation is not anticipated to be feasible. Some upper weathered bedrock may be able to be removed with conventional excavating equipment. For planning purposes, weathered bedrock within 1 m of the rock surface should be backsloped at 1:1, while bedrock below this depth should be able to remain near vertical in the short term (e.g. for the duration of construction activities). Contractors should take into consideration the unconfined compressive strength testing results in selection of their equipment.

Construction of the existing structures may have fractured the bedrock immediately adjacent, and may require additional removals to reach a suitable subgrade. It is accordingly recommended that some additional allowances be made for rock removals.

Stockpiles of excavated materials should be kept away from the edges of open excavations by a distance at least equivalent to the depth of the excavation to avoid slope instability. Care should be taken to avoid overloading any underground services/structures from any construction stockpiles. It should be noted that this distance is also applicable to the passage of heavy machinery near excavations. This condition should be respected at all times, unless specific studies are conducted for individual cases.

A shoring system will be required anywhere appropriate back sloping is not possible. Shoring systems must be designed by a professional engineer licensed in the province of Ontario, in accordance with relevant codes, standards and regulations such as the latest version of the Canadian Foundation Engineering Manual and the Ontario Occupational Health and Safety Act (OHSA) Regulations for Construction Projects. The system should be designed to resist full earth and hydrostatic pressures, as well as surcharges due to construction and highway traffic loadings. The following parameters may be used in the design of temporary shoring:

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Table 6 – Lateral Earth Pressure Parameters

Soil Type	Bulk Unit Weight (kN/m^3)	Angle of Internal Friction (deg.)	Coefficient of Lateral Earth Pressure		
			K_a	K_o	K_p
Sandy Fill	20.5	29	0.35	0.52	2.88
Native Silty Clay	19.0	29	0.35	0.52	2.88
Compacted Gran. 'A'	21.0	34	0.28	0.44	3.54
Compacted Gran. 'B' Type II	21.5	35	0.27	0.43	3.69

At rest parameters should be utilized for non-yielding shoring elements. We recommend shoring plans be reviewed by a geotechnical engineer prior to the start of construction.

6.2 Foundations

New shallow foundations constructed directly over competent limestone bedrock can be designed considering a geotechnical bearing reaction of 5 MPa under factored ultimate limit state (ULS) conditions. There would be no corresponding serviceability limit state (SLS) bearing reaction, as brittle failure of the rock mass would occur prior to any deformation occurring. A lean mix concrete may be considered to provide a uniform working surface or as backfill in any rock overexcavation, with the above mentioned bearing reaction. The minimum 28 day compressive strength of this concrete should be 10 MPa. If a granular pad is placed over rock to support foundations, bearing reactions of 500 kPa at the factored ULS and 450 kPa can be considered.

All subgrade surfaces should be examined by a geotechnical engineer or a qualified technician/technologist acting under the supervision of a geotechnical engineer prior to placement of concrete.

6.2.1 Design for Earthquakes

In accordance with the Canadian Highway Bridge Design Code 2014 (CHBDC), foundations must be designed to withstand a minimum earthquake force. Based on the measured standard penetration resistance of soil strata encountered during the investigation, and assuming bedrock as encountered extends to a minimum of 30 mbg, a Site Classification for Seismic Site Response of 'C' may be considered by designers. Site class can be verified through direct in-situ measurement of shear wave velocities

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by geophysical methods such as multi-channel analysis of surface waves or refraction tomography (and in this case potentially improved).

6.2.2 Frost Protection

A permanent soil cover of 1.5 m or an equivalent in thermal protection must be provided at this Site. If thermal insulation is considered, placement instructions should be in accordance with the manufacturer's directions. It is important to consider that some products may be required to be placed directly on the subgrade surface prior to the placement of concrete.

6.3 Backfilling

Backfill behind the structure should consist of non-frost susceptible, free draining granular material. Below pavement surfaces, all backfill material should be compacted to a minimum of 98% of its Standard Proctor Maximum Dry Density (SPMDD) to 1 m below the pavement subbase, and 100% thereafter. Elsewhere, all backfill should be compacted to at least 98% of its SPMDD.

6.4 Engineered Fill

Engineered Fill application will be required on this project for reconstruction of the roadway and for buried utilities. For any operation to be considered Engineered Fill, the following criteria must be satisfied:

- Materials used as Engineered Fill must be uniform and homogenous. The material should be free of deleterious materials and organics;
- Prior to the placement of Engineered Fill, it must be assessed in a geotechnical laboratory for, at a minimum, gradation and Standard Proctor analyses;
- The material must be within +/- 2% of its optimum moisture content, as determined through laboratory testing;
- Engineered Fill operations must take place under the supervision of a geotechnical engineer or their designate;
- Suitable compaction equipment must be selected for the operation, based on the material to be compacted;

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- Materials should be placed in lifts which are suitable for the compaction equipment utilized, but generally not greater than 0.2 m loose lifts;
- Density testing must be taken on each lift of Engineered Fill;
- Any Engineered Fill which is tested and found to be outside of the specified density range shall be either removed, reworked or retested; and
- Under no circumstances shall frozen material be placed in any Engineered Fill operation.

6.5 Soil Quality Characterization

Soil that cannot be reused within the project area and will be removed is considered excess soil and must be managed in accordance with the requirements of Ontario Regulation 406/19 and the related Rules for Soil Management and Excess Soil Quality Standards (the Soil Rules and ESQS) published by the Ministry of the Environment, Conservation and Parks (MECP) and last updated in 2025.

The soil quality characterization program was undertaken to obtain information to support future excess soil management activities in accordance as required by the regulation. Additional excess soil planning activities (e.g. an Assessment of Past Use and Sampling and Analysis Plan) may need to be completed if the project requires registration on the Excess Soil Registry. Preliminarily, we understand that excess soil registration is not expected to be requirement given that:

- No part of the project area is or has been part of an enhanced investigation project area (e.g. industrial use, garage, or fuel dispensing facility),
- Less than 2,000 m^3 of excess soil is expected to be generated from the project, and
- The project does not include remediation for the purpose of reducing the concentrations of contaminants.

Applicable environmental standards were selected by referencing the ESQS published by the MECP (2025) to assess soil quality for potential reuse of excess soil. Potential excess soil reuse sites have not been identified at the time of issue of this report. However, based on anticipated property uses for potential receiving sites, sample results were compared to the following volume independent ESQS:

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- Table 1 Full Depth Background Site Condition Standards for residential/parkland/institutional/industrial/commercial/community (RPIICC) property use,
- Table 2.1 Full Depth ESQS in a Potable Ground Water Condition for residential/parkland/institutional (RPI) property use, and
- Table 3.1 Full Depth ESQS in a Non-Potable Ground Water Condition for industrial/commercial/community (ICC) property use.

In general, Table 3.1 ICC standards are the least stringent of the foregoing standards, and the Table 1 standards are the most stringent. Once one or more reuse sites have been identified, the Project Leader, in consultation with a Qualified Person (QP), must confirm the appropriate reuse standards. This may require comparison of data to additional/alternate reference standards.

Soil analytical results for the Site are compared to the ESQS in Table D1 (Appendix D). Results of pH analysis between 7.96 and 10.93, which is within the specified range of values for subsurface soil of 5 to 11 to apply the generic ESQS, but exceeded the acceptable range for surface soil of 5 to 9 at sample location BH101-S01. Analytical results exceeded the MECP Table 2.1 RPI and Table 3.1 ICC ESQS as follows:

- Petroleum hydrocarbons (PHC) exceed the Table 2.1 RPI ESQS for fractions 2 and 3 (F2 and F3) in sample BH102-S02.
- Xylenes exceeded the Table 2.1 RPI ESQS at one sample location (BH102-S02);
- Multiple PAHs exceeded the Table 2.1 RPI and Table 3.1 ICC ESQS at one sample location (BH102-S01);
- Boron exceeded the Table 2.1 RPI and/or Table 3.1 ICC ESQS at both samples from BH102.
- EC and/or SAR exceeded the Table 2.1 RPI and/or Table 3.1 ICC ESQS at each of the four sample locations (BH101-S01).

Based the ESQS exceedances identified above, excavated surplus soil is expected to require disposal at a licensed waste disposal facility, unless a suitable reuse site can be identified (e.g., a reuse site where alternate, less stringent soil quality standards have been developed or are otherwise applicable). If an appropriate reuse site is identified, analytical results must meet the applicable standards for the reuse site, as determined

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by a Qualified Person, QP, based on the On-Site and Excess Soil Management regulation and related Rules.

The Source Site Project Leader and contractor must ensure that soil hauling records are created/maintained and available at all time during excess soil transportation, in accordance with section 18 of O. Reg. 406/19. Furthermore, contingency measures must be identified by the Source Site, in accordance with section 19, which identify an alternate site at which soil may be deposited if it cannot be received at the identified disposal or reuse site.

If excavated soil will be reused off-site as excess soil, the Project Leader and contractor must ensure that excess soils are adequately represented by the samples and ensure that soil types and conditions are consistent with the observations provided in this Preliminary Soil Quality Characterization Summary. The soil quality, quantity, and use must be compatible with the reuse site setting and any applicable site instruments (e.g. permits, licenses) and should be confirmed by a QP prior to transferring the soil to the reuse site. Written consent for reuse of the soils must be obtained from the reuse site by the Project Leader.

Throughout the work, the contractor should take all necessary precautions to keep excess soil separated from asphaltic materials and any other non-soil materials encountered during the work.

If further evidence of contamination is encountered during excavation (e.g., stained or discoloured earth, garbage or waste, oily residue on soils, drums or containers, sheen/product/film, cinders/ash, etc.), excavation must be halted and the contract authority should be immediately notified so that soils may be re-evaluated by Malroz or an alternate QP. If evidence of contamination is encountered, appropriate efforts should be undertaken to mitigate potential contaminant migration from erosion or sedimentation, including but not limited to covering stockpiles with an impermeable barrier (e.g., polyethylene sheeting).

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7.0 General Conditions and Limitations

This report was completed for the specific needs of Kingston Health Sciences Centre and is based on a specific scope of work which is defined in the mutually agreed upon workplan. The scope of work has limitations as described throughout the report and in the notice to reader. Data, tables, charts, and interpretive illustrations presented in this document are instruments of service for this mandate and can only be properly evaluated when reviewed together with the accompanying report. Reference to this report should only be made to the complete signed document.

By issuing this report, Malroz is the Geotechnical Engineer of Record for this project. It is recommended that Malroz be retained during construction of all foundations, for earthwork operations and for paving. The intent of this requirement is to verify conditions encountered during construction are consistent with the findings in the report and, that inherent knowledge developed as a part of our study is correctly carried forward to construction phases. We should be retained to review whether our recommendations have been applied appropriately, once drawings and specifications are complete. Without this review, Malroz will not be liable for any misunderstanding of our recommendations or their application and adaptation into final designs.

The work performed in this report was carried out in accordance with the terms and conditions made as a part of our proposal and/or contract pursuant to which this report was issued, in a manner consistent with that level of care and skill ordinarily exercised by members of the Geotechnical Engineering profession currently practicing under similar conditions in the same locality. The conclusions presented in the report are based solely upon the scope of services, governed by the time and budgetary considerations to which this work was subject.

The factual data, recommendations and comments in this report pertain to the specific project as described in the report and are not applicable to any other project or location. If the project is conceptually modified or changes location, or if it is not initiated within twelve months of the date of this report, Malroz should be given an opportunity to confirm that the information in this report is still valid and/or applicable.

The comments in this report are intended only for the guidance of project designers and engineers. Contractors bidding on or undertaking the work should rely on their own

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investigations, as well as their own interpretations of the factual test pit and in-situ test information, and how subsurface conditions may affect their work.

This report must be read as a whole, as sections taken out of context can be misleading. Drafts and working copies, whether or not marked as “draft”, “for discussion purposes” or otherwise, do not necessarily reflect Malroz’s final opinion following consideration of all matters which are subject to the study giving rise thereto; they are issued for comment and information purposes only, and are subject to change and should not be relied upon in any way or for any purpose.

It is important to emphasize that a soil investigation is, in fact, a random sampling of a site and the comments included in this report are based solely on the results obtained at the test pit locations only. Soil and groundwater conditions between and beyond the test pit locations may differ both horizontally and vertically from those encountered at the test pit locations and may become apparent during construction, which could not be detected or anticipated at the time of our investigation. Should any conditions at the site be encountered which differ from those found during this investigation, we request that we be notified immediately in order to permit a reassessment of our comment and recommendations. If changed conditions are identified during construction, no matter how minor, the recommendations in this report shall be considered invalid until sufficient review and written assessment of said conditions by Malroz has been completed.

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8.0 Closure

We trust that this report meets your present requirements. Please do not hesitate to contact us should there be any further questions or comments.

Respectfully Submitted,

Malroz Engineering Inc.,

per: Tristan Brundridge, C.Tech.
Senior Technologist, Project Coordinator

per: Dylan Hill, P. Eng.
Principal Geotechnical Engineer

reviewed: David Hodgson, P.Eng.
Senior Engineer, Principal

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9.0 References

Armstrong, D.K. and Dodge, J.E.P. 2007. Paleozoic geology of southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 219.

Canadian Geotechnical Society (2023). Canadian Foundation Engineering Manual, 5th Edition.

Carson, D.M. (2007) Palaeozoic Geology of the Bath-Yorkshire Island Area, Southern Ontario; Ontario Geological Survey, Map P.2497, Geological Series – Preliminary Map, Scale 1:50 000, Geology 1981.

[OGS] Ontario Geological Survey (2000). Quaternary geology, seamless coverage of the Province of Ontario; Ontario Geological Survey, Data Set 14---Revised.

[OGS] Ontario Geological Survey (2010). Surficial geology of Southern Ontario; Ontario Geological Survey, Miscellaneous Release--Data 128-REV

[OGS] Ontario Geological Survey (2011). 1:250 000 scale bedrock geology of Ontario; Ontario Geological Survey, Miscellaneous Release---Data 126-Revision 1.

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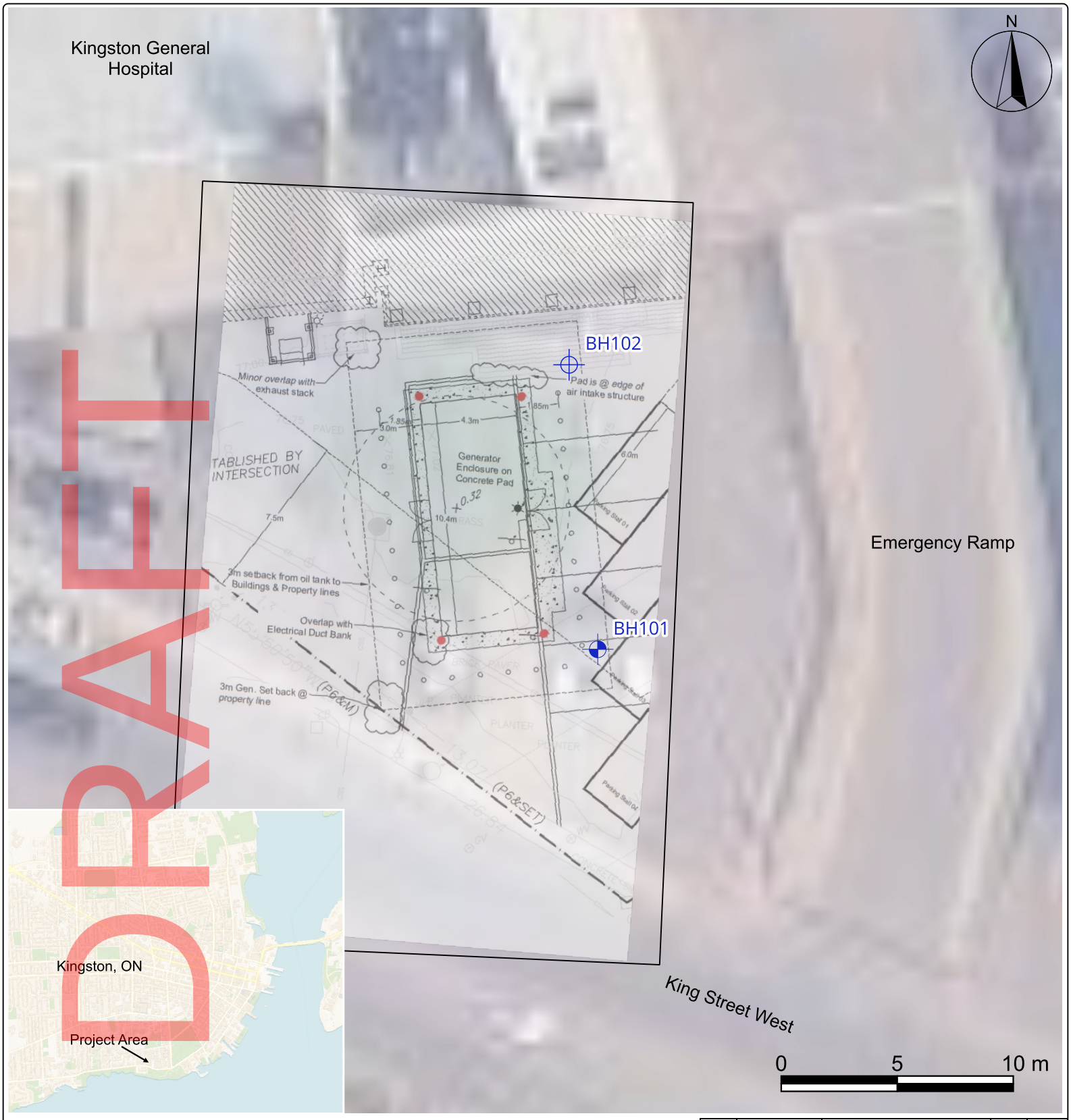
Appendix A
Figures



Legend

- approximate monitoring well location
- approximate borehole location

Rev	Date	Description	By	Chkd
D0	2026-04-16	issued in draft	TB	DPH

Borehole Location Plan

Geotechnical Investigation for Foundation Pad for New 2 kW Generator and Fuel Storage
Kingston General Hospital, Kingston, ON

File: 2021.00-101

Figure 1 Draft

MALROZ

Data Sources: Figure based on Malroz field observations and Google Earth imagery. Generator details provided in e-mail from Client.

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Appendix B
Record of Boreholes

WELL LOG

Enclosure No.: 1

Project Name: **Geotechnical Investigation for Foundation Pad for New 2 kW Generator and Fuel Storage**		Project Number: **2021.00-101**
Client: **Kingston Health Sciences Centre**	Well Number: **BH101**	Page: **1 of 1**
Location: **Kingston General Hospital, Kingston, ON**	Date Started: **2026 March 23**	Datum: **UTM NAD83 - Zone 18T**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2026 March 24**	Elevation: **76.6 m**
Drilling Equipment: **Geoprobe 420M**	Easting: **380754.7 m**	Northing: **4897718.4 m**
Drilling and Sampling Method: **50mm Split Spoons, and Coring (NQ)**	Logged By: **W. Archer**	Checked By: **T. Brundridge**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Monitoring Well	Sample Type	Enviro Sample	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 (DCPT, SPT-N; PL MC LL 20 40 60 80)	Combustible Vapours (%LEL) 10 30 50 70 90 / PID (ppm) 10 30 50 70 90
0.0	77.4		**ASPHALT** Approximately 50 mm.	0.1			S01				nr
0.2			**FILL** Sandy gravel, trace silt, light grey, moist, very dense to compact.				SS1	54	70	6, 70	nr
0.4											
0.6											
0.8				0.9			S02				nr
1.0							SS2	46	12	12, 11	nr
1.2	76.2		**SILTY CLAY** Trace sand, dark brown, moist to damp, firm.	1.2							
1.4							SS3	92	5	5, 38	nr
1.6							S03				nr
1.8							S04				nr
2.0							SS4	36		28	nr
2.2	75.3		**LIMESTONE** Grey, good to excellent quality. Scr: 94%.								
2.4							RC1	100	83		
2.6											
2.8			Scr: 95%.								
3.0											
3.2											
3.4											
3.6							RC2	95	90		
3.8											
4.0											
4.2											
4.4			Scr: 85%.								
4.6											
4.8											
5.0							RC3	98	85		
5.2											
5.4											
5.6											
5.8	71.6		Borehole terminated in limestone bedrock at 5.8 mbg.								
6.0											
6.2											
6.4											

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NOTES:

Well Construction Details
flushmount protective cover
Sch. 40 PVC
slotted screen
0.9 m screen
#1 sand

Groundwater Monitoring Details
monitored on 2026 April 14
DTW[1]: 1.5 m
DTB[1]: 2.1 m
[1]depths are reported from grade

nr: no response on the instrument or below 1% of the lower explosive limit

BOREHOLE LOG 2021.00 - BOREHOLE LOGS.GPJ MALROZ ENGINEERING.GDT 26-4-16

BOREHOLE LOG

Enclosure No.: 2

Project Name: **Geotechnical Investigation for Foundation Pad for New 2 kW Generator and Fuel Storage**		Project Number: **2021.00-101**
Client: **Kingston Health Sciences Centre**	Borehole Number: **BH102**	Page: **1 of 1**
Location: **Kingston General Hospital, Kingston, ON**	Date Started: **2026 March 23**	Datum: **UTM NAD83 - Zone 18T**
Drilling Contractor: **Strata Drilling Group Ltd.**	Date Finished: **2026 March 24**	Elevation: **77.0 m**
Drilling Equipment: **Geoprobe 420M**	Easting: **380753.5 m**	Northing: **4897730.7 m**
Drilling and Sampling Method: **50mm Split Spoons, and Coring (NQ)**	Logged By: **W. Archer**	Checked By: **T.Brundridge**

Depth BGS (m)	Elevation (m)	Stratigraphy	Description	Sample Type	Enviro Sample	Sample Number	Recovery (%)	SPT 'N' / RQD	Shear Strength (kPa) 50 100 150 200 ■ DCPT ● SPT-N ● PL MC LL 20 40 60 80	Combustible Vapours (%LEL) 10 30 50 70 90 ✳ PID (ppm) 10 30 50 70 90
0.0	77.8		**ASPHALT** Approximately 50 mm.			S01				nr
0.2			**FILL** Sandy gravel, light grey, moist, loose to compact.			S02	63	17	17 2	nr
0.4						SS1				nr
0.6										
0.8						SS2	17	6	6 3	nr
1.0										
1.2										
1.4						SS3	25	12	12 3	nr
1.6										
1.8						SS4			12	nr
2.0	75.8		**LIMESTONE** Grey, very poor quality. Scr: 8%.			RC1	100	0		
2.2										
2.4										
2.6			Scr: 31%.							
2.8						RC2	100	11		
3.0										
3.2										
3.4			Scr: 7%.							
3.6						RC3	100	0		
3.8										
4.0			Scr: 36%.							
4.2						RC4	100	19		
4.4										
4.6			Scr: 39%.							
4.8						RC5	100	23		
5.0	72.8		Borehole terminated in limestone bedrock at 5.1 mbg.							
5.2										
5.4										
5.6										
5.8										
6.0										
6.2										
6.4										

NOTES: nr: no response on the instrument or below 1% of the lower explosive limit

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Appendix C
Geotechnical Laboratory Results and Core Photographs

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Summary of Results for Unconfined Compressive Strength

Sample ID	Density (g/cm^3)	UCS (MPa)
BH101-RC2	2.764	140.77

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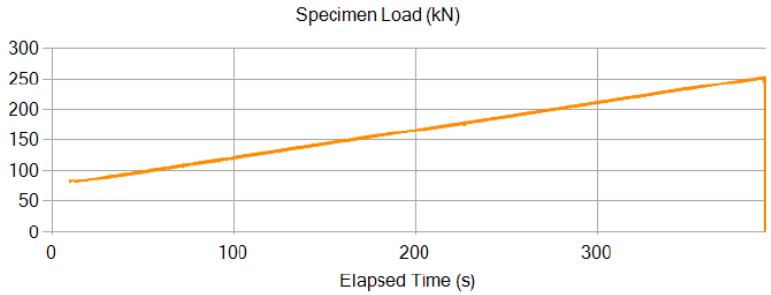
Client:	Jamie Thompson
Project No.:	2021
Location:	Kingston General Hospital, King Street West, Kingston, ON
BH:	BH-101
Depth:	0.91mbg
Lab No.:	SA26-016
Date Sampled:	2026-03-24
Sampled By:	William Archer
Date Tested:	2026-03-26



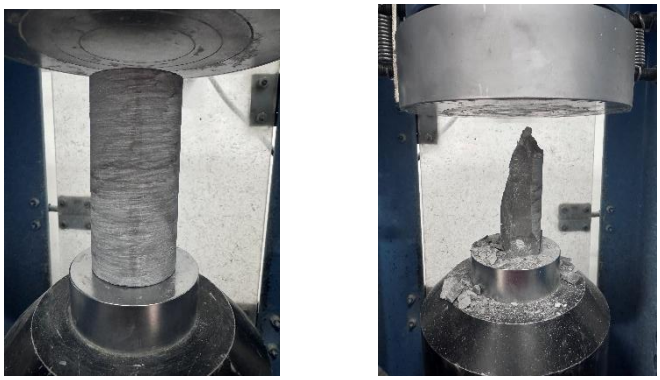


***Figure 1**: Pre- and Post-Test Specimen Photos*

Tested By: Will Archer
Approver:
Date: 2026-03-27

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Summary of Results for Unconfined Compressive Strength

Sample ID	Density (g/cm^3)	UCS (MPa)
BH102-RC2	2.912	138.94

DRAFT

Client:	Jamie Thompson
Project No.:	2021
Location:	Kingston General Hospital, King Street West, Kingston, ON
BH:	BH-102
Depth:	RC-2
Lab No.:	SA26-016A
Date Sampled:	2026-03-23
Sampled By:	William Archer
Date Tested:	2026-03-26

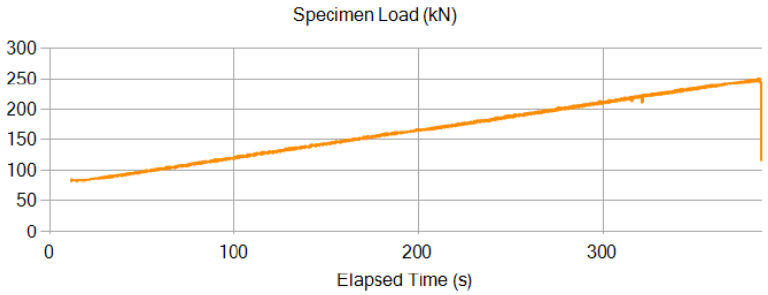


***Figure 1**: Pre- and Post-Test Specimen Photos*

Tested By: Will Archer
Approver:
Date: 2026-03-18

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Figure 1 – BH101/RC1, RC2 & RC3

Figure 2 – BH102/RC1, RC2, RC3, RC4 and RC5

Malroz Engineering Inc. Laboratory
614 Norris Court, Unit 5
Kingston, ON, K7P 2R9

Moisture Content (D2216)

Project:	2021.00			Client:	Kingston Health Sciences Centre			Date:	2026-03-24
Lab No:	SA26-016			Location:	Kingston General Hospital			Tested By:	WA
Borehole No.	Sample No.	Tare Weight (g)	Tare + Wet Soil (g)	Tare + Dry Soil (g)	Moisture (g)	Dry Soil (g)	Wet Soil (g)	Moisture Content (%)	Sample Description
BH101	SS1	1.2	36.0	34.2	1.80	33.00	34.80	**5.5**	
BH101	SS2	1.2	35.0	31.6	3.40	30.40	33.80	**11.2**	
BH101	SS3	1.2	43.3	31.8	11.50	30.60	42.10	**37.6**	
BH101	SS4	1.2	42.4	33.5	8.90	32.30	41.20	**27.6**	
BH102	SS1	1.2	58.2	57.0	1.20	55.80	57.00	**2.2**	
BH102	SS2	1.2	40.8	39.6	1.20	38.40	39.60	**3.1**	
BH102	SS3	1.2	38.4	37.3	1.10	36.10	37.20	**3.0**	
BH102	SS4	1.2	51.8	46.6	5.20	45.40	50.60	**11.5**	

Input By: TB

Validated By: DPH

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Appendix D
Analytical Laboratory Results

Table D1
Sample Submission Summary

Location	Sample ID	Depth to Sample (mbg)	Soil Type	Soil Vapour Concentrations [1]		Analyses								Rationale for Submittal
				Full Gas Combustible (ppm)	Organic (ppm)	PHCs	BTEX	VOCs	PAHs	Metals	EC/SAR	Corrosivity Parameters	pH	
BH101	S01	0.1-0.2	fill, sandy gravel	nr	nr	1	1		1	1	1		1	assesses shallow fill
	S02	0.8-0.9	fill, sandy gravel	nr	nr	1	1		1	1	1		1	assesses fill material
	SS3	1.2-1.8	silty clay	nr	nr							1		assesses deeper soil for contamination
	S03	1.5-1.6	silty clay	nr	nr									assesses native material
	S04	1.6-1.8	silty clay	nr	nr									
BH102	S01	0.1-0.6	fill, sandy gravel	nr	nr	1	1		1	1	1		1	assesses shallow fill
	S02	0.2-0.6	fill, sandy gravel	nr	nr	1	1		1	1	1		1	duplicate of BH102-S01.

Notes:

[1] vapours measured using an RKI Eagle 2 equipped with a combustible gas indicator and photoionization detector; measurements collected from the field during drilling

[1] vapours measured using an RKI Eagle 2 equipped with a combustible gas indicator and photoionization detector; measurements collected from headspace vapours

ppm parts per million
%LEL denotes percent of the lower explosive limit
mbg meters below grade
- not measured
nr no response on instrument

Data Input: WA
Data Check: TB

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Table D2
Soil Analytical Results

Parameter	Location		BH101		BH102		"Table 3.1": Volume Independent, Industrial / Commercial / Community Property Use (2025)		"Table 2.1": Volume Independent, Residential / Parkland / Institutional Property Use (2025)		"Table 1": Residential / Parkland / Institutional / Industrial / Commercial / Community Property Use (2011)	
	Sample ID		BH101-S01	BH101-S02	BH102-S01	BH102-S02						
	Date Sampled		2026-03-23	2026-03-23	2026-03-23	2026-03-23						
	Date Analyzed [1]		2026-03-31	2026-03-31	2026-03-31	2026-03-31						
	Lab Report ID		2613521-01	2613521-02	2613521-03	2613521-04						
	Depth (m)		0.10	0.15	0.13	0.76						
	Soil Type		sandy gravel, fill	sandy gravel, fill	sandy gravel, fill	sandy gravel, fill						
	Units	MDL										
PHCs												
PHC F1 (C6-C10)	ug/g	7	<	<	<	<	25		25		25	
PHC F2 (>C10-C16)	ug/g	4	<	<	10	12	26		10		10	RL
PHC F3 (>C16-C34)	ug/g	8	39	<	108	258	1700		240		240	
PHC F4 (>C34-C50)	ug/g	6	116	<	74	354	3300		2800		120	
F4G PHCs (gravimetric)	ug/g	50	301	-	207	745	3300		2800		120	
BTEX												
Benzene	ug/g	0.02	<	<	<	<	0.034		0.02		0.02	RL
Ethylbenzene	ug/g	0.05	<	<	<	<	1.9		0.05		0.05	RL
Toluene	ug/g	0.05	<	<	<	<	7.8		0.2		0.2	RL
Xylene m,p-	ug/g	0.05	<	<	<	0.13						
Xylene, o-	ug/g	0.05	<	<	<	<						
Xylene, (total)	ug/g	0.05	<	<	<	0.13	3		0.091		0.05	RL
Polycyclic Aromatic Hydrocarbons												
Acenaphthene	ug/g	0.02	<	<	0.43	0.04	15		2.5		0.072	
Acenaphthylene	ug/g	0.02	<	<	0.04	<	0.093		0.093		0.093	
Anthracene	ug/g	0.02	<	<	1.04	0.12	0.16		0.16		0.16	
Benzo(a)anthracene	ug/g	0.02	<	<	1.66	0.22	1		0.5		0.36	
Benzo(a)pyrene	ug/g	0.02	<	<	1.68	0.23	0.7		0.31		0.3	
Benzo(b/j)fluoranthene	ug/g	0.02	<	<	1.10	0.16	7		3.2		0.47	
Benzo(g,h,i)perylene	ug/g	0.02	<	<	0.72	0.10	13		6.6		0.68	
Benzo(k)fluoranthene	ug/g	0.02	<	<	0.62	0.09	7		3.1		0.48	
Chrysene	ug/g	0.02	<	<	1.44	0.20	14		7		2.8	
Dibenzo(a h)anthracene	ug/g	0.02	<	<	0.19	0.03	0.7		0.57		0.1	RL
Fluoranthene	ug/g	0.02	<	<	4.81	0.50	70		0.69		0.56	
Fluorene	ug/g	0.02	<	<	0.47	0.04	6.8		6.8		0.12	
Indeno[1 2 3-cd]pyrene	ug/g	0.02	<	<	0.61	0.09	0.76		0.38		0.23	
Methlynaphthalene, 1-	ug/g	0.02	<	<	0.07	<						
Methlynaphthalene, 2-	ug/g	0.02	<	<	0.10	<					0.59	
Methlynaphthalene, 2-(1-)	ug/g	0.04	<	<	0.17	<	8.7		0.59		0.59	
Naphthalene	ug/g	0.01	0.02	<	0.30	0.02	1.8		0.2		0.09	
Phenanthrene	ug/g	0.02	<	<	4.68	0.43	12		6.2		0.69	
Pyrene	ug/g	0.02	<	<	3.59	0.38	70		28		1	
Metals and Inorganics												
Antimony	ug/g	1.0	<	<	<	<	40		7.5	a	1.3	
Arsenic	ug/g	1.0	2.2	3.9	1.8	1.8	18		18		18	
Barium	ug/g	1.0	66.3	248	41.0	57.2	670	a	390	a	220	
Beryllium	ug/g	0.5	<	1.0	<	<	8	a	4	a	2.5	
Boron	ug/g	5.0	15.2	11.7	19.2	20.2	120		120		36	
Boron (Hot Water Soluble)	ug/g	0.5	0.5	<	1.9	2.3	2		1.5		NA	
Cadmium	ug/g	0.5	<	<	<	<	1.9	a	1.2		1.2	
Chromium (total)	ug/g	5.0	14.8	41.4	10.4	13.5	160	a	160	a	70	
Chromium VI	ug/g	0.2	0.7	<	<	1.5	8		8		0.66	
Cobalt	ug/g	1.0	3.6	14.9	3.6	3.8	80	a	22	a	21	
Copper	ug/g	5.0	7.1	27.9	10.5	13.5	230	a	140	a	92	
Lead	ug/g	1.0	9.2	10.5	13.7	19.0	120		120		120	
Mercury	ug/g	0.1	<	<	<	<	0.27		0.27		0.27	
Molybdenum	ug/g	1.0	<	<	<	1.4	40	a	6.9	a	2	a,RL
Nickel	ug/g	5.0	9.9	29.1	9.9	10.8	270	a	100	a	82	
Selenium	ug/g	1.0	<	<	<	<	5.5	a	2.4	a	1.5	
Silver	ug/g	0.3	<	<	<	<	40	a	20	a	0.5	a,RL
Thallium	ug/g	1.0	<	<	<	<	3.3	a	1	a	1	a,RL
Uranium	ug/g	1.0	<	<	<	<	33	a	23	a	2.5	
Vanadium	ug/g	10.0	13.6	59.1	<	10.2	86		86		86	
Zinc	ug/g	20.0	<	71.6	<	29.1	340	a	340	a	290	
General Chemistry												
Conductivity	mS/cm	0.005	4.190	2.040	2.570	2.190	1.4		0.7		0.57	
pH	pH Units	0.05	10.93	7.96	8.14	8.17						
Sodium Adsorption Ratio (SAR)	N/A	0.01	21.9	9.26	0.97	1.52	12		5		2.4	

Data Input: MM
Data Check: SG

Notes:

BH###-S##	borehole and sample ID
MDL	method detection limit
<	result below method detection limit
<#	elevated MDL
–	not analyzed
na	not applicable
a	leachate analysis is required if parameter is a contaminant of potential concern in excess soil volumes >350 m³ or for environmentally sentitive receiving sites
[1]	samples analysed between March 31, 2026 and April 2, 2026

Red, bold and underlined indicates value exceeds MECP O.Reg. 406/19 "Table 3.1": Volume Independent, Industrial / Commercial / Community Property Use (2025)

Orange, bold and underlined indicates value exceeds MECP O.Reg. 406/19 "Table 2.1": Volume Independent, Residential / Parkland / Institutional Property Use (2025)

Blue, bold and underlined indicates value exceeds MECP O.Reg. 406/19 "Table 1": Residential / Parkland / Institutional / Industrial / Commercial / Community Property Use (2011)

Black, bold and underlined indicates detection limit exceeds MECP Site Condition Standards

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Appendix E
Analytical Laboratory Certificates of Analysis

PARACEL LABORATORIES LTD.

TRUSTED.
RESPONSIVE.
RELIABLE.

300 - 2319 St. Laurent Blvd
Ottawa, ON, K1G 4J8
1-800-749-1947
www.paracellabs.com

Certificate of Analysis

Malroz Engineering Incorporated
308 Wellington Street 2 nd Floor
Kingston, ON K7K 7A8
Attn: Dave Hodgson

Client PO:
Project: 2021
Custody: 80959

Report Date: 2-Apr-2026
Order Date: 27-Mar-2026

Order #: 2613521

This Certificate of Analysis contains analytical data applicable to the following samples as submitted:

Paracel ID	Client ID
2613521-01	BH101-S01
2613521-02	BH101-S02
2613521-03	BH102-S01
2613521-04	BH102-S02
2613521-05	BH101-SS3

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Approved By:

Mark Foto

Mark Foto, M.Sc.
Laboratory Director

Analysis Summary Table

Analysis	Method Reference/Description	Lab Location	Extraction Date	Analysis Date
Anions	EPA 300.1 - IC, water extraction	Ottawa	31-Mar-26	31-Mar-26
Boron, available	MOE (HWE), EPA 200.8 - ICP-MS	Ottawa	31-Mar-26	31-Mar-26
BTEX by P&T GC-MS	EPA 8260 - P&T GC-MS	Ottawa	30-Mar-26	31-Mar-26
Chromium, hexavalent - soil	MOE E3056 - Extraction, colourimetric	Ottawa	31-Mar-26	1-Apr-26
Conductivity	MOE E3138 - probe @25 °C, water ext	Ottawa	1-Apr-26	1-Apr-26
Mercury by CVAA	EPA 7471B - CVAA, digestion	Ottawa	31-Mar-26	31-Mar-26
pH, soil	MOE E3137 - probe @25 °C, CaCl2 ext	Ottawa	2-Apr-26	2-Apr-26
PHC F1	CWS Tier 1 - P&T GC-FID	Ottawa	30-Mar-26	31-Mar-26
PHC F4G (gravimetric)	CWS Tier 1 - Extraction Gravimetric	Ottawa	1-Apr-26	1-Apr-26
PHCs F2 to F4	CWS Tier 1 - GC-FID, extraction	Ottawa	31-Mar-26	31-Mar-26
REG 153: Metals by ICP/MS, soil	EPA 6020 - Digestion - ICP-MS	Ottawa	31-Mar-26	31-Mar-26
REG 153: PAHs by GC-MS	EPA 8270 - GC-MS, extraction	Ottawa	31-Mar-26	31-Mar-26
Resistivity	EPA 120.1 - probe, water extraction	Ottawa	31-Mar-26	31-Mar-26
SAR	Calculated	Ottawa	1-Apr-26	2-Apr-26
Solids, %	CWS Tier 1 - Gravimetric		30-Mar-26	31-Mar-26

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PARACEL LABORATORIES LTD.

Order #: 2613521

Certificate of Analysis

Report Date: 02-Apr-2026

Client: **Malroz Engineering Incorporated**

Order Date: 27-Mar-2026

Client PO:

Project Description: 2021

	Client ID:	BH101-S01	BH101-S02	BH102-S01	BH102-S02	-	-
	Sample Date:	23-Mar-26 10:15	23-Mar-26 10:30	23-Mar-26 14:10	23-Mar-26 14:40		
	Sample ID:	2613521-01	2613521-02	2613521-03	2613521-04		
	Matrix:	Soil	Soil	Soil	Soil		
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	93.1	79.7	96.5	96.6	-	-
General Inorganics							
SAR	0.01 N/A	21.9	9.26	0.97	1.52	-	-
Conductivity	5 uS/cm	4190	2040	2570	2190	-	-
pH	0.05 pH Units	10.93	7.96	8.14	8.17	-	-
Metals							
Antimony	1.0 ug/g	<1.0	<1.0	<1.0	<1.0	-	-
Arsenic	1.0 ug/g	2.2	3.9	1.8	1.8	-	-
Barium	1.0 ug/g	66.3	248	41.0	57.2	-	-
Beryllium	0.5 ug/g	<0.5	1.0	<0.5	<0.5	-	-
Boron	5.0 ug/g	15.2	11.7	19.2	20.2	-	-
Boron, available	0.5 ug/g	0.5	<0.5	1.9	2.3	-	-
Cadmium	0.5 ug/g	<0.5	<0.5	<0.5	<0.5	-	-
Chromium	5.0 ug/g	14.8	41.4	10.4	13.5	-	-
Chromium (VI)	0.2 ug/g	0.7	<0.2	<0.2	1.5	-	-
Cobalt	1.0 ug/g	3.6	14.9	3.6	3.8	-	-
Copper	5.0 ug/g	7.1	27.9	10.5	13.5	-	-
Lead	1.0 ug/g	9.2	10.5	13.7	19.0	-	-
Mercury	0.1 ug/g	<0.1	<0.1	<0.1	<0.1	-	-
Molybdenum	1.0 ug/g	<1.0	<1.0	<1.0	1.4	-	-
Nickel	5.0 ug/g	9.9	29.1	9.9	10.8	-	-
Selenium	1.0 ug/g	<1.0	<1.0	<1.0	<1.0	-	-
Silver	0.3 ug/g	<0.3	<0.3	<0.3	<0.3	-	-
Thallium	1.0 ug/g	<1.0	<1.0	<1.0	<1.0	-	-
Uranium	1.0 ug/g	<1.0	<1.0	<1.0	<1.0	-	-
Vanadium	10.0 ug/g	13.6	59.1	<10.0	10.2	-	-

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Certificate of Analysis

Report Date: 02-Apr-2026

Client: **Malroz Engineering Incorporated**

Order Date: 27-Mar-2026

Client PO:

Project Description: 2021

	Client ID:	BH101-S01	BH101-S02	BH102-S01	BH102-S02	-	-
	Sample Date:	23-Mar-26 10:15	23-Mar-26 10:30	23-Mar-26 14:10	23-Mar-26 14:40		
	Sample ID:	2613521-01	2613521-02	2613521-03	2613521-04		
	Matrix:	Soil	Soil	Soil	Soil		
	MDL/Units						
Metals							
Zinc	20.0 ug/g	<20.0	71.6	<20.0	29.1	-	-
Volatiles							
Benzene	0.02 ug/g	<0.02	<0.02	<0.02	<0.02	-	-
Ethylbenzene	0.05 ug/g	<0.05	<0.05	<0.05	<0.05	-	-
Toluene	0.05 ug/g	<0.05	<0.05	<0.05	<0.05	-	-
m,p-Xylenes	0.05 ug/g	<0.05	<0.05	<0.05	0.13	-	-
o-Xylene	0.05 ug/g	<0.05	<0.05	<0.05	<0.05	-	-
Xylenes, total	0.05 ug/g	<0.05	<0.05	<0.05	0.13	-	-
Toluene-d8	Surrogate	98.8%	112%	98.5%	98.5%	-	-
Hydrocarbons							
F1 PHCs (C6-C10)	7 ug/g	<7	<7	<7	<7	-	-
F2 PHCs (C10-C16)	4 ug/g	<4	<4	10	12	-	-
F3 PHCs (C16-C34)	8 ug/g	39	<8	108	258	-	-
F4 PHCs (C34-C50)	6 ug/g	116 [1]	<6	74 [1]	354 [1]	-	-
F4G PHCs (gravimetric)	50 ug/g	301	-	207	745	-	-
Semi-Volatiles							
Acenaphthene	0.02 ug/g	<0.02	<0.02	0.43	0.04	-	-
Acenaphthylene	0.02 ug/g	<0.02	<0.02	0.04	<0.02	-	-
Anthracene	0.02 ug/g	<0.02	<0.02	1.04	0.12	-	-
Benzo [a] anthracene	0.02 ug/g	<0.02	<0.02	1.66	0.22	-	-
Benzo [a] pyrene	0.02 ug/g	<0.02	<0.02	1.68	0.23	-	-
Benzo [b] fluoranthene	0.02 ug/g	<0.02	<0.02	1.10	0.16	-	-
Benzo [g,h,i] perylene	0.02 ug/g	<0.02	<0.02	0.72	0.10	-	-
Benzo [k] fluoranthene	0.02 ug/g	<0.02	<0.02	0.62	0.09	-	-
Chrysene	0.02 ug/g	<0.02	<0.02	1.44	0.20	-	-
Dibenzo [a,h] anthracene	0.02 ug/g	<0.02	<0.02	0.19	0.03	-	-

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Certificate of Analysis

Report Date: 02-Apr-2026

Client: **Malroz Engineering Incorporated**

Order Date: 27-Mar-2026

Client PO:

Project Description: 2021

	Client ID:	BH101-S01	BH101-S02	BH102-S01	BH102-S02	-	-
	Sample Date:	23-Mar-26 10:15	23-Mar-26 10:30	23-Mar-26 14:10	23-Mar-26 14:40		
	Sample ID:	2613521-01	2613521-02	2613521-03	2613521-04		
	Matrix:	Soil	Soil	Soil	Soil		
	MDL/Units						
Semi-Volatiles							
Fluoranthene	0.02 ug/g	<0.02	<0.02	4.81	0.50	-	-
Fluorene	0.02 ug/g	<0.02	<0.02	0.47	0.04	-	-
Indeno [1,2,3-cd] pyrene	0.02 ug/g	<0.02	<0.02	0.61	0.09	-	-
1-Methylnaphthalene	0.02 ug/g	<0.02	<0.02	0.07	<0.02	-	-
2-Methylnaphthalene	0.02 ug/g	<0.02	<0.02	0.10	<0.02	-	-
Methylnaphthalene (1&2)	0.04 ug/g	<0.04	<0.04	0.17	<0.04	-	-
Naphthalene	0.01 ug/g	0.02	<0.01	0.30	0.02	-	-
Phenanthrene	0.02 ug/g	<0.02	<0.02	4.68	0.43	-	-
Pyrene	0.02 ug/g	<0.02	<0.02	3.59	0.38	-	-
2-Fluorobiphenyl	Surrogate	103%	88.0%	73.0%	94.9%	-	-
Terphenyl-d14	Surrogate	120%	91.2%	86.0%	96.9%	-	-

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Certificate of Analysis

Report Date: 02-Apr-2026

Client: **Malroz Engineering Incorporated**

Order Date: 27-Mar-2026

Client PO:

Project Description: 2021

	Client ID:	BH101-SS3				-	-
	Sample Date:	23-Mar-26 10:55					
	Sample ID:	2613521-05					
	Matrix:	Soil					
	MDL/Units						
Physical Characteristics							
% Solids	0.1 % by Wt.	97.6	-	-	-	-	-
General Inorganics							
pH	0.05 pH Units	7.66	-	-	-	-	-
Resistivity	0.1 Ohm.m	4.8	-	-	-	-	-
Anions							
Chloride	10 ug/g	1170	-	-	-	-	-
Sulphate	10 ug/g	275	-	-	-	-	-

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Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions								
Chloride	ND	10	ug/g					
Sulphate	ND	10	ug/g					
General Inorganics								
Conductivity	ND	5	uS/cm					
Resistivity	ND	0.1	Ohm.m					
Hydrocarbons								
F4G PHCs (gravimetric)	ND	50	ug/g					
F1 PHCs (C6-C10)	ND	7	ug/g					
F2 PHCs (C10-C16)	ND	4	ug/g					
F3 PHCs (C16-C34)	ND	8	ug/g					
F4 PHCs (C34-C50)	ND	6	ug/g					
Metals								
Boron, available	ND	0.5	ug/g					
Chromium (VI)	ND	0.2	ug/g					
Mercury	ND	0.1	ug/g					
Antimony	ND	1.0	ug/g					
Arsenic	ND	1.0	ug/g					
Barium	ND	1.0	ug/g					
Beryllium	ND	0.5	ug/g					
Boron	ND	5.0	ug/g					
Cadmium	ND	0.5	ug/g					
Chromium	ND	5.0	ug/g					
Cobalt	ND	1.0	ug/g					
Copper	ND	5.0	ug/g					
Lead	ND	1.0	ug/g					
Molybdenum	ND	1.0	ug/g					
Nickel	ND	5.0	ug/g					
Selenium	ND	1.0	ug/g					
Silver	ND	0.3	ug/g					
Thallium	ND	1.0	ug/g					
Uranium	ND	1.0	ug/g					
Vanadium	ND	10.0	ug/g					

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Method Quality Control: Blank

Analyte	Result	Reporting Limit	Units	%REC	%REC Limit	RPD	RPD Limit	Notes
Zinc	ND	20.0	ug/g					
Semi-Volatiles								
Acenaphthene	ND	0.02	ug/g					
Acenaphthylene	ND	0.02	ug/g					
Anthracene	ND	0.02	ug/g					
Benzo [a] anthracene	ND	0.02	ug/g					
Benzo [a] pyrene	ND	0.02	ug/g					
Benzo [b] fluoranthene	ND	0.02	ug/g					
Benzo [g,h,i] perylene	ND	0.02	ug/g					
Benzo [k] fluoranthene	ND	0.02	ug/g					
Chrysene	ND	0.02	ug/g					
Dibenzo [a,h] anthracene	ND	0.02	ug/g					
Fluoranthene	ND	0.02	ug/g					
Fluorene	ND	0.02	ug/g					
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g					
1-Methylnaphthalene	ND	0.02	ug/g					
2-Methylnaphthalene	ND	0.02	ug/g					
Methylnaphthalene (1&2)	ND	0.04	ug/g					
Naphthalene	ND	0.01	ug/g					
Phenanthrene	ND	0.02	ug/g					
Pyrene	ND	0.02	ug/g					
Surrogate: 2-Fluorobiphenyl	*1.03*		*%*	*77.0*	*50-140*			
Surrogate: Terphenyl-d14	*1.15*		*%*	*85.9*	*50-140*			
Volatiles								
Benzene	ND	0.02	ug/g					
Ethylbenzene	ND	0.05	ug/g					
Toluene	ND	0.05	ug/g					
m,p-Xylenes	ND	0.05	ug/g					
o-Xylene	ND	0.05	ug/g					
Xylenes, total	ND	0.05	ug/g					
Surrogate: Toluene-d8	*7.79*		*%*	*97.3*	*50-140*			

DRAFT

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	47.8	10	ug/g	51.2			6.9	35	
Sulphate	17.9	10	ug/g	19.4			8.4	35	
General Inorganics									
SAR	0.38	0.01	N/A	0.38			0.2	30	
Conductivity	1890	5	uS/cm	1930			2.1	5	
pH	7.80	0.05	pH Units	7.77			0.4	2.3	
Resistivity	43.7	0.1	Ohm.m	43.9			0.6	20	
Hydrocarbons									
F1 PHCs (C6-C10)	ND	7	ug/g	ND			NC	40	
F2 PHCs (C10-C16)	ND	4	ug/g	ND			NC	30	
F3 PHCs (C16-C34)	ND	8	ug/g	ND			NC	30	
F4 PHCs (C34-C50)	ND	6	ug/g	ND			NC	30	
Metals									
Antimony	ND	1.0	ug/g	ND			NC	30	
Arsenic	2.2	1.0	ug/g	2.2			2.6	30	
Barium	64.0	1.0	ug/g	66.3			3.6	30	
Beryllium	ND	0.5	ug/g	ND			NC	30	
Boron, available	0.75	0.5	ug/g	0.52			NC	35	
Boron	15.7	5.0	ug/g	15.2			3.0	30	
Cadmium	ND	0.5	ug/g	ND			NC	30	
Chromium (VI)	0.8	0.2	ug/g	0.7			10.9	35	
Chromium	14.4	5.0	ug/g	14.8			2.7	30	
Cobalt	3.5	1.0	ug/g	3.6			3.3	30	
Copper	6.8	5.0	ug/g	7.1			4.3	30	
Lead	8.9	1.0	ug/g	9.2			2.8	30	
Mercury	ND	0.1	ug/g	ND			NC	30	
Molybdenum	ND	1.0	ug/g	ND			NC	30	
Nickel	10.0	5.0	ug/g	9.9			0.9	30	
Selenium	ND	1.0	ug/g	ND			NC	30	
Silver	ND	0.3	ug/g	ND			NC	30	

DRAFT

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Thallium	ND	1.0	ug/g	ND			NC	30	
Uranium	ND	1.0	ug/g	ND			NC	30	
Vanadium	12.6	10.0	ug/g	13.6			7.7	30	
Zinc	ND	20.0	ug/g	ND			NC	30	
Physical Characteristics									
% Solids	73.6	0.1	% by Wt.	72.4			1.6	25	
Semi-Volatiles									
Acenaphthene	ND	0.02	ug/g	ND			NC	40	
Acenaphthylene	ND	0.02	ug/g	ND			NC	40	
Anthracene	ND	0.02	ug/g	ND			NC	40	
Benzo [a] anthracene	ND	0.02	ug/g	ND			NC	40	
Benzo [a] pyrene	ND	0.02	ug/g	ND			NC	40	
Benzo [b] fluoranthene	ND	0.02	ug/g	ND			NC	40	
Benzo [g,h,i] perylene	ND	0.02	ug/g	ND			NC	40	
Benzo [k] fluoranthene	ND	0.02	ug/g	ND			NC	40	
Chrysene	ND	0.02	ug/g	ND			NC	40	
Dibenzo [a,h] anthracene	ND	0.02	ug/g	ND			NC	40	
Fluoranthene	ND	0.02	ug/g	ND			NC	40	
Fluorene	ND	0.02	ug/g	ND			NC	40	
Indeno [1,2,3-cd] pyrene	ND	0.02	ug/g	ND			NC	40	
1-Methylnaphthalene	ND	0.02	ug/g	ND			NC	40	
2-Methylnaphthalene	ND	0.02	ug/g	ND			NC	40	
Naphthalene	ND	0.01	ug/g	ND			NC	40	
Phenanthrene	ND	0.02	ug/g	ND			NC	40	
Pyrene	ND	0.02	ug/g	ND			NC	40	
Surrogate: 2-Fluorobiphenyl	*1.06*		*%*		*69.1*	*50-140*			
Surrogate: Terphenyl-d14	*1.25*		*%*		*81.2*	*50-140*			
Volatiles									
Benzene	ND	0.02	ug/g	ND			NC	50	
Ethylbenzene	ND	0.05	ug/g	ND			NC	50	
Toluene	ND	0.05	ug/g	ND			NC	50	

DRAFT

Method Quality Control: Duplicate

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
m,p-Xylenes	ND	0.05	ug/g	ND			NC	50	
o-Xylene	ND	0.05	ug/g	ND			NC	50	
Surrogate: Toluene-d8	*9.25*		*%*		*103*	*50-140*			

DRAFT

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Anions									
Chloride	153	10	ug/g	51.2	102	82-118			
Sulphate	121	10	ug/g	19.4	101	80-120			
Hydrocarbons									
F1 PHCs (C6-C10)	171	7	ug/g	ND	85.3	85-115			
F2 PHCs (C10-C16)	89	4	ug/g	ND	88.3	60-140			
F3 PHCs (C16-C34)	261	8	ug/g	ND	106	60-140			
F4 PHCs (C34-C50)	168	6	ug/g	ND	108	60-140			
F4G PHCs (gravimetric)	1040	50	ug/g	ND	104	80-120			
Metals									
Antimony	50.0	1.0	ug/g	ND	99.8	70-130			
Arsenic	57.2	1.0	ug/g	ND	113	70-130			
Barium	85.3	1.0	ug/g	26.5	118	70-130			
Beryllium	60.0	0.5	ug/g	ND	120	70-130			
Boron, available	4.06	0.5	ug/g	0.52	70.7	60-140			
Boron	64.3	5.0	ug/g	6.1	116	70-130			
Cadmium	55.3	0.5	ug/g	ND	111	70-130			
Chromium (VI)	4.6	0.2	ug/g	0.7	72.5	48-112			
Chromium	66.6	5.0	ug/g	5.9	121	70-130			
Cobalt	57.0	1.0	ug/g	1.4	111	70-130			
Copper	55.9	5.0	ug/g	ND	106	70-130			
Lead	50.4	1.0	ug/g	3.7	93.4	70-130			
Mercury	1.08	0.1	ug/g	ND	72.2	70-130			
Molybdenum	55.4	1.0	ug/g	ND	110	70-130			
Nickel	60.2	5.0	ug/g	ND	112	70-130			
Selenium	51.7	1.0	ug/g	ND	103	70-130			
Silver	46.9	0.3	ug/g	ND	93.9	70-130			
Thallium	50.9	1.0	ug/g	ND	102	70-130			
Uranium	46.0	1.0	ug/g	ND	91.8	70-130			
Vanadium	67.1	10.0	ug/g	ND	123	70-130			
Zinc	57.0	20.0	ug/g	ND	103	70-130			

DRAFT

Method Quality Control: Spike

Analyte	Result	Reporting Limit	Units	Source Result	%REC	%REC Limit	RPD	RPD Limit	Notes
Semi-Volatiles									
Acenaphthene	0.166	0.02	ug/g	ND	86.5	50-140			
Acenaphthylene	0.156	0.02	ug/g	ND	81.2	50-140			
Anthracene	0.169	0.02	ug/g	ND	87.9	50-140			
Benzo [a] anthracene	0.166	0.02	ug/g	ND	86.1	50-140			
Benzo [a] pyrene	0.187	0.02	ug/g	ND	97.3	50-140			
Benzo [b] fluoranthene	0.163	0.02	ug/g	ND	85.0	50-140			
Benzo [g,h,i] perylene	0.161	0.02	ug/g	ND	83.6	50-140			
Benzo [k] fluoranthene	0.145	0.02	ug/g	ND	75.7	50-140			
Chrysene	0.174	0.02	ug/g	ND	90.3	50-140			
Dibenzo [a,h] anthracene	0.154	0.02	ug/g	ND	80.3	50-140			
Fluoranthene	0.162	0.02	ug/g	ND	84.2	50-140			
Fluorene	0.164	0.02	ug/g	ND	85.5	50-140			
Indeno [1,2,3-cd] pyrene	0.153	0.02	ug/g	ND	79.4	50-140			
1-Methylnaphthalene	0.153	0.02	ug/g	ND	79.6	50-140			
2-Methylnaphthalene	0.151	0.02	ug/g	ND	78.7	50-140			
Naphthalene	0.180	0.01	ug/g	ND	93.9	50-140			
Phenanthrene	0.171	0.02	ug/g	ND	88.9	50-140			
Pyrene	0.162	0.02	ug/g	ND	84.4	50-140			
Surrogate: 2-Fluorobiphenyl	*1.25*		*%*		*81.1*	*50-140*			
Surrogate: Terphenyl-d14	*1.34*		*%*		*87.3*	*50-140*			
Volatiles									
Benzene	3.98	0.02	ug/g	ND	99.5	60-130			
Ethylbenzene	4.04	0.05	ug/g	ND	101	60-130			
Toluene	3.98	0.05	ug/g	ND	99.4	60-130			
m,p-Xylenes	8.24	0.05	ug/g	ND	103	60-130			
o-Xylene	4.17	0.05	ug/g	ND	104	60-130			
Surrogate: Toluene-d8	*7.69*		*%*		*96.1*	*50-140*			

DRAFT

Certificate of Analysis

Report Date: 02-Apr-2026

Client: **Malroz Engineering Incorporated**

Order Date: 27-Mar-2026

Client PO:

Project Description: 2021

Qualifier Notes:

Sample Qualifiers :

1: GC-FID signal did not return to baseline by C50

Applies to Samples: BH101-S01, BH102-S01, BH102-S02

QC Qualifiers:

Sample Data Revisions:

None

DRAFT

Certificate of Analysis

Report Date: 02-Apr-2026

Client: **Malroz Engineering Incorporated**

Order Date: 27-Mar-2026

Client PO:

Project Description: 2021

Work Order Revisions / Comments:

None

Other Report Notes:

n/a: not applicable

ND: Not Detected

MDL: Method Detection Limit

Source Result: Data used as source for matrix and duplicate samples

%REC: Percent recovery.

RPD: Relative percent difference.

NC: Not Calculated

Soil results are reported on a dry weight basis unlesss otherwise noted.

Where %Solids is reported, moisture loss includes the loss of volatile hydrocarbons.

Benzo[b]fluoranthene results may be biased high due to co-elution with Benzo[j]fluoranthene

CCME PHC additional information:

- The method for the analysis of PHCs complies with the Reference Method for the CWS PHC and is validated for use in the laboratory. All prescribed quality criteria identified in the method has been met.

- F1 range corrected for BTEX.

- F2 to F3 ranges corrected for appropriate PAHs where available.

- The gravimetric heavy hydrocarbons (F4G) are not to be added to C6 to C50 hydrocarbons.

- In the case where F4 and F4G are both reported, the greater of the two results is to be used for comparison to CWS PHC criteria.

- When reported, data for F4G has been processed using a silica gel cleanup.

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Any use of these results implies your agreement that our total liabilty in connection with this work, however arising, shall be limited to the amount paid by you for this work, and that our employees or agents shall not under any circumstances be liable to you in connection with this work.

PARACEL LABORATORIES LTD. | TRU RES REL

Paracel ID: 2613521

Paracel Order Number (Lab Use Only)	Chain Of Custody (Lab Use Only)
2613521	№ 80959

Client Name: Matrex Engineering Inc.
Contact Name: Will Archer
Address: 308 Wellington St, Kingston
Telephone: (613) 217-9455

Project Ref: 2021
Quote #: Competitive Reg 406 - 19
PO #:
E-mail: archer@matrex.com
bonnelridge@matrex.com

Page 1 of 1

Turnaround Time
☐ 1 day ☐ 3 day
☐ 2 day ☒ Regular
Date Required:

☐ REG 153/04 ☒ REG 406/19

☐ Table 1 ☐ Agri/Other ☐ Med/Fine
☐ Table 2 ☐ Res/Park ☐ Coarse
☐ Table 3 ☐ Ind/Comm
☐ Table ___
For RSC: ☐ Yes ☐ No

Other Regulation
☐ REG 558 ☐ PWQO
☐ CCME ☐ MISA
☐ SU - Sani ☐ SU - Storm
Mun:
☐ Other:

Matrix Type: S (Soil/Sed.) GW (Ground Water) SW (Surface Water) SS (Storm/Sanitary Sewer) P (Paint) A (Air) O (Other)

	Sample ID/Location Name	Matrix	Air Volume	# of Containers	Field Filtered	Sample Taken: Date	Sample Taken: Time	Required Analysis: PHC F1+BTEX	Metals, EC, SAR	PAH's	pH	Corrosivity Parameters	Hold Sample
1	BH101 - SS1	S		2		Mar 23	10:15	X	X	X	X		
2	BH101 - SS2						10:30	X	X	X	X		
3	BH102 - SS1						14:10	X	X	X	X		
4	BH102 - SS2						14:40	X	X	X	X		
5	BH101 - SS3			1			10:55					X	
6	BH101 - SS3	↓		~~2~~		↓	10:50	*					X
7													
8													
9													
10													

Comments: Sample 5 -> Sulphides + Redox potential

Method of Delivery: walk-in

Unless otherwise negotiated by the parties, by signing Paracel's Chain of Custody form, you are agreeing to Paracel Laboratories Terms and Conditions and are subject to the terms and conditions thereof. Available at www.paracellabs.com

Relinquished By (Sign): Will Archer	Received at Depot: Kitchener	Received at Lab:	Verified By:
Relinquished By (Print): Will Archer	Date/Time: Mar 27 11:21	Date/Time: Mar 28 11:34	Date/Time: Mar 28/19
Date/Time: Mar 27/19 11:23	Temperature: 9.1 °C	Temperature: 10.2 °C	pH Verified: ☐ By:

DRAFT

APPENDIX B

Topographic Survey

Hopkins Chitty Land Surveyors Inc.
Ontario Land Surveyors
1224 Gardiners Road, Suite 102
Kingston, Ontario K7P 0G2 Tel:
(613)384-9266 Fax: (613)384-3513

April 10, 2026

Kingston Health Sciences Centre
Attention : Jamie Thompson
24 Barrie Street
Kingston, ON, K7L 3J6
Email: jamie.thompson@kingstonhsc.ca

Our File: H-00055 –Plan Showing Topographic Information at Kingston General Hospital, Kingston

Mr. Thompson:

The subject lands consist of Part of Farm Lot 24, Concession 1 (being Abstract Block A, D and the travelled road known as King Street West), and Part of O'Kill Street as closed by FR148678 per FR223916 comprising a portion of PIN 36038-0041 (KGH) and 36038-0015 (King Street); and Part of the Bed of Kingston Harbour, being a portion of PIN 36264-0249; and Part of the Garrett Water Lot, Registered Plan C-28 being a portion of PIN 36264-0208 in the City of Kingston, County of Frontenac

According to the abbreviated parcel Register for PIN 36038-0041 a portion of the lands within this scope are subject to easement as described by Instrument No. FR223916E.

The survey was geo-referenced to UTM NAD83 CSRS (2010) horizontally, and elevations are geodetic and are referred to the HT2_0 geoid model being a product of the geodetic survey division (GSD) of Natural Resources Canada, derived from real time network GPS observations. The elevations are referred to the following site benchmarks being the top of nails in concrete:

Site Benchmark No. 1:	N4897704.548	E380703.846	Elev:	76.222 (CGVD28)
Site Benchmark No. 2:	N4897730.280	E380710.971	Elev:	76.615 (CGVD28)
Site Benchmark No. 3:	N4897690.278	E380767.293	Elev:	76.475 (CGVD28)

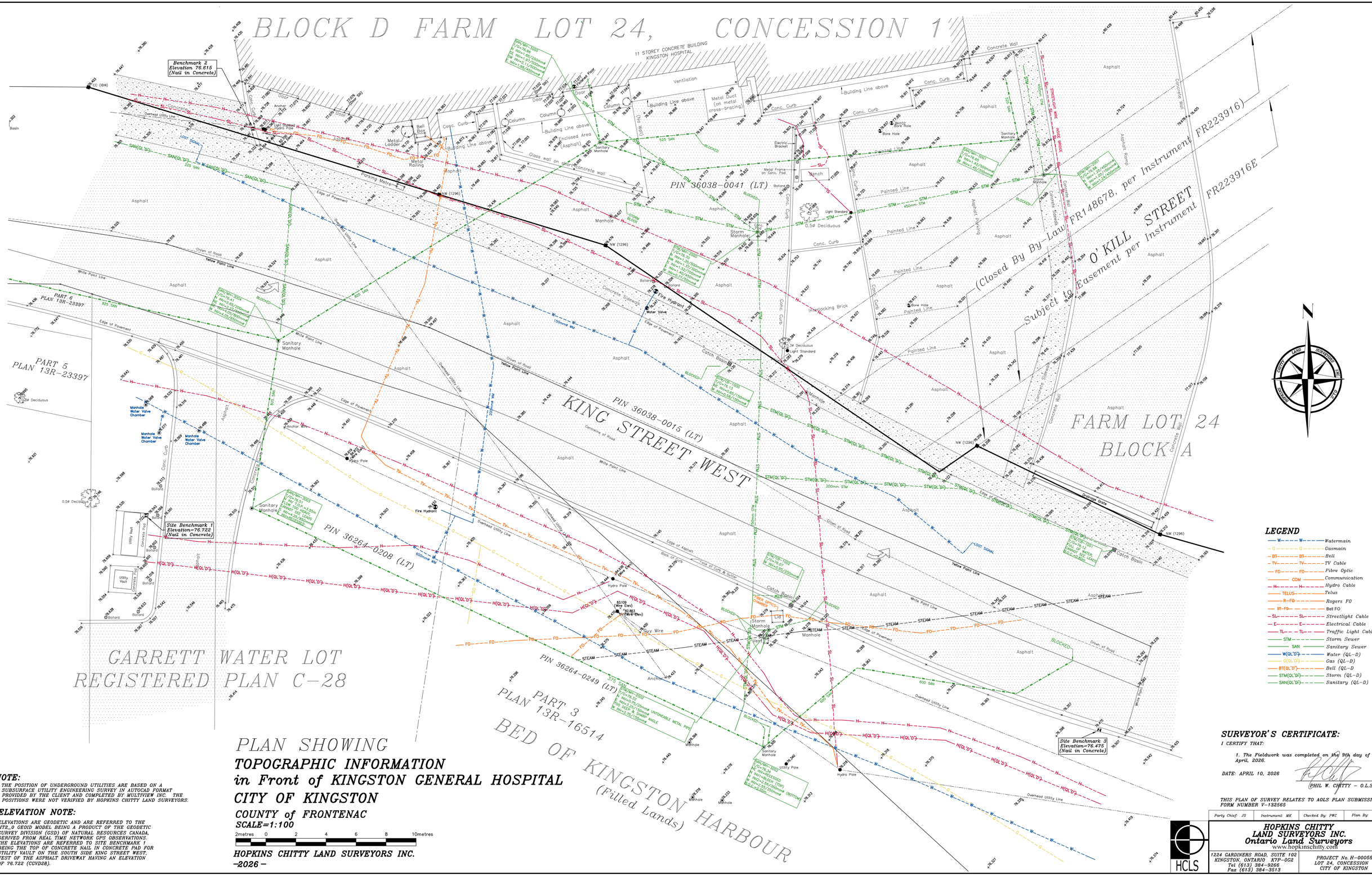
Note that the DWG file provided is in GRID units and would need to be scaled by 1.00022487 for GROUND units.

The PDF and DWG illustrate the results of the Subsurface Utility Engineering Locate provided by MultiView. We provided MultiView an initial version of our AutoCAD file to position their work. Upon review of the results a difference in elevation of T/G was noted on SAN M/H 3001 (76.65 MV - 76.495 HCLS) and STM M/H 2001 (76.68 MV - 76 .606 HCLS). Our observations were taken with a total station, and our crew revisited the structures to confirm our measurements.

The survey illustrates the visible topographic features as outlined in the scope of work provided to this office on November 25, 2025. The final deliverables include a PDF, DWG and the points file (CSV) in PNEZD

Sincerely,

Phil W. Chitty, O.L.S.
Hopkins Chitty Land Surveyors Inc.



LEGEND

- Watermain
- Gasmain
- Bell
- TV Cable
- Fibre Optic
- Communication
- Hydro Cable
- Telus
- Rogers FO
- Bell FO
- Streetlight Cable
- Electrical Cable
- Traffic Light Cable
- Storm Sewer
- Sanitary Sewer
- Water (QL-D)
- Gas (QL-D)
- Bell (QL-D
- Storm (QL-D)
- Sanitary (QL-D)

PLAN SHOWING
TOPOGRAPHIC INFORMATION in Front of KINGSTON GENERAL HOSPITAL CITY OF KINGSTON

COUNTY of FRONTENAC

SCALE=1:100

2metres 0 2 4 6 8 10metres

HOPKINS CHITTY LAND SURVEYORS INC.

–2026 –

NOTE:

THE POSITION OF UNDERGROUND UTILITIES ARE BASED ON A SUBSURFACE UTILITY ENGINEERING SURVEY IN AUTOCAD FORMAT PROVIDED BY THE CLIENT AND COMPLETED BY MULTIVIEW INC. THE POSITIONS WERE NOT VERIFIED BY HOPKINS CHITTY LAND SURVEYORS.

ELEVATION NOTE:

ELEVATIONS ARE GEODETIC AND ARE REFERRED TO THE HTZ_O GEOID MODEL BEING A PRODUCT OF THE GEODETIC SURVEY DIVISION (GSD) OF NATURAL RESOURCES CANADA, DERIVED FROM REAL TIME NETWORK GPS OBSERVATIONS. THE ELEVATIONS ARE REFERRED TO SITE BENCHMARK 1. BEING THE TOP OF CONCRETE NAIL IN CONCRETE PAD FOR UTILITY VAULT ON THE SOUTH SIDE KING STREET WEST, WEST OF THE ASPHALT DRIVEWAY HAVING AN ELEVATION OF 76.722 (CCVD28).

SURVEYOR'S CERTIFICATE:

I CERTIFY THAT:

1. The Fieldwork was completed on the 9th day of April, 2026.

DATE: APRIL 10, 2026

PHIL W. CHITTY – O.L.S.

THIS PLAN OF SURVEY RELATES TO AOLS PLAN SUBMISSION FORM NUMBER V-132565

Party Chief: JO	Instrument: MK	Checked By: PWC	Plan By: RH

HOPKINS CHITTY LAND SURVEYORS INC.
Ontario Land Surveyors
www.hopkinschitty.com
1224 GARDINERS ROAD, SUITE 102
KINGSTON, ONTARIO K7P-0G2
Tel (613) 384-9266
Fax (613) 384-3513

PROJECT No. H-00055
LOT 24, CONCESSION 1
CITY OF KINGSTON

APPENDIX C

Subsurface Utility Engineering Survey

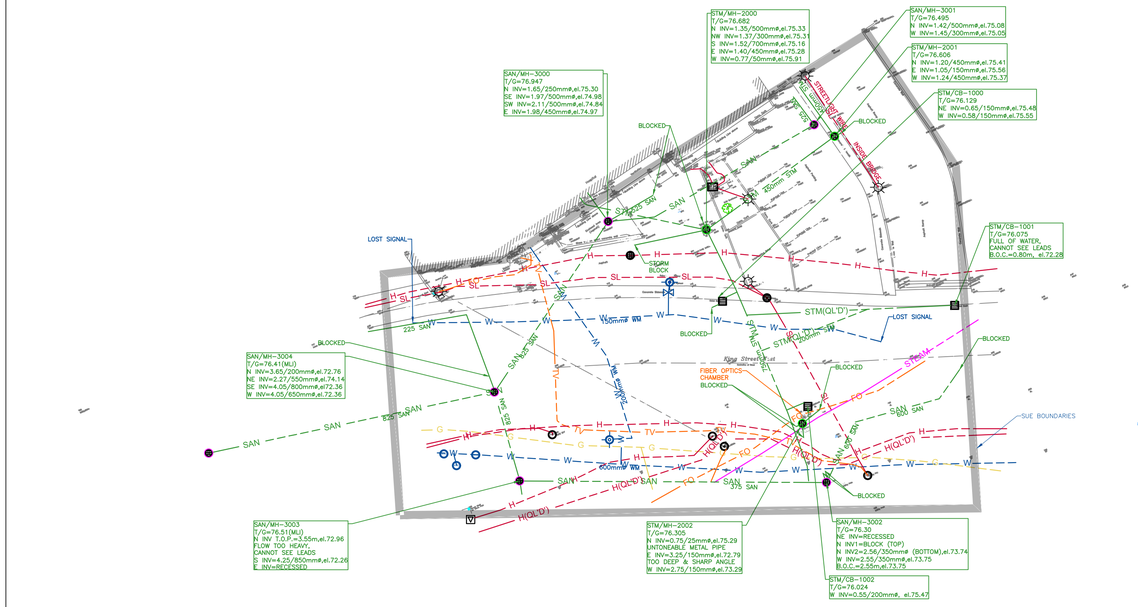
SUE NOTES:

1. All inverts are in meters and are taken from the Top of Grate (T/G) or Rim Elevation reference.
2. No records of service lines were available nor collected. All the depicted service lines included in this composite drawing are based on the geophysical survey only.
3. Some of the utility owners could not provide the records for the service lines, they only provided records for the main lines.
4. Any data or information from records or outside of the project boundaries and scope of work is provided for information purposes only and has not been verified.
5. Overhead Utilities are not included within the scope of work of the SUE Investigation.
6. The size and material descriptions on this drawing are based on record information provided by the utility owners. No testing has been conducted to verify these materials.
7. Please see some SUE Investigation challenges and the Technical limitations on sheet #2

INVERTS MEASUREMENTS NOTE :

There are some discrepancies between the on site measurement and records data of the pipes diameters of the sewers for MHs/CBs, which could be due to measurements tolerances/errors and pipe condition. Discrepancies can be due to too many factors;

I. On site it is the ID of the pipe that is measured not the OD or Standard Diameter of the pipe,
II. In some situations there are debris at the bottom of the pipe / pipe with irregular shape .
III. Pipe recessed, it is difficult to measure accurately the ID of the pipe.
IV. To confirm the actual size of the pipe along its length it is recommended to perform Confined space/entry survey.



KEY MAP

GLOSSARY

CSE	-	CONFINED SPACE ENTRY
SAN	-	SANITARY
STM	-	STORM
INV	-	INVERT
OBV	-	OBVERT
BOC	-	BOTTOM OF CHAMBER
EORI	-	END OF RECORD INFORMATION
AATUR	-	UTILITY ABANDONED ACCORDING TO UTILITY RECORDS
EOI	-	END OF SURFACE GEOPHYSICAL INFORMATION
T/G	-	TOP OF GRATE ELEVATION
ROW	-	RIGHT OF WAY
NPS	-	NOMINAL PIPE SIZE

Kingston Health Sciences Centre

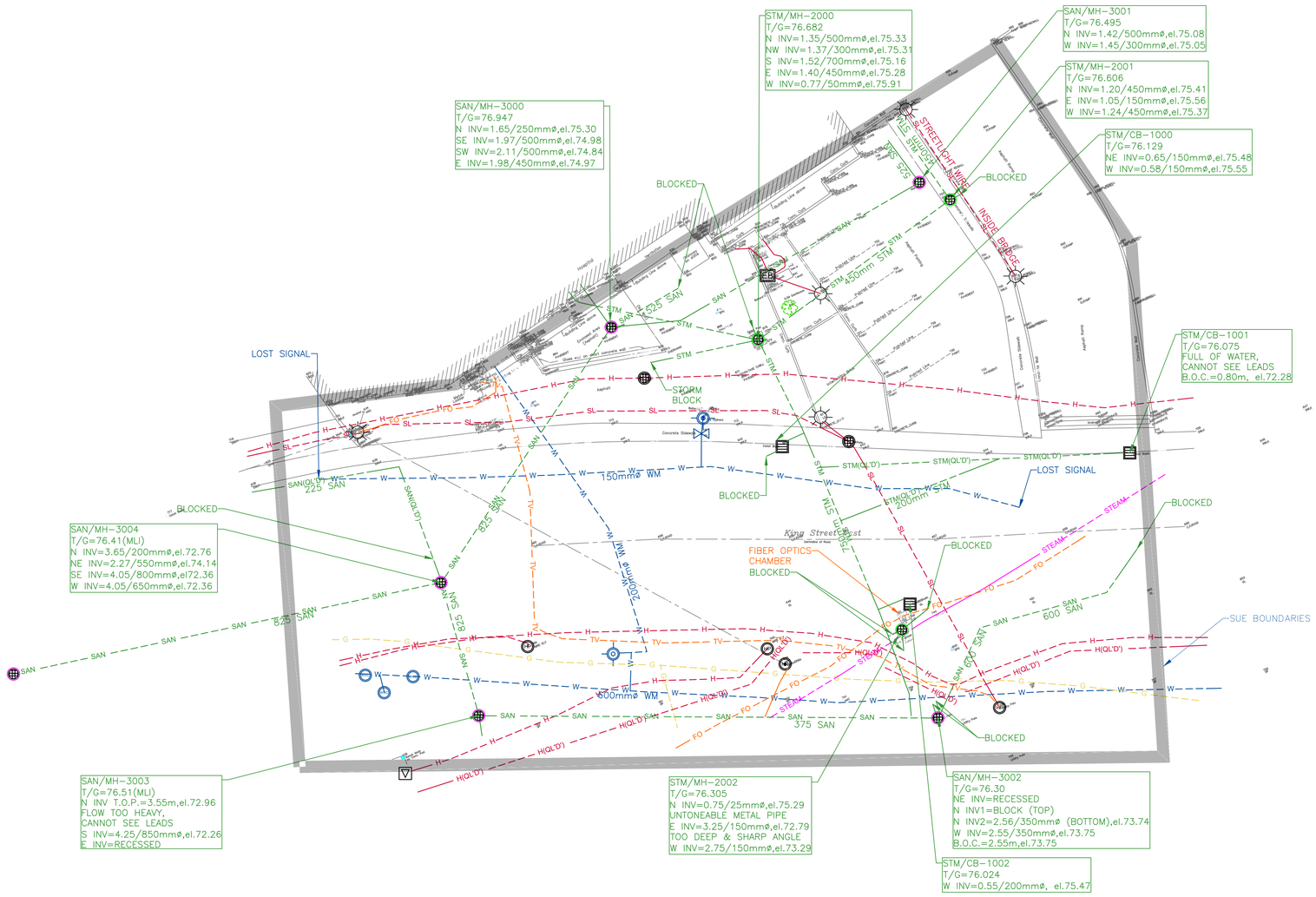
FOR: KINGSTON HEALTH SCIENCES CENTRE

PROJECT NO: 65699

PROJECT NAME: 41 KING STREET WEST, KINGSTON HOSPITAL

DATE: 2026-04-02

multiview® Insight, not hindsight
Tel: 1-800-363-3116
Email: sales@multiview.ca
www.multiview.ca



SCALE 1:200

metres 0 2 4 6 8 10 12 14 16 18 20

Data presented herein is subject to multiVIEW's terms and conditions as listed on the final page of the contract drawings.

multiVIEW® *Insight, not hindsight*

THE LOCATION OF UNDERGROUND SERVICES SHOULD BE VERIFIED PRIOR TO EXCAVATION. UTILITY LOCATES ARE REQUIRED PRIOR TO ANY EXCAVATION ACTIVITY

SUBSURFACE UTILITY ENGINEERING
HYDRO EXCAVATION & CCTV
CONCRETE SCANNING
UTILITY LOCATES
NEAR-SURFACE GEOPHYSICS

Tel: 1-800-363-3116
Fax:1-866-571-5946
www.multiVIEW.ca
325 Matheson Blvd East
Mississauga, ON, L4Z1X8

Project No.:	Date:	Surveyed/Drawn By:	Checked:
65699	2026-04-02	FZ/NB	AD

For: KINGSTON HEALTH SCIENCES CENTRE

Site: 41 KING STREET WEST, KINGSTON, ON

Subsurface Utility Engineering CI/ASCE 38-02 Quality Levels

QL'A': Visual verification of utility location and depth using excavation methods. i.e. Hydrovac.

QL'B': Utility located using surface geophysical methods i.e. electronically applied or induced magnetic field using specific utility locate equipment or ground penetrating radar.

QL'C': Utility plotted using record information in conjunction with a visual field survey of utility furniture.

QL'D': Utility plotted using record information only. This can include oral recollection.

GENERAL NOTES

1. This information is provided for design purposes only.
2. All inverts shown on this plan by multiVIEW Locates Inc.are in meters and were measured from the top of the manhole and/or catch basin lids.
3. Subsurface utility information shown on this drawing was obtained on a best effort, best practices basis, within the technical limitations of the instrumentation.
4. Utilities shown on this map by multiVIEW Locates Inc. were located using ASCE 38-02 Quality Level 'B' methods unless otherwise noted. All other information hereon has been supplied by others and is not certified.
5. Third party information provided on these drawings are for the convenience of use but do not constitute information obtained and delivered by multiVIEW Locates Inc. during the course of this project.
6. Elevations represented for this study were obtained by multiVIEW Locates Inc. utilizing datum derived by differential GPS observations and referred to the CAN-NET Reference Network.

SUE UTILITY CODES & LEGEND

- W — Watermain
- G — Gasmain
- TV — TV Cable
- FO — Fibre Optic
- COM — Communication
- H — Hydro Cable
- SL — Street light Cable
- STEAM — Steam
- STM — Storm Sewer
- SAN — Sanitary Sewer
- STM(QL'D') — Storm (QL-D)
- SAN(QL'D') — Sanitary (QL-D)
- H(QL'D') — Hydro(QL-D)
- Project Boundaries
- Manhole
- Storm Manhole
- Sanitary Manhole
- Catch Basin
- Double Catch Basin
- Combined Manhole
- Gas Valve
- Gas Meter
- Streetlight Pole
- Transformer
- Hydro Pole
- Trafficlight Pole
- Electrical Box
- Guy Pole
- Handwell
- Catch Basin Manhole
- Bell/Rogers Ped
- Flush to Grade
- Water Valve Chamber
- Fire Hydrant
- Water Valve
- Bell Manhole

ALL UTILITIES DEPICTED ARE AT "QUALITY LEVEL B" UNLESS OTHERWISE NOTED

SHEET 1 of 2

Rev. No.	Drawn By	Checked By	Date	Revision
-	-	-	-	-

Technical Limitations

1. Throughout this schedule, "multiVIEW" is the corporate entity multiVIEW Locates Inc.
2. Pipe, cable, conduit, rebar, post-tension cables, anchors, containers, vaults, tanks and similar objects that are buried under the ground or embedded within a structure are referred to in multiVIEW's terms and conditions as Buried Assets
3. Subsurface conditions such as depth to bedrock, change in soil type, presence of karst, voids, contaminated soil or ground water, residual construction or industrial debris or buried waste are referred to in multiVIEW's terms and conditions as Buried Liabilities.
4. The Client acknowledges that the laws of fundamental physics apply and acknowledge that sensing instruments can not detect all Buried Assets and Buried Liabilities. Buried Assets and Buried Liabilities which are detectable by properly deployed and operated instruments are termed Locatable Buried Assets and Locatable Buried Liabilities. Buried Assets and Buried Liabilities which are not clearly detectable in an unambiguous manner due to the laws of fundamental physics are termed Unlocatable Buried Assets and Unlocatable Buried Liabilities. multiVIEW follows industry best-practice procedures but is not responsible for determining the presence and location of Unlocatable Buried Assets or Unlocatable Buried Liabilities.
5. Instruments to locate Buried Assets use a variety of approaches to detect and infer the location of the Buried Assets. Standard pipe and cable locating instruments detect the magnetic fields associated with electrical current flowing in the Buried Asset. GPR (Ground Penetrating radar) techniques depend on the transmission of radio waves into the host material and detection of waves reflected back from the Buried Assets. Sonding methods require insertion of a source of magnetic field into the pipe or conduit and detection of the magnetic field created by source at the surface of the Work Area to locate the sonde position. For the purposes of this estimate, Locatable Buried Assets are normally characterized as:
   a. metallic pipes, cables and conduits that are capable of carrying an electrical current and that can be physically accessed to allow an energizing current source to create an electrical current in the Buried Asset of sufficient magnitude as to be detectable by standard locating instruments;
   b. metallic pipes, cables and conduits that actively carry an identifiable electric current that is sufficiently large and has suitable frequency as to be detectable by standard locating instruments;
   c. metallic and non-metallic pipes, cables, conduits, rods, bars, wires, voids, and inclusions that represent a substantive electrical contrast to the host material and are embedded in a host material transparent to radio waves such that radio waves reflected from the feature are detectable by a GPR instrument;
   d. non-metallic pipes, cables and conduits (i.e. composed of plastic, concrete, asbestos, clay, etc.) which have continuous associated tracer wire capable of carrying an electric current and that can be physically accessed to allow an energizing current source to create an electrical current in the tracer wire of sufficient magnitude as to be detectable by standard cable locating instruments;
   e. non-metallic pipes, cables and conduits which have continuous associated tracer wire capable of carrying an electric current and that naturally carries an electrical current of sufficient magnitude and suitable frequency as to be detectable by standard cable locating instruments;
   f. open pipe and conduits that can be accessed by a sonde and are sufficiently shallow to permit detectable magnetic fields to be sensed at the surface of the Work Area;

   Examples of Unlocatable Buried Assets include, but are not limited to, the following:

   g. pipes, cables and conduits whose depth of burial is too great to create and/or overlain by or in proximity to metallic material which results in signal distortion thus preventing physically measurable signals at the surface or where burial material interferes with current generation and signal emissions;
   h. normally Locatable Buried Assets situated in, or emerging from, an area which is an Inaccessible Area;
   i. normally Locatable Buried Assets with a break or breaks to the electrical continuity of any metallic pipe, cable or tracer wire (i.e. segmented lengths, corroded connections, sections of plastic repair, etc.);
   j. non-metallic pipe, cable and conduits which do not have a continuous and/or accessible associated tracer wire;
   k. the host material is opaque to radio waves;
   l. Buried Assets that are normally characterized as Locatable become Unlocatable when either ambient interfering electromagnetic fields or the material surrounding and/or enclosing and/or above the Buried Asset disrupt the energizing current or the normal operation of the sensing instrument.
6. Instruments used to locate Buried Liabilities use a variety of approaches to detect and infer the location of the Buried Liability. Magnetometers detect the distortion in the local magnetic field induced by the presence of some types of Buried Liabilities. GPR (Ground Penetrating radar) techniques depend on the transmission of radio waves into the host material and detection of waves reflected back from the Buried Liability. In some cases the lack of reflected GPR signal can be a Buried Liability indicator. Electromagnetic induction methods use electromagnetic induction to induce current flow in the subsurface and detect the resulting magnetic fields that are associated with these induced currents to identify Buried Liabilities. Electrical resistivity measurements use direct connect to pass current through host material and map out distortions in the current flow to indicate changes in the subsurface that may indicate the presence of Buried Liabilities. For the purposes of this estimate, Locatable Buried Liabilities are normally characterized as those features that will create a discernable change to the response of the measuring instrument and which differ in character from the background surrounding environment (that is, the features create an Anomalous Response) when industry best practices are followed.
7. The Client acknowledges that the laws of fundamental physics apply and that equipment is subject to measurement distortions that are site specific resulting in limited precision when determining positional coordinates. multiVIEW will use best-practice procedures but is not responsible for determining the location of Buried Assets or Buried Liabilities to an accuracy better that what is typical of normal locate instruments.
8. Determination of type composition, depth or size of the Buried Assets or Buried Liabilities is not possible and does not constitute part of this service. Identification of the type (i.e. gas, electric, communications, etc) of a specific Buried Asset is not technically possible except by visual surface appurtenance or excavation and visual exposure of the Buried Asset. Inferences that may be drawn by correlation with records and as-built drawings may be offered but such inferences are provided on a best effort basis with no guarantee of correctness.
9. Client acknowledges the critical nature of having access to energize Buried Assets to enable locating and assumes full responsibility for identifying and providing access (including provision of licensed plumbing, electrical or confined space entry personnel if required and which adhere to multiVIEW health and safety procedures) to any and all points necessary for the energization of the Buried Assets. multiVIEW accepts no responsibility for locating any Buried Asset for which access and/or appropriate workplace safety measures are not provided.
10. Individual Locatable Buried Assets are deemed Unlocatable Buried Assets where there are numerous Buried Assets clustered together either vertically and/or horizontally ("Clustered Utilities") making identification of individual elements physically impossible. multiVIEW is not responsible for identifying the individual Buried Assets in such situations.
11. Non-metallic pipe and cable (i.e. fibre-optic systems, etc.) are Unlocatable Buried Assets for standard cable locating instruments unless either an unbroken tracer wire or continuous metallic sheathing surrounding such buried plant is easily accessible from the surface. The Client must provide direct and simple access to every traceable wire or continuous metallic sheathing. Otherwise, multiVIEW accepts neither liability nor responsibility for locating such features since they are deemed Unlocatable
12. Non-metallic pipe and conduits (i.e. plastic, concrete, asbestos, clay, etc.) under pressure (i.e. water, gas, forcemain systems, etc.) are Unlocatable Buried Assets for standard cable locating instruments unless an unbroken tracer wire is attached to the pipe and this tracer wire is easily accessible from the surface. The Client must provide direct and simple access to every traceable wire.
13. Non-pressurized, non-metallic (i.e. plastic, concrete, asbestos, clay, etc.) conduits or pipe (i.e. sewers, drains, empty ducts, etc.) are Unlocatable Buried Assets unless a transmitting sonde can be inserted throughout the full length of the pipe or conduit. It is the responsibility of the Client to identify and provide direct access (including provision of licensed plumbing, electrical or confined space entry personnel if required) to any and all access points for such lines. multiVIEW accepts no responsibility for locating such lines where the Client does not provide access and/or appropriate workplace safety measures.
14. Any Buried Asset incapable of generating a reflected radar wave detectable by a GPR instrument is an Unlocatable Buried Assets.
15. All or part of a Work Area is defined as an Inaccessible Area when inaccessible for surveying Inaccessible Areas include the following: those covered by a structure or object (i.e. buildings, vehicles, debris, stockpiled snow, building materials, etc.); those covered by open water; those covered by woods, vegetation, or snow too thick to permit easy walking; those where the surface terrain slopes steeper than 1:2; those covered by snow; and, those where the safety of the operator is jeopardized (i.e. unstable footing, environmental hazards, uncontrolled roads, etc.). The final decision for defining an area as an Inaccessible Area rests with the multiVIEW Health & Safety Officer.
16. Utility data depicted on QL-D CAD lines are derived via utility owners record data and shown only for reference.

Liability Limitations

1. Location and mapping services, marks, reports and results provided by multiVIEW cannot substitute as a legally defined Buried Asset location in jurisdiction where government regulation dictates that the Buried Asset owner is solely responsible for identifying and locating their own Buried Assets. In cases where multiVIEW is legally authorized to act on behalf of the Buried Asset owner to locate the owner's Buried Assets, any results provided by multiVIEW will clearly identify that the Buried Asset location is legally authorized on all records, documents, and reports.
2. multiVIEW's markings of Buried Asset or Buried Liability locations are provided as information to be input into the Client's decision making process and the provision of this information does not relieve the Client, or any other person, party, or corporation, from liability for damages for personal injury including death, or for property damage or liability caused to or from any Buried Asset or Buried Liability, within the Work Area.
3. Cables carrying DC voltages and/or small diameter cables (i.e. fire alarm or security systems, remote signal cables, inaccessible tracer wire, perfectly balanced AC cables, etc.) can only be detected by methods which create electrical currents and signals in the cables. Where a sensitive or dangerous connection is involved, the Client must provide qualified personnel to isolate and enable direct access to these systems. The Client is responsible for defining the impact of locating signals on sensitive electronics. multiVIEW accepts no responsibility for any damage to plant, or any third party, caused by locating signals. Technical information about locating signals is available from multiVIEW upon request.
4. multiVIEW is not liable for damages resulting from physical exposure of any Buried Assets or Buried Liability by the Client, its representatives, their sub-contractors or any other person or corporation.
5. multiVIEW will not accept any liability regarding inaccurate estimates of utility depth secured only by electronic means since multiVIEW recommends exposure of any such issues by vacuum excavating if any such depth information is critical to the design, engineering or construction of subsequent infrastructure.
6. multiVIEW accepts no responsibility and is not liable for damages suffered by any third party as a result of decisions or actions based on the performance of the statement of work by multiVIEW.
7. multiVIEW accepts no responsibility and is not liable for conduit blockage, or restoration of the site to pre-survey conditions, as a result of survey practices needed to fulfill the objectives of the Service provided.
8. The completeness of work carried out by multiVIEW is based on information provided by the Client at or prior to the earlier of the time of issuance of this Estimate. If the scope work or size and/or extent of the Work Area changes, a signed Change Order must be issued so that scope of work can be adjusted to address Client requirement changes. Documents and maps provided by multiVIEW are the definitive means legally defining the extent of the Work Area investigated.
9. multiVIEW accepts no responsibility for locating Buried Assets or Buried Liabilities outside the limit of the Work Area or in the Inaccessible Areas.
10. Except as written in this contract, multiVIEW disclaims any and all promises, representations, warranties and covenants, express, implied, statutory or otherwise.
11. multiVIEW shall not be liable for any amount in excess of the fees paid by the Client to multiVIEW for the work described in this estimate on account of any loss, injury, death, or damage whether resulting directly or indirectly to a person or property irrespective of the cause or origin of such loss, injury, death or damage including, without limitation, loss, injury, death or damage attributable to the negligence of multiVIEW, its employees and agents in the performance or non-performance of the Service.
12. In any action, claim, loss or damage arising out of the work for which this estimate is provided, the Client agrees that multiVIEW Locates Inc.'s liability will be 'several' and not 'joint and several' and the Client may only claim payment from multiVIEW Locates Inc of multiVIEW Locates Inc.'s proportionate share of the total liability based on degree of fault. Any action against multiVIEW Locates Inc must be commenced on or before the date which is the earlier of: i) eighteen months from the date on which the work in this estimate is completed and, ii) the date by which an action must be commenced under any applicable legislation other than limitation legislation. In no event shall multiVIEW Locates Inc be liable to the Client whether the claim be in tort, contract or otherwise, for an amount in excess of the fees paid by the Company for the services work provided. In no event shall multiVIEW Locates Inc be liable to the Client, whether a claim be in tort, contract or otherwise for any consequential, indirect, lost profit or similar damages, or failure to realize expected savings. multiVIEW Locates Inc will use all reasonable efforts to complete within any agreed upon timeframe the performance of the services described herein; however, multiVIEW Locates Inc shall not be liable for failures or delays in performance that arise from causes beyond its control, including the untimely performance or non-performance by the Client of its obligations.