



Stipulated Price Contract (CCDC 2 – 2008)

Bid Documents for

NEW POWERHOUSE

RFQ 2020-06-05Q

Owner: Ontario Shores Centre for Mental Health Sciences

700 Gordon Street
Whitby, Ontario L1N 5S9

Contact: Debbie Taylor, Purchasing Coordinator

taylorde@ontarioshores.ca

905-430-4055 x 6908

Consultant: Morrison Hershfield Limited

125 Commerce Valley Dr. W., Suite 300
Markham, ON L3T 7W4

Contact: Titel Gurau, Project Manager

tgurau@morrisonhershfield.com

416-495-4287



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Tender Call Form

Ontario Shores Centre for Mental Health Sciences New Powerhouse Project

Closing Date and Time: July 18, 2019 at 12:00:00 Noon

Bid submissions in response to this Tender Call must be complete, executed and received at the Procurement Office, Building 5 Level 1, Room 5-1078 of Ontario Shores (700 Gordon Street, Whitby Canada L1N 5S9) by the Closing Date and Time noted above.

Late submissions will not be considered. Delays caused by any delivery service will not be grounds for an extension of the submission deadline. Bids will not be accepted by fax or email.

Bids are requested for project NEW POWERHOUSE at 700 Gordon Street, Whitby, ON.

The undersigned, the Bidder, agrees with Ontario Shores (the "Owner"), the party inviting the Bids referred to above, that:

- the Bidder will furnish to the Owner, in conformance with the Tender documents, specifications, drawings and all other Contract Documents, the goods, materials, articles, equipment, work and services specified in this Tender Call, at the prices quoted herein, on receipt of an official Contract, and
- the Bidder warrants that the goods, materials, articles and equipment, to be supplied pursuant to an official Contract based on this Tender Call, that are to be made or used for a particular purpose, will be fit and suitable for that purpose.

Name of Bidder:	Signature of Authorized Signing Officer:
Address:	Name:
	Title:
	Date:
Phone:	Corporate Seal:
Email:	
Fax:	
Total Base Bid Price (HST included) Item (10) on Pricing Form	\$
Total Alternate Bid Price (HST included) Item (10A) on Pricing Form	\$
I/We acknowledge the receipt of Addenda ____ to ____, dated _____ to _____.	

**Mandatory Tender Site Walk: Friday, June 28, 2019 at 11:00 AM, at 700 Gordon Street, Whitby ON.
Meet at the Information Desk, Building 5 by the main entrance. Contact Debbie Taylor at 905-430-4055 x 6908.**

Instructions to Bidders

1.0 INVITATION

1.1. Intent

1. The intent of this Tender Call is to obtain offers ("Bids") from interested parties ("Bidders") to perform the Work required to complete project **NEW POWERHOUSE at 700 Gordon Street in Whitby, Ontario** for a Stipulated Price, in accordance with the Contract Documents.
2. For the purposes of this Tender Call the Owner is Ontario Shores Centre for Mental Health Sciences ("Ontario Shores"), and its authorized agent is Morrison Hershfield Limited (MH).

1.2. No Bid Form

1. It is important to receive a reply from all registered Bidders. Should a Bidder be unwilling or unable to submit a Bid, the Bidder shall complete and return the No Bid Form included in this Document.

1.3. Bidder Covenant

1. By submitting a Bid in response to this Tender Call, the Bidder confirms it has read, understood, and agrees to comply with the Bid Documents. No allowance will be made on behalf of a Bidder for any error, omission or negligence on its part, unless Ontario Shores or MH, at their sole discretion, decide otherwise.
2. Bidders agree to prepare and submit Bids at their own cost.
3. Ontario Shores will provide the successful Bidder with two (2) copies of the Contract to be signed. Within five (5) working days of the successful Bidder's receipt of the Contract, the successful Bidder shall return the Contract to Ontario Shores fully signed, together with other documentation as required by the Contract Documents.
4. Confidentiality
 1. Ontario Shores reserves all rights with regard to this Tender Call. Bidders may not reproduce, modify, disclose, distribute or publish any portion of this Tender Call or any information about Ontario Shores or MH without the prior written approval of Ontario Shores or MH, save and except for the strict purpose of preparing a Bid, and provided always that any such reproduction, modification, disclosure, distribution or publication of this Tender Call shall only be made to or for the recipient's employees or advisors on a strict need-to-know basis, each of whom the recipient agrees to bind to these same confidentiality obligations.
 2. Bidders may not use the name of Ontario Shores or MH (or their respective affiliates) or refer to this Tender Call in any advertisement or other promotional messages without the prior written consent of Ontario Shores or MH, as applicable.

1.4. Tender Call

1. Refer to the Tender Call Form.
2. Bids submitted after the indicated bid closing time will not be considered and will be returned to the Bidder unopened if a return address has been provided on the envelope.
3. Bids will not be opened in public; they will be opened after the indicated bid closing time.

Instructions to Bidders

4. Amendments to a submitted Bid will be permitted only if received on the Bidder's letterhead prior to the indicated bid closing time and if signed by the same party or parties who signed and sealed the Bid. A Bid amendment shall state the amount to be added to or deducted from the *Total Bid Price*.
5. All erasures, revisions or corrections to the Bidder's entries on the Pricing Form shall be initialled by the Bidder.
6. Bids and amendments to submitted Bids submitted by telephone or electronic mail will not be considered.

2.0 CONTRACT AND BID DOCUMENTS

2.1. Definitions

1. Contract Documents: As defined in the Contract.
2. Bid Documents: Instructions to Bidders, Tender Call Form, Pricing Form, List of Subcontractors Form and any Supplements and other information issued for the benefit of Bidders to prepare and submit a Bid, and Contract Documents.
3. Total Bid Price: The monetary sum identified by the Bidder in the Pricing Form.
4. All capitalized terms, unless otherwise defined, shall have the meanings assigned to them in the General Conditions included in the Contract Documents.

2.2. Availability

1. *Bid Documents* will be posted on the Biddingo portal.
2. After downloading the *Bid Documents*, Bidders shall verify that the documents are complete. Bidders shall immediately notify Ontario Shores if the *Bid Documents* are incomplete or upon finding discrepancies or omissions in the Bid Documents.

2.3. Inquiries and Addenda

1. All inquiries from Bidders regarding the Bid Documents must be in writing and submitted no later than the Deadline for Questions per item 4.2 Bid Schedule.

Ontario Shores Centre for Mental Health Science
Attention: Debbie Taylor, Purchasing Coordinator
Email: taylorde@ontarioshores.ca
Tel: 905-430-4055 x 6908

2. Addenda may be issued by Ontario Shores during the bidding period. All addenda become part of the Contract Documents. Include costs of all addenda in Total Bid Price.
3. Ontario Shores may, by addendum, modify, amend or revise any provision of this Tender, extend the Closing Time, Closing Date or any other scheduled dates relating to this Tender. Ontario Shores shall not be responsible for any costs related to any delays in the Tender.
4. Verbal responses are only binding when confirmed by written addenda.
5. Information obtained from any other source may be inaccurate and is not binding on Ontario Shores. Any attempt by a Bidder or any of its employees, agents, contractors or representatives to contact any person other than the Ontario Shores contact person named above with respect to this Tender will entitle Ontario Shores to disqualify their Bid.
6. Discrepancies between addenda and the original Bid Documents will be resolved in favour of the last-submitted addendum.

Instructions to Bidders

2.4. Alternatives During Bidding

1. Unsolicited
 1. Where the Bid Documents stipulate a particular Product, requests to use unsolicited alternatives made less than seven calendar days before the Bid Closing Date will not be considered.
 2. When a request to use an unsolicited alternative is made, Ontario Shores may, in its sole discretion, approve the unsolicited alternative and in such circumstances will issue an addendum to known Bidders.
 3. When requesting an alternative to specified Products, the Bidder shall include any changes required in the Work to accommodate such unsolicited alternative. A later claim by the Bidder for an addition to the Contract Price resulting from changes in the Work necessitated by use of unsolicited alternative Products will not be considered.
 4. Unsolicited alternatives not approved in writing by Ontario Shores prior to the Bid Closing Date shall not be included in the Bid Price.
 5. Subject to Article 2.4.1.1 above, product or system alternatives proposed by Bidders at the time of bid closing may be considered by Ontario Shores if submitted as an attachment to the Pricing Form.
 6. Requests for unsolicited alternatives submitted with the Pricing Form will be evaluated by Ontario Shores and either included in, or excluded from, the Contract. Subject to Article 2.4.1.1 above, Ontario Shores will be the sole judge as to their acceptability.
 7. Bidders shall provide complete information on revisions to other Work which will be required to accommodate each unsolicited alternative, together with the related dollar amount of all additions to, or reductions from, the Bid Price. The cost of each unsolicited alternative shall be provided net of costs of any other related changes required, so as to incorporate this into the Work.
2. Solicited
 1. Where alternatives are identified and described within the Contract Documents and Pricing Form, Ontario Shores reserves the right in its sole discretion whether to consider the alternatives and associated prices. Evaluation of the bids will be based on the compliant bid, with the lowest price combination of the base bid and those alternatives accepted by Ontario Shores.

3.0 SITE ASSESSMENT

3.1. Site Examination

1. Bidders shall carefully examine the Place of the Work, and fully inform themselves of all existing conditions, limitations and difficulties that may arise during the execution of the Work including but not limited to any or all site specific health and safety, environmental and operational protocols.
2. Refer to the Tender Call Form regarding the mandatory Tender Site walk.
3. Failure of a Bidder to attend, properly register and remain present for the duration of the Tender Site Walk may result in their Bid being rejected.
4. Claims for additional payments, for extra Work, costs, damages or difficulties encountered resulting from conditions which were either visible or could be reasonably inferred from an examination of the Place of the Work prior to the submission of Bids, will not be considered.

Instructions to Bidders

4.0 BID ENCLOSURES AND SCHEDULE REQUIREMENTS

4.1. Taxes

1. Unless specifically excluded by the Contract Documents, Bidders shall include all applicable government taxes in the *Total Bid Price*.

4.2. Bid Schedule

1. Mandatory Site Walkthrough: Friday, June 28, 2019, 11:00 am
2. Notification of Bid/No Bid: Wednesday, July 3, 2019
3. Deadline for Questions: Monday, July 8, 2019
4. Addenda Deadline: Thursday, July 11, 2019
5. Bid Closing: Thursday, July 18, 2019, 12:00:00 Noon.

4.3. Schedule Completion

1. Bidders shall state in the Pricing Form the time duration required to attain Substantial Performance of the Work and Total Performance of the Work.
2. Substantial Performance of the Work is proposed to be the **31th day of May, 2020**.
3. Consideration will be given to the time durations indicated in Article 4.3.1 and 4.3.2 when reviewing submitted Bids.

5.0 OFFER, ACCEPTANCE OR REJECTION

5.1. Delivery of Bid

1. Each Bid must be sealed in an envelope which clearly identifies the Bidder's name, Project name, location, and Ontario Shores project number. All Forms must be fully completed, signed under seal, dated and submitted in a clear and legible manner. Incorporated companies shall affix their corporate seal under the hand of their duly authorized officer(s). Signatures and all other entries shall be written in ink. Photocopied signatures and other entries are not acceptable. All applicable blank spaces in the Bid Documents must be filled in. Bids for *Work* valued greater than \$250,000 or as specified otherwise shall include:
 1. a bid bond from a duly licensed surety company or a bid deposit (e.g., bank draft, certified cheque or letter of credit) totalling 10% of the Bid value. Such bid bond or bid deposit shall be in a commercially reasonable form and name Ontario Shores as beneficiary;
 2. an agreement from a duly licensed surety company to provide final security in the form (as prescribed in the Contract) of a performance bond and a labour and materials payment bond in respect of the Work; or, a written undertaking from the Bidder (e.g., a letter on Bidder's letterhead) to timely provide as security in accordance with the Contract a letter of credit, certified cheque or bank draft totalling 50% of the value of the Contract. Such agreements or undertaking must be in a commercially reasonable form and name Ontario Shores as beneficiary;
2. Bid bonds, bid deposits, agreements to provide a performance bond and a labour and materials payment bond, and written Bidder undertakings deemed commercially unreasonable, may render a Bid non-compliant.

Instructions to Bidders

3. Bids that are unsigned, improperly signed or sealed, conditional, illegible, obscure, contain arithmetical errors, erasures, alterations or irregularities of any kind may be declared non-compliant.
4. Bids with Bid Forms and Bid Form Supplements which are improperly prepared may be declared non-compliant.
5. Bids based upon an unreasonable time duration for the completion of the Work may be declared non-compliant.
6. All submitted Bids and supporting documentation become the property of Ontario Shores and will not be returned except for bid bonds and bid deposits at expiration of bid irrevocability period or upon award of the contract.

5.2. Duration of Offer

1. Bids shall be irrevocable and remain open to acceptance for a period of **sixty (60)** days from the Bid Closing Date.

5.3. Acceptance of Offer

1. **The lowest or any Bid will not necessarily be accepted**
2. Notwithstanding anything else contained in the Bid Documents, Ontario Shores reserves the right to exercise complete discretion in all aspects of the conduct of the Bid process, the assessment and evaluation of Bids, including the determination of criteria, the ranking of Bidders and the selection of a successful Bidder without incurring any liability whatsoever to any Bidder, including any liability for costs, losses or damages, and without giving any reasons therefor.
3. Bids received will be scored by Ontario Shores using the following criteria and weightings:
 1. Bid Price – 55% of total score
 2. Qualifications: - 35% of total score
 3. Schedule (listing and sequence of major tasks, dependencies, timeframes - in Gannt chart format) – 10% of total score
4. Bidders shall outline their qualifications to undertake this project using *CCDC 11 Form – Contractor's Qualification Statement* – submit form with Bid. The content of the qualification statement is briefly outlined below:
 1. Legal structure of Contractor's company (corporation, joint venture, partnership etc.)
 2. Financial References (bank, bonding company), c/w contact information
 3. Annual value of construction work over the last five (5) years (Year – dollars)
 4. Key office personnel proposed for the project (Principal, Project Manager, Estimator) Include resume/qualifications
 5. Key site personnel proposed for the project (Project Manager, Superintendent, Foreman). Include resume and qualifications
 6. List of minimum three (3) principal projects completed in the past five (5) years).
 7. List of similar or related projects (i.e. with utility buildings, Diesel generators, medium voltage switchgear, and controls) completed.

Note: For the projects listed in 6. And 7. above provide the following information:

1. Project Title, Location and Value (\$)
2. Location and Date Completed

Instructions to Bidders

3. Project Description, with emphasis on similarities with this project
4. Owner and Contact Person who can provide additional information/reference
5. Consultant and Contact Person
5. The Bidders shall submit similar Qualification Statements for their M&E subcontractors when such contractors are not selected from the current Ontario Shores Vendors of Record. For the names of the current M&E contractors on the VOR roster, refer to section titled *List of Subcontractors* of this document.
6. Bidders expressly waive any right to make any claim against Ontario Shores for any matter arising from Ontario Shores exercising its rights as stated above.
7. After acceptance by Ontario Shores, the successful Bidder will be notified in writing.
8. Ontario Shores reserves the right, before awarding the Contract, to require the successful Bidder to submit such evidence of qualifications as it may deem necessary and acceptable, including without limitation the technical, financial or other qualifications and abilities of the Bidder.
9. The selection of a Bid shall not, by itself, bind Ontario Shores in any way unless and until Ontario Shores and the successful Bidder have executed the Contract. In the event that the successful Bidder fails to sign, refuses to sign or to commence with the Contract within the time prescribed, or otherwise fails to comply with its obligations under the Bid Documents, Ontario Shores shall in its sole discretion be entitled to:
 1. cancel the award of the Contract, and award the Contract to another Bidder;
 2. claim the Bid bond or deposit, if any;
 3. not accept any Bid;
 4. issue a new Tender.
10. Ontario Shores may disqualify the Bids of parties with whom Ontario Shores is engaged in, or reasonably anticipates to be engaging in any form of dispute.

END OF INSTRUCTIONS TO BIDDERS

Notice of No Bid Form

IMPORTANT – PLEASE READ THIS

It is important that Ontario Shores receive a reply from all registered Bidders. Should a Bidder be unwilling or unable to submit a Bid, returning this completed form will assist Ontario Shores in calling for future bids.

Project Name: _____

Project Number: _____

Please state your reason for not bidding by checking the applicable line(s) or by explaining briefly in the space provided. It is not necessary to return any other Bid Documents. Please return this completed form prior to the time for bid closing. Returning **this form only** via email is acceptable.

1. We do not have the experience necessary to complete the Project Work. _____
2. We do not manufacture / supply this commodity _____
3. We do not manufacture / supply to the stated specifications _____
4. Specification / information is not sufficiently defined _____
5. Unable to bid competitively _____
6. Cannot handle due to present work load _____
7. Quantity / job too large. _____
8. Quantity / job too small. _____
9. Cannot meet delivery / completion time requirements. _____
10. Insufficient time to prepare bid _____
11. Licensing restrictions _____
12. Agreements with distributors / dealers do not permit us to sell direct _____
13. Other reasons for not bidding? Please state _____

Do you wish to bid on similar goods / services / Projects in the future? YES____ NO____

Company Name: _____

Type of Business: _____

Address: _____

Telephone: _____

Date: _____

Signature of Company Representative _____

Position: _____

END OF NOTICE OF NO BID

Pricing Form

Ontario Shores Centre for Mental Health Sciences New Powerhouse

Note: All price cells must be populated with valid entries for a bid submission to be valid.

Name of Bidder: _____

The Bidder must provide the amount for each tender item, the total for each subsection, the Bid Price, HST and Total Bid Price in this form. Bidders that do not fully complete this form (such as leaving lines blank) or provide unclear answers (such as "n/a", "TBD" or "included") will be declared noncompliant.

It is understood and agreed that the prices indicated apply to the entire scope of work as defined on the drawings, in the specifications and in other contract documents, and that they include demolition/removals, new construction, equipment supply, installation, testing, commissioning and all other services and fees related to the delivery of the full scope of the Project, inclusive of overhead, profit and statutory charges, as applicable.

Base Price – for electrical solution using medium voltage switchgear with draw-out circuit breakers

Item	Description	Unit	Itemized Price	Extended Price
1	GENERAL REQUIREMENTS	LS		\$ _____
1.1	Mobilization, Site Administration, Demobilization		\$ _____	
1.2	Submittals: Shop Drawings, Product Sheets, Samples etc.		\$ _____	
1.3	Temporary Facilities and Services		\$ _____	
1.4	Close-out Documentation and Training		\$ _____	
1.5	Facility Management System Update (WSP Fee for Seawood FM)		\$ _____	
2	SITE WORK	LS		\$ _____
2.1	Site Demolition/Removals, Grading and Drainage		\$ _____	
2.2	New Parking Lot, incl. Lighting		\$ _____	
2.3	Landscaping		\$ _____	
3	ARCHITECTURAL	LS		\$ _____
3.1	Building Shell and Interior Partitions		\$ _____	
3.2	Roof Insulation and Membrane		\$ _____	
3.3	Hardware and Finishes (Doors, Louvres, Paint etc.)		\$ _____	

Pricing Form

4	STRUCTURAL	LS		\$ _____
4.1	Foundations and Below-ground Structure		\$ _____	
4.2	Above-ground Structure		\$ _____	
4.3	Roof Deck		\$ _____	
5	MECHANICAL	LS		\$ _____
5.1	Building Heating and Ventilation, incl. Acoustic Silencers		\$ _____	
5.2	Generator Exhaust System		\$ _____	
5.3	Fuel System: Main Tank, Day Tanks, Transfer System		\$ _____	
5.4	Building Automation System		\$ _____	
6	ELECTRICAL	LS		\$ _____
6.1	Concrete Encased Duct Banks		\$ _____	
6.2	High Voltage Cables and Terminations		\$ _____	
6.3	Diesel Generators and Feeders		\$ _____	
6.4	Generator Main Disconnect Devices		\$ _____	
6.5	Generator Paralleling Switchgear and Feeders		\$ _____	
6.6	Distribution and Transfer Switchgear		\$ _____	
6.7	Building Services: Lighting, General Power Distribution, Fire Alarm, Security		\$ _____	
7	CASH ALLOWANCE			\$ 80,000
8	Total Base Bid Price (HST excluded) Sum of items (1), (2), (3), (4), (5), (6) and (7) above			\$ _____
9	HST 13% of item (7)			\$ _____
10	Total Base Bid Price (HST included) Sum of items (8) and (9) Copy this amount to the Tender Call Form			\$ _____

Proposed Date of Substantial Performance of the Work: _____

Proposed Date of Total Performance of the Work: _____

Pricing Form

Alternate Price - for hybrid electrical solution using medium voltage switchgear with combination of draw-out circuit breakers and fused/load-break switches

The Owner may accept all, some or none of the following Alternate Prices. Accepted Alternate Prices, if any, will be made known by the Owner at the time of Contract Award.

Item	Description	Unit		Price (HST excl.) Add (+) / Deduct (-) from Base Bid Price (7)
6.4	Generator Main Disconnect Devices	LS		\$ _____
6.5	Generator Paralleling Switchgear and Feeders	LS		\$ _____
6.6	Distribution and Transfer Switchgear	LS		\$ _____
	Total Add/Deduct (+/-) to/from Base Bid Price (8)			
8A	Total Alternate Bid Price (HST excluded) Sum of Base Bid Price (9) and Item Above			
9A	HST 13% of item (8A)			
10A	Total Alternate Bid Price (HST included) Sum of items (8A) and (9A) Copy this amount to the Tender Call Form			

Proposed Date of Substantial Performance of the Work: SAME AS FOR BASE BID

Proposed Date of Total Performance of the Work: SAME AS FOR BASE BID

List of Subcontractors

The Bidder shall provide the subcontractor's name for each work type indicated in the table below or indicate "Own Forces" in the Subcontractor Name column if a subcontractor will not be used for that type of work. While Ontario Shores prefers subcontractors to be selected from its current Vendors of Record listed in the table below, Bidders are free to select their own subcontractors.

Name of Subcontractor	Location	Contact Name	Phone Number	Email
MECHANICAL				
Antrim Mechanical	Brampton	Callum Victory	(905) 791-5916	info@antrimmech.ca
Canadian Tech Air Systems Inc. (CTAS)	Toronto	Dave Butts	(416) 291-1296	mail@ctas.ca
Mutual Mechanical Ltd..	Oshawa	Boris Varga	(905) 579-6090	admin@mutualmechanical.net
Smith & Long	Markham	Jeff Scott	(416) 649-4690 (416) 258-3652	jscott@smithandlong.com
Honeywell Building Automation/Controls		Vida Safari	(416) 991-3736	Vida.safari@honeywell.com
ELECTRICAL				
BEC Electric	Ajax	Gregory Barr	(905) 239-8800	gb.becelectricinc@gmail.com
Ontario Electrical Construction	Scarborough	Ryan Charlton	(416) 363-5741 X266	RyanCharlton@onelec.com
Smith & Long	Markham	Jeff Scott	(416) 646-4690	jscott@smithandlong.com
Vickery	Whitby	John, Joseph, Wesley Vickery	(905) 668-1108	joseph@vickeryelectric.com wesley@vickeryelectric.com
Vipond - Fire Alarm		Danielle Pearson	(905) 564-7060 x 229 (416) 729-7060	danielle.pearson@vipond.com

The Contractor will not be permitted to change any named Subcontractor following award of the Contract without prior approval from Ontario Shores. Any request for changing a named Subcontractor or manufacturer must be submitted in writing.

List of Subcontractors

List below the names of Subcontractors / Manufacturers for the respective work sublet:

<u>Work Sublet</u>	<u>Subcontractor/Manufacturer Name</u>
Building Automation System - designated	Honeywell
Fire Alarm System – designated	Vipond
Security Subcontractor	_____
Electrical Subcontractor	_____
High Voltage Subcontractor	_____
Mechanical Subcontractor	_____
Generator Manufacturer	_____
Medium Voltage Switchgear Manufacturer	_____

List of Drawings and Specifications

DRAWINGS

Civil

C-101	GRADING PLAN SOUTH PARKING LOT
C-102	POWERHOUSE GRADING PLAN

Architectural

A-001	GENERAL NOTES AND OBC DATA MATRIX
A-101	SITE DEMOLITION PLAN
A-102	SITE PLAN
A-200	FOUNDATION AND FLOOR PLAN
A-201	ROOF AND REFLECTED CEILING PLAN
A-400	BUILDING ELEVATIONS AND SECTIONS
A-500	WALL SECTIONS
A-600	SECTION DETAILS
A-601	SECTION AND PLAN DETAILS
A-900	SCHEDULES

Structural

S-001	GENERAL NOTES
S-002	TYPICAL DETAILS
S-003	TYPICAL DETAILS
S-004	TYPICAL DETAILS
S-005	TYPICAL DETAILS
S-101	FOUNDATION PLAN
S-102	ROOF FRAMING PLAN
S-201	STRUCTURAL FRAMING ELEVATIONS
S-202	STRUCTURAL FRAMING ELEVATIONS
S-301	STRUCTURAL SECTIONS

Mechanical

M-001	DRAWING LIST, LEGEND, SITE LOCATION
M-002	SITE PLAN
M-100	SCHEDULES
M-300	HVAC WORK
M-301	ROOF - NEW WORK
M-302	SECTIONS AND ELEVATIONS
M-400	GENERATOR ROOM - FUEL PIPE LAYOUT
M-500	FIRE PROTECTION - FIRE EXTINGUISHERS
M-700	CONTROLS EQUIPMENT LAYOUT
M-701	GENERATOR ROOM VENTILATION SCHEMATIC
M-702	CONTROLS
M-703	FUEL SYSTEM SCHEMATICS
M-704	BAS PANEL - BUILDING 1 - Level 1
M-705	BAS PANEL - BUILDING 1 - Level 2

List of Drawings and Specifications

M-900	STANDARD DETAILS
M-901	STANDARD DETAILS
M-902	STANDARD DETAILS
M-903	STANDARD DETAILS

Electrical

E-001	SITE PLAN - ELECTRICAL - REMOVALS AND KEY PLAN
E-002	SITE PLAN - ELECTRICAL - NEW WORK
E-101	ELECTRICAL POWER EQUIPMENT LAYOUT
E-102	ELECTRICAL POWER WIRING LAYOUT
E-201	LIGHTING LAYOUT
E-301	FIRE ALARM SYSTEM LAYOUT
E-401	SECURITY SYSTEM LAYOUT
E-501	ROOF PLAN - LIGHTNING PROTECTION
E-502	GROUNDING SYSTEM LAYOUT AND RISER DIAGRAM
E-601	SINGLE LINE DIAGRAM - EXISTING AND REMOVALS
E-602	SINGLE LINE DIAGRAM - NEW
E-603	SINGLE LINE DIAGRAM - STAGE 1
E-60	SINGLE LINE DIAGRAM - STAGE 2A
E-605	SINGLE LINE DIAGRAM - STAGE 2B
E-606	SINGLE LINE DIAGRAM - STAGE 3A
E-607	SINGLE LINE DIAGRAM - STAGE 3B
E-701	PANEL SCHEDULE AND ELECTRICAL DETAILS
E-702	ELECTRICAL DETAILS

Landscaping

L-01	SITE PREPARATION PLAN
L-02	LANDSCAPE PLAN
LD-01	PLANTING DETAILS
LD-02	DETAILS

SPECIFICATIONS

General

00 11 00	SUMMARY OF WORK
01 14 00	WORK RESTRICTIONS
01 21 00	ALLOWANCES
01 23 00	ALTERNATIVES
01 29 00	PAYMENT PROCEDURES
01 29 83	PAYMENT PROCEDURES FOR TESTING LABORATORY SERVICES
01 31 19	PROJECT MEETINGS
01 33 00	SUBMITTAL PROCEDURES
01 35 43	ENVIRONMENTAL PROCEDURES
01 41 00	REGULATORY REQUIREMENTS
01 45 00	QUALITY CONTROL
01 51 00	TEMPORARY UTILITIES
01 52 00	CONSTRUCTION FACILITIES
01 55 26	TRAFFIC CONTROL
01 56 00	TEMPORARY BARRIERS AND ENCLOSURES

List of Drawings and Specifications

01 61 00	COMMON PRODUCT REQUIREMENTS
01 71 00	EXAMINATION AND PREPARATION
01 73 00	EXECUTION
01 74 00	CLEANING
01 74 21	CONSTRUCTION/DEMOLITION WASTE MANAGEMENT AND DISPOSAL
01 77 00	CLOSEOUT PROCEDURES
01 78 00	CLOSEOUT SUBMITTALS
01 79 00	DEMONSTRATION AND TRAINING
01 91 13	GENERAL COMMISSIONING (CX) REQUIREMENTS
01 92 00	FACILITY OPERATION

Civil

01 57 13	EROSION AND SEDIMENT CONTROL
31 00 00	GENERAL SITE WORK
31 11 00	SITE PREPARATION
31 23 33	EXCAVATION TRENCHING AND BACKFILLING
32 11 16	GRANULAR BASE AND SUBBASE
32 12 16	ASPHALT PAVING
32 15 60	DUST CONTROL
32 16 15	CONCRETE WALKS AND CURBS
32 17 23	PAINTED TRAFFIC LINES AND MARKINGS
33 41 13	STORM SEWERS
33 49 13	CATCHBASINS

Architectural

05 50 00	METAL FABRICATIONS
05 51 29	METAL STAIRS AND LADDERS
06 05 73	WOOD TREATMENT
06 10 53	MISCELLANEOUS ROUGH CARPENTRY
07 11 13	BITUMINOUS DAMPPROOFING
07 21 13	BOARD INSULATION
07 21 20	LOW EXPANDING FOAM SEALANT
07 26 00	VAPOUR RETARDERS
07 27 00	AIR BARRIERS
07 52 00	MODIFIED BITUMINOUS MEMBRANE ROOFING
07 62 00	SHEET METAL FLASHING AND TRIM
07 71 23	MANUFACTURED GUTTERS AND DOWNSPOUTS
07 84 00	FIRESTOPPING
07 92 00	JOINT SEALANTS
08 11 00	METAL DOORS AND FRAMES
08 33 00	COILING DOOR
08 71 00	DOOR HARDWARE
08 80 50	GLAZING
08 90 00	LOUVRES AND VENTS
09 67 10	EPOXY FLOORING
09 91 13	EXTERIOR PAINTING
09 91 23	INTERIOR PAINTING

Structural

03 10 00	CONCRETE FORMING AND ACCESSORIES
03 20 00	CONCRETE REINFORCING
03 30 00	CAST-IN-PLACE CONCRETE

List of Drawings and Specifications

04 05 00	COMMON WORK RESULTS FOR MASONRY
04 05 13	MASONRY MORTAR AND GROUT
04 05 19	MASONRY ANCHORAGE AND REINFORCING
04 22 00	CONCRETE UNIT MASONRY
05 12 00	STRUCTURAL STEEL
05 31 00	STEEL DECK

Mechanical

20 01 01	MECHANICAL GENERAL REQUIREMENTS
20 05 01	BASIC MATERIALS & METHODS
20 05 13	MOTORS, STARTERS, WIRING AND ELECTRIC PIPE HEATING
20 05 24	PIPE WELDING
20 05 29	HANGERS AND SUPPORTS
20 05 53	MECHANICAL IDENTIFICATION
20 07 13	MECHANICAL INSULATION
20 08 05	TESTING ADJUSTING AND BALANCING
20 08 15	MECHANICAL COMMISSIONING
20 08 19	PROJECT CLOSE-OUT
23 11 13	FUEL OIL SYSTEMS
23 24 16	DIESEL EXHAUST SYSTEMS
23 33 14	DAMPERS - OPERATING
23 33 15	DAMPERS FIRE
23 33 19	ACOUSTIC SILENCERS
23 34 23	EXHAUST FANS
23 82 39	UNIT HEATERS & ELECTRIC BASEBOARD HEATERS
25 05 01	BUILDING AUTOMATIONS SYSTEMS GENERAL
25 05 13	B.A.S. ALTERNATE PRICES
25 51 00	FUEL MONITORING SYSTEM
25 90 01	B.A.S. SEQUENCE OF OPERATIONS

Electrical

26 05 00	GENERAL REQUIREMENTS
26 05 05	SHORT CIRCUIT, COORDINATION AND ARC FLASH STUDY
26 05 14	POWER CABLES AND TERMINATIONS
26 05 21	WIRE AND CABLES, 0 – 1000 V
26 05 27	GROUNDING
26 05 31	SPLITTERS, JUNCTION AND PULL BOXES
26 05 34	CONDUIT, CONDUIT FASTENINGS AND CONDUIT FITTINGS
26 13 18.01	GENERATOR PARALLELING SWITCHGEAR TO 15 KV
26 13 18.02	TRANSFER AND DISTRIBUTION SWITCHGEAR TO 15 KV
26 27 26	WIRING DEVICES
26 28 23	DISCONNECT SWITCHES
26 32 13	DIESEL GENERATORS
26 33 43	BATTERY CHARGERS
26 13 17	LOAD INTERRUPTER SWITCHES
26 41 13	LIGHTNING PROTECTION FOR STRUCTURES
26 50 00	LIGHTING EQUIPMENT
28 05 00	ELECTRONIC SECURITY SYSTEM
28 31 00	FIRE ALARM SYSTEM

List of Drawings and Specifications

Landscaping

04 43 16.01	QUARRIED STONE
31 11 00.01	CLEARING AND GRUBBING
31 14 13	SOIL STRIPPING AND STOCKPILING
31 22 13	ROUGH GRADING
32 01 90.33	TREE AND SHRUB PRESERVATION
32 91 10	TOPSOIL PLACEMENT AND FINE GRADING
32 92 23	SODDING
32 93 10	TREES, SHRUBS AND GROUND COVER PLANTING

CCDC2 – 2008 Reference Documents

Form of Agreement between Owner and Contractor

The “Agreement Between Owner and Contractor” forming part of Standard Construction Document CCDC 2 – 2008 shall in its entirety constitute the Agreement Form Between Owner and Contractor for the Contract and subject to the Instructions to Bidders appended to this document.

Definitions

The “Definitions” forming part of Standard Construction Document – CCDC 2 – 2008 shall in its entirety as amended by the Supplementary Conditions herein constitute the Definitions of the Contract.

General Agreement, General Definitions and General Conditions of the Stipulated Price Contract

The Agreement, Definitions and General Conditions of the Stipulated Price Contract forming part of Standard Construction Documents – CCDC 2 -2008 shall in its entirety as amended by the Supplementary Articles, Supplementary Definitions and Supplementary Conditions herein, constitute the General Conditions of the Stipulated Price Contract of the Contract.

A copy of CCDC 2-2008 is available at the local Construction Association office.

END OF CCDC 2 – 2008 REFERENCE DOCUMENTS

Supplementary Articles

SUPPLEMENTARY ARTICLES

The Agreement of the Standard Construction Document for Stipulated Price Contract, CCDC 2 – 2008 English version is hereby amended as follows:

SA1 ARTICLE A-3 CONTRACT DOCUMENTS

SA1.1 Paragraph 3.1:

Add the words “ - Supplementary Articles of the *Contract*
 - Supplementary Definitions of the *Contract*
 - Supplementary Conditions of the *Contract*”

to the list of *Contract Documents* in paragraph 3.1.

SA2 ARTICLE A-6 RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING

SA2.1 Paragraph 6.1:

Delete paragraph 6.1 in its entirety and substitute with new paragraph:

6.1 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.

SA3 ARTICLE A-9 SEVERABILITY

SA3.1 Add new Article A-9 as follows:

ARTICLE A-9 SEVERABILITY

9.1 - If any provision of this *Contract* is found to be invalid or unenforceable in any circumstances, the remainder of this *Contract*, and the application of such provision in any other circumstances, shall not be affected.

SA4 ARTICLE A-10 TIME OF ESSENCE

SA4.1 Add new Article A-10 as follows:

ARTICLE A-10 TIME OF ESSENCE

10.1 – Time shall be of the essence of the *Contract* and under all *Contract Documents*.

END OF SUPPLEMENTARY ARTICLES

Supplementary Definitions

SUPPLEMENTARY DEFINITIONS

The Definitions of the Standard Construction Document for Stipulated Price Contract, CCDC 2 – 2008 English version are hereby amended as follows:

SD1 Paragraph 6 – Contract Documents

Add the words “in writing” after the word “upon” in the second line of paragraph 6.

SD2 Add the following definition:

10a Install

Install means completion of the following activities including the associated labour, costs, services, plant & construction machinery, and equipment necessary to:

- .1 Remove products from storage and locate for placement
- .2 Remove and dispose of wrappings and protective coverings
- .3 Orient, position and adjust Products for final placement
- .4 Erect, affix, and anchor Products in final placement, in accordance with the manufacturer's instructions
- .5 Connect, service, commission and adjust Products for proper operation.”

SD3 Add the following definition:

22a. Supply

Supply means completion of the following activities including the associated labour, costs, services, plant & construction machinery, and equipment necessary to:

- .1 Fabricate or purchase Products
- .2 Deliver Products to the Place of the Work
- .3 Unload Products
- .4 Store Products in accordance with the manufacturer's instructions

SD4 Paragraph 27 – Ontario Shores

Add new paragraph 27 – Ontario Shores as follows:

27. Ontario Shores

Ontario Shores means *Ontario Shores Centre for Mental Health Sciences*, its authorized agent or representative as designated to the *Contractor* in writing.

SD5 Paragraph 19a – Submittals

Add new paragraph 19a – Submittals as follows:

Supplementary Definitions

19a. Submittals

Submittals are documents or items required by the *Contract Documents* to be provided by the *Contractor*, such as:

- *Shop Drawings*, samples, models, mock-ups to indicate details or characteristics, before the portion of the *Work* that they represent can be incorporated into the *Work*; and
- Record drawings and manuals to provide instructions to the operation and maintenance of the *Work*.

SD6

Paragraph 29 – Toxic and Hazardous Substances

Add new paragraph 29 - Toxic and Hazardous Substances as follows:

29. Toxic and Hazardous Substances

Toxic and Hazardous Substances means, collectively, any contaminant, waste, subject waste, pollutant, toxic substance, dangerous goods, asbestos, petroleum, its derivatives, by-products or other hydrocarbons, as defined in or pursuant to any applicable laws, regulations, by-laws, guidelines or orders rendered by any governmental authority having jurisdiction or any other substance or material which, when released to, or present in, the environment, is likely to cause in some immediate or foreseeable future time, material harm or degradation of the natural environment or material risk to human health.

END OF SUPPLEMENTARY DEFINITIONS

Appendix A

Facility Information Management System Update (WSP – SeawoodFM) Software

SPECIFICATIONS FOR NEW OR RENOVATION PROJECTS

1 BACKGROUND

- 1.1 As part of the closeout requirements, each proponent must include fees for WSP to conduct as-built verifications and update the drawings, documents and data hosted on SeawoodFM.
- 1.2 Furthermore, WSP will need sufficient project related information in order to provide a quote. i.e.: drawing format (CAD or PDF); area (sq.ft/sq.m) of renovated space, and completed WSP Quote Checklist (see below) outlining the systems affected. i.e.: architectural, plumbing, power. etc.

2 SUBMISSION AND PROCESS REQUIREMENTS

- 2.1 During the bidding period, each proponent will contact WSP regarding the facility/renovation project and supply all required information as noted to:

Gina Giron, Manager, Buildings - Software Services

Skype +1 647.730.7130
Mobile +1 226.220.3805
Email gina.giron@wsp.com

2300 Yonge Street, Suite 2300
Toronto, Ontario
M4P 1E4 Canada

- 2.2 WSP will create a quote for the project and provide it to the proponent during the bidding period. Sufficient turnaround time of five (5) business days is required for WSP to provide a quote.
- 2.3 The proponent will include the fee provided by WSP in the stipulated sum bid submitted for the provision of FM update.
- 2.4 The successful proponent will provide WSP with design/construction drawings and construction schedule to review and prepare for site verifications.
- 2.5 During the construction process, at least twenty (20) business days prior to construction completion and hand-over to the client, the successful proponent will contact WSP to schedule site verification for architectural, mechanical and electrical systems. WSP will need access into the building to verify these systems.
- 2.6 Once the construction is complete, the successful proponent will provide WSP with all design/construction/as-built drawings, operation and maintenance manuals, etc to review and upload into the SeawoodFM system.
- 2.7 WSP will use the as-built drawings provided from the proponent in combination with the site verifications to update the SeawoodFM CAD drawings, for future use by the client.

Appendix A

3 PROJECT CLOSEOUT

- 3.1 Once the as-built drawings are updated and supporting documentation has been loaded onto SeawoodFM, WSP will notify the successful proponent as well as the client and will provide access to review the updates.
- 3.2 Final acceptance of the project/deliverables is contingent upon the drawings, documents and data being updated in SeawoodFM.

4 CHECKLIST REQUIREMENTS

- 4.1 The bidding proponent will fill out the WSP Quote Checklist for the project and provide it to WSP to obtain a proper fee estimate.

5 HOLDBACK CONDITIONS

- 5.1 The specifications set out in this section will be included in the overall holdback of the project. The holdback for this section is based the on the overall value of the SeawoodFM software system being updated, not the standalone as-builts. The overall investment into the SeawoodFM software system is currently valued at \$350,000.



Send Quote Checklist to: **Gina Giron**
Manager, Buildings - Software Services

Email: gina.giron@wsp.com
Mobile: 226-220-3805

WSP QUOTE CHECKLIST FOR RENOVATION PROJECTS

Client: Ontario Shores
Contractor:
Consultant: Morrison Hershfield
New Building Area (sqft)

Indicate if as-built drawings will be provided in CAD or PDF format

Please "x" the Yes or No column for the following questions		
ARCHITECTURAL	Yes	No
Are there Architectural changes?		
Are there new room numbers?		

Please "x" the systems that are effected		
MECHANICAL	Yes	No
Drainage		
Heating		
HVAC		
Medical Gas		
Plumbing		
Sprinkler		
Standpipe		

Please "x" the systems that are effected		
ELECTRICAL	Yes	No
Electrical Panels		
Fire Alarm Devices		
Lighting		
Power Receptacles		
Security		

Please "x" the systems that are effected		
SITE	Yes	No
Electrical		
Fire Hydrants		
Gas		
Sanitary		
Storm		
Telecom		
Watermain		

List any additional system that are affected by the work, which are not listed above:

Supplementary Conditions

1 GENERAL

- 1.1 The Standard Construction Document for Stipulated Price Contract CCDC 2-2008 consisting of the Agreement between Owner and Contractor, Definitions, the General Conditions Articles GC 1.1 to GC 12.3 inclusive, CCDC 40 Rules for Mediation and Arbitration of Construction Disputes, and CCDC 41 CCDC Insurance Requirements, together with these Supplementary General Conditions are hereby confirmed as comprising part of the Contract Documents for the Work.

2 DEFINITIONS

- 2.1 Revise Item 19. Subcontractor by changing the item title to Sub-Contractor and Sub-Sub-Contractor and add a new sentence;

'A Sub-Sub-Contractor is a person or entity having a direct contract with a Sub-Contractor to perform a part or parts of the Work at the Place of the Work'

- 2.2 Revise Item 22. Supplier by inserting after the word 'Contractor' the words 'Sub-Contractor or Sub-Sub-Contractor'

- 2.3 Add the following to 'Definitions' of CCDC 2:

27. Wherever the words 'indicated', 'designated', 'shown', 'noted', 'listed', 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 is 'indicated', 'designated', 'shown', or 'noted', on the Drawings.
28. Wherever the words 'approved', 'satisfactory', 'as directed', 'submit', 'permitted', 'inspected', 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', 'satisfactory to', 'as directed by', 'submitted to', 'permitted by', or 'inspected by' the Consultant.
29. The terms 'Sub-Contractor' and 'this Contractor' used in the Specification covering the Work of the various trades shall mean the person or firm to whom that particular portion of the Work has been let or sublet.
30. The term 'Inspection Engineer', 'Inspection & Testing Company' used in the Specification covering the Work under the various trades, shall mean the person or firm, respectively, appointed by the *Consultant* to carry out the Inspection & Testing Work specified.
31. The term "Notice of Change" is a written description of a proposed change to the Work which requests a quotation from the Contractor.

3 CONTRACT DOCUMENTS

- 3.1 Add paragraph GC1.1.7.5 as follows:

1.1.7.5 Where conflict occurs in or between *Specifications and Drawings* or with codes applicable to the *Work*, the maximum condition shall govern and the Tender or Bid Price shall be based on whichever indicates the greater cost. The Contractor to obtain clarification of the conflict prior to the commencement of the *Work*.

- 3.2 Add paragraph GC1.1.7.6 as follows:

Supplementary Conditions

1.1.7.6 In case of conflict between the General Conditions and the Supplementary Conditions, the General Conditions shall be amended but only to the extent necessary to make the provisions of the Supplementary Conditions effective.

3.3 Delete Article GC1.1.8 and substitute as follows:

1.1.8 In addition to the signed sets of *Contract Documents* required for the Owner/Contractor Agreement the *Consultant* will furnish the General Contractor with up to 15 sets of the working *Drawings and Specifications* and up to 10 copies of each scale or full size detail drawing. The General Contractor shall be responsible for cost of any additional prints and *Specifications* that he may require.

4 LAW OF THE CONTRACT

4.1 Delete Article GC 1.2.1 and substitute as follows:

1.2.1 The law of the *Place of the Work* shall govern the *Work* and the interpretation of the *Contract*.

ADD GC1.5 PROJECT REQUIREMENTS

If the *Contractor* is not maintaining the Contract schedule consistent with its obligations under this Contract, then at the request of the *Owner*, the *Contractor* shall increase its efforts on the project, including, the addition of more personnel to the Project during regular times and during periods of time for which overtime may be required, all of which is to be done promptly at the *Contractor's* own cost and expense.

ADD GC1.6 EXPERIENCE OF CONTRACTOR AND STAFF

1.6.1 the *Contractor* has the necessary high degree of experience and expertise required to enable it to perform the services required by the *Contract Documents*;

1.6.2 the personnel the *Contractor* assigns to the project are highly experienced;

1.6.3 the *Contractor* has a sufficient staff of qualified and competent personnel to replace its designated Supervisor and Project Manager, subject to the *Owner's* approval, in the event of death, incapacity, termination or resignation;

1.6.4 there are no pending, threatened or anticipated claims or litigation that would have a material effect on the financial ability of the *Contractor* to perform its *Work* under this Contract

5 ROLE OF THE CONSULTANT

5.1 Delete Article GC2.2.7 in its entirety and substitute the following:

2.2.7 The *Consultant* will be, in the first instance the interpreter of the requirements of the *Contract Documents*.

5.2 Add the following to Article GC2.2:

2.2.19 The *Consultant* shall not be required to decide on questions arising under agreements or contracts between the Contractor, his *Sub-Contractor's*, their *Sub-Sub-Contractor's*, and *Supplier's*.

Supplementary Conditions

6 REVIEW AND INSPECTION OF THE WORK

6.1 Add the following to Article GC2.3:

2.3.8 The Contractor shall notify the *Consultant* of locations where installation of fixtures, fittings and equipment would interfere with interior treatment and use of building. In such cases detail *Drawings* or instructions exactly locating these items will be issued. If the Contractor claims that any instructions, by *Drawings* or otherwise, involve extra cost under the *Contract* he should give the *Consultant* prior written notice and obtain the Owner's prior written approval in the form of a *Change Order* or *Change Directive*, before proceeding to carry out the *Work*.

7 DEFECTIVE WORK

7.1 Add new subparagraphs 2.4.1.1 and 2.4.1.2:

2.4.1.1 "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*.

2.4.1.2 "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*.

7.2 Delete Article GC2.4.3 in its entirety and substitute as follows:

2.4.3 If in the opinion of the *Consultant* it is not expedient to correct defective *Work* or *Work* not performed as provided in the *Contract Documents*, a *Change Order* will be issued to deduct from the amount otherwise due to the *Contractor*, the difference in value between the *Work* as performed and that called for by the *Contract Documents*.

8 CONTROL OF THE WORK

8.1 Add the 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 contradictions exist, 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.

9 CONSTRCUTION BY THE OWNER OR OTHER CONTRACTORS

9.1 Add new subparagraph 3.2.3.4:

3.2.3.4 "Subject to **GC 9.4 CONSTRUCTION SAFETY**, for the *Owner's* own forces and for 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 Occupational Health and Safety Act."

Supplementary Conditions

10 DOCUMENT REVIEW

10.1 Delete Article GC3.4.1 in its entirety and substitute as follows;

- 3.4.1 During the bidding period the Contractor thoroughly reviewed the Instructions to Bidders, Bid Form, General Conditions, Supplementary Conditions, *Specifications and Drawings* listed in the Agreement, Article A-3 *Contract Documents*, and the included Addenda and accepted and agreed to the same as forming part and parcel of the *Contract* for construction of the *Work* in the *Place of the Work*.
- 3.4.2 The Contractor, by submitting a bid, agrees that he carefully examined the site of the proposed *Work*, the existing conditions, and the *Contract Documents*, and further warrants that the bid price includes for provision of materials, equipment, labour and superintendence to complete the *Work*.
- 3.4.3 During the Bidding Period, where the Contractor found discrepancies, ambiguities, or omissions in the *Drawings* or *Specifications* or has any doubt as to the meaning or intent of any part thereof, the *Contractor* must immediately notify the *Consultant*, who will provide written instructions or explanations. Neither the *Owner* nor the *Consultant* will be responsible for oral instructions.
- 3.4.4 During construction the Contractor shall report promptly to the *Consultant* any subsequently discovered discrepancies, ambiguities, errors, inconsistencies or omissions in the *Contract Documents*, and shall not proceed with the *Work* affected until *Supplemental Instructions* are furnished by the *Consultant*.

11 CONSTRUCTION SCHEDULE

11.1 Delete paragraph 3.5.1 in its entirety and **substitute** new paragraph 3.5.1:

- 3.5.1 The *Contractor* shall,
 - 3.5.1.1 Prior to submitting the first application for payment, submit to the *Owner* and the *Consultant* for their review and acceptance a construction schedule indicating the critical path for the *Project* demonstrating that the *Work* will be performed in conformity with the *Contract Time* and in accordance with the *Contract Documents*. The *Contractor* shall provide the schedule information required by this paragraph 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;
 - 3.5.1.2 Provide the expertise and resources, such resources including manpower and equipment, as are necessary to maintain progress under the accepted baseline construction schedule referred to in paragraph 3.5.1.1 or any successor or revised schedule accepted by the *Owner* pursuant to GC3.5;
 - 3.5.1.3 Monitor the progress of the *Work* on a weekly basis relative to the construction schedule reviewed and accepted pursuant to paragraph 3.5.1.1, or any successor or revised schedule accepted by the *Owner* pursuant to GC 3.5, update the schedule on a monthly basis and advise the *Consultant* and the *Owner* in writing of any variation from the baseline or slippage in the schedule; and,
 - 3.5.1.4 If, after applying the expertise and resources required under paragraph 3.5.1.2, the *Contractor* forms the opinion that the slippage in schedule reported in paragraph 3.5.1.3 cannot be recovered by the *Contractor*, it shall, in the same notice provided under paragraph 3.5.1.3, indicate to the *Consultant* and the *Owner* if the *Contractor* intends to

Supplementary Conditions

apply for an extension of *Contract Time* as provided in PART 6 - CHANGES IN THE WORK.

11.2 Add new paragraph 3.5.2:

"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 3.5.1.3, 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. If the *Contractor* intends to apply for a change in the *Contract Price* in relation to a schedule recovery plan, the *Contractor* shall proceed with PART 6 - CHANGES IN THE WORK."

12 SUPERVISION

12.1 Delete paragraph GC3.6.1 and GC3.6.2 substitute as follows:

3.6.1 The Contractor and each major *Sub-Contractor* shall provide supervision of the *Work* and appoint competent representatives and appropriate assistants who shall be in attendance at the *Place of the Work* while *Work* is being performed. The supervisory staff assigned to the *Project* shall also be fully competent to implement efficiently all requirements for scheduling, co-ordination, field engineering, reviews, inspection and testing and submittals defined in the *Specifications* and have minimum three (3) years documented Superintendent/Project Management experience. The representatives and assistants shall not be changed without approval from the *Consultant*, and upon submission of valid reasons such approval shall not be unreasonably withheld.

3.6.2 The Contractors representative shall represent the Contractor at the *Place of the Work*. Information and instructions provided by the *Consultant* to the Contractors representative shall be deemed to have been received by the Contractor, except with respect to Article A-6 of the Agreement - RECEIPT OF AND ADDRESSES FOR NOTICES IN WRITING. The Contractors representative shall be responsible for prompt transmission of Information and instruction received from the Consultant shall be promptly transmitted to *Sub-Contractors*, *Sub-Sub-Contractors* and *Suppliers* involved.

12.2 Add new paragraph 3.6.3:

3.6.3 The *Owner* may, at any time during the course of the *Work*, request the replacement of the appointed representative(s), where the grounds for the request involve conduct which jeopardizes the safety of the *Owner's* operations. Immediately upon receipt of the request, the *Contractor* shall make arrangements to appoint an acceptable replacement.

13 SUB-CONTRACTOR AND SUPPLIERS

Delete paragraph 3.7.2 in its entirety and **substitute** new paragraph 3.7.2:

13.1 3.7.2 "The *Contractor* agrees not to change *Sub-Contractors* without prior written approval of the *Owner*, which approval will not be unreasonably withheld."

Add the following to Article GC3.7:

3.7.7 The Specification has generally been divided into trade Sections. It is not thereby intended to recognize, set, or define limits to any trade subcontractor or to restrict the Contractor in letting

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subcontracts. Neither is the Contractor relieved of responsibility for completion of *Contract* whether or not portions of the *Work* are sublet.

14 LABOUR AND PRODUCTS

14.1 Delete paragraph GC3.8.1 and GC3.8.3 and substitute the following:

- 3.8.1 The Contractor shall provide *Products*, and arrange and pay for labour, tools Construction Equipment, water, heat, light, power, transportation, and other facilities and services for the completion of the *Work* in accordance with the *Contract*.
- 3.8.3 The Contractor shall maintain good order and discipline among the personnel engaged on the *Work* and shall not allow the employment of anyone not skilled in the tasks assigned.

14.2 Add the following paragraphs:

- 3.8.4 Products may be specified by reference to brand names, proprietary names, trademarks or symbols. The name of a manufacturer, distributor, supplier or dealer may be provided to assist the *Contractor* to find a source supplier. This shall not relieve the *Contractor* from responsibility for finding sources of supply even if the source named no longer supplies the product specified. If the *Contractor* is unable to obtain the specified product, a substitute product equal to or better than the specified product, shall be supplied by the *Contractor*, as approved by the *Consultant*, at no additional cost. Should the *Contractor* be unable to obtain a substitute product equal to or superior to the specified product and the *Owner* accepts an inferior product, the *Contract Price* shall be adjusted accordingly, as approved by the *Consultant*.
- 3.8.5 In performing any and all services and obligations that it has agreed to perform in accordance with the terms of this *Contract*, the *Contractor* shall exercise a standard of care, skill and diligence that would normally be provided by an experienced and prudent contractor supplying similar services for similar projects and in a first class and expeditious manner. The *Contractor* acknowledges and agrees that throughout this *Contract* the *Contractor's* obligations, duties and responsibilities shall be interpreted in accordance with this standard and any default or alleged default by the *Contractor* in the performance of its obligations, duties and responsibilities shall similarly be interpreted in accordance with this standard. 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*.
- 3.8.6 The *Contractor* shall forthwith perform, without cost or expense to the *Owner*, any and all such services as are required to correct or remedy any act, error, omission or default of or attributable to the *Contractor* in the performance of any term of this *Contract*.
- 3.8.7 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*.

Supplementary Conditions

15 SHOP DRAWINGS

- 15.1 Delete 3.10.3 in its entirety and substitute new paragraph 3.10.3.

3.10.3 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*.

- 15.2 Add the following to the first sentence in Article GC3.10.9

and provide written explanation for the deviation, with proposed *Contract Price* adjustment.

- 15.3 Add the following to Article GC3.10:

3.10.13 *Shop Drawings* shall each be noted with the following information:

Project Name and Number
Manufacturer's and Supplier's Name
Catalogue model number
Name of trade supplying item
Number or designation identifying item on *Drawings* and/or in *Specifications*
Drawing and/or Specification reference

16 USE OF THE WORK

- 16.1 Add the following to Article GC3.11:

3.11.3 The *Owner* shall have the right to enter and occupy the building in whole or in part for the purpose of placing fittings and equipment or for other uses before completion of the *Contract*. Both the *Owner* and the *Contractor* shall co-operate with the other, so as to permit the *Contractor* to complete the *Work* and the *Owner* to place fittings and equipment in the most efficient manner possible. Such entry and occupation shall not be considered as acceptance of the *Work* or in any way relieve the *Contractor* from his responsibility to complete the *Contract*.

17 CASH ALLOWANCES

- 17.1 Add the following to paragraph GC4.1.1:

Expenditures from Cash Allowances must be authorized in writing by the *Consultant*. Vouchers shall be submitted by the *Contractor* to substantiate expenditures from Cash Allowances.

- 17.2 Add the following to paragraph GC4.3.1:

If the Cash Allowance is specified to be included by a particular *Sub-Contractor* then the *Contract Price* and not the Cash Allowance includes the *Sub-Contractor's* overhead and profit.

- 17.3 Delete paragraph 4.1.4 in its entirety and substitute new paragraph 4.1.4:

4.1.4 Where costs under a cash allowance exceed the amount of the allowance, unexpended amounts from other cash allowances shall be reallocated at the *Consultant's* direction to cover the shortfall.

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- 17.4 Delete paragraph 4.1.5 in its entirety and substitute new paragraph 4.1.5:

4.1.5. The net amount of any unexpended cash allowances, after providing for any reallocations as contemplated in paragraph 4.1.4, shall be deducted from the *Contract Price* by *Change Order*.

- 17.5 Add new paragraph 4.1.8:

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

18 FINANCING INFORMATION REQUIRED OF THE OWNER

- 18.1 Delete Article GC5.1 and subsequent references to this Article in their entirety.

19 APPLICATIONS FOR PROGRESS PAYMENT

- 19.1 Add to the end of paragraph 5.2.7 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* notwithstanding that title has passed to the *Owner* pursuant to GC 13.4 OWNERSHIP OF MATERIALS.

- 19.2 Add new paragraphs 5.2.8, 5.2.9 and 5.2.10:

5.2.8 The *Contractor* shall submit, with each application for progress payment after the first, 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.

5.2.9 The *Contractor* shall submit Workplace Safety & Insurance Board Clearance Certificate, with each application for progress payment.

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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.

20 PROGRESS PAYMENT

20.1 Delete: 5.3.1.3 and Replace with:

20.2 The *Owner* shall make payment to the *Contractor* on or before 20 working days after receipt of Certificate of Payment as issued by the *Consultant*

20.3 Add Paragraph 5.3.2:

Date of receipt by the *Owner* shall be the same as the date on the Certificate as issued by the *Consultant*.

21 SUBSTANTIAL PERFORMANCE OF THE WORK

21.1 Delete Article GC5.4.3 in its entirety and substitute new paragraph 5.4.3:

5.4.3 Immediately following the issuance of the certificate of Substantial Performance of the Work, the *Contractor*, in consultation with the *Consultant*, shall establish reasonable dates for finishing the Work and correcting deficient work.

21.2 Add new paragraphs 5.4.4, 5.4.5, 5.4.6, 5.4.7 and 5.4.8:

5.4.4 The *Contractor* shall publish, in a construction trade newspaper in the area of the location of the *Work*, a copy of the Certificate of *Substantial Performance of the Work* within seven (7) days of receiving a copy of the Certificate signed by the *Consultant*, and the *Contractor* shall provide suitable evidence of the publication to the *Consultant* and *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.

5.4.5 Prior to submitting its application for *Substantial Performance of the Work*, the *Contractor* shall submit to the *Consultant* all:

- .1 guarantees,
- .2 warranties,
- .3 certificates,
- .4 testing and balancing reports,
- .5 distribution system diagrams,
- .6 spare parts,
- .7 maintenance manuals,

and other materials or documentation required to be submitted under the *Contract*, together with written proof acceptable to the *Owner* and the *Consultant* that the *Work* has been substantially performed in conformance with the requirements of municipal, government and utilities authorities having jurisdiction.

5.4.6 Where the *Contractor* is unable to deliver the documents and materials described in paragraph 5.4.5, then, provided that none of the missing documents and materials interferes, in a material way, with the use and occupancy of the *Work*, failure to deliver shall not be grounds for the *Consultant* to refuse to certify *Substantial Performance of the Work*. Any documents or materials not delivered in accordance with paragraph 5.4.5 shall be delivered as provided in GC 5.7, paragraph 5.7.1.

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5.4.7 The Contractor shall complete the Work at times convenient to the Owner. This may include evening work, weekend or shift work, should the Work be not proceeding in accordance with the original construction schedule provided by the Contractor in order to meet the Substantial Performance date. This will be at no additional cost to the Owner where failure to meet the schedule by acts or omissions by the Contractor and/or their Sub-Contractors and Suppliers.

5.4.8 The Contractor shall inform all insurers who have issued Bonds and Insurance for this Contract, of the extent of occupancy. If occupancy by the Owner requires adjustments of bonds or insurances, the Contractor shall, subject to the Owner's approval, initiate and pay for such adjustments on behalf of the Owner and a Change Order will be issued.

22 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK

22.1 Add to the end of paragraph 5.5.1.3 the following new sentence: "including a declaration that no written notices of lien have been received by it."

22.2 Add new paragraphs 5.5.1.5: Submit Workplace Safety & Insurance Board Clearance Certificate

22.3 Add the following paragraph:

5.5.6 The *Contractor* shall, when requested to do so by the *Owner*, cause any and all construction liens related to this *Contract* registered by any Sub-Contractor or Supplier, to be discharged or vacated by the *Contractor* posting appropriate security and the *Contractor* shall do so within ten calendar days of that request at its sole expense.

23 GC 5.6 PROGRESSIVE RELEASE OF HOLDBACK

23.1 Delete clause.

24 FINAL PAYMENT

24.1 Delete paragraph 5.7.1 in its entirety and substitute new paragraph 5.7.1:

5.7.1 When the *Contractor* considers that the *Work* is completed, 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 pursuant to paragraph 5.4.5 together with complete as-built *Drawings*. Should the *Contractor* fail to deliver any of the foregoing documents, the *Owner* shall be at liberty to withhold from amounts otherwise payable to the *Contractor*, the sum of 4% of the total contract value as security for the obligation of the *Contractor* to deliver the undelivered documents.

24.2 Delete from the first line of paragraph 5.7.2 the words "calendar days" and substitute the words "Working Days".

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24.3 Delete from the second line of paragraph 5.7.4 the words "calendar days" and substitute the words:
"Working Days".

24.4 Add new paragraph 5.7.5:

"5.7.5 As additional requirements for release of finishing construction lien holdback, the *Contractor* shall submit the following documentation.

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

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

.3 *Contractor's* Workplace Safety & Insurance Board Clearance Certificate.

Final Payment shall be issued only upon all conditions of the Agreement being satisfied, including all submittals and rectification of all deficiencies in the Work."

25 WITHHOLDING OF PAYMENT

25.1 Add new paragraph GC5.8.2 and GC 5.8.3 as follows:

5.8.2 In addition to any rights the *Owner* has pursuant to the Construction Lien Act, if a lien is registered or an action commenced against the *Owner*, the *Owner* may withhold from any money otherwise due to the *Contractor*, the full amount claimed in the lien action plus an additional sum sufficient to satisfy all of the *Owner's* expenses relating to such lien actions, including legal costs. These funds held back shall be released to the *Contractor* upon the full discharge of all liens and dismissal of all actions against the *Owner*.

5.8.3 Notwithstanding the provisions of GC 5.3 PROGRESS PAYMENT, GC 5.5 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF THE WORK and GC 5.7 FINAL PAYMENT, the *Owner* may decline to approve any application for payment and may withhold payment of any certificate for payment, including a certificate for payment of the holdback and a final certificate for payment in whole or in part, to the extent necessary to protect the *Owner* and may withhold such funds as the *Owner* shall, pursuant to the opinion of the *Consultant*, be required to offset any previous payment made to the *Contractor*, or to set off against any costs and damages, to such extent as may be necessary in the opinion of the *Consultant* to protect the *Owner* from loss because of:

- 1) defective portions of the Work;
- 2) third party claims or reasonable evidence indicating possible commencement of third party claims;
- 3) evidence of the *Contractor's* failure to make payments promptly to Sub-Contractors or Suppliers;
- 4) delay to work of other *Contractors*;
- 5) the *Contractor's* failure to immediately resolve any liens arising from the *Work*; or
- 6) unsatisfactory prosecution of the *Work* by the *Contractor* or any Sub-Contractor.

Where the *Owner* has withheld payment of any portion of the *Contract Price* pursuant to the provisions of the *Contract*, the *Owner* shall be entitled to apply such portion of the *Contract Price* withheld toward the costs of any required remedial work, or for damages, loss or as indemnification with respect to any third party claims or other loss arising under the *Contract*."

26 CHANGE ORDER

26.1 Add new paragraphs GC6.2.3 through GC6.2.6 as follows:

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- 6.2.3 The value of a proposed change in the Work shall be determined in one or more of the following methods:
- (a) by unit prices set out in the Contract or subsequently agreed upon,
 - (b) by labour and material costs submitted in a detailed quotation.
- 6.2.4 In the case of changes in the *Work* to be paid for under method (a), the form of presentation of costs and methods of measurement shall be agreed to by the *Consultant* and *Contractor* before proceeding with the change. The *Contractor* shall keep accurate records, as agreed upon, of quantities or costs and present an account of the cost of the change in the *Work*, together with vouchers where applicable.
- 6.2.5 In the case of changes in the *Work* to be paid for under method (b) detailed quotations to show three components: material costs, labour charges, and fees. Material costs are to be less trade discounts. Labour costs to include burden on wages, such as Canada Pension Plan contributions, Employment Insurance premiums, and include costs for; taxes, and insurance, workplace safety meetings, estimating, as-built *Drawings*, supervision, small tools, warranty labour, and clean up.]
- 6.2.6 In the case of changes in the Mechanical and Electrical trades *Work* to be paid for under method (b) detailed quotations to show three components: material costs, labour charges, and fees. Material costs are to be less trade discounts. Discount for items taken from Allpriser Catalogue or Electrical Price Guide to be 20%. Labour charges to be based on National Electrical Contractors Association (NECA) Manual of Labor Units (difficult) and Mechanical Contractors Association of America (MCAA) Labor Estimating Manual. Labour costs to include burden on wages, such as Canada Pension Plan contributions, Employment Insurance premiums, and include costs for; taxes, and insurance, workplace safety meetings, estimating, as-built *Drawings*, supervision, small tools, warranty labour, and clean up. Hourly labour rate applicable for changes not to exceed 1.55 times base rate of current union agreement.
- Hourly rate for specialists not covered by union agreements, (controls and instrumentation technicians or engineers) not to exceed 1.75 base rate for unionized plumbers and pipe fitters.
- 6.2.7 The fees allowed for overhead and profit on proposed changes to the *Work* is to include for the *Contractor's* head and site office expense, project manager, assistants, site office and storage facilities, utilities, site security, telephone and facsimile transmission costs.
- The *Contractor*, the *Sub-Contractor*, or the Sub-Subcontractor is allowed an overhead and profit fee of 15% for *Work* to be performed by his own forces. The *Contractor* is allowed an overhead and profit fee of 10% for *Work* performed by a *Sub-Contractor* and a *Sub-Contractor* is allowed an overhead and profit fee of 10% for *Work* performed by a Sub-Subcontractor. No overhead and profit will be allocated to Change Orders issued for *Work* to be performed under Cash Allowances

27 CONCEALED OR UNKNOWN CONDITIONS

27.1 Add new subparagraph 6.4.5:

6.4.5 The *Contractor* confirms that, prior to bidding the *Project*, it carefully investigated the *Place of the Work* and applied to that investigation the degree of care and skill described in

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paragraph 3.14.1, given the amount of time provided between the issue of the bid documents and the actual closing of bids, the degree of access provided to the *Contractor* prior to submission of bid, and the sufficiency and completeness of the information provided by the *Owner*. 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 careful investigation undertaken prior to the submission of the bid.

28 DELAYS

- 28.1 Delete the period at the end of paragraph 6.5.1, and substitute the following words: ", but excluding any consequential, indirect or special damages."
- 28.2 Add new subparagraph 6.5.6:

6.5.6 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 *Contract Time* shall be extended for such reasonable time as the *Consultant* may decide in consultation with the *Contractor*. 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 *Substantial Performance of the Work* 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 *Substantial Performance of the Work* achieved by the *Contractor*."

29 CONTRACTORS RIGHT TO STOP THE WORK OR TERMINATE THE CONTRACT

- 29.1 Delete subparagraph 7.2.3.1 in its entirety.
- 29.2 Delete subparagraph 7.2.3.3 in its entirety and substitute new subparagraph 7.2.3.3:
- 7.2.3.3 the *Owner* fails to pay the *Contractor* when due the amount certified by the *Consultant* or awarded by arbitration or a Court, except where the *Owner* has a bona fide claim for set off, or"
- 29.3 Add the following paragraph:
- 7.2.6 If the *Contractor* stops the *Work* or terminates the *Contract* in accordance with the paragraphs above, the site and the *Work* shall be left by the *Contractor* in secure and safe conditions as required by authorities having jurisdiction and the *Contract Documents*."

30 RETENTION OF RIGHTS

- 30.1 Add new subparagraph 8.3.3:
- 8.3.3 "If the *Owner* gives the notice in writing described in paragraph 8.2.6 to have a dispute resolved by arbitration, the *Contractor* agrees that this paragraph 8.3.3 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

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arbitral award against it in full on the dispute in respect of which the lien proceedings were commenced. Provided nothing in this paragraph 8.3.3 shall prevent the *Contractor* from taking the steps required by the *Construction Lien Act* to preserve and/or perfect a lien to which it may be entitled."

31 PROTECTION OF WORK AND PROPERTY

- 31.1 Delete subparagraph 9.1.1.1 in its entirety and substitute new subparagraph 9.1.1.1:
9.1.1.1 "errors in the *Contract Documents* which the *Contractor* could not have discovered applying the standard of care described in paragraph 3.14.1;"
- 31.2 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 the *Contract Documents*, or that are discoverable by applying to an inspection of the *Place of the Work* the degree of care and skill described in paragraph 3.14.1."
- 31.3 Add new paragraph 9.1.5:
9.1.5 "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."

32 TOXIC AND HAZARDOUS SUBSTANCES

- 32.1 Add to paragraph 9.2.6 after the word "responsible", the following:
"or whether any toxic or hazardous substances or materials 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, "
- 32.2 Add to paragraph 9.2.8 after the word "responsible", the following:
"or that any toxic or hazardous substances or materials 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,"

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32.3 Add new subparagraph 9.3.10:

9.3.10 If the *Contractor* causes or permits:

- 1) any toxic or Hazardous Substances or materials to be brought by the *Contractor*, its Sub-Contractors or Suppliers to the *Place of the Work*, or
- 2) any toxic or Hazardous Substances or materials which were already at the *Place of the Work* (but which were then harmless or stored, contained or otherwise dealt with in accordance with legal and regulatory requirements), to be dealt with in a manner which does not comply with legal or regulatory requirements or which threatens human health and safety or the environment or causes material damage to the property of the *Owner* or others, the *Contractor* shall take all reasonable steps, including stopping the *Work*, to ensure that no person suffers injury, sickness or death and that no property is injured or destroyed as a result of exposure to or the presence of the Hazardous Substances or materials, and
- 3) immediately report the circumstances to the *Consultant* and the *Owner* by telephone, with written confirmation within 12 hours.

In the case of any circumstances described in paragraph 9.3.10, the *Contractor* shall be responsible, at the *Contractor's* sole expense, for cleaning up, removing, containing, storing, or otherwise dealing with the toxic or Hazardous Substances or materials and any damage caused thereby in a manner which the authorities having jurisdiction determine will:

- 1) meet all applicable legal and regulatory requirements and ensure compliance with any applicable permits or other authorizations.
- 2) remove any threat to human health and safety or the environment, and
- 3) rectify all material damage to the property of the *Owner* and others."

33 CONSTRUCTION SAFETY

33.1 Add new subparagraphs 9.4.2, 9.4.3 and 9.4.4:

9.4.2 The *Contractor* shall comply and cause all of its Sub-Contractors, Suppliers and anyone for whom the *Contractor* is responsible to comply with all applicable provisions, requirements and safety standards of the Occupational Health and Safety Act and regulations thereto. Further, the *Contractor* shall comply and cause all of its Sub-Contractors, Suppliers and anyone for whom the *Contractor* is responsible to comply with any Ontario Shores Centre for Mental Health Services' Policies and Procedures that may be in force or brought into force during construction. The *Contractor* shall be designated and hereby accepts the responsibilities and designation as 'Constructor' under the Occupational Health and Safety Act on the Project and hereby assumes all liabilities and obligations imposed on a 'Constructor' by the Occupational Health and Safety Act.

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

- a) Documentation of a valid Workplace Safety and Insurance Board clearance certificate and confirmation of the *Contractor's* WCB CAD-7 performance rating.
- b) Documentation of the *Contractor's* insurance coverage.
- c) Documentation of the *Contractor's* in-house safety related programs.
- d) A copy of the Notice of Project filed with the Ministry of Labour describing the *Work* to be performed and designating the *Contractor* as 'Constructor'.

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

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and Sub-Contractors, Suppliers and anyone for whom the *Contractor* is responsible, before the *Work* is commenced and agrees to provide to the *Owner*, if requested, proof of such instruction and training.

The *Contractor* shall tour the appropriate area to familiarize itself with the job site prior to commencement of the *Work*.

9.4.3 "The *Contractor* shall indemnify and save harmless the *Owner*, its agents, officers, directors, employees, consultants, successors and assigns from and against the consequences of any and all safety infractions committed by the *Contractor* under 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.

9.4.4 "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 contractor or own forces, as the case may be, will comply with directions and instructions from the *Contractor* with respect to occupational health and safety and related matters."

34 LAWS, NOTICES, PERMITS AND FEES

34.1 In Article GC10.2 add the following paragraphs:

10.2.2.1 The *Owner* will, if required, submit the *Drawings and Specifications*, complete with the necessary forms, to obtain approval from the Factory Inspection Branch of the Ministry of Labour and the Certificates of Approval from the Ministry of Environment and Energy and will pay all costs in connection therewith.

10.2.3.1 Applications for permits requiring *Owner's* signature shall be submitted before *Work* is commenced.

Add to the end of paragraph 10.2.4, the following:

"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."

Delete from the first line of paragraph 10.2.5 the word, "The" and substitute the words:

"Subject to paragraph 3.14.1, the".

10.2.6 Inspection Certificates, as follows, shall be submitted before the final certificate will be issued:

Electrical Inspection, Plumbing Inspection, Pressure Vessel, Inspection, Piping and Boiler Inspection

10.2.7 Department of Labour certificates shall be renewed if necessary, to remain in force for the full guarantee period.

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35 INSURANCE

- 35.1 11.1.1.1 General Liability Insurance - *Revise* Sentence One to Read:
"General Liability Insurance shall be in the joint names of the *Contractor*, the *Owner*, and the *Consultant*; Commercial General Liability Insurance including bodily injury (including death), property damage, errors and omissions, contingent employer's liability and including severability of interests and cross liability clauses, in which the limits of liability shall be no less than \$3,000,000.00 per occurrence, and no less than \$2,000,000.00 per claim."
- 35.2 Add *Sentence 11.1.9*:
"The *Contractor* shall at all relevant times carry Workplace Safety and Insurance Board of Ontario (WSIB) coverage."

36 BONDS

- 36.1 Add the following to Article GC11.2:
- 11.2.3 The Bidder shall include with his Bid a written agreement to bond from a Bonding Company stating that the Bidder will be covered by a Performance Bond, and a Labour and Materials Payment Bond, each in the amount of 50% of the *Contract Price* if the Bidder is successful in obtaining the *Contract*. This bond coverage will include for cost of *Work* required under warranty, the payment of all legal and *Consultant's* expenses incurred by the *Owner* in determining the extent of *Work* executed, and the cost of any additional *Work* required as a result of the failure of the *Contractor* to complete the *Work*.
- 11.2.4 The *Contractor* shall furnish these bonds after receiving written notification, in the form of a letter of intent, from the *Owner*. Bonds shall not be terminated until *Consultant* has been notified in writing of this intention and until there is agreement to such termination.
- 11.2.5 The *Contractor* is responsible for notifying the surety of any significant changes in the *Contract*. The bond values are to be fixed upon their issue and not altered unless authorized by the *Owner* .

37 WARRANTY

- 37.1 Add the following to Article 12.3:
- 12.3.7 A letter of warranty covering the above-mentioned correction of defects shall be given to *Owner* at completion of *Work* , but before issue of final certificate. This warranty shall in no way supplant any other warranty of longer period called for on certain equipment or materials.

Add the following Article:

38 PART 13 - ADDITIONAL GENERAL CONDITIONS

38.1 13.1 NO CLAIMS FOR ANTICIPATED PROFIT

- 13.1.1 If any change or deviation in, or omission from the *Work* is made by which the amount of *Work* to be done is decreased, or if the whole or any portion of the *Work* is dispensed with, no compensation is claimable by the *Contractor* or Sub-Contractor for any loss of anticipated profits

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in respects thereof excepting as set out in Bidding And Contract Requirements Document 004113 - Tender Form, 9.1, Separate Prices."

38.2 13.2 FINANCIAL AUDIT

13.2.1 The *Contractor* is required to maintain an independent audit function to assess internal controls over its environment. The *Contractor* will cause its auditor to perform annual audits of its internal controls and security and provide the *Owner* with the results of such audits. The *Contractor* will provide the *Owner* and its representatives, auditors, inspectors and regulators upon reasonable written notice with access to all facilities, systems and assets used by the *Contractor* to provide the services and to all relevant *Contractor* books, records, inventories and facilities in order to conduct appropriate financial and security audits, examinations and inspections including to: verify (i) the existence of adequate internal control procedures surrounding the delivery of the services and the suitability of their design; and (ii) Contract compliance including amounts billed to the *Owner* by the *Contractor* for services; (iii) verify inventory costs.

38.3 GC 13.3 CONFIDENTIALITY AND PRIVACY OBLIGATIONS OF THE CONTRACTOR

13.3.1 Confidentiality and Promotion Restrictions

Any publicity or publications related to this Contract shall be at the sole discretion of the *Owner*. *Owner* may, in its sole discretion, acknowledge the Work provided by the *Contractor* in any such publicity or publication. The *Contractor* shall not make use of its association with *Owner* without the prior written consent of the *Owner*. Without limiting the generality of this paragraph, the *Contractor* shall not, among other things, at any time directly or indirectly communicate with the media in relation to this Contract, including issuing any news release or publicity in connection with this Agreement, unless it has first obtained the express written authorization to do so by the *Owner*.

13.3.2 Owner Confidential Information

During and following the Term, the *Contractor* shall: (a) keep all *Owner* Confidential Information confidential and secure; (b) limit the disclosure of *Owner* Confidential Information to only those of its directors, officers, employees, agents, partners, affiliates, volunteers or subcontractors who have a need to know it for the purpose of providing the Deliverables and who have been specifically authorized to have such disclosure and who have agreed to be bound by confidentiality obligations identical in principle with those in this Agreement; (c) not directly or indirectly disclose, destroy, exploit or use any *Owner* Confidential Information (except for the purpose of providing the Deliverables, or except if required by order of a court or tribunal), without first obtaining: (i) the written consent of the *Owner* and (ii) in respect of any *Owner* Confidential Information about any third-party, the written consent of such third-party; (d) provide *Owner* Confidential Information to the *Owner* on demand; and (e) return all *Owner* Confidential Information to the *Owner* before the end of the Term, with no copy or portion kept by the *Contractor*. The *Contractor* acknowledges that *Owner* Confidential Information is and at all times shall remain the exclusive property of *Owner* or others identified by *Owner* and *Contractor* shall not have any proprietary right to or interest in *Owner* Confidential Information.

13.3.3 Restrictions on Copying

The *Contractor* shall not copy any *Owner* Confidential Information, in whole or in part, unless copying is essential for the provision of the Deliverables. On each copy made by the *Contractor*, the *Contractor* must reproduce all notices which appear on the original.

13.3.4 Injunctive and Other Relief

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The *Contractor* acknowledges that breach of any provisions of this Article may cause irreparable harm to the *Owner* or to any third-party to whom *Owner* owes a duty of confidence, and that the injury to *Owner* or to any third-party may be difficult to calculate and inadequately compensable in damages. The *Contractor* agrees that the *Owner* is entitled to obtain injunctive relief (without proving any damage sustained by it or by any third-party) or any other remedy against any actual or potential breach of the provisions of this Article.

13.3.5 Notice and Protective Order

If the *Contractor* or any of its directors, officers, employees, agents, partners, affiliates, volunteers or subcontractors become legally compelled to disclose any *Owner* Confidential Information, the *Contractor* will provide the *Owner* with prompt notice to that effect in order to allow the *Owner* to seek one or more protective orders or other appropriate remedies to prevent or limit such disclosure, and it shall cooperate with the *Owner* and its legal counsel to the fullest extent. If such protective orders or other remedies are not obtained, the *Contractor* will disclose only that portion of *Owner* Confidential Information which the *Contractor* is legally compelled to disclose, only to such person or persons to which the *Contractor* is legally compelled to disclose, and the *Contractor* shall provide notice to each such recipient (in cooperation with legal counsel for the *Owner*) that such *Owner* Confidential Information is confidential and subject to non-disclosure on terms and conditions equal to those contained in this Contract and, if possible, shall obtain each recipient's written agreement to receive and use such *Owner* Confidential Information subject to those terms and conditions.

13.3.6 FIPPA Records and Compliance

The *Contractor* and the *Owner* acknowledge and agree that FIPPA applies to and governs all Records and may require the disclosure of such Records to third parties. Furthermore, the *Contractor* agrees:

- (i) to keep Records secure and ensure that reasonable measures respecting Records in its custody or under the control are developed, documented and put into place to preserve Records in accordance with any recordkeeping or records retention requirements, rules or policies, whether established under FIPPA or otherwise, that apply to the *Owner*;
- (ii) to provide Records to the *Owner* within seven (7) calendar days of being directed to do so by the *Owner* for any reason including an access request or privacy issue;
- (iii) not to access any Personal Information unless the *Owner* determines, in its sole discretion, that access is permitted under FIPPA and is necessary in order to provide the Deliverables;
- (iv) not to directly or indirectly use, collect, disclose or destroy any Personal Information for any purposes that are not authorized by the *Owner*;
- (v) to ensure the security and integrity of Personal Information and keep it in a physically secure and separate location safe from loss, alteration, destruction or intermingling with other records and databases and to implement, use and maintain the most appropriate products, tools, measures and procedures to do so;
- (vi) to restrict access to Personal Information to those of its directors, officers, employees, agents, partners, affiliates, volunteers or subcontractors who have a need to know it for the purpose of providing the Deliverables and who have been specifically authorized by the *Owner* to have such access for the purpose of providing the Deliverables;
- (vii) to implement other specific security measures that in the reasonable opinion of the *Owner* would improve the adequacy and effectiveness of the *Contractor's* measures to ensure the security and integrity of Personal Information and Records generally; and

Supplementary Conditions

- (viii) that any confidential information supplied to the *Owner* may be disclosed by the *Owner* where it is obligated to do so under FIPPA, by an order of a court or tribunal or pursuant to a legal proceeding or other Requirements of Law;

and the provisions of this paragraph shall prevail over any inconsistent provisions in this **Agreement**.

13.3.7 PHIPA Records and Compliance

The *Contractor* may have access to Personal Health Information in the course of fulfilling its obligations. The *Owner* is a health information custodian under PHIPA and has statutory obligations to safeguard its patients' Personal Health Information.

13.3.8 Contractor Requires Access to Personal Health Information

The parties agree and acknowledge that the *Contractor* will require access to Personal Health Information in the course of fulfilling its obligations under this Agreement. The following provisions set out the obligations of the *Contractor* with respect to its access, collection, use, disclosure, retention and disposal of Personal Health Information under this Agreement.

13.3.9 Contractor is Agent under PHIPA

The parties acknowledge and agree that the *Contractor*, when accessing, collecting, using, disclosing, retaining or disposing of Personal Health Information, does so solely on behalf of the *Owner* and as the *Owner* may direct while providing the Deliverables. As such, the *Contractor* is an "agent" of the *Owner*, as the term "agent" is defined in PHIPA, and with all the responsibilities of an agent imposed by PHIPA.

13.3.10 Use of Personal Health Information

The *Contractor* shall use the Personal Health Information disclosed by the *Owner* solely for the purposes of providing the Deliverables and for no other purpose whatsoever. The *Contractor* shall not disclose any Personal Health Information to any third parties except for *Contractor* Personnel, without the prior written consent of the *Owner* in each instance.

13.3.11 No Contact with Patients

Despite the fact that the *Contractor* is an agent of the *Owner* under PHIPA, the *Contractor* shall not have any contact with patients for any purpose whatsoever, unless expressly authorized by the *Owner*.

13.3.12 Obligations not Conditional

The *Contractor's* obligations under these privacy and security terms and conditions are absolute and are not conditional on the *Owner's* compliance with any of its obligations under this Agreement, including its obligation to pay the *Contractor*.

13.3.13 Contractor Personnel

For the purposes of these privacy and security terms and conditions, "*Contractor* Personnel" includes the *Contractor's* employees, contractors, subcontractors, and agents.

13.3.14 Training of Contractor Personnel

The *Contractor* has provided training to its *Contractor* Personnel with respect to the *Contractor's* legal obligations with respect to Personal Information under FIPPA and PHIPA and will provide additional training with respect to the *Contractor's* specific obligations to protect Personal Health Information under PHIPA and this Agreement. The *Contractor* shall ensure that the *Contractor* Personnel are aware of and agree in writing in the form of a "Pledge of Confidentiality" to be bound by the provisions relating to Personal Information and Personal Health Information that are set out in this Agreement, including without limitation those regarding notification set out in paragraph 22 below.

Supplementary Conditions

13.3.15 Access by Contractor Personnel

The *Contractor* shall give access to Personal Information and Personal Health Information only to those members of the *Contractor* Personnel who have a legitimate need to access the Personal Information and Personal Health Information in order to fulfill the *Contractor's* obligations under this Agreement.

13.3.16 Removal of Personnel

In the event of a breach of these provisions by any of the *Contractor* Personnel, the *Owner* may require that personnel member to cease providing Deliverables.

13.3.17 Compliance with Privacy Legislation

The *Contractor* has a privacy policy and privacy breach protocol in compliance with applicable privacy legislation, addressing its practices relating to the collection, use, disclosure, retention and disposal of Personal Information and Personal Health Information, and containment, notification, investigation and remediation of privacy breaches. The *Contractor* monitors and enforces compliance with its own privacy policy, including without limitation by way of audits, activity logs, limitations on access to Personal Information and Personal Health Information, discipline of policy violators, including reporting of discipline under any Requirements of Law, and any other practices recommended by the Privacy and Information Commissioner/Ontario (the "**IPC**").

13.3.18 Privacy Compliance Officer

The *Contractor* has an appointed privacy compliance officer who shall be given the responsibility for the *Contractor's* compliance with the privacy and security terms and conditions under this Agreement.

13.3.19 Safeguards

The *Contractor* has in place effective administrative, technological and physical safeguards to stop theft, loss and unauthorized access, copying, modification, use, disclosure or disposal of Personal Information and Personal Health Information. These safeguards are consistent with industry practice.

13.3.20 Receipt of Owner's Privacy Policy

The *Contractor* acknowledges receipt of the *Owner's* privacy policy and will only access, collect, use, disclose, retain and dispose of Personal Information and Personal Health Information as permitted by the *Owner*.

13.3.21 Monitoring of its Activities

The *Contractor* shall monitor its activities to ensure that its *Contractor* Personnel are complying with the privacy and security terms and conditions of this Agreement. In particular, the *Contractor* shall monitor and report to the *Owner*, upon the reasonable request of the *Owner*, the *Contractor's* access, use and disclosure of Personal Information and Personal Health Information under this Agreement.

13.3.22 Theft, Loss or Unauthorized Access of Personal Health Information

In the event that the *Contractor* becomes aware that Personal Information or Personal Health Information has been stolen or lost, or a person has obtained unauthorized access to Personal Information or Personal Health Information, or the *Contractor* has used, disclosed or disposed of the Personal Information or Personal Health Information other than as contemplated in this Agreement, the *Contractor* shall at the first reasonable opportunity notify the *Owner's* privacy officer by telephone followed by written notice. The *Contractor* shall not contact the IPC without the advance written approval of the *Owner*.

13.3.23 Indemnity

The *Contractor* hereby agrees to indemnify and hold harmless the *Owner* from all costs, damages, fines, penalties or other liabilities arising out of a breach of its obligations under FIPPA, PHIPA, the common law, or any other Requirements of Law and this Contract with respect to the *Contractor's* failure to comply with the privacy and security terms and conditions of this Agreement.

13.3.24 Owner's Review of Contractor's Practices and Procedures

The *Owner* may, upon reasonable notice, assess and review the *Contractor's* practices and procedures for receiving and processing Personal Information or Personal Health Information under this Agreement,

Supplementary Conditions

for the purposes of ensuring that the privacy and security terms and conditions of this Contract are being complied with. For these purposes, the *Contractor* shall provide the *Owner* with reasonable access to the policies, procedures and protocols used for purposes of providing the Deliverables and any other documents that may be relevant. Any review or assessment by the *Owner* pursuant to this paragraph 24, or the *Owner's* failure to do so, shall not limit or reduce the *Contractor's* responsibilities under this Agreement.

13.3.25 Cooperation with Privacy Assessment or Audit and Privacy Breach Reporting.

The *Contractor* will cooperate with any privacy assessment or audit conducted by the *Owner* or any third party retained by the *Owner*, as well within any privacy breach reporting by the *Owner* to the IPC.

13.3.26 Complaint by the Owner

In the event that the *Owner* makes a complaint to the *Contractor* in respect of the *Contractor's* compliance with the privacy and security terms and conditions of this Agreement, the *Contractor* shall, within five (5) Business Days of receipt of the complaint, investigate the matter and provide the *Owner* with an oral report stating the cause of the deficiency, if any, and the steps taken to prevent a recurrence, if required. Within a further five (5) Business Days, the *Contractor* shall provide the *Owner* with a written report documenting the complaint, investigation, deficiency, if any, and the steps taken to prevent a recurrence, if required.

13.3.27 Cooperation with Complaint to the Owner

The *Contractor* shall cooperate with the *Owner* in responding to any complaints about Personal Information or Personal Health Information that may relate to the *Contractor's* obligations under this Agreement.

13.3.28 Injunctive Relief

The *Contractor* hereby recognizes that any breach of the privacy and security terms and conditions of this Contract will result in irreparable harm to the *Owner* or to any third-party to whom the *Owner* owes a duty of confidence that cannot be calculated or fully or adequately compensated by the recovery of damages. As a result, the *Owner* shall, in addition to any other relief available to it, be entitled to the remedy of injunction without having to establish the inadequacy of any other remedy available to it (or such third-party). The *Contractor* hereby undertakes not to make any defence in proceedings regarding the granting of an injunction or specific performance based on the availability to the *Owner* of other remedies.

13.3.29 Termination upon Breach

At the *Owner's* discretion, it may terminate this Contract immediately, upon written notice, as a result of any breach of these privacy and security terms and conditions by the *Contractor*.

13.3.30 Return of Personal Information and Personal Health Information

On the termination or expiration of this Agreement, the *Contractor* shall return all Personal Information and Personal Health Information received or created under this Contract to the *Owner* and ensure that such Personal Information and Personal Health Information has been permanently removed from any media or hardware on which it was stored. The *Contractor* will provide the *Owner* with a sworn statement or other evidence satisfactory to the *Owner* that it has complied with this provision. The provisions of this paragraph shall prevail over any inconsistent provisions in this Agreement.

13.3.31 Survival

The provisions of this Article shall survive any termination or expiry of this Agreement.

38.4 13.4 OWNERSHIP OF MATERIALS

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13.4.1 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*.

38.5 13.5 CONSTRUCTION LIENS

13.5.1 In the event that a construction lien is registered against the *Project* by or through a *Subcontractor* or *Supplier*, and provided the *Owner* has paid all amounts properly owing under the *Contract*, the *Contractor* shall, at its own expense:

- .1 within ten (10) calendar days, ensure that any and all construction liens and certificates of action are discharged, released or vacated by the posting of security; and
- .2 in the case of written notices of lien, ensure that such notices are withdrawn, in writing.

13.5.2 In the event that the *Contractor* fails to conform with the requirements of 13.5.1, the *Owner* may set off and deduct from any amount owing to the *Contractor*, all costs and associated expenses as related to removal of liens by the *Owner*, including the costs of borrowing the appropriate cash, letter of credit or bond as security and legal fees and disbursements. 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.

38.6 13.6 CONSTRUCTION PROCEDURES

13.6.1 Notwithstanding any other requirement listed in these Specifications and Tender Documents, all Work shall be governed by the *Owner's* Contractors' Procedure Manual attached to and forming part of this Tender Document.

END OF SECTION

CONTRACTORS' PROCEDURE MANUAL

(Updated June 2018)

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ONTARIO SHORES' MISSION & VALUES

“We provide leadership and exemplary mental health care through specialized treatment, research, education and advocacy.”

Recovering Best Health, Nurturing Hope and Inspiring Discovery

We aim for **Excellence** - through leadership and learning, we achieve exceptional performance in all we do, while fostering an environment of optimism, hope and recovery

We encourage **Innovation** - through research and creative approaches, we support the advancement of mental health care.

We value **Safety** - we provide a safe and healing environment for our clients and a sense of security for our patients' families, our employees and the community at large.

We **Respect** all individuals - encouraging diversity and treating everyone with dignity, while embracing the rights, beliefs, opinions and contributions of others.

We are a **Community** - we work together as one team, and with families, providers and the public as our partners, while maintaining mutual trust, transparency and shared purpose to enhance our patients' quality of life.

**Ontario Shores Centre for Mental Health Sciences,
700 Gordon Street, Whitby, ON L1N 5S9
(905) 430-4055**

KEY HOSPITAL CONTACTS**Plant Operations & Maintenance**

- Rob Simpson, Manager – Plant Operations, Ext. 6382
- Trish Conrad, Supervisor – Plant Operations, Ext. 6083
- Shafei Shafei, Supervisor – Plant Operations, Ext. 6384

Security & Emergency Preparedness

- Tim Bachelder, Manager – Security and Parking Services, Ext. 6059

Capital Projects

- John Lin, Manager – Capital Infrastructure, Planning and Purchasing, Ext. 6928
- Heather Eastman, Project Coordinator, Ext. 6079

Information Technology

- Todd Merritt, Coordinator, IT Infrastructure Information Technology, Ext. 6091

Infection Control

- Practitioner, Infection Control Ext. 6368/6331

Security Desk Ext. 6645 Switchboard Ext. 0

DEFINITIONS

Ontario Shores Centre for Mental Health Sciences shall be referred to as either: "Ontario Shores", the "Centre", or the "Hospital".

"Contract" means the aggregate of (a) the executed agreement including any schedules; (b) the procurement document, including any addenda; (c) the successful proposal; and (d) any amendments executed in accordance with the terms of the Contract, which will be entered into by the Hospital and Vendor at the end of the procurement process.

"Contractor" or "Vendor" means an individual, firm, partnership, corporation, association or related person as defined in the Ontario Business Corporations Act, that provides any goods (e.g. equipment), service (i.e. consulting or non-consulting), and/or construction activity to the Hospital or a Hospital project, and has a contract with the Hospital.

"Ontario Shores Representative" or "Project Manager" means the individual at the Hospital who has responsibility for managing or coordinating a Contract or Vendor and is authorized to conduct Vendor Performance evaluation/scorecard.

"Site Lead or Supervisor" means the Contractor's representative, acting as foreman, responsible for the Contractor crew members on site at the Hospital.

INTRODUCTION

- This Ontario Shores Contractors' Procedure Manual sets out the minimum rules for all Contractors (including sub-contractors, trades persons, service persons or all others) who are hired to do work on hospital buildings/grounds at Ontario Shores Centre for Mental Health Sciences. The Manual shall be administered in accordance with the Hospital's policies and procedures.
- Contractors working at the Ontario Shores Centre for Mental Health Sciences and/or any of its satellite offices are obligated to perform their work in compliance with all applicable Acts, Regulations, Standards, Safety Protocol and Procedures, and to the policies governing this facility.
- The Contractor Site Lead or Supervisor shall be responsible for all crew members in maintaining standard practices and protocol outlined within, and any additional instructions issued by the Ontario Shores Representative while working on the property of the Hospital.
- The Contractor must acknowledge and confirm acceptance by way of a signed Contractor Safety Agreement (as attached to this Manual).

CODE OF CONDUCT POLICY

- Ontario Shores Centre for Mental Health Sciences is committed to the principle of a safe and respectful work environment for all employees, patients, guests, contractors and visitors.
- Accordingly, the reputation of Ontario Shores Centre for Mental Health Sciences and its position in the community are built on principles of courtesy and respect, confidentiality, competence, integrity, cultural sensitivity, efficiency and effectiveness, ethical behavior, fairness and impartiality, responsibility and transparency, openness, honesty and accountability. These principles must be incorporated into the decisions, actions and behavior of all affiliates.
- This policy applies to all staff, physicians, those working under contractual arrangements, service providers, volunteers, students and others and encompasses the Discrimination, Harassment and Bullying policy and Violence in the Workplace policy.

WORKING AT THE HOSPITAL

- Ontario Shores is a **SMOKE FREE ENVIRONMENT**; as such smoking is not allowed inside the Hospital or on the Hospital grounds. All smoking material shall be kept out of visible sight when on the Hospital grounds. Alcohol or illegal drugs are strictly prohibited.
- All contractor crew members must be dressed in clean and appropriate clothing.
- Noise, dust, odors, etc., shall be minimized to ensure staff and patients are disturbed as little as possible. Corrective action to cease or limit disagreeable annoyances to staff and patients shall be implemented immediately upon notification by the Hospital representative. This may require that work be stopped and rescheduled to a more convenient time.
- Trade contractors and their workmen will be permitted limited utilization of the facilities of the Hospital, including the cafeteria and food services in non-high use times.
- Designated washroom facilities may be appointed by the Hospital for use by all contractors. The contractor shall maintain the washrooms in a clean and sanitary manner. Should additional cleaning be required due to contractor misuse, equivalent costs shall be withheld as a claim against the contractor or deduction from invoiced amounts for the incurred cost.
- If designated washroom facilities are not available, contractors will be responsible to provide their own temporary facilities for their crew.
- No cameras, photographic or recording equipment are allowed on the Hospital premises without the express permission of the Hospital, on each occasion. Patients or staff are not to be photographed or recorded under any circumstances.

The Contractor will render the Ontario Shores Centre for Mental Health Sciences free from any & all liability (via contract acceptance & commencement) which might arise from any breach of the Municipal, Provincial or Federal Regulations, Ordinances, By-Laws or Laws and from any debts or obligations contracted by itself, agents, representatives, employees, sub-contractors or those for whom the Contractor is in law responsible; in conjunction with the performance of the contract.

CONTRACTOR IDENTIFICATION

- All Contractors, including any subcontractors representing their firm, must have a valid Canadian Police Information Centre (CPIC) security clearance checks, with Vulnerable Sector Clearance (if applicable), on file with Ontario Shores.
- Once security clearances have been validated, contractors will be issued an Ontario Shores Contractor ID and Access Card, which must be visibly worn at all times while working in the facility or on the property.
- All Contractor employees must check-in with Security Services (Building 2, Level 1) upon arrival to the facility prior to commencing work.
- Contractor ID and Access cards are not transferable and must be used only by the person to whom it was issued.
- Any temporarily lost or misplaced Contractor ID and Access Card **MUST** be reported immediately to Security so that the card can be deactivated. Found cards or returned cards will be reactivated and the contractor will be notified.
- Contractors must abide by all procedures for Emergency Codes. The Emergency Colour Codes for the Hospital are printed on the reverse side of the Contractor ID and Access Card, and are illustrated below:

EMERGENCY COLOUR CODES

Code	Incident
Yellow	Missing Person
Amber	Missing Child/Child Abduction
Orange	External Disaster
Red	Fire
White	Violent/Behavioral Situation
Blue	Medical Emergency
Green	Prepare to Evacuate
Green STAT	Evacuate Now
Brown	Hazardous Spill
Code Purple	Hostage Taking
Code Black	Bomb Threat/Suspicious Object
Grey	Infrastructure Loss or Failure
Grey Button-Down	External Air Exclusion

ACCESS TO WORK SITE

- All Contractors must make prior arrangements to access the work site before arriving at the Hospital. The Contractor must complete and submit the Permit to Work Form (as attached to this manual) with 48 hours' advance notice of arriving on site.
- All Contractor employees must check-in with Security Services (Building 2, Level 1), and Ontario Shores Representative / Project Manager upon arrival to the facility prior to commencing work.
- Contractors may only call in consultants or any other special arrangements with the permission of the Support Services Director, Plant Operations & Maintenance Manager, or Manager, Capital Infrastructure, Planning and Purchasing.
- Traffic through existing occupied areas shall be kept to an absolute minimum throughout the duration of the work of this project. Travel between entrances, public areas and the work area will be via the most direct pre-arranged route – not through patient wards or sensitive areas.
- Contractors must use the service corridor when transporting materials, equipment, garbage, etc. – unless pre-authorized by an Ontario Shores representative, where there is no other pre-arranged route.
- Access to mechanical, electrical and communication rooms is restricted. All mechanical and electrical rooms are locked and to be kept locked.
- Access to restricted areas may be made available at the discretion of the Ontario Shores Representative, Plant Operations, or Security/On-Duty Shift Manager (during off-hours).
- Patient Care Areas require a Security Services escort. The contractor shall be responsible to advise the Ontario Shores Representative of any planned work within a Patient Care Area with **48 hours' advanced notice** for additional Security coverage to be arranged. Insufficient notice may require the work to be rescheduled to a later date. Any misused Security coverage costs that may be incurred shall be withheld as a claim against the contractor or deduction from invoiced amounts for the incurred cost
- Where access is required for weekend or after hours work, the contractor shall be responsible to request and obtain authorization from the Ontario Shores Representative, by completing and submitting the Permit to Work Form, with **48 hours' advance notice**
- Do not wedge doors or latches open for any reason. Fire doors and doors to restricted areas are to be kept closed at all times to prevent unauthorized entry by the public, workers and patients.

PARKING

- Contractors may park vehicles in designated spaces (5) allocated outside Building 7 for Contractor Parking; if these spaces are occupied; you may park in General Public parking spaces.
- Parking is not permitted in parking spaces designated for “Visitors”, “Accessibility” or “10 minute” Patient Loading spaces.
- Parking is also not permitted on the Hospital grounds (i.e. behind building, emergency fire routes, loading dock, grassed areas) for any reason except to unload materials and equipment with prior notice and confirmation by an Ontario Shores Representative or Project Manager.
- Any vehicles parked illegally will be ticketed and removed at the owner’s expense.
- Contractors are to ensure that all equipment left in their work area/vehicles is secure and not left exposed in a manner that could be a potential danger.
- Parking options (see the Parking Office located Building 1 level 2);
 - Monthly Permit Parking: \$41.00/month*; a hang tag must be visibly displayed at all times
 - Pay & Display: \$3.50 hour/\$10.00 daily*; pay at machine-display on dash
 - Frequent Visitor FOB 10/20: (\$59/\$95-\$5.90/\$4.75) no expiry, display on dash

**For the Monthly Permit Parking Option, the Contractor must provide the following information to the Parking Office:*

- Start date
- Proposed end date
- Number of hang tags required
- Billing Company Name
- Billing Address
- Billing contact name and phone number
- Completed parking permit agreement for each vehicle

UNDER NO CIRCUMSTANCES IS PARKING ALLOWED ON GRASSED AREAS.

CONTRACTORS ARE TO ENSURE THAT ALL EQUIPMENT LEFT IN THEIR WORK VEHICLE IS SECURE AND NOT LEFT EXPOSED IN A MANNER THAT COULD BE A POTENTIAL DANGER.

TOOLS / EQUIPMENT / MATERIALS / MOVING/STAGING AREAS & DELIVERIES

- All tools, equipment and machinery are to be provided by the contractor to carry out the tasks of the contracted work, each of which is the responsibility of the contractor while not in use. **No Hospital tools or equipment will be supplied or loaned to the contractor for use.**
- All tools, equipment and materials must be properly labeled, secured and protected. The loss of any such material will be the responsibility of the contractor. The Hospital assumes no responsibility for lost or stolen equipment
- The Contractor shall not store **any items**, including tools, supplies, materials and equipment, in stairwells or stairways
- Storage space at the Hospital is limited. Arrangements must be made with the Ontario Shores Representative (with 48 hours advanced notice) before any tools, equipment or materials are brought on site in order to determine acceptable storage and internal delivery routes to work area.
- A designated staging area, potentially outdoor, may be used to serve the construction process. Contractor assumes the responsibility, if required, to enclose with protective fencing and access gate, to the approval of the applicable authorit(ies) having jurisdiction, and the Hospital
- An entrance and if necessary, an elevator, shall be designated by the Hospital for use by the Contractor to transport material and workmen to and from the work site. **DO NOT TRANSPORT** construction personnel, materials or debris in an elevator that is used to transport patients, visitors and staff (unless otherwise instructed by the Hospital).
- Use of the elevators shall be arranged through the Ontario Shores Representative. If an elevator is not available for use by the Contractor, crew members must use a designated stairwell. The Contractor must clear and surrender use of the elevator immediately during a Hospital emergency. The definition of any emergency shall be confirmed by the Hospital before the work commences.
- Where permission is granted to the Contractor to use an elevator, the Contractor shall be responsible for providing protection to the cab and shall be responsible for repairing any damage caused during the use of the elevator at the Contractor's cost. The contractor shall ensure the elevator remains free of dust and debris (at all times), and must damp mop and clean daily at the end of the work day.
- All deliveries will be made to the designated Receiving Area (Building 7, Level 1).The Loading Dock is for the loading and unloading of material only. Safe work practices are to be followed in the loading and unloading of material, and when using lifts.
- It is the responsibility of the contractor to **remove off site** all garbage debris, packaging, surplus material and scrap from his work site on a daily basis – or more often if required. Hospital containers and garbage bins must not be used unless permission is obtained from the Hospital's Representative. Failure to comply may be cause for removal by the Hospital and a claim against the contractor or deduction from invoiced amounts for the incurred cost

- Transport debris in clean containers with tightly fitting lids or completely cover debris with a wet blanket. Wipe and/or vacuum clean containers prior to leaving the work site to reduce risk of dust transfer to occupied areas.
- Materials in the existing building, which by contract or project specification are not called for to be reused, or specifically called for to be removed, are to be removed and/or turned over to the Hospital. The contractor shall be responsible to verify with Plant Operations and Maintenance prior to the removal of any and all items.
- Once verified, materials shall become the property of the contractor and shall be removed from the site. Where services are connected to such items, services shall be removed and capped off except where required or reused when they shall be temporarily capped.
- Contractors must comply with the requirements noted in Infection Control procedures during construction when transporting materials, tools & equipment to or from the work site. Removal of debris, tools, equipment and materials from the work site shall be via an agreed to route and at an agreed to time, generally after hours.

UNDER NO CIRCUMSTANCES are tools, ladders, materials, wrapping, boxes, equipment, etc. to be left UNATTENDED. The safety of our patients, staff, guests and contractor personnel is of primary importance and unattended articles can lead to potential dangers and as well may disappear and be used in harmful means.

STANDARD WORK PROCEDURES

- All work performed at Ontario Shores Centre for Mental Health Sciences must be in compliance with Building Codes, Standards, and all applicable Acts, Regulations, Safety Protocol and Procedures, and the policies governing this facility.
- Facility / construction drawings, if issued, indicate the approximate locations of services. The contractor and subcontractors shall take all measures to verify actual location of service lines prior to start of work. Nevertheless, should any mechanical or electrical service line be damaged or disrupted by contractor actions, the contractor shall repair service lines, and make good all damage to the approval and satisfaction of the Hospital and/or Consultants (please refer to Continuity of Existing Services section for additional details and requirements).
- Before commencing work each day or part thereof, the Hospital shall be notified 48 hours in advance (by receiving a completed Permit To Work form) of the work being done, duration, number of workers, and any possible disturbances, noise, dust obstructions, etc.

DAILY – prior to starting work and at the end of the work shift, the Site Supervisor is to report to the Security Control Centre, and the Hospital Representative or Project Manager.

- The job site must remain clean and tidy at all times. Only those materials required each day are to be brought to the job site. Tool boxes and equipment may be kept on site in the work area, provided that the area is secured. Thoroughly vacuum all tools, tool boxes and equipment prior to removal from work site.
- Fire routes or personnel thoroughfares must not be obstructed. Fire doors must not be wedged open or latches disengaged. If repeated access is required, access rights or keys must be requested and permitted by Ontario Shores Representative, Plant Operations and/or Security.
- All electrical sources must be locked out and tagged where possibility of shock or electrocution exists. 48 hours advance notice by means of a completed Permit to Work form and authorization from the Ontario Shores Representative, Project Manager and/or Plant Operations is required.
- If this project affects/changes the main electrical distribution in any way, it is the responsibility of the consultant/contractor to ensure that the Main Electrical Single Line diagram is updated and posted in the building. Copies, hard and soft shall be included in the final O&M Manuals and/or will be turned over to the building staff upon completion of the work.
- Under no condition will it be permissible to connect welding machines to the existing building electrical panels. Contractors and subcontractors shall provide their own exterior located generators for welding purposes.
- Hazard Warning Tags must be used while working on:
 - Compressed Air
 - Electrical panels
 - Steam lines
 - Water lines
 - Gas lines
 - Other services locked off to avoid injury

WORK SITE PROTECTION

- The contractor will protect the work area and the Hospital staff, patients and visitors from any danger arising from his work. This includes taking all safety precautions, and providing and/or installing, where required: signage, guards, fences, barriers, rails, lights, etc., so as to comply with applicable regulations and by-laws of the municipality and authorities having jurisdiction. The contractor shall hold the Ontario Shores harmless from any damage or expense arising from failure to properly execute this work.
- Protection shall be provided for all entrances and exit ways, floors, walls and all standing fixtures, air intakes, exhaust fan openings, floor drains, elevators and equipment rooms against dust, spillage or overspray of material or damage during the construction period. The required protection shall consist of but is not limited to the following:
 - Filter cloth in all floor drains within the work area
 - Filter cloth over all intakes and exhaust openings and opening
 - Protect sprinkler heads with a Polyethylene or filter cloth to prevent dust build up.

- Damage to Hospital equipment or property by the contractor must be reported immediately. Each Contractor shall be responsible for any and all damage by work of crew members/equipment to the work and materials of other trades, and to Ontario Shores' materials and property and shall, at their own expense, replace all materials, property and work damaged to such an extent that they cannot be restored to their original condition or to Ontario Shores' satisfaction, in a timely manner.
- Damaged work shall be made good by trade who performed the work originally, or an expert in the particular work, at the expense of the Contractor who caused the damage.
- Protect the building, premises and adjoining premises from damage during the construction period and during any period when the work is closed down for any cause.
- All Hospital equipment and supplies must be removed and/or sealed with tape and poly wrap in a closet or cupboard prior to barrier installation.
- Traffic through completed and partially completed areas shall, at all times, be held to a minimum.
- Remove all temporary construction aids at completion of project or as required and make good all new and existing work, construction etc. damaged in the course of erecting and removing said temporary construction aids.
- Keep floors free from contaminating liquids, materials, etc., that may damage, discolor and/or affect bond of finished floors. Conduit or pipe shall not be left in such a way that it constitutes a hazard. Board with protruding nails must not be left on the floor. In addition, bolts must be cut off at floor level to eliminate a possible tripping hazard.
- Openings in the roof or floor must be guarded to prevent anyone from falling through or to prevent stock or scrap from dropping down.
- No promotional signs, advertisements, or notices of any kind shall be placed on or in the buildings, fences, hoarding or any place on the site except as specifically directed in writing and approved by the Owner.

CONTINUITY OF EXISTING SERVICES

- The Hospital is in operation 24 hours a day, seven days a week. Any service disruption may result in emergency or critical situations or serious clinical implications to Hospital departments. As such, disruption to the Hospital must be kept to a minimum.
- Contractors are to schedule and arrange work so that services are not unduly interrupted at any time. Interruption of services must be reviewed and scheduled with the Hospital so that disruption to patients and procedures are kept to a minimum. Generally, service interruptions are to be scheduled to occur after hours.
- Contractors are to submit a procedure as part of the Permit To Work authorization request for any work that affects or disrupts existing services at least 48 hours prior to planned start time for that work.

- Contractor shall be responsible to request authorization, in writing, with **48 hours' advance notice**, for all planned requirements for building access, key authorization, fire alarm, life safety, electrical, heating, ventilation and air conditioning system by-passes.
- Unauthorized switching of electrical breakers, cutting, drilling, welding/soldering, use of power tools, noise disturbances, and other disruption of services are strictly forbidden. This facility is protected by sensitive heat & smoke detection and computer control systems. Contractor assumes all responsibility for unauthorized disruption to Hospital operations.
- Contractor shall be responsible to request authorization, in writing (Permit to Work form), with **two (2) weeks' notice**, for major building system shutdowns and fire alarm bell tests.
- Contractors shall **IMMEDIATELY** notify Plant Operations and Maintenance in the event that any service line is broken or damaged.
- Use of cryogenic procedures is recommended to isolate valves and supply water piping. Hot and cold domestic water piping must not be drained. If drained for any reason arrange with Plant Operations and Maintenance to have piping sanitized. Report any water leaks or flooding to Plant Operations and Maintenance immediately in order to provide the necessary communication to the affected stakeholders.

EMERGENCY AND FIRE PROTECTION

- The contractor must ensure that proper and suitable precautions are taken, and fire extinguishers are provided by crew / trades carrying out said work, before said work is started.
- The contractor shall provide and maintain ready access to firefighting equipment at all times. No cutting, welding or drilling is to be done to the structural elements of the building without the express written consent of Ontario Shores.
- The contractor is responsible to provide "fire-watch" during welding operations or at any time the fire protection systems are degraded as a result of the work
- Oily and waste solvent rags are a fire hazard and shall be deposited in approved containers and removed from site daily.
- All Hot Work requires prior authorization and a Permit from Plant Operations (please refer to Hot Work Permit section).

<p>Hospital Emergency Phone Number 5555 from any hospital phone line</p>
--

To activate a Fire Alarm

- Insert key
- Turn to the right
- Remove key when it is parallel to the ground

If the evacuation alarm has sounded and you are at a locked door, turning in the key station will release that door.

When the fire alarm (Code Red) is activated:

Fire Alarm Sound

- In the zone of alarm you will hear the EVACUATION TONE “Beep, Beep, Beep, (pause for 2 seconds)” and repeat.
- In all other areas of the Centre they will hear the ALERT TONE “Beep, (pause 3 seconds)” and repeat. After 30 seconds an automated voice will come on indicating where the fire is; for example “Code Red, Block 2, Level 2, Patient Care Area” and repeat.

Fire Zones

- Fire Zones are separated by
 - Floor Level
 - Main Street Corridor, and
 - Building Number

All Contractors must stop work upon a fire alarm.

- If the Alert Tone is heard remain in the area until given further instructions or the fire alarm is cancelled. Do not transverse fire door.
- If the fire or emergency becomes more critical an evacuation may be requested in specific areas. The fire alarm will change to an Evacuation Tone “Beep, Beep, Beep, (pause for 2 seconds)” and repeat. Begin to evacuate and report to the person in the red hat (charge person).

If the fire or emergency becomes more critical, an evacuation may be requested in specific areas. The fire alarm will change to an Evacuation Tone “Beep, Beep, Beep, (pause for 2 seconds)” and repeat. Begin to evacuate and report to the person in the red hat (charge person).

If the fire or emergency is cancelled, an announcement will be made acknowledging this cancellation. Contractors may now continue their normal work and circulation in the Hospital.

TEMPORARY FIRE SAFETY AND ALARM

- While work of this contract is proceeding, contractor shall make certain that existing fire alarm system and life safety systems (i.e. smoke detectors, sprinkler, annunciators, bells/horns/ speakers, exit lights, etc.) are in proper operating condition at all times except when work is being done on said system.
- If, during the progress of the work, it is necessary to take all or part of the existing fire alarm system out of temporary or semi-permanent service, **the Contractor shall first receive authorization from an Ontario Shores Representative (Project Manager), providing at least 48 hours minimum notice.**
- Authorized bypasses will be conducted by Plant Operations staff or Security Services staff with the bypass log book filled out for each bypass. Contractors are required to conduct a continuous fire watch in the area until all fire protection systems are returned to full service. When a fire watch is necessary it shall be coordinated with the contractor who will keep records of the fire watch, and if any extra staff is required it will be discussed prior to work being scheduled.

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HOT WORK PERMIT

- Safety clearances are required before any cutting, welding, core drilling, open flame work or dust work is done.
- A Hot Work Permit must be filled out and approved a minimum of 48 hours before this work is anticipated. This will allow Hospital time to warn all persons involved and disable any fire detectors to prevent sounding an alarm.
- The Contractor is responsible for requesting, and receiving authorization for confined space permits, and Hot Work permits for welding, soldering, roofing, grinding, cutting or other sources of heat or dust which may affect the fire system or produce a response to the fire system. Permits can be obtained from the Plant Operations office (Building 2 Room 2-1031)
- Start and completion times must be provided when obtaining the permit(s). Further direction will be provided as to procedures, and applicable Hospital representatives for re-starting the systems.
- The Hot Work Permit (as shown below) must be clearly displayed and visible outside the work area:

HOT WORK PERMIT

STOP!
Avoid hot work or seek an alternative/safer method, if possible.

This *Hot Work Permit* is required for any temporary operation involving open flames or producing heat and/or sparks. This includes, but is not limited to: brazing, cutting, grinding, soldering, torch-applied roofing and welding.

1. Fire safety supervisor:

Instructions

A. Verify precautions listed at right (or do not proceed with the work).
Part 1A to be posted on scene (if necessary).
B. Complete and retain Part 1.
C. Issue Part 2 to person performing hot work.

Part 1

Required Precautions Checklist

☐ Control valves to water supply for sprinkler system are open.
☐ Hose streams and extinguishers are in service/operable.
☐ Hot work equipment in good working condition.
Requirements within 35 ft. (11 m) of hot work
☐ Flammable liquid, dust, fat and oily deposits removed.
☐ Explosive atmosphere is not threatened.
☐ Floors swept clean.
☐ Combustible floors wet down, covered with damp sand or fire-resistant boards.
☐ Remove other combustible material where possible. Otherwise protect with FM Approved welding pads, blankets and curtains, fire-resistant tarpaulins or metal shields.
☐ All walls and floor openings covered.
☐ FM Approved welding pads, blankets and curtains installed under and around work.
☐ Protect or shut down ducts and conveyors that might carry sparks to distant combustible material.
Hot work on walls, ceilings or roofs
☐ Construction is noncombustible and without combustible covering or insulation.
☐ Combustible material on other side of walls, ceilings or roofs is moved away.
Hot work on enclosed equipment
☐ Enclosed equipment cleaned of all combustible material.
☐ Containers purged of flammable liquid/gases.
☐ Personnel wearing goggles and equipment removed from service, isolated and vented.
Fire watch/hot work area monitoring
☐ Fire watch will be provided during and for 30 min. after work, including any break activity.
☐ Fire watch is supplied with suitable extinguishers, and where practical, a charged metal hose.
☐ Fire watch is trained in use of equipment and in sounding alarm.
☐ Fire watch may be required in adjoining areas, above and below.
☐ Weather hot work area for up to an additional three (3) hours after the 30 min. fire watch.

Other precautions taken:

☐

Permit Expires Date: _____ Time: _____ a.m. / p.m.

Note: Emergency notification on back of form.
Use as appropriate for your facility.

To order additional hot work permits or other FM Global resources, order online 24 hours a day, seven days a week, at www.fmglobalequipment.com.

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INFECTION PREVENTION AND CONTROL PROCEDURES

In consultation with Infection Prevention and Control, the Ontario Shores Representative / Project Manager will perform a Canadian Standards Association (CSA) approved Preventative Measures Analysis* according to population at risk and type of construction activity. This analysis will determine the infection prevention and control procedures required prior to start, during and in completion of the specific project.

Failure to comply with the CSA Infection Prevention and Control Measures may be cause for stoppage of work. Any cost that may be incurred as a result of non-compliance may be deducted shall be withheld as a claim against the contractor or deduction from invoiced amounts for the incurred cost.

**CSA Standard Z317.13-12 - Infection control during construction, renovation, and maintenance of health care facilities*

SAFETY PROGRAM

First Aid

Contractors are responsible for maintaining their own First Aid Kit.

For any injury requiring serious medical attention — Dial 5555, explain situation, location and request a Code Blue (per Emergency Colour Code found on the reverse side of Access Card)

- Contractor(s) must adhere to all applicable Acts, Regulations, Standards, Safety Protocol and Procedures, and to the policies governing this facility. The Contractor will be responsible for ongoing safety inspections, implementation enforcement, and compliance to the Hospital's Infection Control Program.
- The Contractor Site Supervisor shall be responsible in maintaining standard safety practices, as well as the specific safety rules outlined, any special protective clothing, and additional instructions issued while working on the property of the Hospital.
- In addition to all safe work practices and procedures that are outlined in the applicable Acts and Regulations; the following safe operating practices shall be strictly adhered to by all employees regardless of the nature of their specific duties. These shall be explained to each new person by the Contractor and re-emphasized in day-to-day contact as required.
- All tools and equipment utilized must be CSA approved and labeled and must be in good condition.
- The contractor shall ensure that all employees and subcontractors representing their firm who work with, or in proximity to, hazardous materials fully understand all potential hazards and have been thoroughly trained to deal with all emergencies in accordance with the Workplace Hazard Management Information System (WHMIS).
- All contractor crew members shall be able to:
 - Recognize and understand the labeling on hazardous materials.

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- Understand Materials and Safety Data Sheets and are knowledgeable on how to safely use, store, handle and dispose of hazardous materials.
- Material Safety Data Sheets (MSDS) are to be on site, with a copy supplied to the Ontario Shores Representative prior or at the time all WHMIS regulated material arrives on site. When using WHMIS Regulated Materials, all instructions provided on the MSDS must be followed.
- Any and all injuries must IMMEDIATELY be reported to the Hospital via the Ontario Shores Representative, with a copy of the WSIB Report to follow. Contract workers will abide by applicable Acts and Regulations and Standards.
- Each subcontractor shall provide his own scaffolding, ladders and platforms where it is normal practice to do so. The responsibility as to who provides scaffolding and platforms shall rest with the Contractor. All workers will have proof of the required Health & Safety Training, including the Ministry of Labour 'Working from Heights' training.

ACCESSIBILITY STANDARDS AND COMPLIANCE

- Any goods (e.g. equipment), service, and/or construction activity provided by the Contractor shall comply with applicable accessibility standards under the Accessibility for Ontarians with Disabilities Act, 2005 and its regulations. If requested by the Hospital, acting reasonable, the Contractor shall provide evidence of the policies, procedures and training practices that it has implemented to comply with the foregoing.
- The Contractor shall comply, and shall ensure that its personnel read and comply with all Hospital policies in respect of the Accessibility of Ontarians with Disabilities Act, 2005 and its regulations, as may be applicable to the services.

VENDOR PERFORMANCE EVALUATION PROGRAM

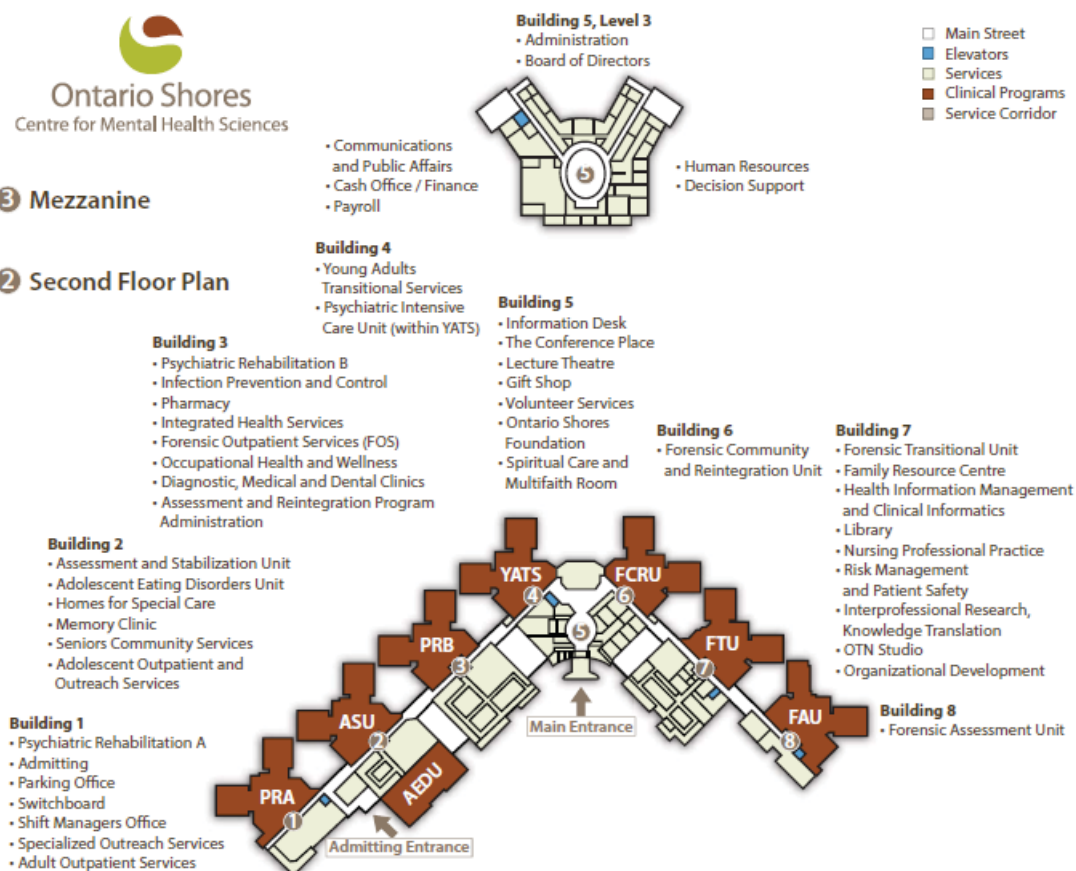
- The purpose of the Hospital's Vendor Performance Evaluation Program is to monitor performance of contractors in order to ensure the responsible management of contracts and enhancement of the value of services providers to the Hospital. The program:
 - Establishes an evaluation framework to use a Vendor's past performance as criteria in assessing a Vendors' bid on future work;
 - Monitors and evaluates a Vendor's performance against the contractual requirements and deliverables based on the Vendor's achievement of the Hospital's values of "excellence", "innovation", "safety", "respect", "community" and "value for money"
- A Closeout Checklist (as attached) **and** an evaluation scorecard (or similar written evaluation) will be completed in conjunction with the Project Manager and/or the Ontario Shores representative at the end of the Contract, or upon completion of specific deliverables as set out in the Contract.
- Feedback from the Hospital to each Contractor will be given through written evaluation or scorecard. Vendor performance outcomes will be assessed over both the short and long term and may be used as evaluation criteria on future tender opportunities.

BUILDING FLOOR PLAN

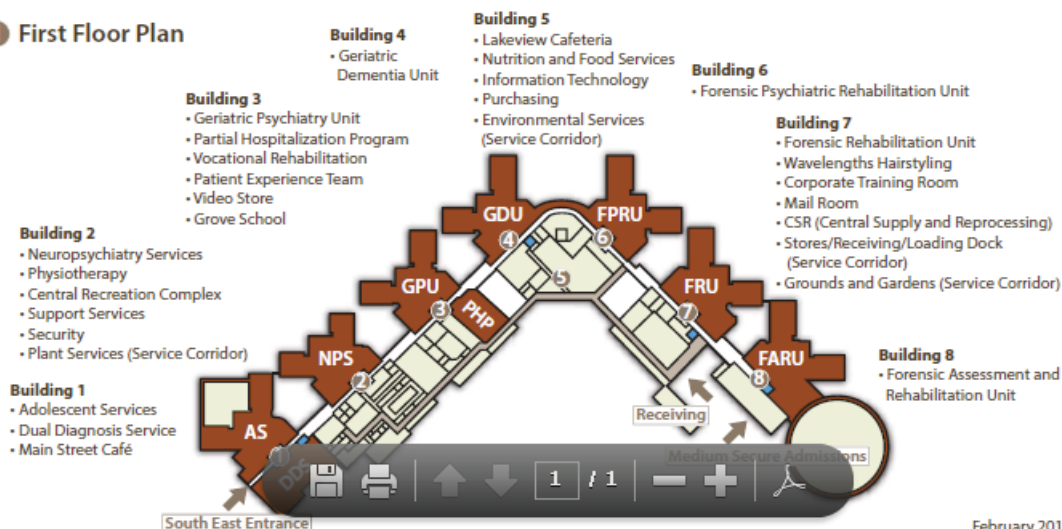


3 Mezzanine

2 Second Floor Plan




1 First Floor Plan



February 2015

CONTRACTOR PERMIT TO WORK FORM

**electronic version will be available from Ontario Shores Representative and/or Project Manager*

 CONTRACTOR PERMIT TO WORK FORM <i>rev. 07-01-15</i>	
A. FACILITY AND PROJECT WORK REQUIREMENTS	
<input type="checkbox"/> N.A.	<input type="checkbox"/> Work requested on this permit meets the requirements stipulated in the Project Contract and Project Start Up Meeting.
<input type="checkbox"/> N.A.	<input type="checkbox"/> Contractor IP&C Permit submittals have been approved for this project; Identified measures will be maintained for the duration of the
<input type="checkbox"/> N.A.	<input type="checkbox"/> Safety Data Sheets have been provided for materials used to complete the work. SDS Sheets will be updated and on site at all times
<input type="checkbox"/> N.A.	<input type="checkbox"/> Contractor crew/subtrades have reviewed and will abide by the Contractors' Procedure Manual; Signed Contractor Safety Agreement received
<input type="checkbox"/> N.A.	<input type="checkbox"/> Contractor has provided CPIC VSS clearance for all employees/subtrades, is on the approved vendor list and/or is being escorted by Security
B. CONTRACTOR AND WORK INFORMATION	
REQUESTED BY	COMPANY NAME
REQUEST DATE	PHONE #
PROJECT / PO#	
GENERAL CONTRACTOR	JOB FOREPERSON
PHONE #	
SUBCONTRACTORS <input type="checkbox"/> List Attached	
WORK AREA	SECURITY REQUIRED <input type="checkbox"/> Yes
WORKER'S NAMES	<input type="checkbox"/> List Attached
DESCRIPTION OF WORK PERFORMED, AND HOW WORK WILL BE CARRIED OUT (PRECAUTIONS TAKEN) - Shut down request must indicate date and time <input type="checkbox"/> Description attached	
WORK HOURS - FACILITY MANAGER APPROVAL REQUIRED FOR DAYTIME WORK <input type="checkbox"/> Schedule Attached	
MONDAY	TUESDAY
WEDNESDAY	THURSDAY
FRIDAY	SATURDAY
SUNDAY	
START	
END	
START DATE (mm/dd/yyyy)	APPROVAL SIGNATURE(S)
	PHONE #
ONTARIO SHORES REPRESENTATIVE / PROJECT MANAGER	
C. WORKER SAFETY AND SITE PROTECTION REQUIREMENTS	
ISOLATION & LOCK OUT TAG OUT	
<input type="checkbox"/> PIPING DISCONNECTED AND BLANKED OFF	
<input type="checkbox"/> ELECTRICAL SWITCHES IN OFF POSITION & TESTED FOR ZERO ENERGY	
<input type="checkbox"/> VALVE/SWITCH LOCKED AND TAGGED	
HOT WORK & FIRE SAFETY	
<input type="checkbox"/> FIRE EXTINGUISHER <input type="checkbox"/> HOT WORK PERMIT	
<input type="checkbox"/> SPRINKLER VALVES ISOLATED	
<input type="checkbox"/> FIRE ZONE DISABLED <input type="checkbox"/> FIRE WATCH	
PERSONAL PROTECTION EQUIPMENT	
<input type="checkbox"/> FALL ARREST <input type="checkbox"/> FOOT PROTECTION <input type="checkbox"/> HEAD PROTECTION	
<input type="checkbox"/> EYE PROTECTION <input type="checkbox"/> RESPIRATORY PROTECTION <input type="checkbox"/> FACESHIELD	
IP&C MEASURES TO IMPLEMENT AND MAINTAIN	
<input type="checkbox"/> TYPE 1 REGULATED PROCEDURES	
<input type="checkbox"/> TYPE 2 REGULATED PROCEDURES	
<input type="checkbox"/> TYPE 3 REGULATED PROCEDURES	
<input type="checkbox"/> TYPE 4 REGULATED PROCEDURES	
<input type="checkbox"/> MOULD ABATEMENT REGULATED PROCEDURES	
<input type="checkbox"/> HAZARDOUS WASTE REGULATED REMOVAL PROCEDURES	
D. CONTRACTOR AGREEMENT	
I HAVE REVIEWED THE PERMIT AND UNDERSTAND THE NATURE AND EXTENT OF THE RULES, REGULATIONS AND PRECAUTIONS TO BE FOLLOWED IN PERFORMING THE WORK.	
CONTRACTOR SIGNATURE: _____	
PRINT NAME: _____	
ISSUE DATE	
EXPIRY DATE	

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CONTRACTOR CLOSEOUT CHECKLIST

**electronic version will be available from Ontario Shores Representative and/or Project Manager*

CONTRACTOR CLOSEOUT CHECKLIST			Date Recieved	Location	OS Representative
ENVIROMENTAL	<input type="checkbox"/>	<input type="checkbox"/>	Work Site clean and ready for occupancy		
	<input type="checkbox"/>	<input type="checkbox"/>	All tools/materials/equipment removed from Work Site / Storage		
	<input type="checkbox"/>	<input type="checkbox"/>	New product cleaning methodology document received		
	<input type="checkbox"/>	<input type="checkbox"/>	Waste diversion log and waybills received		
HEALTH & SAFETY	<input type="checkbox"/>	<input type="checkbox"/>	Sustainable purchasing log received		
	<input type="checkbox"/>	<input type="checkbox"/>	SDS provided for all materials used in work site		
INFECTION PREVENTION & CONTROL	<input type="checkbox"/>	<input type="checkbox"/>	Staff training completed for all new products		
	<input type="checkbox"/>	<input type="checkbox"/>	Site inspection reports received		
PLANT	<input type="checkbox"/>	<input type="checkbox"/>	Final sign-off received		
	<input type="checkbox"/>	<input type="checkbox"/>	Close out binders with all required submittals received		
SECURITY	<input type="checkbox"/>	<input type="checkbox"/>	Surplus stock received		
	<input type="checkbox"/>	<input type="checkbox"/>	Key copies for all installed locks received		
CORPORATE	<input type="checkbox"/>	<input type="checkbox"/>	All site access control means returned		
OTHER	<input type="checkbox"/>	<input type="checkbox"/>	Project acceptance signed off by all parties involved		
	<input type="checkbox"/>	<input type="checkbox"/>			
	<input type="checkbox"/>	<input type="checkbox"/>			
	<input type="checkbox"/>	<input type="checkbox"/>			

Final Sign Off
 (INSERT CONTRACTOR'S NAME)
 ONTARIO SHORES CENTRE FOR MENTAL HEALTH SCIENCES

Per: _____ Title: _____ Date: _____

Contractor Closeout Checklist (June 2015)

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CONTRACTOR SAFETY AGREEMENT

**electronic version will be available from Ontario Shores Representative and/or Project Manager*

**CONTRACTOR SAFETY AGREEMENT**

Between:

(INSERT NAME)
(hereinafter referred to as the "Contractor")
Project: _____

and

ONTARIO SHORES CENTRE FOR MENTAL HEALTH SCIENCES
(hereinafter referred to as the "Hospital")

Contractors working at the Ontario Shores Centre for Mental Health Sciences (**Ontario Shores**) and/or any of its satellite offices are obligated to perform their work in compliance with all applicable Health, Safety, Environmental legislative requirements and Ontario Shores requirements.

General Conditions

1. Contractor selection criteria will include an evaluation of the Contractor's ability to comply with all Health, Safety and Environmental requirements as set out in applicable governmental legislation and those established by the Ontario Shores Centre for Mental Health Sciences as policies, procedures, statements of work, etc..
2. The Contractors shall ensure that their Health, Safety and Environmental policies comply with the requirements and regulations of the Occupational Health and Safety Act 1990, as may be amended from time to time, with particular focus on the Health Care and Residential Facilities Regulation, O. Reg. 67/93 and Occupational Health and Safety Awareness and Training, O. Reg. 297/13 plus any other Federal and Provincial legislation governing worker's safety.
3. The Contractor hereby acknowledges receipt of the Hospital's Contractors' Procedure Manual, and agrees to comply with such policies/procedures/guidelines. Employees, agents, subcontractors, and those for whom the Contractor is in law responsible, who refuse to comply with such policies, rules and regulations of the Hospital shall, at the request of the Hospital, be removed from the Hospital's premises, and replaced by the Contractor. Should such replacement not be carried out within a reasonable time, the Contractor shall be deemed to be in breach of its contract with the Hospital.
4. The Contractor shall provide a copy of its Worker's Safety & Insurance Board (WSIB) Clearance Certificate (Generic and Specific) to the Hospital upon signing of this contract, and every sixty (60) days thereafter for the duration of the contract term.

5. The Contractor shall have recent (within the previous 12 month period) Canadian Police Information Centre (CPIC) security clearances for all staff &/or individuals who will be on-site. The required CPIC clearance is the basic level and can be obtained in person at any police station.
6. The Contractor shall not rely upon the Hospital for fire, liability, or other insurance coverage during the performance of its obligations under this contract. Notwithstanding the foregoing, the Contractor shall, without in any way limiting their liability, secure, maintain, and keep in force:
 - A. **comprehensive liability insurance**, naming the Hospital as co-insured, of not less than five million dollars (\$5,000,000.00) per occurrence, against damages arising from property damage and personal injury (including death) which may arise directly or indirectly out of the operations of the Contractor, its staff, agents, employees, or those for whom the Contractor is responsible at law, in carrying out its obligations under this contract;
 - B. **automobile liability insurance** covering owned units, and unowned units, with an inclusive limit of two million dollars (\$2,000,000.00) per accident.

All such policies of insurance, which shall be issued by a company licensed to conduct business in the Province of Ontario, shall contain a waiver of any subrogation rights against the Hospital.

7. The Contractor agrees to indemnify and save harmless the Hospital from any and all damages which may result from any accident to any of its employees, agents, subcontractors, or any other person (including employees, agents or representatives of the Hospital), by reason on any negligence, wilful act or omission to act by any employee, agent, subcontractor or those for whom the Contractor is in law responsible, whether on the Hospital's premises or otherwise. This indemnity by the Contractor shall include any additional assessments which the Worker's Compensation Board may assess/apply to the Hospital as a result of any accident involving the Contractor, its employees, agents, subcontractors or those for whom the Contractor is in law responsible.
8. The Contractor shall indemnify the Hospital from any suits, claims, causes of actions, costs or damages incurred by reason of any negligence, wilful act or omission of any employee, agent, subcontractor or those for whom the Contractor is in law responsible, and any costs of preparing for and attending any hearing, and any legal fees involved in obtaining the services of expert witnesses.
9. Before any work is initiated, the Hospital shall provide, as may be applicable, to the Contractor the following information:
 - A. information, including Safety Data Sheets (SDS) of known existing work site hazards, and precautionary measures for which the Contractor, their employees, agents and subcontractors should be aware;
 - B. the Hospital's policies & procedures regarding working at Ontario Shores (Contractors' Procedure Manual);
 - C. the Hospital's applicable Health, Safety and Environmental requirements, including emergency response codes and applicable procedures (Contractors' Procedure Manual);
 - D. the Hospital's Infection Control Policies & Procedures (Contractors' Procedure Manual)
 - E. the Hospital's policies and procedures relating to Smoking, Workplace Violence and the Code of Conduct (Contractors' Procedure Manual).

- 10 The Contractor agrees to attend regular meetings at the request of the Hospital to review any incident reports with respect to Contractor activities, and to ensure that all the requirements of the Occupational Health and Safety Act and its Regulations, along with the Hospital's policy/procedure/guideline requirements are being met by the Contractor. Contractor performance on these matters will be reviewed annually by representatives of the Hospital.
- 11 The Contractor acknowledges and agrees that: the Hospital is not required to provide direct supervision, instructions or management of Contractor personnel unless unusual circumstances require such involvement, the Contractor is acting as an independent contractor in the performance of its work, and the Contractor, its personnel or agents shall not be deemed to be the employee, agent, partner, etc. of the Hospital. **The contractor is fully responsible to ensure all their staff is supplied with, understand, follow and implement the supplied guidelines, policies & procedures and direction submitted and discussed by Ontario Shores.**
- 12 In order to comply with **Regulation 965 of the Public Hospitals Act**, the Contractor agrees that if the Contractor is on the Hospital's premises for 30 consecutive days or more and is working in close proximity to patients, the Contractor shall submit a completed "Record of Immunity" for all its employees, agents and representatives working at the Hospital's premises. (Communicable Disease Surveillance).
- 13 The Contractor shall ensure that the removal and disposal of any and all debris, waste material/garbage meets the requirements of the **Environmental Protection Act**, Waste Management Act, and the regulations of the Durham Region Works Department, and the Ontario Waste Reduction Office.
- 14 The Contractor, its employees, agents and representatives agree that, during the performance of their duties and activities at the Hospital's premises, they will comply with all municipal, provincial and federal laws and regulations as well as the Hospital's safety and security policies and procedures. Specifically, the Contractor agrees that:
 - A. smoking is prohibited within the buildings and grounds of the Hospital's premises. This regulation also applies to the consumption of alcoholic beverages.
 - B. no cameras, photographic or recording equipment are allowed on the Hospital's premises without the express permission of the Hospital on each occasion. Patients \ and staff are not to be photographed or recorded under any circumstances.
 - C. all persons working at the Hospital's premises shall wear a visible Identification Badge at all times. All badges issued to Contractor staff, agents or representatives shall be surrendered to the Security department when leaving the Hospital's premises.
 - D. all electrical tools and equipment used by the Contractor in the performance of its duties shall meet CSA /Ontario Hydro standards, be in good repair and used in a safe manner.
 - E. utilize the following Emergency Response Code procedures while on the Hospital's premises:

Code Red – Fire

In case of explosion or fire:

- Activate a fire key panel
- Report the fire immediately by dialing 5555 and advising of the fire location
- Report to the Nursing Station (if in a Patient Care Unit) or Administrative Assistant (Administrative Area)
- Evacuate the area and await the "all clear"

Code Green – Evacuation

- Report to the Nursing Station (if in a Patient Care Unit) or Administrative Assistant (Administrative Area)

Code Black – Bomb Threat

- Report to the Nursing Station (if in a Patient Care Unit) or Administrative Assistant (Administrative Area)

Code Grey – Air Exclusion

- Ensure all windows and doors are closed, all HEPA Filters & equipment with external exhaust/intake must be turned off and entry way closed
- Report to the Nursing Station (if in a Patient Care Unit) or Administrative Assistant (Administrative Area)

- 15 Where applicable, the Contractor, its employees, agents and representatives, etc. **must wear personal protective equipment** suitable (or deemed appropriate by the Hospital) for the work being done, including but not limited to eye, foot, head, noise, and respiratory protection equipment.
- 16 All scaffolds used or erected by the Contractor must comply with all municipal, provincial and federal regulations. Wheels are to be removed to prevent mobility and disappearance. Proper barriers are to be erected to prevent access & improper use of scaffolds (refer to Contractors' Procedure Manual for policies on erecting dust free, etc. barriers.)
- 17 The Contractor shall obtain authorization from the Hospital's Fire Marshall/Emergency Response Manager for the use and storage of any flammable liquids in excess of their daily requirements used by the Contractor on the Hospital's premises.
- 18 The Contractor shall at all times keep the workplace free from accumulations of rejected, demolished, or waste materials, or garbage resulting from the work. At the completion of the day and specified work, the Contractor shall remove all surplus material, debris, tools, and supplies, leaving the premises in a state of cleanliness acceptable to the Hospital.
- 19 Where applicable, the Contractor shall have on site copies of the SDS for all hazardous materials used on the work site, and shall produce them for review by the Hospital's representative as required. All such materials by the Contractor are to be used in accordance with the instructions specified in the SDS.
- 20 Where applicable, the Contractor shall post in visible locations, signs indicating that work is in progress and the area is "Closed to the Public". The Contractor shall barricade the work area to prevent any other persons from entering the area at any time of the day or night. **Key to barricade access door will be supplied to Hospital and maintained with Fire Key Ring (Switchboard).**
- 21 The Hospital's Project Manager in conjunction with the Plant Services Manager shall approve the working hours of all building contractors and sub-contractors working on the Hospital's premises. **48 hour notice must be provided to the Plant Services Manager prior to gaining access to the facility.**
- 22 Under no circumstances are tools, materials, wrappings, boxes, equipment, etc., to be left unattended. The safety of our patients, staff, guest, contractor personnel and others is of

primary importance and unattended articles can lead to potential dangers as well may disappear and be used in harmful means.

- 23 The Contractor warrants that its staff, agents, and employees and sub-contractors assigned to work on the Hospital's premises shall maintain strict confidentiality of any information obtained by whatever means, and not allow it to be used or disclosed to anyone. Should any confidential information be accessed, used or disclosed by the Contractor, its staff, agents, employees, or sub-contractors, the Contractor shall be liable for any and all loss or damages or claims arising from such disclosure. This duty to maintain the confidentiality of the confidential information shall continue after and beyond the completion of project.

Signed and accepted this _____ day of _____, 201_

(INSERT CONTRACTOR'S NAME)

Per _____

Title _____

Documentation received: (attached)

Date _____

() WSIB

() Liability Insurance Certificate

() SDS Sheets

() Canadian Police Information Centre (CPIC) security clearance – all individuals on-site

ONTARIO SHORES CENTRE FOR MENTAL HEALTH SCIENCES

Per _____

Title _____

Documentation provided by the Hospital:

Date _____

() Contractors' Procedure Manual

() SDS Sheets

() Other: Please specify _____

PART 1 - GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 Work of this Contract comprises general construction of a new Powerhouse and Parking Lot, located at 700 Gordon Street, Whitby, and further identified as the Project.

1.2 CONTRACT METHOD

- .1 Construct Work under stipulated price contract.

1.3 WORK BY OTHERS

- .1 Co-operate with other Contractors in carrying out their respective works and carry out instructions from Consultant.
- .2 Co-ordinate work with that of other Contractors. If any part of work under this Contract depends for its proper execution or result upon work of another Contractor, report promptly to Consultant, in writing, any defects which may interfere with proper execution of Work.
- .3 Work of this Project must include provisions for co-ordinating some aspects of work related to the Hospital's new Combined Heating and Power (CHP) Plant, namely provision of ducts for installation of signal wiring between Main Substation and the CHP.

1.4 WORK SEQUENCE

- .1 Construct Work in stages to accommodate Owner's continued use of existing premises during construction.
- .2 Co-ordinate Progress Schedule during construction.
- .3 Maintain fire access/control.

1.5 CONTRACTOR USE OF PREMISES

- .1 Unrestricted use of site until Substantial Performance.
- .2 Limit use of premises for Work, access and storage,]to allow:
 - .1 Owner occupancy.
 - .2 Work by other contractors.
 - .3 Public usage.
- .3 Co-ordinate use of premises under direction of Owner.
- .4 Obtain and pay for use of additional storage or work areas needed for operations under this Contract.
- .5 Remove or alter existing work to prevent injury or damage to portions of existing work which remain.
- .6 Repair or replace portions of existing work which have been altered during construction operations to match existing or adjoining work, as directed by Consultant.
- .7 At completion of operations condition of existing work: equal to or better than that which existed before new work started.

1.6 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING FACILITIES

- .1 Execute work with least possible interference or disturbance to occupants, building operations, public and normal use of premises. Arrange with Owner to facilitate execution of work.

1.7 EXISTING SERVICES

- .1 Notify, Owner, Consultant and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Owner and Consultant 10 days' notice for necessary interruption of mechanical or electrical service throughout course of work. Minimize duration of interruptions. Carry out work at times as directed by Owner and governing authorities with minimum disturbance to operations.
- .3 Provide alternative routes for personnel, pedestrian and vehicular traffic.
- .4 Establish location and extent of service lines in area of work before starting Work. Notify Owner and Consultant of findings.
- .5 Submit schedule to and obtain approval from Owner and Consultant for any shut-down or closure of active service or facility including power and communications services. Adhere to approved schedule and provide notice to affected parties.
- .6 Provide temporary services when directed by Owner and/or Consultant to maintain critical building and tenant systems.
- .7 Provide adequate bridging over trenches which cross sidewalks or roads to permit normal traffic.
- .8 Where unknown services are encountered, immediately advise Owner and Consultant and confirm findings in writing.
- .9 Protect, relocate or maintain existing active services. When inactive services are encountered, cap off in manner approved by authorities having jurisdiction.
- .10 Record locations of maintained, re-routed and abandoned service lines.
- .11 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.8 DOCUMENTS REQUIRED

- .1 Maintain at job site, one copy each document as follows:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Reviewed Shop Drawings.
 - .5 List of Outstanding Shop Drawings.
 - .6 Change Orders.
 - .7 Other Modifications to Contract.
 - .8 Field Test Reports.
 - .9 Copy of Approved Work Schedule.

- .10 Health and Safety Plan and Other Safety Related Documents.
- .11 Other documents as specified.

PART 2 - PRODUCTS

- 2.1 NOT USED

PART 3 - EXECUTION

- 3.1 NOT USED

END OF SECTION

Part 1 General

1.1 ACCESS AND EGRESS

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

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of the site. Make arrangements with Owner to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Owner will assign sanitary facilities for use by Contractor's personnel, or direct that the Contractor provide its own on-site facilities. Keep facilities clean.
- .5 Closures: protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to building and site operations, the occupants and the public. Arrange with Owner to facilitate execution of work.

1.4 EXISTING SERVICES

- .1 Notify the Owner, Consultant and utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give the Owner and Consultant ten (10) days' notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.
- .3 Provide for pedestrian and vehicular traffic.
- .4 Construct barriers in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

1.5 SPECIAL REQUIREMENTS

- .1 Submit schedule in accordance with Section 01 32 16.07 - Construction Progress Schedule
- .2 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .3 Keep within limits of work and avenues of ingress and egress.
- .4 Ingress and egress of Contractor vehicles at site is limited to the driveway designated by Owner. .
- .5 Deliver materials outside of peak traffic hours unless otherwise approved by Owner.

1.6 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security clearances:
 - .1 Personnel employed on this project will be subject to security check. Obtain clearance, as instructed, for each individual who will require to enter premises.
 - .2 Contractor's personnel will require satisfactory security screening by an agency designated by the Owner in order to complete Work in premises and on site.

1.7 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is not permitted.

Part 2 Products

- 2.1 NOT USED

Part 3 Execution

- 3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC), CCDC 2-2008, Stipulated Price Contract.
- .2 Project Supplementary Conditions

1.2 CASH ALLOWANCES

- .1 Refer to CCDC 2, GC 4.1.
- .2 Include in Contract Price specified cash allowances.
- .3 Cash allowances, unless otherwise specified, cover net cost to Contractor of services, products, construction machinery and equipment, freight, handling, unloading, storage installation and other authorized expenses incurred in performing Work.
- .4 Contract Price, and not cash allowance, includes Contractor's overhead and profit in connection with such cash allowance.
- .5 Contract Price will be adjusted by written order to provide for excess or deficit to each cash allowance.
- .6 Where costs under a cash allowance exceed amount of allowance, Contractor will be compensated for excess incurred and substantiated plus allowance for overhead and profit as set out in Contract Documents.
- .7 Include progress payments on accounts of work authorized under cash allowances in Consultant's monthly certificate for payment.
- .8 Prepare schedule jointly with Consultant to show when items called for under cash allowances must be authorized by [Consultant] for ordering purposes so that progress of Work will not be delayed.

1.3 CONTINGENCY ALLOWANCE

- .1 Refer to CCDC 2, GC 4.2.
- .2 Include in Contract Price specified contingency allowance.
- .3 Do not include in Contract Price, additional contingency allowances for products, installation, overhead or profit
- .4 Expenditures under contingency allowance will be authorized in accordance with procedures provided in CCDC 2, GC 6.1 - Changes CCDC 2, 6.2 Change Order and CCDC 2, 6.3 Change Directive.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 23-[2005], A Guide to Calling Bids and Awarding Contracts.

1.2 REQUIREMENTS

- .1 Referenced specification Sections stipulate pertinent requirements for products and methods to achieve Work stipulated under each Alternative.
- .2 Co-ordinate affected related Work and modify surrounding Work to integrate Work under each Alternative.

1.3 AWARD/SELECTION OF ALTERNATIVES

- .1 Indicate variation of Bid Price for Alternatives listed in Bid Form. Note that this form requests a 'difference' in Bid. Price by adding to or deducting from base Bid price.
- .2 Bids will be evaluated on 'Base Bid' price. After determination of lowest Bidder, consideration will be given to Alternatives and Bid Price adjustments.
- .3 In accordance with CCDC Document No. 23 - A Guide to Calling Bids and Awarding Contracts, low Bid will be determined on basis of lowest Bid in accordance with Contract Documents on which Project is to be actually constructed, including those alternatives for which prices have been invited and which are to be incorporated in Work.

1.4 ALTERNATIVES

- .1 Base Bid: generator and switchgear using dead field/start-up synchronization
- .2 Alternative: generator and switchgear using conventional synchronization controls for paralleling

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC), CCDC 2-2008, Stipulated Price Contract.

1.2 APPLICATIONS FOR PROGRESS PAYMENT

- .1 Refer to CCDC 2.
- .2 Make applications for payment on account monthly as Work progresses.
- .3 Date applications for payment last day of agreed monthly payment period and ensure amount claimed is for value, proportionate to amount of Contract, of Work performed and Products delivered to Place of Work at that date.
- .4 Submit to Consultant, at least 14 days before first application for payment. Schedule of Values for parts of Work, aggregating total amount of Contract Price, to facilitate evaluation of applications for payment.

1.3 SCHEDULE OF VALUES

- .1 Refer to CCDC 2
- .2 Provide schedule of values supported by evidence as Consultant may reasonably direct and when accepted by Consultant, be used as basis for applications for payment.
- .3 Include statement based on schedule of values with each application for payment.
- .4 Support claims for products delivered to Place of Work but not yet incorporated into Work by such evidence as Consultant may reasonably require to establish value and delivery of products.

1.4 PREPARING SCHEDULE OF UNIT PRICE TABLE ITEMS

- .1 Submit separate schedule of unit price items of Work requested in [Bid] form.
- .2 Make form of submittal parallel to Schedule of Values, with each line item identified same as line item in Schedule of Values. Include in unit prices only:
 - .1 Cost of material.
 - .2 Delivery and unloading at site.
 - .3 Sales taxes.
 - .4 Installation, overhead and profit.
- .3 Ensure unit prices multiplied by quantities given equal material cost of that item in Schedule of Values.

1.5 PROGRESS PAYMENT

- .1 Refer to CCDC 2.
- .2 Consultant will issue to Owner, no later than 10 days after receipt of an application for payment, certificate for payment in amount applied for or in such other amount as Consultant determines to be due. If Consultant amends application, Consultant will give notification in writing giving reasons for amendment.

1.6 SUBSTANTIAL PERFORMANCE OF WORK

- .1 Refer to CCDC 2.
- .2 Prepare and submit to Consultant] comprehensive list of items to be completed or corrected and apply for a review by Consultant to establish Substantial Performance of Work. Failure to include items on list does not alter responsibility to complete Contract.
- .3 No later than 10 days after receipt of list and application, Consultant will review Work to verify validity of application, and no later than 7 days after completing review, will notify Contractor if Work or designated portion of Work is substantially performed.
- .4 Consultant: state date of Substantial Performance of Work or designated portion of Work in certificate.
- .5 Immediately following issuance of certificate of Substantial Performance of Work, in consultation with Consultant, establish reasonable date for finishing Work.

1.7 PAYMENT OF HOLDBACK UPON SUBSTANTIAL PERFORMANCE OF WORK

- .1 Refer to CCDC 2.
- .2 After issuance of certificate of Substantial Performance of Work:
 - .1 Submit application for payment of holdback amount.
 - .2 Submit sworn statement that accounts for labour, subcontracts, products, construction machinery and equipment, and other indebtedness which may have been incurred in Substantial Performance of Work and for which Owner might in be held responsible have been paid in full, except for amounts properly retained as holdback or as identified amount in dispute.
- .3 After receipt of application for payment and sworn statement, Consultant will issue certificate for payment of holdback amount.
- .4 Where holdback amount has not been placed in a separate holdback account, Owner shall, 10 days prior to expiry of holdback period stipulated in lien legislation applicable to Place of Work, place holdback amount in bank account in joint names of Owner and Contractor.
- .5 Amount authorized by certificate for payment of holdback amount is due and payable on day following expiration of holdback period stipulated in lien legislation applicable to Place of Work. Where lien legislation does not exist or apply, holdback amount is due and payable in accordance with other legislation, industry practice, or provisions which may be agreed to between parties. Owner may retain out of holdback amount sums required by law to satisfy liens against Work or, if permitted by lien legislation applicable to Place of Work, other third party monetary claims against Contractor which are enforceable against Owner.

1.8 PROGRESSIVE RELEASE OF HOLDBACK

- .1 Refer to CCDC 2.
- .2 Where legislation permits, if Consultant has certified that Work of subcontractor or supplier has been performed prior to Substantial Performance of Work, Owner shall pay holdback amount retained for such subcontract Work, or products supplied by such supplier, on day following expiration of holdback period for such Work stipulated in lien legislation applicable to Place of Work.
- .3 In addition to provisions of preceding paragraph, and certificate wording, ensure that such subcontract Work or products is protected pending issuance of final certificate for payment and be responsible for correction of defects or Work not performed regardless of whether or not such was apparent when such certificates were issued.

1.9 FINAL PAYMENT

- .1 Refer to CCDC 2, GC 5.7.
- .2 Submit application for final payment when Work is completed.
- .3 Consultant] will, no later than 10 days after receipt of application for final payment, review Work to verify validity of application. Consultant will give notification that application is valid or give reasons why it is not valid, no later than 7 days after reviewing Work.
- .4 Consultant will issue final certificate for payment when application for final payment is found valid.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 APPOINTMENT AND PAYMENT

- .1 Owner, at Consultant's recommendation, will appoint and pay for services of 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 [Design-Builder's] [Contractor's] convenience.
 - .3 Testing, adjustment and balancing of conveying systems, mechanical and electrical equipment and systems.
 - .4 Mill tests and certificates of compliance.
 - .5 Tests specified to be carried out by Contractor under the supervision of Consultant
- .2 Where tests or inspections by designated testing laboratory reveal Work not in accordance with contract requirements, pay costs for additional tests or inspections as required by Consultant to verify acceptability of corrected work.

1.2 CONTRACTOR'S RESPONSIBILITIES

- .1 Provide labour, equipment and facilities to:
 - .1 Provide access to Work for inspection and testing.
 - .2 Facilitate inspections and tests.
 - .3 Make good Work disturbed by inspection and test.
 - .4 Provide storage on site for laboratory's exclusive use to store equipment and cure test samples.
- .2 Notify [Departmental Representative] [Consultant] [48] [DCC Representative] hours minimum sufficiently in advance of operations to allow for assignment of laboratory personnel and scheduling of test.
- .3 Where materials are specified to be tested, deliver representative samples in required quantity to testing laboratory.
- .4 Pay costs for uncovering and making good Work that is covered before required inspection or testing is completed and approved by [Consultant] [Departmental Representative] [DCC Representative].

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 ADMINISTRATIVE

- .1 Schedule and administer project meetings throughout the progress of the work
- .2 Prepare agenda for meetings.
- .3 Distribute written notice of each meeting four days in advance of meeting date to Consultant and Owner.
- .4 Provide physical space and make arrangements for meetings.
- .5 Preside at meetings.
- .6 Record the meeting minutes. Include significant proceedings and decisions. Identify actions by parties.
- .7 Reproduce and distribute copies of minutes within three days after meetings and transmit to meeting participants and affected parties not in attendance.
- .8 Representative of Contractor, Subcontractor and suppliers attending meetings will be qualified and authorized to act on behalf of party each represents.

1.2 PRECONSTRUCTION MEETING

- .1 Within 15 days after award of Contract, request a meeting of parties in contract to discuss and resolve administrative procedures and responsibilities.
- .2 Owner, Consultant, Contractor, major Subcontractors, field inspectors and supervisors shall be in attendance.
- .3 Establish time and location of meeting and notify parties concerned minimum 5 days before meeting.
- .4 Incorporate mutually agreed variations to Contract Documents into Agreement, prior to signing.
- .5 Agenda to include:
 - .1 Appointment of official representative of participants in the Work.
 - .2 Schedule of Work: in accordance with Section 01 32 16.- Construction Progress Schedules - Bar (GANTT) Chart
 - .3 Schedule of submission of shop drawings, samples, colour chips. Submit submittals in accordance with Section 01 33 00 - Submittal Procedures.
 - .4 Requirements for temporary facilities, site sign, offices, storage sheds, utilities, fences in accordance with Section [01 52 00 - Construction Facilities.
 - .5 Delivery schedule of specified equipment.
 - .6 Site security in accordance with Section 01 56 00 - Temporary Barriers and Enclosures.

- .7 Proposed changes, change orders, procedures, approvals required, mark-up percentages permitted, time extensions, overtime, administrative requirements.
- .8 Record drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .9 Maintenance manuals in accordance with Section 01 78 00 - Closeout Submittals.
- .10 Take-over procedures, acceptance, warranties in accordance with Section [01 78 00 - Closeout Submittals.
- .11 Monthly progress claims, administrative procedures, photographs, hold backs.
- .12 Appointment of inspection and testing agencies or firms.
- .13 Insurances, transcript of policies.

1.3 PROGRESS MEETINGS

- .1 Schedule monthly progress meetings during the course of Work
- .2 Contractor, major Subcontractors involved in Work, Consultant and Owner shall be in attendance.
- .3 Notify parties minimum 5 days prior to meetings.
- .4 Record minutes of meetings and circulate to attending parties and affected parties not in attendance within 3] days after meeting.
- .5 Agenda to include the following:
 - .1 Review, approval of minutes of previous meeting.
 - .2 Review of Work progress since previous meeting.
 - .3 Field observations, problems, conflicts.
 - .4 Problems which impede construction schedule.
 - .5 Review of off-site fabrication delivery schedules.
 - .6 Corrective measures and procedures to regain projected schedule.
 - .7 Revision to construction schedule.
 - .8 Progress schedule, during succeeding work period.
 - .9 Review submittal schedules: expedite as required.
 - .10 Maintenance of quality standards.
 - .11 Review proposed changes for effect on construction schedule and on completion date.
 - .12 Other business

PART 2 - PRODUCTS

- 2.1 NOT USED

PART 3 - EXECUTION

- 3.1 NOT USED.

END OF SECTION

PART 1 - GENERAL

1.1 ADMINISTRATIVE

- .1 Submit to Consultant submittals listed for review. Submit promptly and in orderly sequence to not cause delay in Work. Failure to submit in ample time is not considered sufficient reason for extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .2 Do not proceed with Work affected by submittal until review is complete.
- .3 Present shop drawings, product data, samples and mock-ups in SI Metric units.
- .4 Where items or information is not produced in SI Metric units converted values are acceptable.
- .5 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of Work and Contract Documents. Submittals not stamped, signed, dated and identified as to specific project will be returned without being examined and considered rejected.
- .6 Notify Consultant and Owner, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .7 Verify field measurements and affected adjacent Work are co-ordinated.
- .8 Contractor's responsibility for errors and omissions in submission is not relieved by Consultant's review of submittals.
- .9 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Consultant's review.
- .10 Keep one reviewed copy of each submission on site.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Refer to CCDC 2 GC 3.11.
- .2 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .3 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
- .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .5 Allow 5 days for Consultant's review of each submission.

- .6 Adjustments made on shop drawings by Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Consultant prior to proceeding with Work.
- .7 Make changes in shop drawings as Consultant may require, consistent with Contract Documents. When resubmitting, notify Consultant in writing of revisions other than those requested.
- .8 Accompany submissions with transmittal letter, in [duplicate], containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .9 Submissions include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.
 - .3 Setting or erection details.
 - .4 Capacities.
 - .5 Performance characteristics.
 - .6 Standards.
 - .7 Operating weight.
 - .8 Wiring diagrams.
 - .9 Single line and schematic diagrams.
 - .10 Relationship to adjacent work.
- .10 After Consultant's review, distribute copies.

- .11 Submit electronic copy of shop drawings for each requirement requested in specification Sections and as Consultant may reasonably request.
- .12 Submit electronic copies of product data sheets or brochures for requirements requested in specification Sections and as requested by Consultant where shop drawings will not be prepared due to standardized manufacture of product.
- .13 Submit electronic copies of test reports for requirements requested in specification Sections and as requested by Consultant.
 - .1 Report signed by authorized official of testing laboratory that material, product or system identical to material, product or system to be provided has been tested in accord with specified requirements.
 - .2 Testing must have been within 3 years of date of contract award for project.
- .14 Submit electronic copies of certificates for requirements requested in specification Sections and as requested by Consultant.
 - .1 Statements printed on manufacturer's letterhead and signed by responsible officials of manufacturer of product, system or material attesting that product, system or material meets specification requirements.
 - .2 Certificates must be dated after award of project contract complete with project name.
- .15 Submit electronic copies of manufacturers instructions for requirements requested in specification Sections and as requested by Consultant.
 - .1 Pre-printed material describing installation of product, system or material, including special notices and Material Safety Data Sheets concerning impedances, hazards and safety precautions.
- .16 Submit electronic copies of Manufacturer's Field Reports for requirements requested in specification Sections and as requested by Consultant
- .17 Documentation of the testing and verification actions taken by manufacturer's representative to confirm compliance with manufacturer's standards or instructions.
- .18 Submit 6]copies of Operation and Maintenance Data for requirements requested in specification Sections and as requested by Consultant. Also submit this document in electronic format.
- .19 Delete information not applicable to project.
- .20 Supplement standard information to provide details applicable to project.
- .21 If upon review by Consultant, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.
- .22 The review of shop drawings by the Consultant is for sole purpose of ascertaining conformance with general concept.

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

1.3 SAMPLES

- .1 Submit for review samples in as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to site office.
- .3 Notify Owner and Consultant in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Owner and/or Consultant are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Owner and Consultant prior to proceeding with Work.
- .6 Make changes in samples which Owner and/or Consultant may require, consistent with Contract Documents.
- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.4 MOCK-UPS

- .1 Erect mock-ups in accordance with 01 45 00 - Quality Control.

1.5 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic and hard copy of colour digital photography in jpg format, standard resolution monthly with progress statement.
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Frequency of photographic documentation: weekly or as directed by Consultant and/or Owner, and upon completion of: excavation, foundation, framing and services before concealment, as directed by Owner and/or Consultant.

1.6 CERTIFICATES AND TRANSCRIPTS

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.
- .2 Submit transcription of insurance immediately after award of Contract.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC), CCDC 2-2008 Stipulated Price Contract.
- .2 U.S. Environmental Protection Agency (EPA)/Office of Water: EPA 832/R-92-005, Storm Water Management for Construction Activities, Chapter 3.

1.2 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humans; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures.
- .3 Before commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Consultant and Owner.
- .4 Environmental Protection Plan must include comprehensive overview of known or potential environmental issues to be addressed during construction.
- .5 Address topics at level of detail commensurate with environmental issue and required construction tasks.
- .6 Include in Environmental Protection Plan:
 - .1 Name of person responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Names and qualifications of person responsible for manifesting hazardous waste to be removed from site.
 - .3 Name and qualifications of person responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.

- .5 Erosion and sediment control plan identifying type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .6 Drawings indicating locations of proposed material storage areas, structures, sanitary facilities, and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.
- .7 Traffic Control Plans including measures to minimize amount of material transported onto paved public roads by vehicles or runoff.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas and methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan to include procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, are contained on project site.
- .12 Contaminant Prevention Plan identifying potentially hazardous substances to be used on job site; intended actions to prevent introduction of such materials into air, water, or ground; and detailing provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste Water Management Plan identifying methods and procedures for management of discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Pesticide treatment plan to be included and updated, as required.

1.4 FIRES

- .1 Fires and burning of rubbish on site is not permitted.
- .2 Provide supervision, attendance and fire protection measures as directed.

1.5 DRAINAGE

- .1 Develop and submit erosion and Sediment Control Plan (ESC) identifying type and location of erosion and sediment controls provided. Plan to include monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
- .2 Storm Water Pollution Prevention Plan (SWPPP) to be substituted for erosion and sediment control plan.

- .3 Provide temporary drainage and pumping required to keep excavations and site free from water.
- .4 Ensure pumped water into sewer or drainage systems is free of suspended materials.
- .5 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with local authority requirements.

1.6 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties as indicated.
- .2 Protect trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m minimum.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated.

1.7 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this Contract.
- .2 Control emissions from equipment and plant in accordance with local authorities' emission requirements.
- .3 Prevent sandblasting and other extraneous materials from contaminating air beyond application area. Provide temporary enclosures where directed by Consultant or Owner. .
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.8 NOTIFICATION

- .1 Consultant or Owner will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, shall inform Owner and Consultant of proposed corrective action and take such action for approval by Owner or Consultant.
 - .1 Take action only after receipt of written approval by Owner or Consultant.
- .3 Owner or Consultant will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning
- .2 Leave Work area clean at end of each day
- .3 Bury rubbish and waste materials on site where directed after receipt of written approval from Owner.
- .4 Ensure storm and sanitary sewers remain free of waste and volatile materials disposal.
- .5 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .6 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7 Remove recycling containers and bins from site and dispose of materials at appropriate facility

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 This Section references to laws, by laws, ordinances, rules, regulations, codes, orders of Authority Having Jurisdiction, and other legally enforceable requirements applicable to Work and that are; or become, in force during performance of Work.

1.2 REFERENCES TO REGULATORY REQUIREMENTS

- .1 Perform Work in accordance with the Ontario National Building Code including amendments up to tender closing date and other codes of provincial or local application provided that in case of conflict or discrepancy, more stringent requirements apply.
- .2 Specific design and performance requirements listed in specifications or indicated on Drawings may exceed minimum requirements established by referenced Building Code; these requirements will govern over the minimum requirements listed in Building Code
- .3 Meet: or exceed requirements of Contract documents and specified standards, codes and referenced documents.

1.3 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions and municipal by-laws.

1.4 QUALITY ASSURANCE

- .1 Regulatory Requirements: Except as otherwise specified, Constructor will apply for, obtain, and pay fees associated with, permits, licenses, certificates, and approvals required by regulatory requirements and Contract Documents, based on General Conditions of Contract and the following:
 - .1 Regulatory requirements and fees in force on date of Bid submission, and
 - .2 A change in regulatory requirements or fees scheduled to become effective after date of tender submission and of which public notice has been given before date of tender submission

PART 2 - PRODUCTS

2.1 EASEMENTS AND NOTICES

- .1 Owner will obtain permanent easements and rights of servitude that may be required for performance of Work.
- .2 Constructor will give notices required by regulatory requirements.

2.2 PERMITS

- .1 Building Permit:

- .1 Owner has applied for and will be paying for building permit. Constructor is responsible for obtaining or coordinating other permits required for Work and its various parts.
- .2 Constructor will display building permit and other permits in a conspicuous location at Place of Work.
- .2 Occupancy Permits:
 - .1 Constructor will apply for, obtain, and pay for occupancy permits, including partial occupancy permits where required by authority having jurisdiction.
 - .2 Consultant will issue appropriate instructions to Constructor for correction to Work where Contract Document deficiencies are required to be corrected in order to obtain occupancy permits, including partial occupancy permits.
 - .3 Constructor will correct deficiencies in accordance with Consultant's instructions. Where deficiency is not corrected, Owner reserves the right to make correction and charge Constructor for costs incurred.
 - .4 Constructor will turn occupancy permits over to Owner.

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC), CCDC 2-2008, Stipulated Price Contract.

1.2 INSPECTION

- .1 Refer to CCDC 2, GC 2.3.
- .2 Allow Consultant and Owner access to Work. If part of Work is in preparation at locations other than Place of Work, allow access to such Work whenever it is in progress.
- .3 Give timely notice requesting inspection if Work is designated for special tests, inspections or approvals by Owner or Consultant instructions, or law of Place of Work.
- .4 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .5 Owner or Consultant will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents. If, upon examination such work is found not in accordance with Contract Documents, correct such Work and pay cost of examination and correction. If such Work is found in accordance with Contract Documents, Owner shall pay cost of examination and replacement.

1.3 INDEPENDENT INSPECTION AGENCIES

- .1 Independent Inspection/Testing Agencies will be engaged by Owner for purpose of inspecting and/or testing portions of Work. Cost of such services will be borne by Owner.
- .2 Allocated costs: to Section 01 21 00 - Allowances.
- .3 Provide equipment required for executing inspection and testing by appointed agencies.
- .4 Employment of inspection/testing agencies does not relax responsibility to perform Work in accordance with Contract Documents.
- .5 If defects are revealed during inspection and/or testing, 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 reinspection.

1.4 ACCESS TO WORK

- .1 Allow inspection/testing agencies access to Work, off site manufacturing and fabrication plants.
- .2 Co-operate to provide reasonable facilities for such access.

1.5 PROCEDURES

- .1 Notify appropriate agency, Owner and Consultant in advance of requirement for tests, in order that attendance arrangements can be made.
- .2 Submit samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.6 REJECTED WORK

- .1 Refer to CCDC, GC 2.4.
- .2 Remove defective Work, whether result of poor workmanship, use of defective products or damage and whether incorporated in Work or not, which has been rejected by Consultant or Owner as failing to conform to Contract Documents. Replace or re-execute in accordance with Contract Documents.
- .3 Make good other Contractor's work damaged by such removals or replacements promptly.
- .4 If in opinion of Owner or Consultant it is not expedient to correct defective Work or Work not performed in accordance with Contract Documents, Owner will deduct from Contract Price difference in value between Work performed and that called for by Contract Documents, amount of which will be determined by Owner and Consultant.

1.7 REPORTS

- .1 Submit inspection and test reports to Owner and Consultant.
- .2 Provide copies to manufacturer or fabricator of material being inspected or tested, or to subcontractor of work being inspected or tested.

1.8 TESTS AND MIX DESIGNS

- .1 Furnish test results and mix designs as requested.
- .2 Cost of tests and mix designs beyond those called for in Contract Documents or beyond those required by law of Place of Work will be appraised by Consultant and may be authorized as recoverable.

1.9 EQUIPMENT AND SYSTEMS

- .1 Submit adjustment and balancing reports for mechanical and electrical systems.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit erosion and sedimentation control plan

1.2 INSTALLATION AND REMOVAL

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

1.3 DEWATERING

- .1 Provide temporary drainage and pumping facilities to keep excavations and site free from standing water.

1.4 WATER SUPPLY

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

1.5 TEMPORARY HEATING AND VENTILATION

- .1 Provide temporary heating required during construction period, including attendance, maintenance and fuel.
- .2 Construction heaters used inside building must be vented to outside or be non-flameless type. Solid fuel salamanders are not permitted.
- .3 Provide temporary heat and ventilation in enclosed areas as required to:
 - .1 Facilitate progress of Work.
 - .2 Protect Work and products against dampness and cold.
 - .3 Prevent moisture condensation on surfaces.
 - .4 Provide ambient temperatures and humidity levels for storage, installation and curing of materials.
 - .5 Provide adequate ventilation to meet health regulations for safe working environment.
- .4 Maintain temperatures of minimum 10 degrees C in areas where construction is in progress.
- .5 Ventilating:
 - .1 Prevent accumulations of dust, fumes, mists, vapours or gases in areas occupied during construction.

- .2 Provide local exhaust ventilation to prevent harmful accumulation of hazardous substances into atmosphere of occupied areas.
- .3 Dispose of exhaust materials in manner that will not result in harmful exposure to persons.
- .4 Ventilate storage spaces containing hazardous or volatile materials.
- .5 Continue operation of ventilation and exhaust system for time after cessation of work process to assure removal of harmful contaminants.
- .6 Permanent heating system of building, to be used when available. Be responsible for damage to heating system if use is permitted.
- .7 Ensure Date of Substantial Performance and Warranties for heating system do not commence until entire system is in as near original condition as possible and is certified by Consultant.
- .8 Owner will pay utility charges for maintaining temporary heat.
- .9 Maintain strict supervision of operation of temporary heating and ventilating equipment to:
 - .1 Conform with applicable codes and standards.
 - .2 Enforce safe practices.
 - .3 Prevent abuse of services.
 - .4 Prevent damage to finishes.
 - .5 Vent direct-fired combustion units to outside.
- .10 Be responsible for damage to Work due to failure in providing adequate heat and protection during construction.

1.6 TEMPORARY POWER AND LIGHT

- .1 Provide and pay for temporary power during construction for temporary lighting and operating of power tools.
- .2 Arrange for connection with appropriate utility company. Pay costs for installation, maintenance and removal.
- .3 Provide and maintain temporary lighting throughout project.
- .4 Electrical power and lighting systems installed under this Contract may be used for construction requirements only with prior approval of Owner and/or Consultant provided that guarantees are not affected. Make good damage to electrical system caused by use under this Contract. Replace lamps which have been used for more than 3 months.

1.7 TEMPORARY COMMUNICATION FACILITIES

- .1 Provide and pay for temporary data and telephone hook up, line[s] and equipment necessary for own use.

1.8 FIRE PROTECTION

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

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction and sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC), CCDC 2-2008, Stipulated Price Contract.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA-0121, Douglas Fir Plywood.
 - .3 CAN/CSA-S269.2, Access Scaffolding for Construction Purposes.
 - .4 CAN/CSA-Z321, Signs and Symbols for the Occupational Environment.
- .3 U.S. Environmental Protection Agency (EPA) / Office of Water: EPA 832R92005, Storm Water Management for Construction Activities: Developing Pollution Prevention Plans and Best Management Practices.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

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

1.3 INSTALLATION AND REMOVAL

- .1 Prepare site plan indicating proposed location and dimensions of area to be fenced and used by Contractor, number of trailers to be used, avenues of ingress/egress to fenced area and details of fence installation.
- .2 Identify areas which have to be gravelled to prevent tracking of mud.
- .3 Indicate use of supplemental or other staging area.
- .4 Provide construction facilities in order to execute work expeditiously.
- .5 Remove from site all such work after use.

1.4 SCAFFOLDING

- .1 Scaffolding in accordance with CAN/CSA-S269.2.
- .2 Provide and maintain ramps, scaffolding, temporary stairs, ladders and platforms.

1.5 HOISTING

- .1 Provide, operate and maintain hoists / cranes required for moving of workers, materials and equipment. Make financial arrangements with Subcontractors for their use of hoists.
- .2 Hoists / cranes to be operated by qualified operator.

1.6 SITE STORAGE/LOADING

- .1 Refer to CCDC 2, GC 3.12.
- .2 Confine work and operations of employees by Contract Documents. Do not unreasonably encumber premises with products.
- .3 Do not load or permit to load any part of Work with weight or force that will endanger Work.

1.7 CONSTRUCTION PARKING

- .1 Parking will be permitted on site provided it does not disrupt performance of Work.
- .2 Provide and maintain adequate access to project site.

1.8 SECURITY

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

1.9 OFFICES

- .1 Provide office heated to 22 degrees C, lighted 750 lx and ventilated, of sufficient size to accommodate site meetings and furnished with drawing laydown table.
- .2 Provide marked and fully stocked first-aid case in a readily available location.
- .3 Subcontractors to provide their own offices as necessary. Direct location of these offices.

1.10 EQUIPMENT, TOOL AND MATERIALS STORAGE

- .1 Provide and maintain, in clean and orderly condition, lockable weatherproof sheds for storage of tools, equipment and materials.
- .2 Locate materials not required to be stored in weatherproof sheds on site in manner to cause least interference with work activities.

1.11 SANITARY FACILITIES

- .1 Provide sanitary facilities for work force in accordance with governing regulations and ordinances.
- .2 Post notices and take precautions as required by local health authorities. Keep area and premises in sanitary condition.

1.12 CONSTRUCTION SIGNAGE

- .1 Provide and erect project sign, within three (3) weeks of signing Contract, in a location designated by Owner.
- .2 Construction sign of wood frame and plywood construction painted with exhibit lettering produced by a professional sign painter.

- .3 Indicate on sign, name of Owner, Consultant, Contractor, of design style established by Owner.
- .4 No other signs or advertisements, other than warning signs, are permitted on site.
- .5 Provide project identification site sign comprising foundation, framing, and 1200 x 2400 signboard
- .6 Locate project identification sign as directed by Owner
- .7 Signs and notices for safety and instruction in both official languages Graphic symbols to CAN/CSA-Z321.
- .8 Maintain approved signs and notices in good condition for duration of project, and dispose of off site on completion of project or earlier if directed by Consultant or Owner.

1.13 PROTECTION AND MAINTENANCE OF TRAFFIC

- .1 Provide access and temporary relocated roads as necessary to maintain traffic.
- .2 Maintain and protect traffic on affected roads during construction period except as otherwise specifically directed by Owner or Consultant.
- .3 Provide measures for protection and diversion of traffic, including provision of watch-persons and flag-persons, erection of barricades, placing of lights around and in front of equipment and work, and erection and maintenance of adequate warning, danger, and direction signs
- .4 Protect travelling public from damage to person and property.
- .5 Contractor's traffic on roads selected for hauling material to and from site to interfere as little as possible with public traffic.
- .6 Verify adequacy of existing roads and allowable load limit on these roads. Contractor: responsible for repair of damage to roads caused by construction operations.
- .7 Construct access and haul roads necessary.
- .8 Haul roads: constructed with suitable grades and widths; sharp curves, blind corners, and dangerous cross traffic shall be avoided.
- .9 Provide necessary lighting, signs, barricades, and distinctive markings for safe movement of traffic.
- .10 Dust control: adequate to ensure safe operation at all times.
- .11 Location, grade, width, and alignment of construction and hauling roads: subject to approval by Owner and Consultant.
- .12 Lighting: to assure full and clear visibility for full width of haul road and work areas during night work operations.
- .13 Provide snow removal during period of Work.
- .14 Remove, upon completion of work, haul roads designated by Owner and/or Consultant.

1.14 CLEAN-UP

- .1 Remove construction debris, waste materials, packaging material from work site daily.
- .2 Clean dirt or mud tracked onto paved or surfaced roadways.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control plan, specific to site, that complies with EPA 832/R-92-005 or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

END OF SECTION

PART 1 - GENERAL

1.1 PROTECTION OF PUBLIC TRAFFIC

- .1 Comply with requirements of Acts, Regulations and By-Laws in force for regulation of traffic or use of roadways upon or over which it is necessary to carry out Work or haul materials or equipment.
- .2 When working on travelled way:
 - .1 Place equipment in position to minimize interference and hazard to travelling public.
 - .2 Keep equipment units as close together as working conditions permit and preferably on same side of travelled way.
 - .3 Do not leave equipment on travelled way overnight.
- .3 Close lanes of road only after receipt of written approval from Owner or Consultant. Before re-routing traffic erect suitable signs and devices to Ontario Traffic Manual, Book 7: Temporary Conditions.
- .4 Keep travelled way graded, free from pot holes and of sufficient width for required number of lanes of traffic.
 - .1 Provide 7 m wide minimum temporary roadway for traffic in two-way sections through Work and on detours.
 - .2 Provide 5 m wide minimum temporary roadway for traffic in one-way sections through Work and on detours.
- .5 Provide gravelled detours or temporary roads to facilitate passage of traffic around restricted construction area:
 - .1 Place and compact granular sub-base in accordance with Section 32 11 16 - Granular Sub-base.
 - .2 Place and compact asphalt concrete pavement in accordance with Section 32 12 16 - Asphalt Paving.
- .6 Provide and maintain road access and egress to property fronting along Work under Contract and in other areas, except where other means of road access exist that meet approval of Owner and Consultant.

1.2 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 Project Work which requires road user response.
- .2 Supply and erect signs, delineators, barricades and miscellaneous warning devices to Ontario Traffic Manual, Book 7: Temporary Conditions.
- .3 Place signs and other devices in locations recommended in Ontario Traffic Manual, Book 7: Temporary Conditions.

- .4 Meet with Consultant and Owner prior to commencement of Work to prepare list of signs and other devices required for project. If situation on site changes, revise list to approval of owner and Consultant.
- .5 Continually maintain traffic control devices in use:
 - .1 Check signs daily for legibility, damage, suitability and location. Clean, repair or replace to ensure clarity and reflectance.
 - .2 Remove or cover signs which do not apply to conditions existing from day to day.

1.3 CONTROL OF PUBLIC TRAFFIC

- .1 Provide competent flag personnel, trained in accordance with, and properly equipped to Ontario Traffic Manual, Book 7: Temporary Conditions for situations as follows:
 - .1 When public traffic is required to pass working vehicles or equipment that block all or part of travelled roadway.
 - .2 When it is necessary to institute one-way traffic system through construction area or other blockage where traffic volumes are heavy, approach speeds are high and traffic signal system is not in use.
 - .3 Where temporary protection is required while other traffic control devices are being erected or taken down.
 - .4 For emergency protection when other traffic control devices are not readily available.
 - .5 In situations where complete protection for workers, working equipment and public traffic is not provided by other traffic control devices.
 - .6 At each end of restricted sections where pilot cars are required.
 - .7 Delays to public traffic due to contractor's operators: 15 minutes maximum.

PART 2 - PRODUCTS

- 2.1 NOT USED

PART 3 - EXECUTION

- 3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian General Standards Board (CGSB)
 - .1 CGSB 1.59, Alkyd Exterior Gloss Enamel.
 - .2 CAN/CGSB 1.189, Exterior Alkyd Primer for Wood.
- .2 Canadian Standards Association (CSA International)
 - .1 CSA-O121, Douglas Fir Plywood.

1.2 INSTALLATION AND REMOVAL

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

1.3 HOARDING

- .1 Erect temporary site enclosures using 38 x 89 mm construction grade lumber framing at 600 mm centres and 1200 x 2400 x 13 mm exterior grade fir plywood to CSA O121.
- .2 Apply plywood panels vertically flush and butt jointed.
- .3 Provide one lockable truck entrance gate and at least one pedestrian door and conforming to applicable traffic restrictions on adjacent streets. Equip gates with locks and keys.
- .4 Paint public side of site enclosure in selected colours with one coat primer to CAN/CGSB 1.189 and one coat exterior paint to CGSB 1.59. Maintain public side of enclosure in clean condition.
- .5 Erect temporary site enclosure using new 1.2 m high snow fence wired to rolled steel "T" bar fence posts spaced at 2.4 m on centre. Provide one lockable truck gate. Maintain fence in good repair.
- .6 Provide barriers around trees and plants designated to remain. Protect from damage by equipment and construction procedures.

1.4 WEATHER ENCLOSURES

- .1 Provide weather tight closures to unfinished door and window openings, tops of shafts and other openings in floors and roofs.
- .2 Close off floor areas where walls are not finished; seal off other openings; enclose building interior work for temporary heat.
- .3 Design enclosures to withstand wind pressure and snow loading.

1.5 DUST TIGHT SCREENS

- .1 Provide dust tight screens or partitions to localize dust generating activities, and for protection of workers, finished areas of Work.
- .2 Maintain and relocate protection until such work is complete.

1.6 ACCESS TO SITE

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

1.7 PUBLIC TRAFFIC FLOW

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

1.8 FIRE ROUTES

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

1.9 PROTECTION FOR OFF-SITE AND PUBLIC PROPERTY

- .1 Protect surrounding private and public property from damage during performance of Work.
- .2 Be responsible for damage incurred.

1.10 PROTECTION OF BUILDING FINISHES

- .1 Provide protection for finished and partially finished building finishes and equipment during performance of Work.
- .2 Provide necessary screens, covers, and hoardings.
- .3 Confirm with Consultant and Owner locations and installation schedule 3 days prior to installation.
- .4 Be responsible for damage incurred due to lack of or improper protection.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC), CCDC 2-2008, Stipulated Price Contract.
- .2 Within text of each specifications section, reference may be made to reference standards.
- .3 Conform to these reference standards, in whole or in part as specifically requested in specifications.
- .4 If there is question as to whether products or systems are in conformance with applicable standards, Consultant or Owner reserves right to have such products or systems tested to prove or disprove conformance.
- .5 Cost for such testing will be born by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 Refer to CCDC 2.
- .2 Products, materials, equipment and articles incorporated in Work shall be new, not damaged or defective, and of best quality for purpose intended. If requested, furnish evidence as to type, source and quality of products provided.
- .3 Procurement policy is to acquire, in cost effective manner, items containing highest percentage of recycled and recovered materials practicable consistent with maintaining satisfactory levels of competition. Make reasonable efforts to use recycled and recovered materials and in otherwise utilizing recycled and recovered materials in execution of work.
- .4 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility, but is precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .5 Should disputes arise as to quality or fitness of products, decision rests strictly with Owner and/or Consultant based upon requirements of Contract Documents.
- .6 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .7 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located in mechanical or electrical rooms.

1.3 AVAILABILITY

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

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

1.4 STORAGE, HANDLING AND PROTECTION

- .1 Handle and store products in manner to prevent damage, adulteration, deterioration and soiling and in accordance with manufacturer's instructions when applicable.
- .2 Store packaged or bundled products in original and undamaged condition with manufacturer's seal and labels intact. Do not remove from packaging or bundling until required in Work.
- .3 Store products subject to damage from weather in weatherproof enclosures.
- .4 Store cementitious products clear of earth or concrete floors, and away from walls.
- .5 Keep sand, when used for grout or mortar materials, clean and dry. Store sand on wooden platforms and cover with waterproof tarpaulins during inclement weather.
- .6 Store sheet materials on flat, solid supports and keep clear of ground. Slope to shed moisture.
- .7 Store and mix paints in heated and ventilated room. Remove oily rags and other combustible debris from site daily. Take every precaution necessary to prevent spontaneous combustion.
- .8 Remove and replace damaged products at own expense and to satisfaction of Owner and Consultant.
- .9 Touch-up damaged factory finished surfaces to Owner and Consultant's satisfaction. Use touch-up materials to match original. Do not paint over name plates.

1.5 TRANSPORTATION

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

1.6 MANUFACTURER'S INSTRUCTIONS

- .1 Unless otherwise indicated in specifications, install or erect products in accordance with manufacturer's instructions. Do not rely on labels or enclosures provided with products. Obtain written instructions directly from manufacturers.
- .2 Notify Consultant and Owner in writing, of conflicts between specifications and manufacturer's instructions, so that Owner or Consultant will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes Owner and/or Consultant to require removal and re-installation at no increase in Contract Price or Contract Time.

1.7 QUALITY OF WORK

- .1 Ensure Quality of Work is of highest standard, executed by workers experienced and skilled in respective duties for which they are employed. Immediately notify Owner and Consultant if required Work is such as to make it impractical to produce required results.

- .2 Do not employ anyone unskilled in their required duties. Consultant and Owner reserve right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with Consultant, whose decision is final.

1.8 CO-ORDINATION

- .1 Ensure co-operation of workers in laying out Work. Maintain efficient and continuous supervision.
- .2 Be responsible for coordination and placement of openings, sleeves and accessories.

1.9 CONCEALMENT

- .1 In finished areas conceal pipes, ducts and wiring in floors, walls and ceilings, except where indicated otherwise.
- .2 Before installation inform Consultant if there is interference. Install as directed by Consultant.

1.10 REMEDIAL WORK

- .1 Refer to CCDC 2 Section 01 73 00 - Execution Requirements.
- .2 Perform remedial work required to repair or replace parts or portions of Work identified as defective or unacceptable. Co-ordinate adjacent affected Work as required.
- .3 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.

1.11 LOCATION OF FIXTURES

- .1 Consider location of fixtures, outlets, and mechanical and electrical items indicated as approximate.
- .2 Inform Owner or Consultant of conflicting installation. Install as directed.

1.12 FASTENINGS

- .1 Provide metal fastenings and accessories in same texture, colour and finish as adjacent materials, unless indicated otherwise.
- .2 Prevent electrolytic action between dissimilar metals and materials.
- .3 Use non-corrosive hot dip galvanized steel fasteners and anchors for securing exterior work, unless stainless steel or other material is specifically requested in affected specification Section.
- .4 Space anchors within individual load limit or shear capacity and ensure they provide positive permanent anchorage. Wood, or any other organic material plugs are not acceptable.
- .5 Keep exposed fastenings to a minimum, space evenly and install neatly.
- .6 Fastenings which cause spalling or cracking of material to which anchorage is made are not acceptable.

1.13 FASTENINGS - EQUIPMENT

- .1 Use fastenings of standard commercial sizes and patterns with material and finish suitable for service.
- .2 Use heavy hexagon heads, semi-finished unless otherwise specified. Use No. 304 stainless steel for exterior areas.
- .3 Bolts may not project more than one diameter beyond nuts.
- .4 Use plain type washers on equipment, sheet metal and soft gasket lock type washers where vibrations occur. Use resilient washers with stainless steel.

1.14 PROTECTION OF WORK IN PROGRESS

- .1 Prevent overloading of parts of building. Do not cut, drill or sleeve load bearing structural member, unless specifically indicated without written approval of Consultant.

1.15 EXISTING UTILITIES

- .1 When breaking into or connecting to existing services or utilities, execute Work at times directed by local governing authorities, with minimum of disturbance to Work, and pedestrian and vehicular traffic.
- .2 Protect, relocate or maintain existing active services. When services are encountered, cap off in manner approved by authority having jurisdiction. Stake and record location of capped service.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC): CCDC 2-[94], Stipulated Price Contract.
- .2 Owner's identification of existing survey control points and property limits.

1.2 QUALIFICATIONS OF SURVEYOR

- .1 Qualified registered land surveyor, licensed to practice in Place of Work, acceptable to Owner and Consultant.

1.3 SURVEY REFERENCE POINTS

- .1 Existing base horizontal and vertical control points are designated on drawings.
- .2 Locate, confirm and protect control points prior to starting site work. Preserve permanent reference points during construction.
- .3 Make no changes or relocations without prior written notice to Consultant.
- .4 Report to Owner and Consultant when reference point is lost or destroyed, or requires relocation because of necessary changes in grades or locations.
- .5 Require surveyor to replace control points in accordance with original survey control.

1.4 SURVEY REQUIREMENTS

- .1 Establish permanent bench marks on site, referenced to established bench marks by survey control points. Record locations, with horizontal and vertical data in Project Record Documents.
- .2 Establish lines and levels, locate and lay out, by instrumentation.
- .3 Stake for grading, fill and topsoil placement and landscaping features.
- .4 Stake slopes and berms.
- .5 Establish pipe invert elevations.
- .6 Stake batter boards for foundations.
- .7 Establish foundation column locations and floor elevations.
- .8 Establish lines and levels for mechanical and electrical work.

1.5 EXISTING SERVICES

- .1 Before commencing work, establish location and extent of service lines in area of Work and notify Owner and Consultant of findings.

- .2 Remove abandoned service lines within 2 m of structures. Cap or otherwise seal lines at cut-off points as directed by Consultant.

1.6 LOCATION OF EQUIPMENT AND FIXTURES

- .1 Location of equipment, fixtures and outlets indicated or specified are to be considered as approximate.
- .2 Locate equipment, fixtures and distribution systems to provide minimum interference and maximum usable space and in accordance with manufacturer's recommendations for safety, access and maintenance.
- .3 Submit field drawings to indicate relative position of various services and equipment when required by Owner and Consultant.

1.7 RECORDS

- .1 Maintain a complete, accurate log of control and survey work as it progresses.
- .2 On completion of foundations and major site improvements, prepare a certified survey showing dimensions, locations, angles and elevations of Work.
- .3 Record locations of maintained, re-routed and abandoned service lines.

1.8 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit name and address of Surveyor to Owner and Consultant.
- .2 On request of Owner or Consultant, submit documentation to verify accuracy of field engineering work.
- .3 Submit certificate signed by surveyor certifying and noting those elevations and locations of completed Work that conform and do not conform with Contract Documents.

1.9 SUBSURFACE CONDITIONS

- .1 Promptly notify Consultant in writing if subsurface conditions at Place of Work differ materially from those indicated in Contract Documents, or a reasonable assumption of probable conditions based thereon.
- .2 After prompt investigation, should Consultant determine that conditions do differ materially, instructions will be issued for changes in Work as provided in Changes and Change Orders.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit written request in advance of cutting or alteration which affects:
 - .1 Structural integrity of elements of project.
 - .2 Integrity of weather-exposed or moisture-resistant elements.
 - .3 Efficiency, maintenance, or safety of operational elements.
 - .4 Visual qualities of sight-exposed elements.
- .3 Include in request:
 - .1 Identification of project.
 - .2 Location and description of affected Work.
 - .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 separate contractor.
 - .7 Written permission of affected separate contractor.
 - .8 Date and time work will be executed.

1.2 MATERIALS

- .1 Required for original installation.
- .2 Change in Materials: Submit request for substitution in accordance with Section 01 33 00 - Submittal Procedures.

1.3 PREPARATION

- .1 Inspect existing conditions, including elements subject to damage or movement during cutting and patching.
- .2 After uncovering, inspect conditions affecting performance of Work.
- .3 Beginning of cutting or patching means acceptance of existing conditions.
- .4 Provide supports to assure structural integrity of surroundings; provide devices and methods to protect other portions of project from damage.
- .5 Provide protection from elements for areas which are to be exposed by uncovering work; maintain excavations free of water.

1.4 EXECUTION

- .1 Execute cutting, fitting, and patching including excavation and fill, to complete Work.

- .2 Fit several parts together, to integrate with other Work.
- .3 Uncover Work to install ill-timed Work.
- .4 Remove and replace defective and non-conforming Work.
- .5 Provide openings in non-structural elements of Work for penetrations of mechanical and electrical Work.
- .6 Execute Work by methods to avoid damage to other Work, and which will provide proper surfaces to receive patching and finishing.
- .7 Employ original installer to perform cutting and patching for weather-exposed and moisture-resistant elements, and sight-exposed surfaces.
- .8 Cut rigid materials using masonry saw or core drill. Pneumatic or impact tools not allowed on masonry work without prior approval.
- .9 Restore work with new products in accordance with requirements of Contract Documents.
- .10 Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- .11 At penetration of fire rated wall, ceiling, or floor construction, completely seal voids with firestopping material in accordance with Section 07 84 00 - Firestopping, full thickness of the construction element.
- .12 Refinish surfaces to match adjacent finishes: Refinish continuous surfaces to nearest intersection. Refinish assemblies by refinishing entire unit.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for [recycling] [reuse] in accordance with Section 01 74 21 - Construction/Demolition Waste Management And Disposal

PART 2 - PRODUCTS

- 2.1 NOT USED

PART 3 - EXECUTION

- 3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC): CCDC 2-2008 , Stipulated Price Contract.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by Owner or other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Owner or Consultant . Do not burn waste materials on site .
- .3 Clear snow and ice from access to building, pile snow in designated areas only .
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide and use marked separate bins for recycling. Refer to Section 01 74 19- Waste Management and Disposal .
- .6 Clean interior areas prior to start of finishing work, and maintain areas free of dust and other contaminants during finishing operations.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Provide adequate ventilation during use of volatile or noxious substances. Use of building ventilation systems is not permitted for this purpose.
- .9 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .10 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

- .1 Refer to CCDC 2, GC 3.14 .
- .2 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .3 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .4 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .5 Remove waste materials from site at regularly scheduled times or dispose of as directed by Owner or Consultant . Do not burn waste materials on site .

- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .7 Clean and polish glass, hardware, stainless steel, chrome, and mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.
- .8 Remove stains, spots, marks and dirt from electrical and mechanical fixtures, fitments, walls, and floors.
- .9 Clean lighting reflectors, lenses, and other lighting surfaces.
- .10 Vacuum clean and dust building interiors, behind grilles, louvres and screens.
- .11 Wax, seal, shampoo or prepare floor finishes, as recommended by manufacturer.
- .12 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .13 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .14 Remove dirt and other disfiguration from exterior surfaces.
- .15 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .16 Sweep and wash clean paved areas.
- .17 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .18 Clean roofs, downspouts, and drainage systems.
- .19 Remove debris and surplus materials from crawl areas and other accessible concealed spaces.
- .20 Remove snow and ice from access to building.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling in accordance with Section 01 74 19- Waste Management and Disposal

PART 2 - PRODUCTS

- 2.1 NOT USED

PART 3 - EXECUTION

- 3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 WASTE MANAGEMENT GOALS

- .1 Prior to start of Work conduct meeting with Owner and Consultant to review and discuss Contractor's proposed Waste Reduction Workplan for Construction waste to be project generated.
- .2 Waste management goal: to divert a minimum 75 percent of total Project Waste from landfill sites. Prior to project completion provide Consultant and Owner documentation certifying that waste management, recycling, reuse of recyclable and reusable materials have been extensively practiced.
- .3 Specific material target percentages for reuse and/or recycling:
 - .1 Masonry and pavement: 50%.
 - .2 Electrical - wiring: 75 %.
 - .3 Packaging: 100%.
- .4 Minimize amount of non-hazardous solid waste generated by project and accomplish maximum source reduction, reuse and recycling of solid waste produced by the construction activities.
- .5 Protect environment and prevent environmental pollution damage.

1.2 REFERENCE STANDARDS

- .1 Ontario Ministry of Environment
 - .1 Ontario Environmental Protection Act (EPA)
 - .1 Regulation 102/94, Waste Audits and Waste Reduction Workplans.
 - .2 Regulation 103/94, Source Separation Programs.
 - .2 Canadian Construction Association (CCA): CCA 81-2001: A Best Practices Guide to Solid Waste Reduction.

1.3 DEFINITIONS

- .1 Approved/Authorized recycling facility: waste recycler approved by applicable provincial authority or other users of material for recycling approved by the Owner and Consultant [Departmental Representative].
- .2 Class III: non-hazardous waste - construction renovation and demolition waste.
- .3 Construction, Renovation and/or Demolition (CRD) Waste: Class III solid, non-hazardous waste materials generated during construction, demolition, and/or renovation activities
- .4 Inert Fill: inert waste - exclusively asphalt and concrete.

- .5 Waste Source Separation Program (WSSP): implementation and co-ordination of ongoing activities to ensure designated waste materials will be sorted into pre-defined categories and sent for recycling and reuse, maximizing diversion and potential to reduce disposal costs.
- .6 Recyclable: ability of product or material to be recovered at end of its life cycle and re-manufactured into new product for reuse.
- .7 Recycle: process by which waste and recyclable materials are transformed or collected for purpose of being transferred into new products.
- .8 Recycling: process of sorting, cleansing, treating and reconstituting solid waste and other discarded materials for purpose of using in altered form. Recycling does not include burning, incinerating, or thermally destroying waste.
- .9 Source Separation: act of keeping different types of waste materials separate beginning from the point they became waste.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Prepare and submit following prior to project start-up one (1) copy and one (1) electronic copy of Waste Source Separation Program (WSSP).
- .3 Prepare and submit on monthly basis, throughout project or at intervals agreed to by Owner and Consultant the following:
 - .1 Receipts, scale tickets, waybills, and/or waste disposal receipts that show quantities and types of materials recycled, or disposed of.
 - .2 Written summary report detailing cumulative amounts of waste materials reused, recycled and landfilled, and brief status of ongoing waste management activities.
- .4 Submit prior to final payment the following:
 - .1 Waste Diversion Report, indicating final quantities by material types salvaged for reuse, recycling or disposal in landfill and recycling centres, re-use depots, landfills and other waste processors that received waste materials.
 - .2 Provide receipts, scale tickets, waybills, waste disposal receipts that confirm quantities and types of materials reused, recycled or disposed of and destination.

1.5 WASTE SOURCE SEPARATION PROGRAM (WSSP)

- .1 As part of Waste Reduction Workplan, prepare WSSP prior to project start-up.
- .2 WSSP will detail methodology and planned on-site activities for separation of reusable and recyclable materials from waste intended for landfill.
- .3 Provide list and drawings of locations that will be made available for sorting, collection, handling and storage of anticipated quantities of reusable and recyclable materials.
- .4 Provide sufficient on-site facilities and containers for collection, handling, and storage of anticipated quantities of reusable and recyclable materials.

- .5 Locate containers to facilitate deposit of materials without hindering daily operations.
- .6 Provide training for [workers] [sub-contractors] [contractor] in handling and separation of materials for reuse and/or recycling.
- .7 Locate separated materials in area which minimizes material damage.
- .8 Clearly and securely label containers to identify types/conditions of materials accepted and assist sub-contractors in separating materials accordingly.
- .9 Monitor on-site waste management activities by conducting periodic site inspections to verify: state of signage, contamination levels, bin locations and condition, personnel participation, use of waste tracking forms and collection of waybills, receipts and invoices.

1.6 USE OF SITE AND FACILITIES

- .1 Execute Work with minimal interference and disturbance to normal use of premises.
- .2 Maintain security measures established by facility provide temporary security measures approved by Owner

1.7 STORAGE, HANDLING AND PROTECTION

- .1 Store, materials to be recycled in locations as directed by Owner or Consultant.
- .2 Unless specified otherwise, materials for removal become Contractor's property.
- .3 Transport and deliver non-salvageable items to licensed disposal facility.
- .4 Protect structural components not removed and salvaged materials from movement or damage.
- .5 Protect surface drainage from damage and blockage.
- .6 Provide on-site facilities and containers for collection and storage of reusable and recyclable materials.
- .7 Separate and store materials produced during project in designated areas.
- .8 Prevent contamination of materials to be recycled and handle materials in accordance with requirements for acceptance by designated processing facilities.
 - .1 On-site source separation is recommended.
 - .2 Remove co-mingled materials to off site processing facility for separation.
 - .3 Obtain waybills, receipts and/or scale tickets for separated materials removed from site.
 - .4 Materials reused on-site are considered to be diverted from landfill and as such are to be included in all reporting.

1.8 DISPOSAL OF WASTES

- .1 Do not bury rubbish or waste materials.

.2 Do not dispose of oil, volatile materials, mineral spirits, paint thinner waste into storm, or sanitary sewers.

.3 Keep records of construction waste including:

.1 Number and size of bins.

.2 Waste type of each bin.

.3 Total tonnage generated.

.4 Tonnage reused or recycled.

.5 Reused or recycled waste destination.

.4 Remove materials on-site as Work progresses.

1.9 SCHEDULING

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

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 APPLICATION

.1 Do Work in compliance with WSSP.

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

3.2 CLEANING

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

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

.3 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

.1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

.2 Source separate materials to be reused/recycled into specified sort areas.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Construction Documents Committee (CCDC) CCDC 2-2008, Stipulated Price Contract.
- .2 Canadian Environmental Protection Act (CEPA): SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Acceptance of Work Procedures:
 - .1 Contractor's Inspection: conduct inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Owner and Consultant in writing of satisfactory completion of Contractor's inspection and submit verification that corrections have been made.
 - .2 Request Consultant's and Owner's inspection.
 - .2 Owner's and Consultant's Inspection:
 - .1 Consultant and Owner to inspect Work and identify defects and deficiencies.
 - .2 Contractor to correct Work as directed.
 - .3 Completion Tasks: submit written certificates that tasks have been performed as follows:
 - .1 Work: completed and inspected for compliance with Contract Documents.
 - .2 Defects: corrected and deficiencies completed.
 - .3 Equipment and systems: tested, adjusted and fully operational.
 - .4 Certificates required by regulatory agencies: submitted.
 - .5 Operation of systems: demonstrated to Owner's personnel.
 - .6 Commissioning of mechanical and electrical systems: completed in accordance with 01 91 13 - General Commissioning (Cx) Requirements and two (2) copies of final Commissioning Report submitted to Consultant and Owner.
 - .7 Aboveground storage tank inspection documentation, registration, forms, in accordance with CEPA SOR/2008-197.
 - .8 Work: complete and ready for final inspection.
 - .4 Final Inspection:
 - .1 When completion tasks are done, request final inspection of Work by Consultant and Owner.
 - .2 When Work incomplete according to Owner or Consultant, complete outstanding items and request re-inspection.

- .5 Declaration of Substantial Performance: when Owner and Consultant considers deficiencies and defects corrected and requirements of Contract substantially performed, make application for Certificate of Substantial Performance.
- .6 Commencement of Lien and Warranty Periods: date of Owner's acceptance of submitted declaration of Substantial Performance to be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .7 Final Payment:
 - .1 When Owner and Consultant considers final deficiencies and defects corrected and requirements of Contract met, make application for final payment.
 - .2 When Work deemed incomplete by Owner or Consultant, complete outstanding items and request re-inspection.
- .8 Payment of Holdback: after issuance of Certificate of Substantial Performance of Work, submit application for payment of holdback amount in accordance with contractual agreement.

1.3 FINAL CLEANING

- .1 Clean in accordance with Section 01 74 11 – Cleaning: Remove surplus materials, excess materials, rubbish, tools and equipment.
- .2 Waste Management: separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Environmental Protection Act (CEPA)
- .1 SOR/2008-197, Storage Tank Systems for Petroleum Products and Allied Petroleum Products Regulations.

1.2 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-warranty Meeting:
 - .1 Convene meeting prior to contract completion with Consultant and Owner Section 01 31 19 - Project Meetings] to:
 - .1 Verify Project requirements.
 - .2 Review warranty requirements.
 - .2 Owner and Consultant to establish communication procedures for:
 - .1 Notifying construction warranty defects.
 - .2 Determine priorities for type of defects.
 - .3 Determine reasonable response time.
 - .3 Contact information for bonded and licensed company for warranty work action: provide name, telephone number and address of company authorized for construction warranty work action.
 - .4 Ensure contact is located within local service area of warranted construction, is continuously available, and is responsive to inquiries for warranty work action.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Owner and Consultant final copies of operating and maintenance manuals in English.
- .3 Provide spare parts, maintenance materials and special tools of same quality and manufacture as products provided in Work.
- .4 Provide evidence, if requested, for type, source and quality of products supplied.

1.4 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf [219 x 279] mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings. Identify contents of each binder on spine.

- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content by systems, under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
- .9 Provide 1:1 scaled CAD files in dxf and dwg format on CD.

1.5 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system: List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.
- .6 Training: refer to Section 01 79 00 - Demonstration and Training.

1.6 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain, in addition to requirements in General Conditions, one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.

- .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Consultant and Owner.

1.7 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Owner.
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 Referenced Standards to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain [field test records,] [manufacturer's certifications,] [inspection certifications,] required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.8 FINAL SURVEY

- .1 Submit final site survey certificate in accordance with Section 01 71 00 - Examination and Preparation, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents.

1.9 EQUIPMENT AND SYSTEMS

- .1 For each item of equipment and each system include description of unit or system, and component parts.
 - .1 Give function, normal operation characteristics and limiting conditions.
 - .2 Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts.
- .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications.
- .3 Include installed colour coded wiring diagrams.
- .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's co-ordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 01 91 13 - General Commissioning (Cx) Requirements and 01 45 00 - Quality Control.
- .15 Aboveground storage tank inspection documentation, registration, forms, decommissioning and removal in accordance with CEPA SOR/2008-197.

- .16 Additional requirements: as specified in individual specification sections.

1.10 MATERIALS AND FINISHES

- .1 Building products, applied materials, and finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and weather-exposed products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional requirements: as specified in individual specifications sections.

1.11 MAINTENANCE MATERIALS

- .1 Spare Parts:
 - .1 Provide spare parts, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to [location as directed] [site] ; place and store.
 - .4 Receive and catalogue items. Submit inventory listing to Owner and Consultant. Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .2 Extra Stock Materials:
 - .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
 - .2 Provide items of same manufacture and quality as items in Work.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.
 - .1 Submit inventory listing to Consultant and Owner
 - .2 Include approved listings in Maintenance Manual.
 - .5 Obtain receipt for delivered products and submit prior to final payment.
- .3 Special Tools:
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue items.

1.12 DELIVERY, STORAGE AND HANDLING

- .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
- .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
- .3 Store components subject to damage from weather in weatherproof enclosures.
- .4 Store paints and freezable materials in a heated and ventilated room.
- .5 Remove and replace damaged products at own expense and for review by Consultant [Departmental Representative] [DCC Representative].

1.13 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Consultant and Owner, for approval.
- .3 Warranty management plan to include required actions and documents to assure that Owner receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Consultant and Owner for approval prior to each monthly pay estimate.
- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within [ten] days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Conduct joint 4 month and 9 month warranty inspection, measured from time of acceptance, by Owner].
- .9 Include information contained in warranty management plan as follows:

- .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
- .2 Listing and status of delivery of Certificates of Warranty for extended warranty items, to include roof, generators, switchgear, commissioned systems, alarm systems, lightning protection system.
- .3 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item
 - .2 Model and serial numbers
 - .3 Location where installed
 - .4 Name and phone numbers of manufacturers or suppliers
 - .5 Names, addresses and telephone numbers of sources of spare parts
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates
 - .7 Cross-reference to warranty certificates as applicable
 - .8 Starting point and duration of warranty period
 - .9 Summary of maintenance procedures required to continue warranty in force
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals
 - .11 Organization, names and phone numbers of persons to call for warranty service
 - .12 Typical response time and repair time expected for various warranted equipment
- .4 Contractor's plans for attendance at 4 and 9 month post-construction warranty inspections.
- .5 Procedure and status of tagging of equipment covered by extended warranties.
- .6 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .10 Respond in timely manner to oral or written notification of required construction warranty repair work.

1.14 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Consultant and Owner.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.

- .2 Model number.
- .3 Serial number.
- .4 Contract number.
- .5 Warranty period.
- .6 Inspector's signature.
- .7 Construction Contractor.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 ADMINISTRATIVE REQUIREMENTS

- .1 Demonstrate operation and scheduled maintenance of equipment and systems to Owner's personnel prior to date of substantial performance.
- .2 Owner: provide list of personnel to receive instructions, and co-ordinate their attendance at agreed-upon times.
- .3 Preparation:
 - .1 Verify conditions for demonstration and instructions comply with requirements.
 - .2 Verify designated personnel are present.
 - .3 Ensure equipment has been inspected and put into operation in accordance with the manufacturers' recommendations.
 - .4 Ensure testing, adjusting, and balancing has been performed and equipment and systems are fully operational.
- .4 Demonstration and Instructions:
 - .1 Demonstrate start-up, operation (in Automatic and Manual modes), control, adjustment, trouble-shooting, servicing, and maintenance of each item of equipment at agreed upon times, at the equipment location.
 - .2 Instruct personnel in phases of operation and maintenance using operation and maintenance manuals as basis of instruction.
 - .3 Review contents of manual in detail to explain aspects of operation and maintenance.
 - .4 Prepare and insert additional data in operations and maintenance manuals when needed during instructions.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit schedule of time and date for demonstration of each item of equipment and each system two weeks prior to designated dates, for Owner and Consultant's approval.
- .3 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .4 Give time and date of each demonstration, with list of persons present.
- .5 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.3 QUALITY ASSURANCE

- .1 When specified in individual Sections requiring manufacturer to provide authorized representative to demonstrate operation of equipment and systems:

- .1 Instruct Owner's personnel.
- .2 Provide written report that demonstration and instructions have been completed.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 General requirements relating to commissioning of project's components and systems, specifying general requirements to PV of components, equipment, sub-systems, systems, and integrated systems.
- .2 Acronyms:
 - .1 AFD - Alternate Forms of Delivery, service provider
 - .2 BMM - Building Management Manual
 - .3 Cx - Commissioning
 - .4 EMCS - Energy Monitoring and Control Systems
 - .5 O&M - Operation and Maintenance
 - .6 PI - Product Information
 - .7 PV - Performance Verification
 - .8 TAB - Testing, Adjusting and Balancing

1.2 GENERAL

- .1 Cx is a planned program of tests, procedures and checks carried out systematically on systems and integrated systems of the finished Project. Cx is performed after systems and integrated systems are completely installed, functional and Contractor's Performance Verification responsibilities have been completed and approved. Objectives:
 - .1 Verify installed equipment, systems and integrated systems operate in accordance with Contract Documents and design criteria and intent.
 - .2 Ensure appropriate documentation is compiled into the BMM.
 - .3 Effectively train O&M staff.
- .2 Contractor assists in Cx process, operating equipment and systems, troubleshooting and making adjustments as required.
 - .1 Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency. Systems to be interactively with each other as intended in accordance with Contract Documents and design criteria.
 - .2 During these checks, adjustments to be made to enhance performance to meet environmental or user requirements.
- .3 Design Criteria: as per client's requirements or determined by designer. To meet Project functional and operational requirements.
- .4 AFD managed projects the term [Consultant] [DCC Representative] [Departmental Representative] in Cx specifications to be interpreted as AFD Service Provider.

1.3 COMMISSIONING OVERVIEW

- .1 Section 01 91 31- Commissioning (Cx) Plan.
- .2 For Cx responsibilities refer to Section 01 91 31- Commissioning (Cx) Plan.
- .3 Cx to be a line item of Contractor's cost breakdown.
- .4 Cx activities supplement field quality and testing procedures described in relevant technical sections.
- .5 Cx is conducted in concert with activities performed during each stage of project delivery. Cx identifies issues in Planning and Design stages which are addressed during Construction and Cx stages to ensure the built facility is constructed and proven to operate satisfactorily under weather, environmental and occupancy conditions to meet functional and operational requirements. Cx activities include transfer of critical knowledge to facility operational personnel.
- .6 Consultant will issue Interim Acceptance Certificate when:
 - .1 Completed Cx documentation has been received, reviewed for suitability and approved by Consultant and.
 - .2 Equipment, components and systems have been commissioned.
 - .3 O&M training has been completed.

1.4 NON-CONFORMANCE TO PERFORMANCE VERIFICATION REQUIREMENTS

- .1 Should equipment, system components, and associated controls be incorrectly installed or malfunction during Cx, correct deficiencies, re-verify equipment and components within the unfunctional system, including related systems as deemed required by Consultant and Owner, to ensure effective performance.
- .2 Costs for corrective work, additional tests, inspections, to determine acceptability and proper performance of such items to be borne by Contractor. Above costs to be in form of progress payment reductions or hold-back assessments.

1.5 PRE-CX REVIEW

- .1 Before Construction:
 - .1 Review Contract Documents and confirm by writing to Owner and Consultant:
 - .1 Adequacy of provisions for Cx.
 - .2 Aspects of design and installation pertinent to success of Cx.
- .2 During Construction: Co-ordinate provision, location and installation of provisions for Cx.
- .3 Before start of Cx:
 - .1 Have completed Cx Plan up-to-date.
 - .2 Ensure installation of related components, equipment, sub-systems, systems is complete.
 - .3 Fully understand Cx requirements and procedures.

- .4 Have Cx documentation shelf-ready.
- .5 Understand completely design criteria and intent and special features.
- .6 Submit complete start-up documentation to Owner and Consultant.
- .7 Have Cx schedules up-to-date.
- .8 Ensure systems have been cleaned thoroughly.
- .9 Complete TAB procedures on systems, submit TAB reports to Consultant and Owner for review and approval.
- .10 Ensure "As-Built" system schematics are available.

- .4 Inform Consultant and Owner in writing of discrepancies and deficiencies on finished works.

1.6 CONFLICTS

- .1 Report conflicts between requirements of this section and other sections to Consultant before start-up and obtain clarification.
- .2 Failure to report conflict and obtain clarification will result in application of most stringent requirement.

1.7 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00- Submittal Procedures.
 - .1 Submit no later than 4 weeks after award of Contract:
 - .1 Name of Contractor's Cx agent.
 - .2 Draft Cx documentation.
 - .3 Preliminary Cx schedule.
 - .2 Request in writing Consultant and Owner for changes to submittals and obtain written approval at least 8 weeks prior to start of Cx.
 - .3 Submit proposed Cx procedures to Consultant and Owner where not specified and obtain written approval at least 8 weeks prior to start of Cx.
 - .4 Provide additional documentation relating to Cx process required by Consultant and Owner.

1.8 COMMISSIONING DOCUMENTATION

- .1 Prepare Commissioning (Cx) Forms including Installation Check Lists and Product Information (PI), Performance Verification (PV) Forms for requirements and instructions for use.
- .2 Owner and Consultant to review and approve Cx documentation.
- .3 Provide completed and approved Cx documentation to Owner and Consultant.

1.9 COMMISSIONING SCHEDULE

- .1 Provide detailed Cx schedule as part of construction schedule.

- .2 Provide adequate time for Cx activities prescribed in technical sections and commissioning sections including:
 - .1 Approval of Cx reports.
 - .2 Verification of reported results.
 - .3 Repairs, retesting, re-commissioning, re-verification.
 - .4 Training.

1.10 COMMISSIONING MEETINGS

- .1 Convene Cx meetings following project meetings as specified herein.
- .2 Purpose: to resolve issues, monitor progress, identify deficiencies, relating to Cx.
- .3 Continue Cx meetings on regular basis until commissioning deliverables have been addressed.
- .4 At 60% construction completion stage. Owner and Consultant to call a separate Cx scope meeting to review progress, discuss schedule of equipment start-up activities and prepare for Cx. Issues at meeting to include:
 - .1 Review duties and responsibilities of Contractor and subcontractors, addressing delays and potential problems.
 - .2 Determine the degree of involvement of trades and manufacturer's representatives in the commissioning process.
- .5 Thereafter Cx meetings to be held until project completion and as required during equipment start-up and functional testing period.
- .6 Meeting will be chaired by Contractor, who will record and distribute minutes.
- .7 Ensure subcontractors and relevant manufacturer representatives are present at 60% and subsequent Cx meetings and as required.

1.11 STARTING AND TESTING

- .1 Contractor assumes liabilities and costs for inspections. Including disassembly and re-assembly after approval, starting, testing and adjusting, including supply of testing equipment.

1.12 WITNESSING OF STARTING AND TESTING

- .1 Provide 14 days notice prior to commencement.
- .2 Consultant and Owner to witness of start-up and testing.
- .3 Contractor's Cx Agent (if any) to be present at tests performed and documented by sub-trades, suppliers and equipment manufacturers.

1.13 MANUFACTURER'S INVOLVEMENT

- .1 Factory testing - Manufacturer to:

- .1 Coordinate time and location of testing.
- .2 Provide testing documentation for approval by Owner and Consultant
- .3 Arrange for Owner and Consultant to witness tests.
- .4 Obtain written approval of test results and documentation from Owner and Consultant before delivery to site.
- .2 Obtain manufacturers installation, start-up and operations instructions prior to start-up of components, equipment and systems and review with Owner and Consultant
 - .1 Compare completed installation with manufacturer's published data, record discrepancies, and review with manufacturer.
 - .2 Modify procedures detrimental to equipment performance and review same with manufacturer before start-up.
- .3 Integrity of warranties:
 - .1 Use manufacturer's trained start-up personnel where specified elsewhere in other divisions or required to maintain integrity of warranty.
 - .2 Verify with manufacturer that testing as specified will not void warranties.
- .4 Qualifications of manufacturer's personnel:
 - .1 Experienced in design, installation and operation of equipment and systems.
 - .2 Ability to interpret test results accurately.
 - .3 To report results in clear, concise, logical manner.

1.14 PROCEDURES

- .1 Verify that equipment and systems are complete, clean, and operating in normal and safe manner prior to conducting start-up, testing and Cx.
- .2 Conduct start-up and testing in following distinct phases:
 - .1 Included in delivery and installation:
 - .1 Verification of conformity to specification, approved shop drawings and completion of PI report forms.
 - .2 Visual inspection of quality of installation.
 - .2 Start-up: follow accepted start-up procedures.
 - .3 Operational testing: document equipment performance.
 - .4 System PV: include repetition of tests after correcting deficiencies.
 - .5 Post-substantial performance verification: to include fine-tuning.
- .3 Correct deficiencies and obtain approval from Consultant and Owner after distinct phases have been completed and before commencing next phase.
- .4 Document require tests on approved PV forms.
- .5 Failure to follow accepted start-up procedures will result in re-evaluation of equipment by an independent testing agency selected by Owner or Consultant. If results reveal that equipment

start-up was not in accordance with requirements, and resulted in damage to equipment, implement following:

- .1 Minor equipment/systems: implement corrective measures approved by Consultant.
- .2 Major equipment/systems: if evaluation report concludes that damage is minor, implement corrective measures approved by Consultant.
- .3 If evaluation report concludes that major damage has occurred, Owner and/or Consultant shall reject equipment.
 - .1 Rejected equipment to be remove from site and replace with new.
 - .2 Subject new equipment/systems to specified start-up procedures.

1.15 START-UP DOCUMENTATION

- .1 Assemble start-up documentation and submit to Consultant and Owner for approval before commencement of commissioning.
- .2 Start-up documentation to include:
 - .1 Factory and on-site test certificates for specified equipment.
 - .2 Pre-start-up inspection reports.
 - .3 Signed installation/start-up check lists.
 - .4 Start-up reports,
 - .5 Step-by-step description of complete start-up procedures, to permit Consultant and Owner to repeat start-up at any time.

1.16 OPERATION AND MAINTENANCE OF EQUIPMENT AND SYSTEMS

- .1 After start-up, operate and maintain equipment and systems as directed by equipment/system manufacturer.
- .2 With assistance of manufacturer develop written maintenance program and submit to Consultant for approval before implementation.
- .3 Operate and maintain systems for length of time required for commissioning to be completed.
- .4 After completion of commissioning, operate and maintain systems until issuance of certificate of interim acceptance.

1.17 TEST RESULTS

- .1 If start-up, testing and/or PV produce unacceptable results, repair, replace or repeat specified starting and/or PV procedures until acceptable results are achieved.
- .2 Provide manpower and materials, assume costs for re-commissioning.

1.18 START OF COMMISSIONING

- .1 Notify Owner and Consultant at least 21 days prior to start of Cx.
- .2 Start Cx after elements of building affecting start-up and performance verification of systems have been completed.

1.19 COMMISSIONING PERFORMANCE VERIFICATION

- .1 Carry out Cx:
 - .1 Under accepted simulated operating conditions, over entire operating range, in all modes.
 - .2 On independent systems and interacting systems.
- .2 Cx procedures to be repeatable and reported results are to be verifiable.
- .3 Follow equipment manufacturer's operating instructions.

1.20 WITNESSING COMMISSIONING

- .1 Consultant to witness activities and verify results.

1.21 AUTHORITIES HAVING JURISDICTION

- .1 Where specified start-up, testing or commissioning procedures duplicate verification requirements of authority having jurisdiction, arrange for authority to witness procedures so as to avoid duplication of tests and to facilitate expedient acceptance of facility.
- .2 Obtain certificates of approval, acceptance and compliance with rules and regulation of authority having jurisdiction.
- .3 Provide copies to Owner and Consultant within 5days of test and with Cx report.

1.22 EXTRAPOLATION OF RESULTS

- .1 Where Cx of weather, occupancy, or seasonal-sensitive equipment or systems cannot be conducted under near-rated or near-design conditions, extrapolate part-load results to design conditions when approved by Consultant, in accordance with equipment manufacturer's instructions, using manufacturer's data, with manufacturer's assistance and using approved formulae.

1.23 EXTENT OF VERIFICATION

- .1 Provide manpower and instrumentation to verify up to 30% of reported results, unless specified otherwise in other sections.
- .2 Number and location to be at discretion of Owner and Consultant.
- .3 Conduct tests repeated during verification under same conditions as original tests, using same test equipment, instrumentation.
- .4 Review and repeat commissioning of systems if inconsistencies found in more than 20% of reported results.
- .5 Perform additional commissioning until results are acceptable to Owner and Consultant.

1.24 REPEAT VERIFICATIONS

- .1 Assume costs incurred by Consultant and/or Owner for third and subsequent verifications where:

- .1 Verification of reported results fail to receive Owner and Consultant's approval.
- .2 Repetition of second verification again fails to receive approval.
- .3 Consultant or Owner deems Contractor's request for second verification was premature.

1.25 SUNDRY CHECKS AND ADJUSTMENTS

- .1 Make adjustments and changes which become apparent as Cx proceeds.
- .2 Perform static and operational checks as applicable and as required.

1.26 DEFICIENCIES, FAULTS, DEFECTS

- .1 Correct deficiencies found during start-up and Cx to satisfaction of Consultant and Owner.
- .2 Report problems, faults or defects affecting Cx to Consultant and Owner in writing. Stop Cx until problems are rectified. Proceed with written approval from Owner or Consultant.

1.27 COMPLETION OF COMMISSIONING

- .1 Upon completion of Cx leave systems in normal operating mode.
- .2 Except for warranty and seasonal verification activities specified in Cx specifications, complete Cx prior to issuance of Interim Certificate of Completion.
- .3 Cx to be considered complete when contract Cx deliverables have been submitted and accepted by Owner and Consultant.

1.28 ACTIVITIES UPON COMPLETION OF COMMISSIONING

- .1 When changes are made to baseline components or system settings established during Cx process, provide updated Cx form for affected item.

1.29 TRAINING

- .1 In accordance with Section 01 79 00 – Demonstration and Training.

1.30 MAINTENANCE MATERIALS, SPARE PARTS, SPECIAL TOOLS

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

1.31 OCCUPANCY

- .1 Cooperate fully with Owner and Consultant during all stages of acceptance and occupancy of facility.

1.32 OWNER'S PERFORMANCE TESTING

- .1 Performance testing of equipment or system by Owner or Consultant will not relieve Contractor from compliance with specified start-up and testing procedures.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This section specifies the requirements for the supply, installation and maintenance of silt fence barriers, and catchbasin cover in accordance with the guidelines outlined below in areas as necessary prior to commencing excavation operations.

1.2 RELATED SECTIONS

- .1 General Site Work..... Section 31 00 00
- .2 Site Preparation Section 31 11 00
- .3 Clearing and Grubbing..... Section 31 11 00.01
- .4 Dust Control Section 32 15 60

1.3 REFERENCES

- .1 Occupational Health & Safety Act and Regulations for Construction Projects.
- .2 Ontario Provincial Standard Specification (OPSS):
 - .1 OPSS.MUNI 805, latest revision, "Temporary Erosion and Sediment Control Measures".
 - .2 OPSS.MUNI 1860, latest revision, "Geotextiles".

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 The silt fence fabric shall be filter fabric geotextile – TerraFix 270R or approved equivalent.
- .2 The stakes shall be of sufficient strength to satisfy silt fence barrier performance and maintenance requirements. The stakes shall be a minimum of 2.1 metres in length with a maximum spacing of 2.4 metres between stakes.
- .3 Catchbasin cover shall be TerraFix 270R filter cloth or equivalent set under grates on all catchbasins.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Silt fence barrier:
 - .1 The Contractor shall install silt fence as necessary to prevent sediment from passing from one side of the barrier to the other.
 - .2 Posts shall be spaced a maximum of 2.4m apart, and shall be driven vertically into the ground to a minimum of 900mm.

- .3 A trench measuring approximately 300mm wide by 300mm deep shall be excavated along the entire line of stakes. The trench shall be on the side of the stakes where grading work is to be conducted.
- .4 The geotextile from the silt fence shall extend into the trench a minimum of 300mm. The prefabricated silt fence shall be installed without sags and have an overlap of 450mm wherever its length is extended.
- .5 The trench should be backfilled and tamped to existing grade so as to hold the base of the geotextile firmly in place. The completed silt fence barrier shall have a minimum height of 1200mm above the ground surface.
- .2 Catchbasin Cover:
 - .1 Place TerraFix 270R filter cloth or equivalent under grates on all catchbasins to trap sediment.

3.2 MAINTENANCE

- .1 All silt fences shall be inspected immediately after runoff event and at least daily during prolonged rainfall. Any required repairs shall be made immediately. The silt fence barriers shall be maintained in place, without gaps and without undermining, so as to prevent sediment passage through or under barrier. Silt fence barriers shall be maintained vertical without tears and without sagging and maintain a 450 mm overlap on seams.
- .2 Accumulated sediment shall be removed at the direction of the Consultant in a manner that avoids escape to the downstream side of the barriers. Sediment shall be removed to the level of the grade existing at the time of barrier installation and shall conform to the following:
 - .1 Accumulated sediment shall be removed when it reaches a depth of one-half the height of the silt fence barrier.
 - .2 Accumulated sediment shall be removed as necessary to perform maintenance repairs.
 - .3 Accumulated sediment shall be removed immediately prior to the removal of the silt fence.
 - .4 All collected sediments to be disposed of at an approved location.

3.3 REMOVAL

- .1 Silt fence barriers and catchbasin cover shall be removed when, in the opinion of the Consultant, the measure is no longer required. Area disturbed by the installation and removal shall be restored to the original grade or to the satisfaction of the Consultant and sodded.

END OF SECTION

PART 1 - GENERAL

1.1 RESTRICTIONS ON CONSTRUCTION OPERATIONS

- .1 The Contractor shall be responsible for the provision of traffic control during construction.
- .2 The Contractor shall be responsible for all short duration, construction signage for the implementation of the various construction stages. The Contractor will also be responsible for maintaining signage during each work stage and for relocating signs and delineators to suit working stages.
- .3 The Contractor shall observe all necessary precautions and shall provide and maintain signs and barricades to protect all persons from injury during the progress of the work.
- .4 Prior to construction, the Contractor shall obtain all utility locates.
- .5 During construction, the Contractor shall be responsible for protecting all utilities. Repair to any damaged utility plant shall be the Contractor's responsibility.

1.2 PROTECTION OF PUBLIC

- .1 The Contractor shall comply with the requirements of all applicable Acts, Regulations and By-laws in force for the protection of the public in the affected jurisdictions where it is necessary to carry out work or haul materials or equipment and shall keep ways of access/egress, adjacent roadways and parking lots free of dirt and debris resulting from the construction operation.

1.3 INFORMAL AND WARNING DEVICES

- .1 Provide and maintain signs and other devices required to indicate construction activities or other temporary and unusual conditions resulting from project work which may require public response.
- .2 Prepare a list of signs and other devices required for the project and submit same to Consultant for review prior to commencement of the work.

1.4 GEOTECHNICAL

- .1 Scope of Work:
 - .1 Geotechnical (soils, granular) testing shall be carried out by geotechnical engineer, approved by the Consultant. Payment shall from the Base Bid Price.
 - .2 Geotechnical (asphalts & concrete) testing shall be carried out by a geotechnical engineer, approved by the Consultant. Payment shall be made from the Base Bid Price.
 - .3 Any on-site soils encountered by the Contractor that are suspected as being contaminated shall be brought to the attention of the Consultant for testing, prior to its removal from the site.

1.5 MOBILIZATION AND DEMOBILIZATION

- .1 The scope of work for the above item includes:
 - .1 All preparatory work within and outside the work areas;
 - .2 Security on site to guard all materials, tools, equipment, offices, vehicles and installations, as necessary;
 - .3 The supply and transportation of all required materials, equipment and labour;
 - .4 Restoration of the natural areas and temporary work zones to their original condition to the satisfaction of the Owner and Consultant;
 - .5 Payment for permits will be obtained by the Contractor;
 - .6 All costs associated with obtaining bonds and insurance coverage, and, all other costs, including administrative costs, which are not directly associated with the execution of items specified in the Form of Tender.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not Used

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This Section specifies the requirements for removal of excess materials as required for the work indicated on the Contract Drawings, including the requirements for excavation, backfilling of resulting trenches holes or pits.

1.2 RELATED WORK

- .1 Erosion and Sediment Control.....Section 01 57 13
- .2 General Site Work.....Section 31 00 00
- .3 Clearing and Grubbing.....Section 31 11 00.01

1.3 REFERENCES

- .1 Ontario Provincial Standard Specifications and Ontario Provincial Standard Drawings
- .2 Environmental Protection Act, Regulation 153, Records of Site Condition
- .3 Environmental Protection Act, Regulation 347, General Waste Management

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Contractor to inspect site and verify with Consultant items designated for removal and items to be preserved.
- .2 Locate and protect all utility lines. Preserve in operating condition active utilities traversing the site.
- .3 Notify and obtain approvals from all agencies prior to commencing work.
- .4 Contractor to maintain vehicle traffic in all stages of work.

3.2 PROTECTION

- .1 Existing buried utilities and structures
 - .1 Confirm locations of buried utilities
 - .2 Maintain and protect from danger, water, sewer, gas, electric, telephone and other utilities and structures encountered.

- .2 Existing building and surface features:
 - .1 Protect existing buildings and surface features which may be affected by the work from damage while work is in progress and repair damage resulting from the work.
 - .2 Where excavation necessitates root or branch cutting, perform work in accordance with the landscape specifications.
- .3 Protect work in progress or completed and protect existing properties, stored products, services, utilities, trees, landscaping and natural features from damage.
- .4 Keep roads clear of debris and dirt resulting from work of this section to acceptance of Governmental Authorities having jurisdiction.

3.3 BACKFILL

- .1 Backfill in accordance with Sections 31 23 33 and 32 11 16.

3.4 DISPOSAL OF WASTE AND SURPLUS MATERIAL

- .1 Remove excess excavated material from the site, except material approved to be reused, at appropriate on-site locations.
- .2 The excess soil and fill material shall be disposed of at MECP approved soil treatment site, waste disposal site or any other appropriate disposal site meeting applicable regulations for excess soil and fill material disposal. Identify and propose an off-site disposal option or disposal facility meeting all applicable and current regulations for excess soil and fill material disposal.
- .3 Obtain all regulatory approvals, permits and any other requirements for off-site disposal. This includes requirements for all additional testing, such as any chemical analysis required by the current MECP guideline and Ontario Regulation 347.
- .4 Remove from site, waste and surplus materials resulting from site preparation work in accordance with authorities having jurisdiction.

3.5 RESTORATION

- .1 Leave site clean upon completion of work.
- .2 Reinstate areas and existing works outside areas of demolition to conditions that existed prior to commencement of work.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This section includes labour, materials, and equipment for completion of Excavation, Trenching, Backfill, and compaction to accommodate underground storm sewer system installation.
- .2 Compaction methods and material specifications for such work are also detailed in this Section.

1.2 RELATED SECTIONS

- .1 Erosion and Sediment Control.....Section 01 57 13
- .2 General Site Work.....Section 31 00 00
- .3 Soil Stripping & Stockpiling.....Section 31 14 13
- .4 Granular Base and Subbase.....Section 32 11 16
- .5 Dust Control.....Section 32 15 60
- .6 Storm Sewers.....Section 33 41 13
- .7 Catchbasin.....Section 33 49 13

1.3 REFERENCES

- .1 Occupational Health & Safety Act and Regulations for Construction Projects.
- .2 Construction Safety Association of Ontario, Trenching Safety – Introduction to Trenching Hazards, 1999.
- .3 CAN/CSA-A23.1-04, Concrete Materials and Methods of Concrete Construction.
- .4 Ontario Provincial Standard Specification (OPSS):
 - .1 OPSS.MUNI 501, latest revision, “Compacting”.
 - .2 OPSS.MUNI 401, latest revision. “Trenching, Backfilling, Compaction”.
 - .3 OPSS.MUNI 1010, latest revision, “Material Specification for Aggregates – Base, Subbase, Select Subgrade and Backfill Materials”.
 - .4 OPSS.MUNI 1359, latest revision, “Material Specification for Unshrinkable Backfill”.
- .5 American Society for Testing and Materials ASTM D422, latest revision, “Standard Test Method for Particle-Size Analysis of Soils”.
- .6 American Society for Testing and Materials ASTM D698, latest revision, “Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort”.

- .7 American Society for Testing and Materials ASTM D4253, latest revision, "Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table".

1.4 SUBMITTALS

- .1 Submit shop drawings for temporary shoring design and erection.
- .2 Shop drawings will include material grades, core thicknesses, connections, joints, method of anchorage, number of anchors, supports, details and accessories.
- .3 Ensure shop drawings are of uniform size and based on field measurements.
- .4 Shop drawings shall bear the stamp of a qualified professional engineer registered in the Province of Ontario.
- .5 The Consultant review of the shop drawings will be for member structural strength and material only and will not be reviewed for structural strength design, the responsibility for which shall remain with the designer whose stamp appears on the shop drawings.

1.5 QUALITY ASSURANCE AND TESTING

- .1 Ensuring proper compaction techniques and adherence to the required densities will be the responsibility of the Contractor. Consultant shall appoint an independent testing company and payment shall be made from the Base Bid Price for checking and approval of the placement and compaction of granular materials. The Contractor will be responsible for payment of all costs associated with re-testing of materials if corrective actions are required to restore defective areas. The Contractor is required to coordinate with the Consultant and the testing company to ensure at least two (2) business days notice is given prior to placement and compaction of granular materials.

1.6 PROTECTION

- .1 Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are assumed, not guaranteed. The Contractor is responsible for location of all underground utilities, piping, abandoned services, etc.
- .2 Prior to commencing excavation work, notify applicable owner or authorities having jurisdiction, establish location and state of use of buried utilities and structures. Confirm locations of buried utilities by careful test excavations.
- .3 Maintain and protect from damage, water, sewer, gas, electric, communication and other utilities and structures encountered as indicated.
- .4 Where utility lines or structures exist in area of excavation obtain direction of Consultant before removing or rerouting.
- .5 Protect existing buildings and surface features which may be affected by Work from damage while Work is in progress. Provide shoring, designed by a Professional Engineer, as required for structures that may be affected by the Work. In event of damage, immediately make repair suitable to Consultant.

- .6 Erect necessary hoarding, fencing, guardrails, markers; place temporary warning lights; and take all other precautions to ensure that no damage or injury is caused to persons or property as a result of this Work.
- .7 Protect trenches or any open excavations, maintaining warning devices during construction and periods of inactivity.
- .8 Protect the work of other trades or other Contractors working at the Site as well as Owner's existing property, stored products, services, and utilities.
- .9 Record location of maintained or re-routed and abandoned underground lines for record keeping purposes, and transposing to the as-built version of the Contract Drawings.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Backfill shall conform to OPSS.MUNI 401, Granular B or select native to a minimum 98% SPMD.
- .2 Pipe Bedding shall be Granular A material conforming to OPSS.MUNI 1010 and OPSS.MUNI 401, placed beneath and above pipe in accordance with the Contract Documents. Gradation to be within the limits specified when tested to ASTM C136 and ASTM C117.
- .3 Unshrinkable Fill, if required, shall be a very weak mixture of Portland cement, concrete aggregate, and water to 0.7 MPa strength such that the mix resists settlement when placed in trenches, but can be readily excavated if required.
- .4 Embankment materials require approval by the Consultant.
- .5 Material used for embankment not to contain organic matter, frozen lumps, weeds, sod, roots, logs, stumps or any other unsuitable material.

2.2 COMPACTION EQUIPMENT

- .1 Compaction equipment must be capable of obtaining required densities in materials on project.

PART 3 - EXECUTION

3.1 PREPARATION AND LAYOUT

- .1 Establish extent of excavation.
- .2 Set out all lines and levels as indicated in Contract Documents or as directed by the Consultant required for proper excavation.
- .3 Maintain benchmarks, monuments and other reference points. Re-establish if disturbed or destroyed at no additional cost to the Owner.

- .4 Dust control shall be applied by the contractor as required and/or when directed to do so by the Consultant. Dust suppressant materials shall be utilized as specified in Section 32 15 60, Dust Control.

- .5 Erosion control as specified in Section 01 57 13 is the responsibility of the Contractor.

3.2 UTILITIES

- .1 Prior to commencement of excavation work, establish location and extent of all underground utilities occurring in work area. Inform consultant immediately of any discrepancy from the information regarding utilities in the drawings provided.
- .2 Maintain, re-route or extend as required existing utility lines which pass through work area and which must remain. Pay all costs for this work.
- .3 Protect utility services uncovered by excavation.
- .4 Remove abandoned utility service lines encountered from areas of construction. Cap, plug or seal such lines and identify at grade with markers.
- .5 Accurately locate and record abandoned and active utility line re-routed or extended on as-built Contract Documents.

3.3 DEWATERING AND HEAVE PREVENTION

- .1 Keep excavations free of water while work is in progress.
- .2 Submit for Consultant's approval details of the proposed dewatering or heave prevention methods such as temporary sumps, pumping, dikes, well points, or any other means.
- .3 Protect open excavations against flooding and damage due to surface run-off.
- .4 Dispose of excess water in a manner not detrimental to public and private property, or any portion of work completed or under construction.

3.4 TRENCHING AND EXCAVATION

- .1 Excavate to lines, grades and dimensions as indicated on the Contract Documents.
- .2 For trench excavation, unless otherwise authorized by Consultant in writing, do not excavate more than 30 m of trench in advance of installation operations and do not leave open more than 15 m at end of day's operation.
- .3 Keep width of trenches to a minimum to ensure minimum loading on buried pipes.
- .4 Dispose of surplus and unsuitable excavated material offsite, at a licensed, approved facility in accordance with the authority having jurisdiction.
- .5 Do not obstruct flow of surface drainage or natural watercourses.
- .6 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft or organic matter. Remove unsuitable material from trench bottom to extent and depth as directed by Consultant.

- .7 Notify Consultant when bottom of excavation is reached. During trenching or excavation ensure that side slopes of the excavation are stable, with a minimum of 1H : 1V slope, unless directed otherwise by the Consultant. Alternatively, trench boxes or shoring may be used to prevent collapse provided that plans and specifications are signed and sealed by a Professional Engineer, licensed in the Province of Ontario, and experienced in design of earth retaining systems.
- .8 Where required due to unauthorized over-excavation, correct as directed onsite by the Consultant. Fill under future paved and unpaved areas with material as shown on the drawings and details, and compact to as outlined in the contract documents.
- .9 Hand excavate or "Hydrovac" excavate, using a non-destructive tools, in any location that is near or adjacent to existing underground services, structures, etc.
- .10 Excess material resulting from trenching and excavation may be re-used as select fill provided it meets or exceeds the requirements of select fill and if approved by the Consultant. Any material that is not approved for re-use shall be treated as non-hazardous solid waste and transported and disposed of at an approved waste disposal facility, in accordance with the authorities having jurisdiction.

3.5 BEDDING AND MATERIAL SURROUNDING OF UNDERGROUND SERVICES

- .1 Place and compact indicated granular bedding material for bedding underground services, piping, cables, structures, etc. to a minimum thickness of 150 mm.
- .2 Place and compact indicated granular material around pipes to a minimum thickness of 300 mm above top of pipe, in accordance with the contract drawings and details.

3.6 EMBANKMENTS

- .1 Bench slopes greater than 4:1 or where shown on the drawings, to ensure proper bond between new materials and existing surfaces. Obtain prior approval from the Consultant of method to be used.
- .2 Scarify slopes of 4:1 and flatter 200 mm deep, after topsoil stripping, unless otherwise indicated on the drawings.
- .3 Break up or scarify existing pavement to sub-grade elevation as indicated.
- .4 Do not place material which is frozen nor place material on frozen surfaces.
- .5 Maintain crowned surface during construction to ensure ready run-off of surface water. Do not place material in free standing water.
- .6 Place and compact to full width in uniform layers not exceeding 200 mm loose thickness. The Consultant may authorize thicker lifts if specified compaction can be achieved.
- .7 Compact to density of not less than 95% maximum dry density in accordance with ASTM D698.
- .8 Bring moisture content of soil to level required to achieve specified compaction. Add water or aerate as required.

3.7 SUBGRADE COMPACTION

- .1 After grading has been completed, scarify and mix subgrade surface to a depth of 200 mm unless otherwise shown on the drawings.
- .2 Remove unsuitable materials found during work. Replace with material approved by the Consultant.
- .3 Compact top 200 mm of subgrade soil to at least 100% maximum density to ASTM D 698.
- .4 Bring moisture content of soil to level required to achieve specified compaction. Add water or aerate as required.

3.8 PROOF ROLLING OF SUBGRADE

- .1 Proof roll subgrade using standard roller of 45400 kg gross mass with four pneumatic tires each carrying 11350 kg and inflated to 620 kPa. Four tires arranged abreast with centre to centre spacing of 730 mm.
- .2 If use of non standard proof rolling equipment is approved, Consultant to determine level of proof rolling.
- .3 Make sufficient passes with proof roller to subject every point on surface to three separate passes of loaded tire.
- .4 Where proof rolling reveals areas of defective subgrade reconstruct the defective work and repeat proof rolling.

3.9 BACKFILLING AND COMPACTION

- .1 Do not proceed with backfilling operations until Consultant has inspected and approved installations.
- .2 Areas to be backfilled to be free from debris, snow, ice, water and frozen materials.
- .3 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades indicated. Compact each layer before placing succeeding layer.
- .4 Place backfill uniformly and simultaneously on each side of pipe.
- .5 Backfill areas must be compacted to 98% SPMDD.

3.10 RESTORATION

- .1 Upon completion of the Work, immediately remove and dispose of waste materials and debris, replace topsoil, trim slopes, and correct defects as directed by Consultant.
- .2 Clean and reinstate areas affected by work as directed by Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 Supply, place, shape, adjust water content and compact Granular Subbase and Base.

1.2 RELATED WORK

- .1 Erosion and Sedimentation Control.....Section 01 57 13
- .2 General Site Work.....Section 31 00 00
- .3 Site Preparation.....Section 31 11 00
- .4 Excavation Trenching And Backfilling.....Section 31 23 33
- .5 Dust Control.....Section 32 15 60

1.3 COORDINATE WITH OTHERS

- .1 Coordinate and schedule work with the Owner.

1.4 REFERENCES

- .1 Ontario Provincial Standard Specification OPSS.MUNI 314, latest revision, "Construction Specification for Untreated Granular, Subbase, Base, Surface Shoulder and Stockpiling".
- .2 Ontario Provincial Standard Specification OPSS.MUNI 501, latest revision, "Compacting".
- .3 Ontario Provincial Standard Specification OPSS.MUNI 1001, latest revision, "Aggregates - General".
- .4 Ontario Provincial Standard Specification OPSS.MUNI 1010, latest revision, "Aggregates – Base, Subbase, Select Subgrade and Backfill Material".

PART 2 - PRODUCTS

2.1 SUBBASE – GRANULAR "B"

- .1 Granular Subbase materials shall be Granular "B" Type II conforming to OPSS.MUNI 1010 composed of clean, hard, durable uncoated particles obtained from crushed quarried rock, except that 100% of the material shall pass the 50 mm sieve and not contain any slag or asphalt products.

2.2 BASE – GRANULAR "A"

- .1 Granular "A", conforming to OPSS.MUNI 1010, composed of only clean, hard, durable, uncoated particles obtained from crushed quarried rock, and not containing any reclaimed asphalt.

PART 3 - EXECUTION

3.1 PLACING

- .1 Supply, place, shape and compact Granular Subbase as indicated in the Contract Documents in conformance with OPSS.MUNI 314, except where the following requirements specify otherwise:
 - .1 Supply and place in lifts not exceeding 150 mm compacted thickness.
 - .2 Do not mix Granular Subbase or base course with underlying materials.
 - .3 Scarify and air-dry excess moisture or add and mix water as required to obtain the specified soil density. Control watering and rolling to prevent pumping of fines to the surface.
 - .4 Compact Granular Subbase to a dense, uniform condition, free from ruts or excess deflection under construction traffic. Compact in accordance with OPSS.MUNI 501, Method A.
 - .5 Shape the surface to the lines and grades specified.
- .2 Supply, place, shape and compact Granular base as indicated in the Contract Documents in conformance with OPSS.MUNI 314 and in the above mentioned specifications, except where the following requirements specify otherwise:
 - .1 Supply and place in lifts not exceeding 150 mm compacted thicknesses.
 - .2 Do not mix Granular Base course with underlying materials.
 - .3 Scarify and air-dry excess moisture or add and mix water as required to obtain the specified soil density. Watering and rolling must be controlled to prevent pumping of fines to the surface.
 - .4 Shape the surfaces to the lines and grades specified. Finished surface shall be free of any ruts or irregularities. The finished surface shall be free from depressions exceeding 10 mm as measured in any direction with a 3.0 meter straight edge.
 - .5 To prepare for placement of granular base, the completed subbase shall be shaped and smoothed to within ± 25 mm of design elevations and shall, on average, meet the lines and grades specified in the Contract Documents.
 - .6 Compact Granular Base to 100% Standard Proctor Maximum Dry Density.
 - .7 The final granular base elevations shall meet the approval of the Consultant prior to placement of the asphalt.
 - .8 Repair failures in compacted Granular Base course at Contractor's expense.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 Supply, place and compact Hot Mix Asphalt Concrete Pavement to lines, grades and sections indicated in the Contract Documents. Prepare existing surfaces for asphalt placement.

1.2 COORDINATE WITH OTHERS

- .1 Provide the Consultant with 24 hours prior notice before starting Hot Mix Asphalt Concrete Pavement.

1.3 RELATED SECTIONS

- .1 General Site Work.....Section 31 00 00
- .2 Site Preparation.....Section 31 11 00
- .3 Excavation Trenching And Backfilling.....Section 31 23 33
- .4 Dust Control.....Section 32 15 60
- .5 Granular Base and Subbase.....Section 32 11 16

1.4 REFERENCES

- .1 Ontario Provincial Standard Specification (OPSS):
 - .1 OPSS.MUNI 310, latest revision, "Construction Specification for Hot Mix Asphalt".
 - .2 OPSS.MUNI 1001, latest revision, "Material Specification for Aggregates - General".
 - .3 OPSS.MUNI 1003, latest revision, "Material Specification for Aggregates - Hot Mix Asphalt".
 - .4 OPSS.MUNI 1150, latest revision, "Material Specification for Hot Mix Asphalt".
- .2 CAN/CGSB-16.3-M90, "Asphalt Cements for Road Purposes".

PART 2 - PRODUCTS

2.1 ASPHALT CEMENT

- .1 Asphalt cement to be PG 58-28 grade, conforming to CAN/CGSB-16.3-M90.
- .2 Aggregate shall conform to OPSS.MUNI 1003 for HL3 and HL8 mixes, subject to the following exceptions, modifications and additions:
- .3 Steel slag, iron blast furnace slag, nickel and copper slag are not accepted for use as aggregate;

- .4 Reclaimed asphalt pavement and reclaimed Portland cement concrete are not accepted for use as aggregate;
- .5 Fine aggregate shall consist of a combination of crushed particles manufactured by crushing bedrock material and natural blending sand. The natural blending sand shall not exceed 10% of the total weight of the aggregate;
- .6 Hot Mix Asphalt Concrete mix design shall be the responsibility of the Contractor and shall conform to OPSS.MUNI 1150. Contractor to submit to the Consultant, for approval, the mix designs a minimum 10 days prior to commencing with paving operations.

2.2 TACK COAT

- .1 Tack coat to comply with OPSS.MUNI 310.

2.3 JOINT SEALER

- .1 Joint sealer shall be rubberized asphalt conforming to ASTM D3405.
- .2 Joint sealer shall be SafeSeal 3405 by W.R. Meadows, or approved equivalent.

2.4 EQUIPMENT

- .1 Pavers: mechanical, self-powered, pavers capable of spreading mix within specified tolerances, true to line, grade and crown indicated.
- .2 Rollers: sufficient number of rollers of type and weight to obtain specified density of compacted mix.
- .3 Equipment employed shall not cause overloading of structures. Temporary support shall be provided where necessary for the proper execution of the work.
- .4 Vibratory rollers for parking lots:
 - .1 Minimum drum diameter: 750 mm.
 - .2 Maximum amplitude of vibration (machine setting): 0.5 mm for lifts less than 40 mm thick.
 - .3 At least one steel wheel roller, minimum 20,000 lbs (9,000 kg).
- .5 Haul trucks: of sufficient number and of adequate size, speed and condition to ensure orderly and continuous operation and as follows:
 - .1 Boxes with tight metal bottoms.
 - .2 Covers of sufficient size and weight to completely cover and protect asphalt mix when truck fully loaded.
- .6 Suitable hand tools.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Produce and Supply Hot Mixed, Hot Laid Asphaltic Concrete in accordance with OPSS.MUNI 1150, except where the following requirements specify otherwise:
 - .1 Provide plant to consistently produce the designed Hot Mix Asphalt Concrete mixture.
 - .2 Supply asphalt binder and aggregate materials.
 - .3 Clean truck boxes of all accumulations of bituminous mix and foreign materials. The inside surface of all truck boxes used for hauling asphalt concrete mix shall be sprayed with soap solution prior to loading, but excess of lubrication will not be permitted. The use of gasoline, kerosene or similar products will not be permitted.
 - .4 Maintain asphalt concrete mix temperature at a depth of 80 mm below surface and prior to unloading into the paving machine at not less than 120°C for the 85-100 asphalt cement binder.
 - .5 Do not turn trucks at points where damage may be caused to the surface of the recently constructed pavement structure.
 - .6 Remove loose dirt or other objectionable material from the surface to be paved by brooming and other methods before the asphalt concrete mix is spread.
- .2 Place and Compact Hot Mixed, Hot Laid Asphaltic Concrete in accordance with OPSS.MUNI 310, except where the following requirements specify otherwise:
 - .1 Place asphalt concrete on dry surfaces only, after tack coating.
 - .2 Place asphalt concrete mix by a self-propelled paving machine(s). The paving machine(s) shall be equipped with automatic screed controls for the control of longitudinal and transverse slope and joint matching, as recommended or supplied by the manufacturer of the paving machine. The first pass of each lift of asphalt concrete surface course shall be controlled as to grade by reference to ski, floating beam or traveling string line. The automatic control device shall be capable of being operated from either side of the paving machine.
 - .3 If required, coat contact edges of the mat with a thin layer of hot asphalt cement before the asphalt concrete is placed against them.
 - .4 Coat contact faces of curbs, gutters, maintenance holes, catch basins and other items with tack coat (SS-1) before placing the asphalt concrete.
 - .5 Produce surface of the mat behind the paving machine to be true to cross section, and have a uniform, close texture.
 - .6 Do not place asphalt concrete mix when the atmospheric temperature is less than 5°C and secondary rolling of the asphalt concrete shall be completed before the temperature of the mat falls below 80°C.

- .7 Compact each lift of asphalt concrete to not less than 97% of the field Marshall densities, based on an average of not less than three cores, with no individual test result to be below 95%.
- .8 Keep steel and pneumatic-tired rollers slightly moistened by water. Steel rollers shall be equipped with scrapers. Excessive use of water will not be permitted.
- .9 Control roller speed. The speed of steel tire rollers shall not exceed 5 km/h. The speed of pneumatic tire rollers shall not exceed 8 km/h.
- .10 Operate rollers with drive roll or wheels nearest the paving machine.
- .11 Compact longitudinal joints directly behind the paving operation.
- .12 Rolling after the longitudinal joints and edges have been compacted shall start longitudinally at the edge and gradually progress toward the center of the mat.
- .13 Do not drive roller onto or off the mat over the longitudinal edge of the mat.
- .14 Do not change the line or direction of rolling suddenly. Any pronounced change of direction shall be made on stable material.
- .15 Do not permit rollers to stand on mat unless the mat has thoroughly cooled.
- .16 Produce a finished surface of the mat free from waves, hairline cracks, roller marks, and other unevenness. The finished surface shall be free from depressions exceeding 5.0 mm as measured in any direction with a 3.0 m straight edge.
- .17 If the finished surface of the mat does not comply with the aforementioned smoothness requirements the Contractor shall remove and replace the deficient section(s) at his own expense. Recapping is not acceptable. The replacement of the mat shall be performed with a paving machine and shall comply with the specified riding quality requirements.
- .18 Mill existing asphalt entrances interface to "key" in new asphalt.

3.2 PROTECTION

- .1 Keep vehicular traffic off newly paved areas until paving surface temperature has cooled below 38°C. Do not permit stationary loads on pavement until 48 hours after placement.
- .2 All newly installed joints shall be protected from construction traffic until the joint material has cured.

3.3 TESTING

- .1 Inspection and testing of asphalt pavement will be carried out on behalf of the Owner by designated Testing Laboratory.
- .2 The Contractor is required to cooperate with, and to provide access and samples to the Testing Laboratory. The Contractor shall give 24 hours advance notice for inspection and/or testing services.

- .3 Asphalt concrete will be tested in accordance with the Laboratory Procedures of the MTO.
The following shall be tested:
 - .1 In-situ compaction – with a nuclear density gauge.
 - .2 Asphalt cement content - one sample from each mix and each day of production.
 - .3 Gradation - one sample from each mix and each day of production.
 - .4 In addition to the above, for the PG64-34 asphalt concrete mix, the recovered asphalt cement shall be performance graded. The performance grade of the asphalt cement is to be confirmed in writing by the testing laboratory.
- .4 Costs of tests will be paid by Contractor, from the Base Bid Price.
- .5 Any work not accepted by the Consultant shall be immediately corrected by the Contractor to the Consultant's satisfaction.

3.4 CLEANING

- .1 Upon completion of work, wash and sweep paving clean.
- .2 Remove debris and leave work site clean.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This Section covers the requirements for the use of dust suppressants and their application on surfaces subjected to vehicular traffic.

1.2 RELATED WORK

- .1 General Site Work.....Section 31 00 00
- .2 Granular Base and Subbase.....Section 32 11 16

1.3 REFERENCES

- .1 Ontario Provincial Standard Specification (OPSS):
 - .1 OPSS.MUNI 501, latest revision, "Construction Specification for Compacting".
 - .2 OPSS.MUNI 506, latest revision, "Construction Specification for Dust Suppressants".
 - .3 OPSS.MUNI 2501, latest revision, "Material Specification for Calcium Chloride".
- .2 Environmental Protection Act and the Ontario Water Resources Act.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Water, Calcium Chloride Solid and/or Calcium Chloride Solution shall be supplied conforming to OPSS.MUNI 506 and OPSS.MUNI 2501.

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Supply and utilize dust suppressants in accordance with OPSS.MUNI 506.
- .2 Use and apply dust suppressants in compliance with the Environmental Protection Act and the Ontario Water Resources Act and when instructed to do so by the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This section includes supply of materials, installation of granular sub-base, base and concrete sidewalks and curbs as shown on the drawings.

1.2 RELATED SECTIONS

- .1 General Site Work.....Section 31 00 00
- .2 Excavation Trenching And Backfilling.....Section 31 23 33
- .3 Dust ControlSection 32 15 60
- .4 Granular Base and Subbase.....Section 32 11 16

1.3 REFERENCES

- .1 Ontario Provincial Standards (OPSS)
 - .1 OPSS.MUNI 904, latest revision, "Construction Specification for Concrete Structures".
 - .2 OPSS.MUNI 905, latest revision, "Construction Specification for Steel Reinforcement for Concrete".
 - .3 OPSS.MUNI 1010, latest revision, "Material Specification for Aggregates - Base, Subbase, Select Subgrade, and Backfill Material".

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Concrete sidewalks: to OPSS 351, OPSS.MUNI 1350
- .2 Concrete curb: to OPSS.MUNI 353, OPSS.MUNI 1350

PART 3 - EXECUTION

3.1 BASE INSPECTION

- .1 Obtain Geotechnical testing and inspection agency approval of granular base prior to placing concrete.

3.2 CONCRETE PAVEMENTS AND CURBS

- .1 Concrete mixes and materials: to OPSS.MUNI 904: Construction Specification for Concrete Structures.

- .2 Reinforcing steel: to OPSS.MUNI 905: Construction Specification for Steel Reinforcement for Concrete.
- .3 Joint filler: to OPSS.MUNI 904: Construction Specification for Concrete Structures.
- .4 Obtain Geotechnical testing and inspection agency approval of granular base and reinforcing steel prior to placing concrete.
- .5 Do concrete work in accordance with the applicable requirements of OPSS.MUNI 904: Construction Specification for Concrete Structures.
- .6 Immediately after floating, give sidewalk surface uniform broom finish to produce regular corrugations not exceeding 2 mm deep, by drawing broom in direction normal to centre line.
- .7 Provide edging as indicated with 10 mm radius edging tool.
- .8 Slip-form pavers equipped with string line system for line and grade control may be used if quality of work acceptable to Consultant can be demonstrated. Hand finish surfaces when directed by Consultant.
- .9 Concrete tolerances:
 - .1 Finish surfaces to within 3 mm in 3 m as measured with 3 m straightedge placed on surface.
- .10 Expansion and Contraction Joints in Concrete:
 - .1 Install tooled transverse contraction joints after floating, when concrete is stiff, but still plastic, at intervals of 1.5 m.
 - .2 Install joints as required to prevent concrete from cracking:
 - .1 Provide expansion joints where length of concrete placing exceeds 15 m.
 - .3 When roadway surface and sidewalk is adjacent to curb, make joints of curb, gutters and sidewalk coincide.
- .11 Isolation Joints in Concrete:
 - .1 Install isolation joints around manholes and catch basins and along length adjacent to concrete curbs, catch basins, buildings, or permanent structures.
 - .2 Install joint filler in isolation joints.
 - .3 Seal isolation joints with sealant.
- .12 Concrete Curing:
 - .1 Cure concrete by adding moisture continuously in accordance with CAN/CSA-A23.1 to exposed finished surfaces for at least 1 day after placing, or sealing moisture in by curing compound.

- .2 Where burlap is used for moist curing, place two pre-wetted layers on concrete surface and keep continuously wet during curing period.
- .3 Apply curing compound evenly to form continuous film, in accordance with manufacturer's requirements.

END OF SECTION

PART 1 - GENERAL

1.1 DESCRIPTION

- .1 Supply all materials, plant, labour and equipment to paint lines and markings on asphalt pavement, concrete curbs and islands to match existing.

1.2 RELATED SECTIONS

- .1 Asphalt Paving Section 32 12 16

1.3 REFERENCES.

- .1 Ontario Provincial Standard Specifications.
- .2 Ontario Traffic Manuals, Ontario Ministry of Transportation
- .3 Construction Specification for Pavement Marking MT 816-M & OPSS 532
- .4 CAN/CGSB-1.5-M91, Low Flash Petroleum Spirits Thinner.
- .5 CGSB 1-GP-12c-68, Standard Paint Colours.
- .6 CGSB 1-GP-71-83, Method, of Testing Paints and Pigments.
- .7 CGSB 1-GP-74M-79, Paint, Traffic, Alkyd.
- .8 LEED Green Building Rating System Reference Package: For New Construction & Major Renovations LEED Canada-NC Version 1.0, December 2004.
- .9 LEED Green Building Rating System Reference Guide Addendum: LEED Canada for New Construction & Major Renovations Version 1.0, September 2007.

PART 2 - MATERIALS

2.1 ROADWAYS

- .1 Hot applied thermoplastic pavement marking material: to OPSS 1713, lead-free with glass beads OPSS 1750, colour to CBSB 1-GP-12c yellow 505-308, white 513-301.
- .2 Cold applied plastic pavement marking material: Flexible 2 component, solvent-and lead-free, cold curing acrylic or methacrylate road marking material to OPSS 1714, 'with glass beads OPSS 1750, colour to yellow 505-308, white 513-301.

2.2 PARKING AREAS

- .1 Traffic Paint: Organic solvent based, lead-free to OPSS 171 2 or CGSB 1-GP-74M, colour yellow 505-308, white 513-301.

2.3 THINNER

- .1 Thinner to CAN/CGSB-1.5.

PART 3 - EXECUTION

3.1 EQUIPMENT REQUIREMENTS

- .1 Paint applicator to be an approved pressure type mobile distributor capable of applying paint in single, double and dashed lines. Applicator to be capable of applying marking components uniformly, at rates specified, and to dimensions as indicated, and to have positive shut-off.

3.2 CONDITION OF SURFACES

- .1 Pavement surface to be dry, free from ponded water, frost, ice, dust, oil, grease and other foreign materials.

3.3 APPLICATION

- .1 Unless otherwise approved by Consultant, apply paint only when air temperature is above 10°C, wind speed is less than 60 km/h and no rain is forecast within next 4 hours.
- .2 Apply traffic paint evenly at rate of 3m²/L.
- .3 Do not thin paint unless approved by Consultant.
- .4 Symbols and letters to conform to dimensions indicated.
- .5 Paint lines to be of uniform colour and density with sharp edges.
- .6 Thoroughly clean distributor tank before refilling with paint of different colour.

3.4 TOLERANCE

- .1 Paint markings to be within plus or minus 12 mm of dimensions indicated.
- .2 Remove incorrect markings.

3.5 PROTECTION OF COMPLETED WORK

- .1 Protect pavement markings until dry.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This section specifies the requirements for the construction of storm sewer pipes and connections into the existing storm sewer system.
- .2 Also included in this Section are closed circuit video inspections of as-constructed sewers as per OPSS 409.

1.2 RELATED SECTIONS

- .1 General Site Work.....Section 31 00 00
- .2 Excavation Trenching And Backfilling.....Section 31 23 33
- .3 Granular Base and Subbase.....Section 32 11 16

1.3 REFERENCES

- .1 Ontario Provincial Standard Specifications (OPSS).
 - .1 OPSS 409, latest revision of, "Construction Specification for Closed-Circuit Television Inspection of Pipelines".
 - .2 OPSS 410, latest revision of, "Construction Specification for Pipe Sewer Installation in Open Cut."
- .2 Ontario Provincial Standard Drawings (OPSD).

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 All PVC storm sewer pipes shall be SDR-35 to CSA Specification B182.2.
- .2 Bedding for PVC sewer pipes shall be in accordance with OPSD 802.010.

PART 3 - EXECUTION

3.1 STORM SEWER CONSTRUCTION

- .1 Construct storm sewers and connect with the existing storm sewer system as shown on the drawings.
- .2 The storm sewers installation should be in general conformance with OPSS 410.
- .3 Storm sewer service connections from the proposed building shall be installed at a minimum of 0.5% positive grade to the mainline storm sewer. Storm service connection pipe to be fitted with approved rubber gasket joints.

3.2 INSPECTION AND TESTING

- .1 All proposed sanitary sewer pipes will be inspected upon delivery by the Consultant. Those pieces not conforming to the requirements of the Specification will be rejected and must be immediately removed by the Contractor, who shall furnish all labour necessary to assist the Consultant or inspectors in inspecting the material.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This section specifies the requirements for the construction of manholes and catchbasins.

1.2 RELATED WORK

- .1 General Site Work.....Section 31 00 00
- .2 Excavation Trenching and Backfilling.....Section 31 23 33
- .3 Granular Base and Subbase.....Section 32 11 16

1.3 REFERENCES

- .1 Region of Peel, Sanitary Sewer Design Criteria.
- .2 City of Mississauga, Transportation and Works Development Requirement Manual.
- .3 Ontario Provincial Standard Specification (OPSS):
 - .1 OPSS 407, latest revision of, "Construction Specification for Maintenance Hole, Catch Basin, Ditch Inlet, and Valve Chamber Installation".
 - .2 OPSS 1351, latest version of, "Material Specification for Precast Reinforced Concrete Components for Maintenance Holes, Catch Basins, Ditch Inlets, and Valve Chambers".
- .4 Ontario Provincial Standard Drawings (OPSD):
 - .1 401.010, latest revision of, "Cast Iron, Square Frame with Circular Closed or Open Cover for Maintenance Holes".

PART 2 - PRODUCTS

2.1 GENERAL

- .1 The manufacturer of precast concrete units shall perform quality testing and control in accordance with CAN/CSA A257.0.

2.2 MATERIALS

- .1 Precast Concrete Part:
 - .1 All catch basins shall be in accordance with OPSD 705.010 – single catch basin.
 - .2 Maintenance holes and Catch basin maintenance hole shall be constructed as per OPSD 701.010 and OPSD 704.010.
 - .3 All precast units to be marked with manufacturer's identification, date of casting, type of cement and CSA standard.
 - .4 Precast manhole sections, catch basins, neck rings and manhole rungs to conform to CAN/CSA A257.4.
 - .5 Top section eccentric cone or flat slab top type with opening offset for vertical ladder installation.

- .6 Monolithic bases to be approved by Consultant and set on concrete slabs cast in place.
- .7 Joints:
 - .1 Cover frame set on a mortar joint covering the full area of the frame flange.
 - .2 Manhole and catch basins sections including neck rings to be made watertight using flexible rubber gaskets, except as indicated.
 - .3 Where a rung is to be set between neck rings this joint shall be made with mortar covering the full cross section of the neck rings.
 - .4 Rubber joints to conform to CAN/CSA A257.3
- .8 Mortar to CSA 179, type S using type 50 sulphate resistant Portland cement.
- .9 Ladder rungs: to CAN/CSA-G30.18, No. 25M billet steel deformed bars hot dipped galvanized to CAN/CSA G164. Rungs to be safety pattern (drop step type).
- .2 Frames and Gratings
 - .1 Frame and cover on all sanitary sewer manholes shall be as per OPSD 401.010 Type 'A' closed cover, unless otherwise specified.
 - .2 Metal gratings and covers to bear evenly on frames. A frame with grating or cover to constitute one unit. Assemble and mark unit components before shipment.
 - .3 Gray iron castings: to ASTM A48, strength class 20B.
 - .4 Castings to be cleaned and ground to eliminate surface imperfections and be true to pattern, free of defects, cracks, porosity, flaws and excessive shrinkage.
 - .5 Covers or grates that rock on a clean frame are not acceptable.
 - .6 Manhole frames, covers and gratings: Use heavy duty municipal type for areas subject to vehicular traffic and light duty type for landscape service, unless otherwise indicated.
- .3 Unshrinkable Fill
 - .1 Use unshrinkable fill where indicated on the drawings to Section 31 23 33 - Excavating, Trenching and Backfilling.

PART 3 - EXECUTION

3.1 EXCAVATION AND BACKFILL

- .1 Excavate and backfill in accordance with Section 31 23 33 - Excavating Trenching and Backfilling and as indicated.
- .2 Obtain Consultant's approval of foundations before installing structures, manholes or catch basins.

3.2 INSTALLATION OF MANHOLES, CATCHBASINS AND STRUCTURES

- .1 Construct units in accordance with details indicated, plumb and true to alignment and grade.
- .2 Complete units as pipe laying progresses. Maximum of three units behind point of pipe laying will be allowed.
- .3 Dewater and keep excavation free of standing or running water to approval of Consultant.

- .4 Cast bottom slabs directly on undisturbed ground unless the Consultant has ordered removal of unsatisfactory material according to Section 31 23 33- Excavating Trenching and Backfilling.
- .5 Set precast concrete base on 150 mm minimum of granular bedding compacted to 100% maximum density to ASTM D 698.
- .6 Install safety rungs in manholes and catch basin manholes and where indicated on the drawings.
- .7 Set rungs with equal spacing no more than 410 mm. First rung within 300 mm of the cover and the bottom rung within 600 mm of the base or benching.
- .8 Orient manholes so that the safety rungs are above the manhole benching and not above the sewer channel. Where possible set the rungs so that a person exiting the manhole faces oncoming traffic.
- .9 Where a rung is to be set between neck rings make this joint with mortar covering the full area of the joint.
- .10 Set frame and cover on top section using a mortar joint. Set cover to finished grade by adjusting mortar joint thickness and number of neck rings as required.
- .11 Clean units of debris and foreign materials. Remove fins and sharp projections. Prevent debris from entering system.
- .12 Additional requirements for precast units:
 - .1 Set bottom section of precast unit in bed of cement mortar and bond to concrete slab or base. Make all joints watertight with rubber ring gaskets, unless indicated otherwise.
 - .2 Clean surplus mortar and joint compounds from interior surface of unit as work progresses.
 - .3 Plug lifting holes with precast concrete plugs set in cement mortar or mastic compound.

3.3 INSTALLING UNITS IN EXISTING SYSTEMS

- .1 Support and protect existing pipe when installing a new unit in the exiting run of pipe. Cut out the existing pipe as indicated and remove from the site.
- .2 Make joints watertight between new unit and existing pipe.
- .3 Where existing pipes are to remain in service or parts of this Work are ready to be put in operation, provide appropriate break-outs, removals, redirection of flows, blocking of unused pipes, or other necessary work.

3.4 BACKFILL

- .1 Place in accordance with Section 31 23 33 - Excavating, Trenching and Backfill.

3.5 LEAKAGE TEST

- .1 Install watertight plugs or seals on inlets and outlets of each new manhole and catch basin and fill with water. Drop in water, level due to leakage, not to exceed 0.3% of the initial water depth per hour.
- .2 If permissible leakage is exceeded, correct defects. Repeat until acceptable to Consultant.
- .3 Consultant will issue Test Certificate for each manhole passing test.

END OF SECTION

SPECIFICATIONS

DIVISION 00	PROCUREMENT & CONTRACTING REQUIREMENTS
00 01 10	..... Table of Contents
DIVISION 01	GENERAL REQUIREMENTS
01 35 43	..... Environmental Procedures
01 74 11	..... Cleaning
DIVISION 04	QUARRIED STONE
04 43 16.01	..... Quarried stone
DIVISION 31	EARTHWORK
31 11 00.01	..... Clearing & Grubbing
31 14 13	..... Soil Stripping & Stockpiling
31 22 13	..... Rough Grading
DIVISION 32	EXTERIOR IMPROVEMENTS
32 01 90.33	..... Tree & Shrub Preservation
32 91 10	..... Topsoil Placement & Fine Grading
32 92 23	..... Sodding
32 93 10	..... Trees, Shrubs, & Ground Cover Planting

DRAWINGS

L-01	..... Landscape Plan
LD-01	..... Landscape Details
LD-02	..... Landscape Details

END OF SECTION



PART 1 - GENERAL

1.1 SCOPE

.1 N/A

1.2 DEFINITIONS

- .1 Environmental Pollution and Damage: presence of chemical, physical, biological elements or agents which adversely affect human health and welfare; unfavourably alter ecological balances of importance to human life; affect other species of importance to humankind; or degrade environment aesthetically, culturally and/or historically.
- .2 Environmental Protection: prevention/control of pollution and habitat or environment disruption during construction. Control of environmental pollution and damage requires consideration of land, water, and air; biological and cultural resources; and includes management of visual aesthetics; noise; solid, chemical, gaseous, and liquid waste; radiant energy and radioactive material as well as other pollutants.

1.3 SUBMITTALS

- .1 Submittals: in accordance with Architectural Submittal Procedures.
- .2 Prior to commencing construction activities or delivery of materials to site, submit Environmental Protection Plan for review and approval by Consultant. Environmental Protection Plan is to present comprehensive overview of known or potential environmental issues that must be addressed during construction.
- .3 Address topics at level of detail commensurate with environmental issue and required construction task[s].
- .4 Environmental protection plan: include:
 - .1 Name(s) of person(s) responsible for ensuring adherence to Environmental Protection Plan.
 - .2 Name(s) and qualifications of person(s) responsible for manifesting hazardous waste to be removed from site.
 - .3 Name(s) and qualifications of person(s) responsible for training site personnel.
 - .4 Descriptions of environmental protection personnel training program.
 - .5 Erosion and sediment control plan which identifies type and location of erosion and sediment controls to be provided including monitoring and reporting requirements to assure that control measures are in compliance with erosion and sediment control plan, Federal, Provincial, and Municipal laws and regulations.
 - .6 Drawings showing locations of proposed temporary excavations or embankments for haul roads, stream crossings, material storage areas, structures, sanitary facilities,

and stockpiles of excess or spoil materials including methods to control runoff and to contain materials on site.

- .7 Traffic control plans including measures to reduce erosion of temporary roadbeds by construction traffic, especially during wet weather. Plans include measures to minimize amount of mud transported onto paved public roads by vehicles or runoff.
- .8 Work area plan showing proposed activity in each portion of area and identifying areas of limited use or non-use. Plan to include measures for marking limits of use areas including methods for protection of features to be preserved within authorized work areas.
- .9 Spill Control Plan: including procedures, instructions, and reports to be used in event of unforeseen spill of regulated substance.
- .10 Non-Hazardous solid waste disposal plan identifying methods and locations for solid waste disposal including clearing debris.
- .11 Air pollution control plan detailing provisions to assure that dust, debris, materials, and trash, do not become air borne and travel off project site.
- .12 Contaminant prevention plan that: identifies potentially hazardous substances to be used on job site; identifies intended actions to prevent introduction of such materials into air, water, or ground; and details provisions for compliance with Federal, Provincial, and Municipal laws and regulations for storage and handling of these materials.
- .13 Waste water management plan that identifies methods and procedures for management and/or discharge of waste waters which are directly derived from construction activities, such as concrete curing water, clean-up water, dewatering of ground water, disinfection water, hydrostatic test water, and water used in flushing of lines.
- .14 Historical, archaeological, cultural resources biological resources and wetlands plan that defines procedures for identifying and protecting historical, archaeological, cultural resources, biological resources and wetlands.
- .15 Pesticide treatment plan: to be included and updated, as required.

1.4 FIRES

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

1.5 DISPOSAL OF WASTES

- .1 Burying of rubbish and waste materials on site will not be permitted.
- .2 Note that certain materials are required to be recycled and must be transported to required location.
- .3 Note that all transportation and dumping costs are to be included in Tender Price

1.6 DRAINAGE

- .1 Provide temporary drainage and pumping as necessary to keep excavations and site free from water.
- .2 Dispose of water containing silt in suspension in accordance with local authority requirements.
- .3 Take full responsibility for maintenance of existing drainage - above ground and underground, - adjacent to the work or affected by the work.
- .4 Before commencing any work likely to affect the drainage of water from the existing buildings or site, provide necessary alternative drainage systems to ensure that water will be conducted to alternative outlets. Do not block or impede any drain, roof outlet or rainwater leader until such safety precautions have been made.

1.7 SITE CLEARING AND PLANT PROTECTION

- .1 Protect trees and plants on site and adjacent properties where indicated.
- .2 Wrap in burlap, trees and shrubs adjacent to construction work, storage areas and trucking lanes, and encase with protective wood framework from grade level to height of 2 m.
- .3 Protect roots of designated trees to dripline during excavation and site grading to prevent disturbance or damage. Avoid unnecessary traffic, dumping and storage of materials over root zones.
- .4 Minimize stripping of topsoil and vegetation.
- .5 Restrict tree removal to areas indicated or designated by Consultant.

1.8 WORK ADJACENT TO WATERWAYS

- .1 Do not operate construction equipment in waterways.
- .2 Do not use waterway beds for borrow material without Consultant's approval.
- .3 Do not dump excavated fill, waste material or debris in waterways.
- .4 Design and construct temporary crossings to minimize erosion to waterways.
- .5 Do not skid logs or construction materials across waterways.
- .6 Avoid indicated spawning beds when constructing temporary crossings of waterways.
- .7 Do not blast under water or within 100 m of indicated spawning beds.

1.9 POLLUTION CONTROL

- .1 Maintain temporary erosion and pollution control features installed under this contract.
- .2 Control emissions from equipment and plant to local authorities' emission requirements.

- .3 Prevent sandblasting and other extraneous materials from contaminating air and waterways beyond application area, by providing temporary enclosures.
- .4 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary roads.

1.10 NOTIFICATION

- .1 Consultant will notify Contractor in writing of observed noncompliance with Federal, Provincial or Municipal environmental laws or regulations, permits, and other elements of Contractor's Environmental Protection plan.
- .2 Contractor: after receipt of such notice, inform Consultant of proposed corrective action and take such action for approval by Consultant.
- .3 Consultant will issue stop order of work until satisfactory corrective action has been taken.
- .4 No time extensions granted or equitable adjustments allowed to Contractor for such suspensions.

PART 2 - PRODUCTS

- 2.1 NOT USED

PART 3 - EXECUTION

- 3.1 NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian Construction Documents Committee (CCDC)
 - .1 CCDC 2-94, Stipulated Price Contract.

1.2 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Consultant. Do not burn waste materials on site, unless approved by Consultant.
- .3 Clear snow and ice from access to building(s), bank/pile snow in designated areas only or as directed by Consultant.
- .4 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .5 Provide on-site containers for collection of waste materials and debris.
- .6 Dispose of waste materials and debris at designated dumping locations.
- .7 Store volatile waste in covered metal containers, and remove from premises at end of each working day.
- .8 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.
- .9 Schedule cleaning operations so that resulting dust, debris and other contaminants will not fall on wet, newly painted surfaces nor contaminate building systems.

1.3 FINAL CLEANING

- .1 When Work is Substantially Performed remove surplus products, tools, construction machinery and equipment not required for performance of remaining Work.
- .2 Remove waste products and debris other than that caused by others, and leave Work clean and suitable for occupancy.
- .3 Prior to final review remove surplus products, tools, construction machinery and equipment.
- .4 Remove waste products and debris including that caused by other Contractors.
- .5 Remove waste materials from site at regularly scheduled times or dispose of at an approved location. Do not burn waste materials on site, unless approved by Consultant.
- .6 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.

- .7 Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floors. Power wash all concrete hard surfaces.
- .8 Clean lighting reflectors, lenses, and other lighting surfaces.
- .9 Inspect finishes, fitments and equipment and ensure specified workmanship and operation.
- .10 Broom clean and wash exterior walks, steps and surfaces; rake clean other surfaces of grounds.
- .11 Remove dirt and other disfiguration from exterior surfaces.
- .12 Clean and sweep roofs, gutters, areaways, and sunken wells.
- .13 Remove silt traps from Catch Basins.
- .14 Sweep and power wash clean paved areas.
- .15 Clean equipment and fixtures to sanitary condition; clean or replace filters of mechanical equipment.
- .16 Clean roofs, downspouts, and drainage systems.
- .17 Remove snow and ice from access to building.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 This work involves construction of river stone beds.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Stone unit material shall be hard, durable non-friable, free from weak bedding planes, deep cracks and crevices. Slate or shale shall not be permitted in the works.
- .2 The Contractor shall submit samples of the stone river stone material and quarry location to Landscape Architect to receive approval prior to stone order. Stone must be approved by the Landscape Architect before use and samples shall be submitted at the Contractor's expense for testing if required by the Landscape Architect.
- .3 Stone units delivered and placed into the works shall conform to the following classifications, to be approved by Landscape Architect:
 - .1 Size of river stone:
 - .1 $\frac{3}{4}$ " Natural stone average size $\frac{3}{4}$ " to 1 $\frac{1}{2}$ " Ø size. From Oshawa Sand and Gravel or approved equal
 - .2 Special care shall be taken in the selection of quarried stone abutting paved / pedestrian areas. All corners and edges shall be made rounded.

PART 3 - EXECUTION

3.1 GRADING

- .1 Grade back slope to lines and grades as shown on Landscape details.
- .2 Excavated material to be used as fill requires approval before placing.
 - .1 Remove from site, material rejected for fill or surplus to fill requirements.
- .3 Place granular fill where required to bring surfaces to required levels.
- .4 Place fill in layers not exceeding 200 mm, loose thickness. Compact each layer as per Civil Engineer drawings and specs.
- .5 Fill to be placed only in unfrozen, dry, workable condition.

3.2 GEOTEXTILE

- .1 Place geotextile as indicated, free from wrinkles, with side overlap not less than 300mm, and end lap not less than 600mm.

3.3 STONE FILTER

- .1 Place stone filter material over areas as indicated. Avoid segregation of material.

3.4 BASE COURSE STONE

- .1 Do not disturb existing surface when placing base course stone. Do not end dump unless approved by unless approved by the Landscape Architect.
- .2 Place to thickness as indicated.
- .3 Fill in voids and provide solid level surface for base course of revetment.

3.5 STONE-PLACEMENT

- .1 All stones shall be placed to the lines and grades indicated on the Contract Drawings and as directed by the Landscape Architect. The stones shall be carefully placed in a stable position and regular alignment in order to provide a uniformly aligned wall. Each stone shall be keyed in with the adjoining stones. Crevices and openings between adjacent stone shall be small enough that no openings are greater than 12mm.
- .2 Stones that are damaged during installation or transportation, shall be disposed of as directed by the Landscape Architect at the Contractors' expense.

3.6 PROTECTION

- .1 Carry out revetment construction so that each phase of work is not left exposed for an undue period of time.
- .2 The City may order excavation to be stopped or may order placing of final protective stone layers to be advanced, depending on anticipated weather conditions.

3.7 CLEANUP

- .1 In accordance with Section 01 74 00 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 32 91 10 – Topsoil Placement and Grading.
- .2 Section 31 22 13 – Rough Grading.

1.2 MEASUREMENT PROCEDURES

- .1 Fixed price payments will be made for:
 - .1 Clearing.
 - .2 Clearing isolated trees.
 - .3 Grubbing.

1.3 DEFINITIONS

- .1 Clearing consists of cutting off trees and brush vegetative growth to not more than specified height above ground and disposing of felled trees, previously uprooted trees and stumps, and surface debris.
- .2 Clearing isolated trees consists of cutting off to not more than specified height above ground of designated trees, and disposing of felled trees and debris.
- .3 Underbrush clearing consists of removal from treed areas of undergrowth, deadwood, and disposing of fallen timber and surface debris.
- .4 Grubbing consists of excavation and disposal of stumps and roots, boulders and rock fragments to not less than specified depth below existing ground surface.

1.4 QUALITY ASSURANCE

- .1 Do construction occupational health and safety in accordance with Ministry of Labour Occupational Health and Safety Act.
- .2 Safety Requirements: worker protection.
 - .1 Workers must wear gloves, respirators, dust masks, long sleeved clothing, eye protection, protective clothing when applying herbicide materials.
 - .2 Workers must not eat, drink or smoke while applying herbicide material.
 - .3 Clean up spills of preservative materials immediately with absorbent material and safely discard to landfill or as to the instructions provided by the project manager.

1.5 STORAGE AND PROTECTION

- .1 Prevent damage to fencing, trees, landscaping natural features, bench marks, existing buildings, existing pavement, utility lines, site appurtenances, water courses and root systems of trees which are to remain.
 - .1 Repair damaged items to approval of Project Manager.
 - .2 Replace trees designated to remain, if damaged, as directed by Project Manager.

1.6 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for disposal, reuse or recycling in accordance with Site Preparation Section 31 11 00.

PART 2 - PRODUCTS

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings or requirements of authorities having jurisdiction, whichever is more stringent.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

PART 4 - PREPARATION

4.1 PREPARATION

- .1 Inspect site and verify with Consultant, items designated to remain.
- .2 Locate and protect utility lines: preserve in operating condition active utilities traversing site unless otherwise ordered by Project Manager.
 - .1 Notify Consultant immediately of damage to or when unknown existing utility line[s] are encountered.
 - .2 When utility lines which are to be removed are encountered within area of operations, notify Consultant in ample time to minimize interruption of service.
- .3 Notify utility authorities before starting clearing and grubbing.

- .4 Keep roads and walks free of dirt and debris.

4.2 APPLICATION

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

4.3 CLEARING

- .1 Clearing includes felling, trimming, and cutting of trees, and the satisfactory disposal of trees and other vegetation designated for removal, including downed timber, snags, brush, and rubbish occurring within cleared areas.
- .2 Clear as indicated Consultant by cutting at height of not more than 300 mm above ground. In areas to be subsequently grubbed, height of stumps left from clearing operations to be not more than 1 m above ground surface.
- .3 Cut off branches and cut down trees overhanging area cleared as directed by Consultant.
- .4 Cut off unsound branches on trees designated to remain.
- .5 Apply herbicide in accordance with manufacturer's label to top surface of stumps designated not to be removed.

4.4 ISOLATED TREES

- .1 Cut off isolated trees as indicated Consultant at height of not more than 300mm above ground surface.
- .2 Grub out isolated tree stumps.
- .3 Prune individual trees as indicated.
- .4 Trim trees designated to be left standing within cleared areas of dead branches 4 cm or more in diameter; and trim branches to heights as indicated.
- .5 Cut limbs and branches to be trimmed close to bole of tree or main branches.
- .6 Paint cuts more than 3cm in diameter with approved tree wound paint.

4.5 UNDERBRUSH CLEARING

- .1 Clear underbrush from areas as indicated at ground level.

4.6 GRUBBING

- .1 Remove and dispose of roots larger than 7.5cm in diameter, matted roots, and designated stumps from indicated grubbing areas.
- .2 Grub out stumps and roots to not less than 300 mm below ground surface.

- .3 Grub out visible rock fragments and boulders, greater than 300 mm in greatest dimension, but less than 0.25m³.
- .4 Fill depressions made by grubbing with suitable material and to make new surface conform with existing adjacent surface of ground.

4.7 REMOVAL AND DISPOSAL

- .1 Burning not usually allowed on construction site.
- .2 Chip or mulch and spread cleared and grubbed vegetative material on site as directed by Consultant.
- .3 Remove diseased trees infected with EAB by mulching or fire. Obtain any permits required for fire

4.8 FINISHED SURFACE

- .1 Leave ground surface in condition suitable for immediate grading operations and or stripping of topsoil.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 31 11 00 – Clearing and Grubbing
- 31 22 13 – Rough Grading

1.2 SUBMITTALS

- .1 Submit in accordance with Architectural Submittal Procedures.
- .2 Submit two (2) copies of soil analysis and recommendations for corrections to Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Topsoil will be free of subsoil, roots, grass, weeds, stones in excess of 25mm and foreign objects.
- .2 Topsoil will have an acidity range (pH) as per the Soil Report Recommendations.
- .3 Native Topsoil: Stripped topsoil from the site is to be reinstated as required. Topsoil is subject to inspection, testing and amendment by the contractor. Do not commence work until topsoil is accepted by the Consultant.
- .4 Arrange for testing of native topsoil as stockpiled to determine any amendments required to meet Topsoil specifications
- .5 Imported Topsoil: Should the native topsoil quantity be insufficient, additional topsoil will be required, imported topsoil shall be used. Imported topsoil is subject to inspection and testing by the contractor. Do not commence work until topsoil is accepted by the Consultant.

PART 3 - EXECUTION

3.1 TEMPORARY EROSION AND SEDIMENTATION CONTROL

- .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to sediment and erosion control drawings, specific to site, that complies with requirements of authorities having jurisdiction.
- .2 Inspect, repair, and maintain erosion and sedimentation control measures during construction until permanent vegetation has been established.
- .3 Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.2 STRIPPING OF TOPSOIL

- .1 Ensure that procedures are conducted in accordance with applicable Municipal requirements.
- .2 Remove topsoil before construction procedures commence to avoid compaction of topsoil.
- .3 Handle topsoil only when it is dry and warm.
- .4 Remove vegetation from targeted areas by non-chemical means and dispose of stripped vegetation by disposal.
- .5 Remove brush from targeted area by non-chemical means and dispose of through mulching.
- .6 Strip topsoil to depths as noted in geotechnical report and from bore hole sampling
- .7 Avoid mixing topsoil with subsoil.
- .8 Stockpiling of topsoil to a height higher than 3.0m will result in compaction of the soil and destruction of the anaerobic bacteria required for plant growth. Piling topsoil over 3m in height is to employ a mechanical hoe will allow sufficient oxygen to be present in the soil to maintain anaerobic bacteria.
- .9 Pile topsoil in berms in locations so as not to delay work in other areas of the construction site. Contractor will be responsible for locating topsoil stockpiles in such a location that they will not impede any other ongoing work on site.
- .10 Stockpile height not to exceed 3.0 m.
- .11 Dispose of unused topsoil off-site.
- .12 Protect stockpiles from contamination and compaction.
- .13 Cover topsoil that has been piled for long term storage, with trefoil or clover to maintain agricultural potential of soil.
- .14 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 32 91 21 Topsoil Placement and Finish Grading

1.2 REFERENCES

- .1 Codes and standards referenced in this section refer to the latest edition thereof.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM D698, Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (600kN-m/m³).

1.3 EXISTING CONDITIONS

- .1 Examine subsurface investigation report which is available for inspection from Owner's Representative.
- .2 Known underground and surface utility lines and buried objects are as indicated on site plan.

1.4 PROTECTION

- .1 Protect and/or transplant existing fencing trees, landscaping, natural features, bench marks, buildings, pavement, surface or underground utility lines which are to remain as directed by Landscape architect. If damaged, restore to original or better condition unless directed otherwise.
- .2 Maintain access roads to prevent accumulation of construction related debris on roads.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Fill material: Type 3 fill: selected material from excavation or other sources, approved by Consultant for use intended, unfrozen and free from rocks larger than 75 mm, cinders, ashes, sods, refuse or other deleterious materials.
- .2 Excavated or graded material existing on site may be suitable to use as fill for grading work if approved by Landscape Architect.

PART 3 - EXECUTION

3.1 STRIPPING OF TOPSOIL

- .1 Do not handle topsoil while in wet or frozen condition or in any manner in which soil structure is adversely affected as determined by Landscape Architect.

- .2 Commence topsoil stripping of areas as indicated after area has been cleared of brush, weeds and grasses and removed from site.
- .3 Strip topsoil to depths as indicated. Avoid mixing topsoil with subsoil.
- .4 Stockpile in locations as directed by Landscape Architect. Stockpile height not to exceed 3.0m.
- .5 Dispose of unused topsoil as directed by Landscape Architect.

3.2 GRADING

- .1 Rough grade to levels, profiles, and contours allowing for surface treatment as indicated.
- .2 Slope rough grade away from building 1:50 minimum.
- .3 Grade ditches to depth as indicated.
- .4 Prior to placing fill over existing ground, scarify surface to depth of 150 mm. Maintain fill and existing surface at approximately same moisture content to facilitate bonding.
- .5 Compact filled and disturbed areas to corrected maximum dry density to ASTM D698, as follows:
 - .1 85% under landscaped areas.
- .6 Do not disturb soil within branch spread of trees or shrubs to remain.

3.3 TESTING

- .1 Inspection and testing of soil compaction will be carried out by testing company designated
- .2 Contractor to be responsible for testing agency costs.
- .3 Submit testing procedure, frequency of tests, to Landscape Architect for approval

3.4 SURPLUS MATERIAL

- .1 Remove surplus material and material unsuitable for fill, grading or landscaping as directed by Landscape Architect.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

.1 Section Includes:

- .1 Materials and installation for fertilizing and preserving root systems of plants affected by changing grades or excavation.

.2 Related Sections:

- .1 Section 31 11 00 – Clearing and Grubbing
- .2 Section 32 91 10 – Topsoil Placement & Grading
- .3 Section 32 92 23 - Sodding

1.2 REFERENCES

.1 Canadian Standards Association (CSA International).

- .1 CSA G30.5-[M1983(R1998)], Welded Steel Wire Fabric for Concrete Reinforcement.

.2 Department of Justice Canada (Jus).

- .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .2 Fertilizers Act (R.S. 1985, c. F-10).
- .3 Fertilizers Regulations (C.R.C., c. 666).
- .4 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.

.3 Health Canada - Pest Management Regulatory Agency (PMRA).

- .1 National Standard for Pesticide Education, Training and Certification in Canada (1995).

.4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).

- .1 Material Safety Data Sheets (MSDS).

1.3 DEFINITION

- .1 Mycorrhiza : association between fungus and roots of plants. This symbiosis, enhances plant establishment in newly landscaped and imported soils.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Architectural Submittal Procedures.

.2 Submit monthly written reports on maintenance during warranty period, to Consultant identifying:

- .1 Maintenance work carried out.
- .2 Development and condition of plant material.
- .3 Preventative or corrective measures required which are outside Contractor's responsibility.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

SPEC NOTE ENVIRONMENT: The disposal of packaging waste into landfill site demonstrates an inefficient use of natural resources and consumes valuable landfill space.

SPEC NOTE ENVIRONMENT: Since emptied containers retain product residues (vapours, liquids or solids) extreme care should be exercised in their handling. Keep out of reach of children.

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastics, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers Steel and Metal waste in accordance with Waste Management Plan.
- .5 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
- .6 Divert unused wood materials from landfill by alternative disposal such as composting or mulching as approved by CONSULTANT.
- .7 Divert unused stone and aggregate materials from landfill to local facility as approved by CONSULTANT.
- .8 Divert unused plastic materials from landfill to local recycling facility approved by CONSULTANT.
- .9 Place materials defined as hazardous or toxic in designated containers.
- .10 Dispose of unused fertilizer material at official hazardous material collections site approved by CONSULTANT.
- .11 Handle and dispose of hazardous materials in accordance with CEPA, TDGA and Regional/Municipal regulations.

- .12 Do not dispose of unused fertilizer material into sewer system, into streams, lakes, onto ground or in any other location where they will pose health or environmental hazard.
- .13 Ensure emptied containers are sealed and stored safely.
- .14 Fold up metal banding, flatten and place in designated area for recycling.

1.6 SCHEDULING

- .1 Obtain approval from CONSULTANT of schedule indicating beginning of Work.

1.7 MAINTENANCE DURING WARRANTY PERIOD

- .1 From time of acceptance by CONSULTANT to end of warranty period, perform following maintenance operations.
 - .1 Water to maintain soil moisture conditions for optimum growth and health of plant material without causing erosion.
 - .2 Apply pesticides in accordance with National Standard for Pesticide Education, Training and Certification in Canada, Federal, Provincial and Municipal regulations as and when required to control insects, fungus and disease. Obtain product approval from CONSULTANT prior to application.
 - .3 Apply fertilizer in early spring at rate of 0.025 kg of nitrogen/m².
 - .4 Remove dead, broken or hazardous branches from plant material. Dispose of debris through mulching.

PART 2 - PRODUCTS

SPEC NOTE ENVIRONMENT: Choose products and materials with recycled content or resource efficient characteristics.

2.1 MATERIALS

- .1 Fill:
 - .1 Type (A): clean, natural sand and gravel material, free from silt, clay, loam, friable or soluble materials and organic matter.
 - .2 Type (B): excavated. pervious soil, free from roots, rocks larger than 75 mm, building debris, and toxic ingredients (salt, oil, etc). Excavated material shall be approved by CONSULTANT before use as fill.
- .2 Coarse washed stones: 35-75 mm diameter clean round hard stone.
- .3 Drain tile: 100 mm diameter corrugated plastic perforated tubing complete with snap couplings. Fill vents with 20 mm clear stone.
- .4 Peat moss:

- .1 Derived from partially decomposed species of Sphagnum Mosses.
- .2 Elastic and homogeneous.
- .3 Free of wood and deleterious material which could prohibit growth.
- .4 Shredded minimum particle size: 5 mm.
- .5 Fertilizer:
 - .1 To Canada Fertilizer Act and Fertilizers Regulations.
 - .2 Complete, commercial, slow release with 35 % of nitrogen content in water-insoluble form.

SPEC NOTE: Adding mycorrhiza during planting operation might improve better root system and provide stress relief in plant growth. It is important that new root growth be in contact with mycorrhiza. Use as recommended by the manufacturer.

- .6 Anti-desiccant: commercial, wax-like emulsion.
- .7 Filter Cloth:
 - .1 Type 1: 100 % non-woven needle punched polyester, 2.75 mm thick, 240 g/m² mass.
 - .2 Type 2: biodegradable burlap.
- .8 Wood posts: 38 x 89 x 2400 mm length, untreated wood.
- .9 Welded wire fabric (WWF): 100 x 100mm, MW x MW, to CSA G30.5.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND PROTECTION

- .1 Identify plants and limits of root systems to be preserved as approved by CONSULTANT.
- .2 Protect plant and root systems from damage, compaction and contamination resulting from construction as approved CONSULTANT.
- .3 Ensure no pruning is done inside drip line. If pruning inside drip line is required consult an certified and registered, practicing arborist as approved by CONSULTANT.

3.2 ROOT CURTAIN SYSTEM

- .1 Identify limits for required construction excavation as approved by CONSULTANT.
- .2 Prior to construction excavation, hand dig trench minimum 500 mm wide x 1500 mm deep, along perimeter of excavation limits.

- .3 Prune exposed roots cleanly at side of trench nearest plants to be preserved. Pruned ends to point obliquely downwards.
- .4 Install wooden posts and welded wire fabric against construction edge of trench.
- .5 Securely attach Type 2 filter fabric on plant side of wire mesh.
- .6 Prepare homogeneous mixture of fertilizer, parent material and organic matter.
 - .1 Add organic matter to mixture to achieve 7-9% organic matter content by weight.
 - .2 Incorporate with mixture grade 2:12:8 ratio fertilizer (dry) at rate of 1.5 kg/m³.
- .7 Backfill with homogeneous mixture between curtain wall and plants to be preserved in layers not exceeding 150 mm in depth. Compact each layer to 85% Standard Proctor Density.
- .8 Protect root curtain from damage during construction operations.
- .9 Water plants and root curtain sufficiently during construction to maintain optimum soil moisture condition until backfill operations are complete.
- .10 Remove root curtain before backfill operations. Ensure root curtain is cut down to 300 mm below finished grade and remove cut material.

3.3 AIR LAYERING SYSTEM, RAISING GRADE AROUND EXISTING TREE

Refer to drawings to indicate where treatment occurs.

- .1 Using manual methods, carefully remove turf, plants, leaves and organic matter in area of root system, dispose of plant matter through compost and slightly loosen topsoil surface. Avoid damage to root system.
- .2 Lay horizontal system of perforated drain pipe on surface of existing grade.
 - .1 Slope drain tile minimum 2% for drainage away from trunk of tree.
 - .2 Connect system with general site drainage system or drain to low point on site.
- .3 Install plastic "vent" pipes vertically over joints in horizontal pipe system or where indicated. Top of vent pipe to be 20 mm above finished grade of fill. Keep top of vent pipe covered during construction.
- .4 Cover joints with Type 1 filter fabric and place coarse washed stone around joints and vertical pipes to secure their position.
- .5 Construct drywell around trunk of tree.
 - .1 Ensure open ends of horizontal pipe system and vertical vent pipes are left exposed for air circulation to root system.
 - .2 Protect openings from blockage during construction.
 - .3 Install protective caps on exposed horizontal openings.

- .6 Place 200 mm depth of coarse washed stone on surface of original ground and horizontal pipe system to limits.
- .7 Place Type 1 filter fabric over surface of granular layer.
- .8 Place Type A granular fill over filter fabric to required depth without disturbing or damaging drain pipe system. Avoid damage to filter fabric.
- .9 Complete topsoil, sodding or finished paving over area of sub-surface system within one week of placing fill.
- .10 Remove temporary protective covering from vent pipe openings. Install protective caps flush with finished grade.

3.4 TRENCHING AND TUNNELING FOR UNDERGROUND SERVICES

Use when service trenching/excavating within limits of tree root system is necessary. Use only for trees greater than 150 mm diameter. Do not use for trees with major tap roots. Centre line of service to be in line with trunk of tree.
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- .1 Centre line location and limits of trench/tunnel excavation to be approved by CONSULTANT prior to excavation. Tunnel excavation to extend 2000 mm from edge of trunk on either side.
- .2 Excavate manually within zone of root system. Do not sever roots greater than 40 mm diameter except at greater than 500 mm below existing grade. Protect roots, and cut roots cleanly with sharp disinfected tools.
- .3 Excavate tunnel under centre of tree trunk using methods and equipment approved by Consultant.
- .4 Minimum acceptable depth to top of tunnel: 1000 mm.
- .5 Backfill for tunnel and trench to 85% Standard Proctor Density. Avoid damage to trunk and roots of tree.
- .6 Complete tunneling and backfilling at tree within 2 weeks of beginning Work.

3.5 LOWERING GRADE AROUND EXISTING TREE

- .1 Begin Work in accordance with schedule approved by CONSULTANT.
- .2 Cut slope not less than 500mm from tree trunk to new grade level.
- .3 Excavate to depths as indicated. Protect from damage root zone which is to remain.
- .4 When severing roots at excavation level, cut roots with sharp tools.
- .5 Cultivate excavated surface manually to 15mm depth.
- .6 Prepare homogeneous soil mixture consisting by volume of:
 - .1 60 % excavated soil cleaned of roots, plant matter, stones, debris.

- .2 25 % coarse, clean sterile sand.
 - .3 15 % organic matter.
 - .4 Grade 2:12:8 fertilizer at rate of 1.5 kg/m³.
 - .7 Place soil mixture over area of excavation to finished grade level. Compact to 85% Standard Proctor Density.
 - .8 Water entire root zone to optimum soil moisture level.
 - .9 Install surface cover of sodding in accordance with Section 02925 - Sodding.
- 3.6 PRUNING
- .1 Prune crown to compensate for root loss while maintaining general form and character of plant. Dispose of debris through mulching.
- 3.7 ANTI DESICCANT
- .1 Apply anti-desiccant to foliage where applicable and as directed by Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 CONFORMANCE

- .1 The General Conditions are part of this Section and shall apply as if written herein.

1.2 RELATED SECTIONS

- .1 Section 32 92 23 – Sodding.
- .2 Section 31 22 13 – Rough Grading.

1.3 SCOPE OF WORK

- .1 Placement and grading of imported and blended site topsoil to levels and dimensions as per drawings or instructions of Consultant.
- .2 Placing and grading of topsoil produced from stripping of existing soil to levels and dimensions as per drawings or instructions of Consultant.

1.4 SUBMITTALS

- .1 Submit in accordance with Architectural Submittal Procedures.
- .2 Submit two (2) copies of soil analysis and recommendations for corrections to Consultant.

1.5 SCHEDULING

- .1 Schedule placing of topsoil to permit sodding and planting operations under optimum conditions.

1.6 PROTECTION

- .1 Prevent damage to fencing, railing, posts, trees, landscaping, benchmarks, existing pavement and surface or underground utility lines that are to remain. Make good any damage.

PART 2 - PRODUCTS

2.1 SOURCE QUALITY CONTROL

- .1 Acceptance of imported topsoil is subject to inspection and soil analysis test results. Do not commence work until topsoil accepted by the Consultant.
- .2 Inspection and testing of topsoil to be carried out by an approved testing laboratory.
- .3 Test topsoil from source prior to stockpiling, for clay, sand and silt, percentage and particle size, dry density, NPK, Mg, soluble salt content, pH value, growth inhibitors, soil sterility, organic material, trace elements.

- .1 Use 25mm (1") diameter sampling tube or spade and in presence of Consultant take 20 samples from topsoil stockpile at random locations. Mix samples together thoroughly before submitting for testing.
- .2 Submit .5 kg. samples of topsoil to testing laboratory and indicate present use, intended use, type of subsoil and quality of drainage. Prepare and ship sample in accordance with provincial regulations and testing laboratory requirements.
- .3 Determine required limestone treatment to bring pH level of soil to 6-7.
- .4 Acceptable topsoil source - Hermanns Screened Topsoil for sodding and seeding and amended with BioEarth as planting mix.
- .5 Bioretention topsoil – acceptable source – Hermanns Bioretention Media

2.2 MATERIALS

- .1 Topsoil: All topsoil used for planting purposes shall be screened, fertile, friable, natural loam containing four percent (4%) minimum organic matter for clay loams and two percent (2%) minimum organic matter for sandy loams. Acidity of topsoil shall range from 6.0pH to 7.5 pH (levels of NPK and Mg are to be noted). It shall be free of any mixture of subsoil, clay lumps, stones, and roots over 50mm in diameter and any toxic materials or foreign objects and shall be reasonably free of weed and weed seeds.
- .2 Loam: Sandy loam topsoil.
- .3 Compost: Processed organic matter containing 40% or more organic matter as determined by the Walkley-black or LOI test. Decayed leaf or mushroom compost as available by Gro Bark, All Treat Farms or Grower's Choice or approved equal. Compost shall be free of metals and glass or other unacceptable materials for planting use. Product must be sufficiently decomposed (i.e. stable) so that any further decomposition does not adversely affect plant growth.
- .4 Manure: Well-rotted, unbleached cattle manure; free from harmful chemicals and other injurious substances, and sawdust, shavings or similar refuse; at least eight (8) months old, but not more than two (2) year old; and with no more that 25% straw, leaves, or other unacceptable materials for planting use.
- .5 Pine Bark Compost: Decomposed pine bark mulch with or without Perlite as available from Gro Bark, All Treat Farms or Grower's Choice or approved equal.
- .6 Pine Bark Mulch: Finely Shredded Pine bark mulch as available from Gro Bark, All Treat Farms or Grower's Choice or approved equal.
- .7 Peatmoss: Derived from partially decomposed sphagnum mosses; brown in colour, elastic and homogeneous with shredded particle sizes of minimum 5mm, free of wood and deleterious material which could prohibit plant growth.
- .8 Bonemeal: Raw, commercial, finely ground and with a minimum content of 4% nitrogen and 20% phosphoric acid.
- .9 Fertilizer:

- .1 Complete commercial fertilizer, 50% of the elements of which shall be derived from organic sources, and containing no less than 60% urea-formaldehyde with percentages by weight of nitrogen, phosphoric acid, and potash required to make up chemical deficiencies of soil and as required by plant growth and noted in soil test results.
- .2 Incorporate finely ground commercial superphosphate with a minimum analysis of 20% phosphorous (v) oxide.
- .3 Acid Fertilizer 15-5-10, pH level 5.5 – 6.5.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Remove soil contaminated with toxic materials. Dispose of removed materials as directed by Consultant. Do not perform work under adverse field conditions such as frozen soil, excessively wet soil, ice, or standing water.
- .2 Cultivate entire area that is to receive topsoil to a minimum depth of 150mm (6") in sodded and seeded areas. Repeat cultivation in those areas where equipment use for hauling and spreading has compacted soil.
- .3 Follow depth requirements for planting areas as per section 32 93 10 Trees Shrubs and Ground Cover.
- .4 Remove and dispose of weeds; debris; stones 40mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; as directed by Landscape Architect or Consultant.

3.2 SPREADING OF TOPSOIL/PLANTING SOIL

- .1 Spread topsoil after Consultant has inspected subgrade.
- .2 Fine-grade topsoil eliminating rough and low areas to ensure positive drainage and meet the lines and levels indicated. Do all fine grading with approved equipment being careful not to excessively compact topsoil. Roll topsoil with a light roller.
- .3 Spread topsoil in uniform layers not exceeding 150mm.
- .4 For sodded areas keep topsoil 15mm below finished grade adjacent to walkways to ensure no obstruction to drainage.
- .5 Apply topsoil as indicated to following minimum depths:
 - .1 150mm (6") Sodded areas.
 - .2 150mm (6") for seeded areas.
 - .3 500mm (20") for planting beds.
- .6 Manually spread topsoil/planting soil around trees, shrubs and obstacles.

- .7 If specific site areas are not designated for grade changes, the Contractor shall not be excused from his responsibility to fine-grade these areas. In this situation, the area should be mowed to eliminate excess organic matter with all cuttings thus generated disposed of in location approved by the Consultant.

3.3 SOIL AMENDMENTS

- .1 Apply soil amendments at rate as specified and as determined from soil sample test. Start laying sod at bottom of slopes.
- .2 Mix soil amendments into full depth of topsoil prior to application of fertilizer.

3.4 APPLICATION OF FERTILIZER

- .1 Spread fertilizer uniformly over entire area of topsoil at manufacturer's recommended rate of application.
- .2 Mix fertilizer thoroughly to full depth of topsoil.
- .3 Add Fertilizer no later than June.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 32 91 10 - Topsoil Placement and Fine Grading.

1.2 SUBMITTALS

- .1 Samples.
 - .1 Submit:
 - .1 Bio-degradable geotextile fabric.

1.3 SCHEDULING

- .1 Schedule deliveries in order to keep storage at job site to minimum without causing delays.
- .2 Deliver, unload and store sod on pallets.
- .3 Deliver sod to site within 24 hours of being lifted and lay sod within 36 hours of being lifted.
- .4 Do not deliver small, irregular or broken pieces of sod.
- .5 During wet weather allow sod to dry sufficiently to prevent tearing during lifting and handling.
- .6 During dry weather protect sod from drying and water sod as necessary to ensure its vitality. Dry sod will be rejected.
- .7 Schedule sod laying to coincide with preparation of soil surface.
- .8 Schedule sod installation when frost is not present in ground

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Divert unused fertilizer from landfill to official hazardous material collections site approved by Consultant.
- .2 Do not dispose of unused fertilizer into sewer systems, into lakes, streams, onto ground or in locations where it will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Number One Turf Grass Nursery Sod: sod that has been especially sown and cultivated in nursery fields as turf grass crop. Quality and source to comply with standards outlined in the latest issue of the Nursery Sod Growers Association of Ontario.
 - .1 Turf Grass Nursery Sod types:

Number One Kentucky Bluegrass Sod - Fescue Sod: Nursery Sod grown solely from seed mixture of cultivars of Kentucky Bluegrass and Chewing Fescue or Creeping Red Fescue, containing not less than 40% Kentucky Bluegrass cultivars and 30% Chewing Fescue or Creeping Red Fescue cultivar[s].

- .1 Number One Named Cultivars: Nursery Sod grown from certified seed.
- .2 Turf Grass Nursery Sod quality:
 - .1 Not more than 2 broadleaf weeds or 10 other weeds per 40 square metres.
 - .2 Density of sod sufficient so that no soil is visible from height of 1500 mm when mown to height of 50 mm.
 - .3 Mowing height limit: 35 to 65 mm.
 - .4 Soil portion of sod: 6 to 15 mm in thickness.
- .2 Sod establishment support:
 - .1 Wooden pegs: 17 x 8 x 200mm.
 - .2 Geotextile.
 - .3 Biodegradable starch pegs: 17 x 8 x 200mm.
- .3 Water:
 - .1 Potable
- .4 Fertilizer:
 - .1 To Canada "Fertilizers Act" and "Fertilizers Regulations".
 - .2 Complete, synthetic, slow release with 35% of nitrogen content in water-insoluble form.

2.2 SOURCE QUALITY CONTROL

- .1 Obtain approval from Consultant of sod at source.
- .2 When proposed source of sod is approved, use no other source without written authorization from Consultant.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Verify that grades are correct and prepared in accordance with Section 32 91 10 - Topsoil Placement and Grading. Prior to sodding, obtain approval from Consultant that finished grade and depth of topsoil are satisfactory.



- .2 Do not perform work under adverse field conditions such as frozen soil, excessively wet soil or soil covered with snow, ice, or standing water.
- .3 Fine grade surface free of humps and hollows to smooth, even grade, to tolerance of plus or minus 10 mm, for Turf Grass Nursery Sod.
- .4 Remove and dispose of weeds; debris; stones 40mm in diameter and larger; soil contaminated by oil, gasoline and other deleterious materials; as directed by Consultant or project manager.

3.2 SOD PLACEMENT

- .1 Lay sod within 36 hours of being lifted if air temperature exceeds 20 degrees C.
- .2 Lay sod sections in rows, joints staggered. Butt sections closely without overlapping or leaving gaps between sections. Lay sod perpendicular to slope. Cut out irregular or thin sections with sharp implements.
- .3 Lay 2 rolls wide of side on sides of hard surfaces and to rear of curbs as indicated in plans
- .4 Lay sod in bottom of swales and bio-swales.
- .5 Provide close contact between sod and soil with a light power roller providing a maximum weight of 680kg/sq. metre. Use of heavy roller to correct irregularities in grade is not permitted.

3.3 SOD PLACEMENT ON SLOPES AND PEGGING

- .1 Install and secure geotextile fabric in areas indicated, in accordance with manufacturer's instructions.
- .2 Start laying sod at bottom of slopes.
- .3 Peg sod on slopes steeper than 3 horizontal to 1 vertical, within 1.5m of catch basins and within 1m of drainage channels and ditches to following pattern:
 - .1 100mm below top edge at 200mm on centre for first sod sections along contours of slopes.
 - .2 Not less than 3-6 pegs per square metre.
 - .3 Not less than 6-9 pegs per square metre in drainage structures.
 - .4 Drive pegs to 20mm above soil surface of sod sections.

3.4 MAINTENANCE DURING ESTABLISHMENT PERIOD

- .1 Perform following operations from time of installation until acceptance.
- .2 Water sodded areas in sufficient quantities and at frequency required to maintain optimum soil moisture condition to depth of 75 to 100mm.

- .3 Cut grass to 40mm when or prior to it reaching height of 60mm. Remove clippings that will smother grassed areas or mulch clippings.
- .4 Maintain sodded areas weed free.
- .5 Fertilize sodded areas one month after sodding with 2:1:1 ratio fertilizer. Spread evenly at rate of 0.5 kg of nitrogen/100 M2 and water in well.

3.5 ACCEPTANCE

- .1 Turf Grass Nursery Sod areas will be accepted by Consultant or Owner provided that:
 - .1 Sodded areas are properly established.
 - .2 Sod is free of bare and dead spots.
 - .3 No surface soil is visible from height of 1500 mm when grass has been cut to height of 50 mm.
 - .4 Sodded areas have been cut minimum 2 times prior to acceptance.
- .2 Areas sodded in fall will be accepted in following spring one month after start of growing season provided acceptance conditions are fulfilled.

3.6 MAINTENANCE DURING WARRANTY PERIOD

- .1 Perform following operations from time of acceptance until end of warranty period:
 - .1 Water sodded areas at weekly intervals to obtain optimum soil moisture conditions to depth of 75 - 100 mm.
- .2 Repair and renovate areas of poor sod as directed by Owner.
 - .1 Remove existing and dead sod, weeds and debris from area to be re-sodded. Loosen top layer by disking or rototilling. Prepare smooth loose surface for laying sod.
 - .2 Apply fertilizer based on soil analysis. Rake into top layer of soil.
 - .3 Lay sod with sections closely butted, without overlapping of gaps, smooth and even with adjoining areas. Stagger sod joints when sodding large areas. Roll lightly and tamp. Water to obtain moisture penetration of 75 to 100mm. Continue watering at intervals to maintain sufficient growth.
 - .4 Maintain grass height at 50mm in spring and fall. July and August mow height to be 60 mm.
- .3 Repair and renovate areas of poor drainage as directed by Consultant.
 - .1 Remove sod and topsoil from areas requiring regrading to new elevations with sub grade 150 mm below final grade.

.2 Remove excess material from site or supply and spread fill to bring subgrade to required elevations.

.3 After regrading sub grade, supply and spread topsoil to depth of 150 minimum.

3.7 CLEANING

.1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- .1 Section Includes:
 - .1 Materials and installation for fertilizing and preserving root systems of plants affected by changing grades or excavation.
- .2 Related Sections:
 - .1 Section 31 11 00 – Clearing and Grubbing
 - .2 Section 32 91 10 – Topsoil Placement & Grading
 - .3 Section 32 92 23 - Sodding

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CSA G30.5-[M1983(R1998)], Welded Steel Wire Fabric for Concrete Reinforcement.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
 - .2 Fertilizers Act (R.S. 1985, c. F-10).
 - .3 Fertilizers Regulations (C.R.C., c. 666).
 - .4 Transportation of Dangerous Goods Act (TDGA), 1992, c. 34.
- .3 Health Canada - Pest Management Regulatory Agency (PMRA).
 - .1 National Standard for Pesticide Education, Training and Certification in Canada (1995).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS).

1.3 DEFINITION

- .1 Mycorrhiza : association between fungus and roots of plants. This symbiosis, enhances plant establishment in newly landscaped and imported soils.

1.4 SUBMITTALS

- .1 Make submittals in accordance with Architectural Submittal Procedures.

.2 Submit monthly written reports on maintenance during warranty period, to Consultant identifying:

- .1 Maintenance work carried out.
- .2 Development and condition of plant material.
- .3 Preventative or corrective measures required which are outside Contractor's responsibility.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Waste Management and Disposal:

- .1 Separate waste materials for reuse and recycling.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal paper, plastics, polystyrene, corrugated cardboard and packaging material in appropriate on-site bins in accordance with Waste Management Plan.
- .4 Separate for reuse and recycling and place in designated containers Steel and Metal waste in accordance with Waste Management Plan.
- .5 Divert unused metal and wiring materials from landfill to metal recycling facility as approved by Consultant.
- .6 Divert unused wood materials from landfill by alternative disposal such as composting or mulching as approved by Consultant.
- .7 Divert unused stone and aggregate materials from landfill to local facility as approved by Consultant.
- .8 Divert unused plastic materials from landfill to local recycling facility approved by Consultant.
- .9 Place materials defined as hazardous or toxic in designated containers.
- .10 Dispose of unused fertilizer material at official hazardous material collections site approved by Consultant.
- .11 Handle and dispose of hazardous materials in accordance with CEPA, TDGA and Regional/Municipal regulations.
- .12 Do not dispose of unused fertilizer material into sewer system, into streams, lakes, onto ground or in any other location where they will pose health or environmental hazard.
- .13 Ensure emptied containers are sealed and stored safely.
- .14 Fold up metal banding, flatten and place in designated area for recycling.

1.7 SCHEDULING

- .1 Obtain approval from Consultant of schedule indicating beginning of Work.

1.8 MAINTENANCE DURING WARRANTY PERIOD

- .1 From time of acceptance by Consultant to end of warranty period, perform following maintenance operations.
 - .1 Water to maintain soil moisture conditions for optimum growth and health of plant material without causing erosion.
 - .2 Apply pesticides in accordance with National Standard for Pesticide Education, Training and Certification in Canada, Federal, Provincial and Municipal regulations as and when required to control insects, fungus and disease. Obtain product approval from Consultant prior to application.
 - .3 Apply fertilizer in early spring at rate of 0.025 kg of nitrogen/m².
 - .4 Remove dead, broken or hazardous branches from plant material. Dispose of debris through mulching.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Fill:
 - .1 Type (A): clean, natural sand and gravel material, free from silt, clay, loam, friable or soluble materials and organic matter.
 - .2 Type (B): excavated. pervious soil, free from roots, rocks larger than 75 mm, building debris, and toxic ingredients (salt, oil, etc). Excavated material shall be approved by Consultant before use as fill.
- .2 Coarse washed stones: 35-75 mm diameter clean round hard stone.
- .3 Drain tile: 100 mm diameter corrugated plastic perforated tubing complete with snap couplings. Fill vents with 20 mm clear stone.
- .4 Peat moss:
 - .1 Derived from partially decomposed species of Sphagnum Mosses.
 - .2 Elastic and homogeneous.
 - .3 Free of wood and deleterious material which could prohibit growth.
 - .4 Shredded minimum particle size: 5 mm.
- .5 Fertilizer:

- .1 To Canada Fertilizer Act and Fertilizers Regulations.
- .2 Complete, commercial, slow release with 35 % of nitrogen content in water-insoluble form.
- .6 Anti-desiccant: commercial, wax-like emulsion.
- .7 Filter Cloth:
 - .1 Type 1: 100 % non-woven needle punched polyester, 2.75 mm thick, 240 g/m² mass.
 - .2 Type 2: biodegradable burlap.
- .8 Wood posts: 38 x 89 x 2400 mm length, untreated wood.
- .9 Welded wire fabric (WWF): 100 x 100mm, MW x MW, to CSA G30.5.

PART 3 - EXECUTION

3.1 IDENTIFICATION AND PROTECTION

- .1 Identify plants and limits of root systems to be preserved as approved by Consultant.
- .2 Protect plant and root systems from damage, compaction and contamination resulting from construction as approved Consultant.
- .3 Ensure no pruning is done inside drip line. If pruning inside drip line is required consult an certified and registered, practicing arborist as approved by Consultant.

3.2 ROOT CURTAIN SYSTEM

- .1 Identify limits for required construction excavation as approved by Consultant.
- .2 Prior to construction excavation, hand dig trench minimum 500 mm wide x 1500 mm deep, along perimeter of excavation limits.
- .3 Prune exposed roots cleanly at side of trench nearest plants to be preserved. Pruned ends to point obliquely downwards.
- .4 Install wooden posts and welded wire fabric against construction edge of trench.
- .5 Securely attach Type 2 filter fabric on plant side of wire mesh.
- .6 Prepare homogeneous mixture of fertilizer, parent material and organic matter.
 - .1 Add organic matter to mixture to achieve 7-9% organic matter content by weight.
 - .2 Incorporate with mixture grade 2:12:8 ratio fertilizer (dry) at rate of 1.5 kg/m³.
- .7 Backfill with homogeneous mixture between curtain wall and plants to be preserved in layers not exceeding 150 mm in depth. Compact each layer to 85% Standard Proctor Density.

- .8 Protect root curtain from damage during construction operations.
- .9 Water plants and root curtain sufficiently during construction to maintain optimum soil moisture condition until backfill operations are complete.
- .10 Remove root curtain before backfill operations. Ensure root curtain is cut down to 300 mm below finished grade and remove cut material.

3.3 AIR LAYERING SYSTEM, RAISING GRADE AROUND EXISTING TREE

Refer to drawings to indicate where treatment occurs.

- .1 Using manual methods, carefully remove turf, plants, leaves and organic matter in area of root system, dispose of plant matter through compost and slightly loosen topsoil surface. Avoid damage to root system.
- .2 Lay horizontal system of perforated drain pipe on surface of existing grade.
 - .1 Slope drain tile minimum 2% for drainage away from trunk of tree.
 - .2 Connect system with general site drainage system or drain to low point on site.
- .3 Install plastic "vent" pipes vertically over joints in horizontal pipe system or where indicated. Top of vent pipe to be 20 mm above finished grade of fill. Keep top of vent pipe covered during construction.
- .4 Cover joints with Type 1 filter fabric and place coarse washed stone around joints and vertical pipes to secure their position.
- .5 Construct drywell around trunk of tree.
 - .1 Ensure open ends of horizontal pipe system and vertical vent pipes are left exposed for air circulation to root system.
 - .2 Protect openings from blockage during construction.
 - .3 Install protective caps on exposed horizontal openings.
- .6 Place 200 mm depth of coarse washed stone on surface of original ground and horizontal pipe system to limits.
- .7 Place Type 1 filter fabric over surface of granular layer.
- .8 Place Type A granular fill over filter fabric to required depth without disturbing or damaging drain pipe system. Avoid damage to filter fabric.
- .9 Complete topsoil, sodding or finished paving over area of sub-surface system within one week of placing fill.
- .10 Remove temporary protective covering from vent pipe openings. Install protective caps flush with finished grade.

3.4 TRENCHING AND TUNNELING FOR UNDERGROUND SERVICES

Use when service trenching/excavating within limits of tree root system is necessary. Use only for trees greater than 150 mm diameter. Do not use for trees with major tap roots. Centre line of service to be in line with trunk of tree.

- .1 Centre line location and limits of trench/tunnel excavation to be approved by CONSULTANT prior to excavation. Tunnel excavation to extend 2000 mm from edge of trunk on either side.
- .2 Excavate manually within zone of root system. Do not sever roots greater than 40 mm diameter except at greater than 500 mm below existing grade. Protect roots, and cut roots cleanly with sharp disinfected tools.
- .3 Excavate tunnel under centre of tree trunk using methods and equipment approved by Consultant.
- .4 Minimum acceptable depth to top of tunnel: 1000 mm.
- .5 Backfill for tunnel and trench to 85% Standard Proctor Density. Avoid damage to trunk and roots of tree.
- .6 Complete tunneling and backfilling at tree within 2 weeks of beginning Work.

3.5 LOWERING GRADE AROUND EXISTING TREE

- .1 Begin Work in accordance with schedule approved by CONSULTANT.
- .2 Cut slope not less than 500mm from tree trunk to new grade level.
- .3 Excavate to depths as indicated. Protect from damage root zone which is to remain.
- .4 When severing roots at excavation level, cut roots with sharp tools.
- .5 Cultivate excavated surface manually to 15mm depth.
- .6 Prepare homogeneous soil mixture consisting by volume of:
 - .1 60 % excavated soil cleaned of roots, plant matter, stones, debris.
 - .2 25 % coarse, clean sterile sand.
 - .3 15 % organic matter.
 - .4 Grade 2:12:8 fertilizer at rate of 1.5 kg/m³.
- .7 Place soil mixture over area of excavation to finished grade level. Compact to 85% Standard Proctor Density.
- .8 Water entire root zone to optimum soil moisture level.
- .9 Install surface cover of sodding in accordance with Section 02925 - Sodding.

3.6 PRUNING

- .1 Prune crown to compensate for root loss while maintaining general form and character of plant. Dispose of debris through mulching.

3.7 ANTI DESICCANT

- .1 Apply anti-desiccant to foliage where applicable and as directed by Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Design, labour, products, and services necessary to complete the work of this Section in accordance with the Contract Documents.
- .2 List of metal fabrication items include, but is not limited to: metal stairs, railings, access ladders, cages, trench covers and frames, angle edging at concrete floors, angle supports for manifolds, pipe bollards, bolts, anchor bolts, screws and other fasteners as required, miscellaneous metal channels, angles, plates and closure plates.
- .3 All requirements of Division 01 apply to this section and are to be read in conjunction.

1.2 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A269, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
- .2 CSA International
 - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .3 CSA S16-09, Design of Steel Structures.
 - .4 CSA W48-06, Filler Metals and Allied Materials for Metal Arc Welding (Developed in co-operation with the Canadian Welding Bureau).
 - .5 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .3 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .4 The Master Painters Institute (MPI)
 - .1 Architectural Painting Specification Manual - current edition.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.

.2 Product Data:

- .1 Submit manufacturer's instructions, printed product literature and data sheets for sections, plates, pipe, tubing, bolts and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Submit two copies of WHMIS MSDS in accordance with Section 01 35 43 - Environmental Procedures.
 - .1 For finishes, coatings, primers, and paints applied on site: indicate VOC concentration in g/L.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
- .2 Indicate materials, core thicknesses, finishes, connections, and joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements, and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Steel sections and plates: to CSA G40.20/G40.21, Grade 300W and 350W.
- .2 Steel pipe: to ASTM A53/A53M standard weight, galvanized finish.
- .3 Welding materials: to CSA W59.
- .4 Welding electrodes: to CSA W48 Series.

- .5 Bolts and anchor bolts: to ASTM A307.
- .6 Aluminum sheet: plain pattern, 0.53 mm minimum thickness, pre-finished, colour to be selected by Consultant.
- .7 Grout: non-shrink, non-metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

- .1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Use self-tapping shake-proof round headed screws on items requiring assembly by screws or as indicated.
- .3 Where possible, fit and shop assemble work, ready for erection.
- .4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Shop coat primer: MPI- EXT 5.1B, MPI- EXT 5.1C, MPI- EXT 5.3B, in accordance with chemical component limits and restrictions requirements and VOC limits of GS-11.

2.4 ISOLATION COATING

- .1 Isolate aluminum from following components, by means of bituminous paint:
 - .1 Dissimilar metals except stainless steel, zinc, or white bronze of small area.
 - .2 Concrete, mortar and masonry.
 - .3 Wood.

2.5 SHOP PAINTING

- .1 Primer: VOC limit 250 g/L maximum to GS-11.
- .2 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
- .3 Use primer unadulterated, as prepared by manufacturer. Paint on dry surfaces, free from rust, scale, grease. Do not paint when temperature is lower than 7 degrees C.
- .4 Clean surfaces to be field welded; do not paint.

2.6 ANGLE LINTELS

- .1 Steel angles: exterior galvanized and interior prime painted, sizes indicated for openings. Provide 150 mm minimum bearing at ends.
- .2 Weld or bolt back-to-back angles to profiles as indicated.

.3 Finish: exterior galvanized and interior site painted.

.1 Primer: VOC limit 250 g/L maximum to GS-11 when applied onsite.

2.7 PIPE RAILINGS

.1 Steel pipe: 40 mm nominal outside diameter, formed to shapes and sizes as indicated.

.2 Galvanize exterior pipe railings after fabrication.

2.8 ACCESS LADDERS

.1 Design Requirements:

.1 Design fixed metal ladder and cage construction and connections to Ontario OHSA requirements.

.2 Rails: 102 x 102 x 8 mm thick, steel angle.

.3 Steel Rungs: 20 mm diameter x 400, welded to rails at 305 mm on centre.

.4 Brackets: sizes and shapes as indicated, bolted to rails at 1800 mm on centre, complete with fixing anchors.

.5 Accessories:

.1 Lockable metal hinged gate. Fabricate gate from 14 gauge steel plate, minimum 2100 mm high by 75 mm deep, to width of the ladder.

.6 Shop paint exterior ladder and accessories after fabrication.

2.9 CHANNEL FRAMES

.1 Fabricate frames from steel, sizes of channel and opening as indicated.

.2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.

.3 Weld 50 x 200 x 5 mm thick steel strap anchors to channel jamb frame at 800mm on centre.

.4 Finish: galvanized.

2.10 MISCELLANEOUS FABRICATIONS

.1 Louvre framing, dampeners and silencer, and exhaust muffler supports and brackets.

.2 Equipment hangers and supports: Cold rolled structural steel to be sized by supplier's structural steel Engineer, as required for application.

.3 Bollards.

.4 OH Door Jambs & Heads.

.5 Roof Mechanical Equipment supports, stands & curbs.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal fabrications installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 ERECTION

- .1 Do welding work in accordance with CSA W59 unless specified otherwise.
- .2 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .3 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .4 Exposed fastening devices to match finish and be compatible with material through which they pass.
- .5 Supply components for work by other trades in accordance with shop drawings and schedule.
- .6 Make field connections with bolts to CSA S16.
- .7 Deliver items over for casting into concrete and building into masonry together with setting templates to appropriate location and construction personnel.
- .8 Touch-up field welds, bolts and burnt or scratched surfaces with primer after completion of installation.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.
- .9 Touch-up galvanized surfaces with zinc rich primer where burned by field welding or surface damaged.
 - .1 Primer: maximum VOC limit 250 g/L to GS-11.

3.3 PIPE RAILINGS

- .1 Install pipe railings on steel stair stringers as indicated.

3.4 ACCESS LADDERS

- .1 Install access ladders in locations as indicated.
- .2 Erect ladders 150 mm clear of wall on bracket supports.

3.5 CHANNEL FRAMES

- .1 Install steel channel frames to openings as indicated.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning].
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
- .3 Waste Management: separate waste materials for reuse or recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.7 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by metal fabrications installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Design, labour, products, and services necessary to complete the work of this Section in accordance with the Contract Documents.
- .2 All requirements of Division 01 apply to this section and are to be read in conjunction.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 04 22 00 – Concrete Unit Masonry
- .5 Section 05 50 00 – Metal fabrications
- .6 Section 07 62 00 – Sheet Metal Flashing and Trim
- .7 Section 09 91 13 – Exterior Painting

1.3 REFERENCES

- .1 American National Standards Institute/National Association of Architectural Metal Manufacturers (ANSI/NAAMM)
 - .1 ANSI/NAAMM MBG 531-00, Metal Bar Grating Manual.
- .2 ASTM International
 - .1 ASTM A53/A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .3 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa Minimum Tensile Strength.
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.40-97, Anti-corrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 CSA International
 - .1 CSA G40.20/G40.21-04(R2009), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

- .2 CAN/CSA G164-M92(R2003), Hot Dip Galvanizing of Irregularly Shaped Articles.
- .3 CSA W59-03, Welded Steel Construction (Metal Arc Welding).
- .5 Health Canada / Workplace Hazardous Materials Information System (WHMIS)
- .1 Material Safety Data Sheets (MSDS).
- .6 National Association of Architectural Metal Manufacturers (NAAMM)
- .1 AMP 510-92, Metal Stair Manual.
- .7 The Society for Protective Coatings (SSPC)
- .1 Systems and Specifications Manual, Volume 2, 2008 Edition.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate construction details, sizes of steel sections and thickness of steel sheet.

1.5 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.
- .2 Certifications: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect stairs and ladders from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 Design Requirements:
 - .1 Design metal stair, balustrade and landing construction and connections to OBC vertical and horizontal live load requirements.
 - .2 Detail and fabricate stairs to NAAMM Metal Stairs Manual.

2.2 MATERIALS

- .1 Steel sections: to CSA G40.20/G40.21 Grade 300W and 350W.
- .2 Steel pipe: to ASTM A53/A53M, standard weight, schedule 40 seamless black.
- .3 Metal bar grating: to ANSI/NAAMM MBG 531, steel, Type W-19-4, with checkered plate nosings.
- .4 Welding materials: to CSA W59.
- .5 Bolts: to ASTM A307.
- .6 High strength bolts: to ASTM A325M.

2.3 FABRICATION

- .1 Fabricate in accordance with NAAMM, Metal Stair Manual.
- .2 Weld connections where possible, otherwise bolt connections. Countersink exposed fastenings, cut off bolts flush with nuts. Make exposed connections of same material, colour and finish as base material on which they occur.
- .3 Accurately form connections with exposed faces flush:
 - .1 Make mitres and joints tight.
 - .2 Make risers of equal height.
- .4 Grind or file exposed welds and steel sections smooth.
- .5 Shop fabricate stairs in sections as large and complete as practicable.

2.4 PLATE/GRATING STAIRS

- .1 Form steel grating treads and landings from metal bar grating to profile indicated and secure to stringers and supports as indicated. Form landings of steel grating and reinforce as required.
- .2 Form stringers from MC 310 x 15.8.
- .3 Close ends of stringers where exposed.

2.5 PIPE/TUBING BALUSTRADES

- .1 Construct balusters and handrails from steel pipe.
- .2 Cap and weld exposed ends of balusters and handrails.
- .3 Terminate at abutting wall with end flange.
- .4 Weld balustrades to stringers as indicated.

2.6 FINISHES

- .1 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CAN/CSA-G164.
- .2 Shop coat primer: to CAN/CGSB-1.40.
- .3 Zinc primer: zinc rich, ready mix to CAN/CGSB-1.181.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrates previously installed under other Sections or Contracts are acceptable for metal stairs and ladders installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Owner and Consultant.
 - .2 Inform Owner and Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Owner and Consultant.

3.2 INSTALLATION OF STAIRS

- .1 Install in accordance with NAAMM, Metal Stair Manual.
- .2 Install plumb and true in exact locations, using welded connections wherever possible to provide rigid structure. Provide anchor bolts, bolts and plates for connecting stairs to structure.
- .3 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .4 Do welding work in accordance with CSA W59 unless specified otherwise.
- .5 Touch up shop primer to bolts, welds, and burned or scratched surfaces at completion of erection.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00 - Cleaning.

- .1 Leave Work area clean at end of each day.
 - .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 00 - Cleaning.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
 - .3 Perform cleaning as soon as possible after installation to remove construction and accumulated environmental dirt.
 - .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.
- 3.4 PROTECTION
- .1 Protect installed products and components from damage during construction.
 - .2 Repair damage to adjacent materials caused by metal stairs and ladders installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 04 22 00 – Concrete Unit Masonry.
- .4 Section 06 05 73 – Wood Treatment.
- .5 Section 07 21 13 – Board Insulation.
- .6 Section 07 26 00 – Vapour Retarders.
- .7 Section 07 27 00 – Air Barriers.
- .8 Section 07 52 00 – Modified Bituminous Membrane Roofing.
- .9 Section 07 62 00 – Sheet Metal Flashing and Trim.

1.2 REFERENCES

- .1 American Wood-Preservers' Association (AWPA)
 - .1 AWPA M2, Standard Inspection of Treated Wood Products.
 - .2 AWPA M4, Standard for the Care of Preservative-Treated Wood Products.
- .2 Canadian Standards Association (CSA)
 - .1 CSA O80 Series, Wood Preservation.
 - .2 CSA O80.20, Fire-Retardant Treatment of Lumbering Pressure Processes. This Standard applies to the fire-retardant treatment of lumber by pressure processes. Fire-Retardant Treatment of Lumber by Pressure Processes. This is not a stand alone specification.
 - .3 CSA O80.27, Fire-Retardant Treatment of Plywood by Pressure Processes. This Standard covers the fire-retardant treatment of Douglas Fir, hardwood, softwood, and Poplar plywood by pressure processes. Fire-Retardant Treatment of Plywood by Pressure Processes. This not a standalone specification.
 - .4 CSA O80.201, Standard for Hydrocarbon Solvents for Preservatives. This Standard covers hydrocarbon solvents for preparing solutions of preservatives.- This is not stand alone specification
 - .5 CSA O322, Procedure for Certification of Pressure-Treated Wood Materials for Use in Preserved Wood Foundations.

1.3 REGULATORY REQUIREMENTS

- .1 Each board or bundle of fire-retardant treated material panel to bear ULC label indicating Flame Spread Classification (FSC), and smoke developed.

1.4 CERTIFICATES

- .1 For products treated with preservative, fire-retardant by pressure impregnation submit following information certified by authorized signing officer of treatment plant:
 - .1 Information listed in AWP A M2 and revisions specified in CSA O80 Series, Supplementary Requirement to AWP A M2 applicable to specified treatment.
 - .2 Moisture content after drying following treatment with water-borne preservative, fire-retardant.
 - .3 Acceptable types of paint, stain, and clear finishes that may be used over treated materials to be finished after treatment.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Do not dispose of preservative treated wood through incineration.
- .2 Do not dispose of preservative treated wood with other materials destined for recycling or reuse.
- .3 Dispose of treated wood, end pieces, wood scraps and sawdust at sanitary landfill approved by Owner's Representative.
- .4 Dispose of unused wood preservative material at official hazardous material collections site approved by Owner's Representative.
- .5 Do not dispose of unused preservative material into sewer system, into streams, lakes, onto ground or in other location where they will pose health or environmental hazard.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Preservative: to CAN/CSA-O80 Series, stained finish.
- .2 Fire-Retardant: to CAN/CSA O80.20.
- .3 Solvent: to CAN/CSA-O80.201.

PART 3 - EXECUTION

3.1 APPLICATION: PRESERVATIVE

- .1 Treat lumber to CAN/CSA- O80 Series.
- .2 Following water-borne preservative treatment, dry material to maximum moisture content of 19%.

3.2 APPLICATION: FIRE-RETARDANT

- .1 Treat lumber by pressure impregnation with fire-retardant chemicals in accordance with CAN/CSA - O80.20.
- .2 Following treatment, kiln-dry material to maximum moisture content of 19%.

3.3 APPLICATION: FIELD TREATMENT

- .1 Comply with AWP A M4 and revisions specified in CAN/CSA-O80 Series, Supplementary Requirements to AWP A Standard M2.
- .2 Treat all field cuts with two (2) coats of clear copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.
- .3 Remove chemical deposits on treated wood to receive applied finish.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 61 00- Common Product Requirements.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 04 22 00 – Concrete Unit Masonry.
- .4 Section 06 05 73 - Wood Treatment.
- .5 Section 07 52 00 - Modified Bituminous Membrane Roofing
- .6 Section 07 91 00 - Joint Sealants.
- .7 Section 09 21 16 - Gypsum Board Assemblies.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM C578, Specification for Rigid, Cellular Polystyrene Thermal Insulation.
 - .4 ASTM C1396/C1396M, Standard Specification for Gypsum Board.
 - .5 ASTM D5055, Specification for Establishing and Monitoring Structural Capacities of Prefabricated Wood I-Joists.
 - .6 ASTM F1667, Standard Specification for Driven Fasteners: Nails, Spikes and Staples.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-71.26, Adhesive for Field-Gluing Plywood to Lumber Framing for Floor Systems.
- .3 Canadian Wood Council
 - .1 Wood Design Manual.
 - .2 Engineering Guide for Wood Frame Construction.
- .4 Canadian Standards Association (CSA)
 - .1 CSA A123.2, Asphalt Coated Roofing Sheets.

- .2 CSA B111, Wire Nails, Spikes and Staples.
- .3 CSA 0112.9, Evaluation of Adhesives for Structural Wood Products (Exterior Exposure).
- .4 CSA O121, Douglas Fir Plywood.
- .5 CSA-O141, Softwood Lumber.
- .6 CSA O151, Canadian Softwood Plywood.
- .7 CSA-O325.0, Construction Sheathing.
- .5 National Lumber Grades Authority (NLGA)
 - .1 Standard Grading Rules for Canadian Lumber.
- .6 National Research Council Canada (NRC)
 - .1 Ontario Building Code of Canada (OBC).

1.3 QUALITY ASSURANCE

- .1 Lumber identification: by grade stamp of an agency certified by Canadian Lumber Standards Accreditation Board.
- .2 Plywood, particleboard, OSB and wood based composite panels in accordance with CSA and ANSI standards.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00- Submittal Procedures.
- .2 Submit proof of compatibility between Alkaline Copper Quaternary (ACQ) pressure treated lumber and fasteners to be utilized.
- .3 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for wood products and accessories and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include manufacturer's pre-engineered floor, ceiling and roof joist span charts, and manufacturer's pre-engineered installation details.
 - .3 Submit certified test reports for prefabricated structural members from approved independent laboratory indicating compliance with specifications for specified performance characteristics and physical properties.
 - .4 Submit CCMC Product Evaluation Report for engineered wood products.
 - .5 Submit manufacturer's installation instructions.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00- Common Product Requirements.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location, off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store materials off ground with moisture barrier at both ground level and as a cover forming a well-ventilated enclosure, with drainage to prevent standing water.
 - .3 Stack, lift, brace, cut and notch engineered lumber products in strict accordance with manufacturer's instructions and recommendations.
 - .4 Store and protect architecturally exposed lumber from nicks, scratches, and blemishes.
 - .5 Replace defective or damaged materials with new.
 - .6 Store separated reusable wood waste convenient to cutting station and work areas.

PART 2 - PRODUCTS

2.1 STRUCTURAL FRAMING

- .1 Lumber: unless specified otherwise, softwood, No. 1 or No. 2 grade, S4S, moisture content 19% (S-dry) or less in accordance with following standards:
 - .1 CAN/CSA-O141.
 - .2 NLGA Standard Grading Rules for Canadian Lumber.
- .2 Framing and board lumber: in accordance with OBC.
- .3 Furring, blocking, nailing strips, grounds, rough bucks, fascia backing and sleepers:
 - .1 Board sizes: "Standard" or better grade.
 - .2 Dimension sizes: "Standard" light framing or better grade.
 - .3 Post and timbers sizes: "Standard" or better grade.
- .4 Pressure treated material to be Alkaline Copper Quaternary (ACQ).
- .5 Where indicated, provide pressure treated materials for furring, blocking, nailing strips, grounds, rough bucks, cants, curbs, fascia backing and sleepers in accordance with Section 06 05 73.

2.2 PANEL MATERIALS

- .1 Plywood, OSB and wood based composite panels: to CAN/CSA-O325.0.
- .2 Douglas fir plywood (DFP): to CSA O121, standard construction.
- .3 Canadian softwood plywood (CSP): to CSA O151, standard construction.
- .4 Insulating fiberboard sheathing: to CAN/CSA-A247.
- .5 Expanded polystyrene sheathing: to Section 07 21 13 – Board Insulation.
- .6 Gypsum sheathing: to 09 21 16 – Gypsum Board Assemblies.

2.3 ACCESSORIES

- .1 Polyethylene film: to Section 07 26 00 – Vapour Retarders.
- .2 Sill Gasket Air seal: closed cell polyurethane or polyethylene.
- .3 Sealants: Section 07 92 00 – Joint Sealants.
- .4 General purpose adhesive: to CSA O112.9.
- .5 Nails, spikes and staples: to CSA B111.
- .6 Bolts: 12.5 mm diameter unless indicated otherwise, complete with nuts and washers.
- .7 Proprietary fasteners: toggle bolts, expansion shields and lag bolts, screws and lead or inorganic fibre plugs, explosive actuated fastening devices, recommended for purpose by manufacturer.

2.4 FASTENER FINISHES

- .1 Galvanizing: to ASTM A123/A123M, ASTM A653, use galvanized fasteners for exterior work, interior highly humid areas and fire-retardant treated lumber.

2.5 WOOD PRESERVATIVE

- .1 Surface-applied wood preservative: clear or copper naphthenate or 5% pentachlorophenol solution, water repellent preservative.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Treat surfaces of material with wood preservative, before installation.
- .2 Apply preservative by dipping, or by brush to completely saturate and maintain wet film on surface for minimum 3 minute soak on lumber and one minute soak on plywood.
- .3 Re-treat surfaces exposed by cutting, trimming or boring with liberal brush application of preservative before installation.

- .4 Treat all material as indicated as follows:
 - .1 Wood fascia, backing, curbs, nailers.
 - .2 Wood furring for sheeting/siding on outside surface of exterior masonry concrete walls.
 - .3 Wood sleepers supporting wood subflooring over concrete slabs in contact with ground or fill.

3.2 SYSTEMS INTEGRATION

- .1 Install air barrier and vapour retarder sheeting around framing members to ensure continuity of protection and to lap and seal to main sheets.
- .2 Install insulation in exterior wall framing cavities that will not be accessible after completion of framing.

3.3 INSTALLATION

- .1 Comply with requirements of OBC latest edition, Part 9 supplemented by following paragraphs.
- .2 Install members true to line, levels and elevations, square and plumb.
- .3 Construct continuous members from pieces of longest practical length.
- .4 Install spanning members with "crown-edge" up.
- .5 Select exposed framing for appearance. Install lumber and panel materials so that grade-marks and other defacing marks are concealed or are removed by sanding where materials are left exposed.
- .6 Frame, anchor, fasten, tie and brace members to provide necessary strength and rigidity.
- .7 Countersink bolts where necessary to provide clearance for other work.
- .8 Install specified panel product for each application.
- .9 Install wall sheathing in accordance with manufacturer's printed instructions.
- .10 Install roof sheathing in accordance with requirements of OBC.
- .11 Install furring and blocking as required to space-out and support casework, cabinets, wall and ceiling finishes, facings, fascia, soffit, siding electrical equipment mounting boards, and other work as required.
- .12 Install furring to support siding applied vertically where there is no blocking and where sheathing is not suitable for direct nailing.
 - .1 Align and plumb faces of furring and blocking to tolerance of 1:600.
- .13 Install rough bucks, nailers and linings to rough openings as required to provide backing for frames and other work.

.14 Install wood cants, fascia backing, nailers, curbs and other wood supports as required and secure using galvanized steel fasteners. Coordinate height of roof curbs with Section 07 52 00 – Modified Bituminous Membrane Roofing.

.15 Install sleepers as indicated.

.16 Use dust collectors and high quality respirator masks when cutting or sanding wood panels.

3.4 SCHEDULES

.1 Roof sheathing:

.1 Plywood, DFP or CSP sheathing grade (SHG) T&G edge, 16 mm thick, unless otherwise indicated.

.2 Exterior wall sheathing:

.1 Plywood, DFP or CSP sheathing grade or (SHG) grade, T&G edge, 16 mm thick, unless otherwise indicated.

.2 Gypsum sheathing, Section 09 21 16 – Gypsum Board Assemblies.

.3 Electrical equipment mounting boards:

.1 Plywood, DFP or CSP grade, (G1S) select square edge 16 mm thick, unless otherwise indicated.

.4 Underlay:

.1 Plywood, DFP or CSP sheathing grade (Select), square edge 6 mm thick, unless otherwise indicated.

3.5 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by rough carpentry installation.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation for asphalt for use as dampproofing.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 51 00 - Temporary Utilities.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .5 Section 03 30 00 – Cast-In-Place Concrete.
- .6 Section 04 22 00 – Concrete Unit Masonry.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 37.2, Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings.
 - .2 CAN/CGSB 37.3, Application of Emulsified Asphalts for Dampproofing or Waterproofing.
 - .3 CAN/CGSB 37.5, Cutback Asphalt Plastic Cement.
 - .4 CGSB 37-GP-9Ma, Primer, Asphalt, Unfilled, for Asphalt Roofing, Dampproofing and Waterproofing.
 - .5 CGSB 37-GP-11M, Application of Cutback Asphalt Plastic Cement.
 - .6 CAN/CGSB 37.16, Filled, Cutback, Asphalt for Dampproofing and Waterproofing.
 - .7 CGSB 37-GP-36M, Application for Filled Cutback Asphalts for Dampproofing and Waterproofing.
- .2 National Research Council Canada (NRC)/Institute for Research in Construction (IRC)
 - .1 Canadian Construction Materials Centre (CCMC)

1.4 PRODUCT DATA

- .1 Submit product data sheets for bituminous dampproofing products. Including:
 - .1 Product characteristics.

.2 Performance criteria.

.3 Application methods.

.4 Limitations.

.2 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence, cleaning procedures.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver, handle, store and protect materials of this section in accordance with Section 01 61 00 - Common Product Requirements.

.2 Provide and maintain dry, off-ground weatherproof storage.

.3 Store materials on supports to prevent deformation.

.4 Remove only in quantities required for same day use.

.5 Store materials in accordance with manufacturer's written instructions.

1.6 PROJECT/SITE ENVIRONMENTAL REQUIREMENTS

.1 Temperature, relative humidity, moisture content.

.1 Apply dampproofing materials only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

.2 Do not proceed with Work when wind chill effect would tend to set bitumen before proper curing takes place.

.3 Maintain air temperature and substrate temperature at dampproofing installation area above 5°C for 24 hours before, during and 24 hours after installation.

.4 Do not apply dampproofing in wet weather.

.2 Safety: Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of asphalt, sealing compounds, primers and caulking materials.

.3 Ventilation:

.1 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.

.2 Provide continuous ventilation during and after dampproofing application. Run ventilation system 24 hours per day during installation; provide continuous Ventilation for 3 days after completion of dampproofing installation.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 For application and curing at temperatures above 5 degrees C: waterproof emulsion, mineral colloid emulsifier type to CAN/CGSB 37.2.
 - .1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range and final blowing temperature.
- .2 For applications and curing at temperatures above 0 degrees C but below 5 degrees C: solvent type waterproofing and dampproofing compound of selected asphalts and fibers to CAN/CGSB 37.16.
 - .1 Package label or bill of lading for bulk hot liquid asphalt must indicate type, flash point, equiviscous temperature range and final blowing temperature.
- .3 Primer for applications at temperatures above 0 degrees C but below 5 degrees C: asphalt/solvent cutback to CAN/CGSB 37.9.
- .4 Sealing compound: plastic cutback asphalt cement to CAN/CGSB-37.5. C.

PART 3 - EXECUTION

3.1 WORKMANSHIP

- .1 Keep hot asphalt:
 - .1 Below its flash point.
 - .2 At or below its final blowing temperature.
 - .3 Within its equiviscous temperature range at place of application.

3.2 PREPARATION

- .1 Before applying dampproofing:
 - .1 Seal exterior joints between foundation walls and footings, joints between concrete floor slab and foundation and around penetrations through dampproofing with sealing compound.

3.3 APPLICATION

- .1 Do dampproofing in accordance with CAN/CGSB 37.3 and CGSB 37-GP-36M except where specified otherwise.
- .2 Do sealing work in accordance with CGSB 37-GP-11M except where specified otherwise.
- .3 Do priming of surface in accordance with CGSB 37-GP-15M except where specified otherwise.
- .4 Apply primer.

3.4 SCHEDULE

- .1 Apply continuous, uniform coating to entire exterior faces of foundation walls as indicated on drawings, to and including tops of foundation wall footings.
- .2 Apply two additional coats of dampproofing to vertical corners and construction joints for a minimum width of 230 mm on each side, and all around and for 230 mm along pipes passing through walls.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 03 30 00 – Cast in Place Concrete.
- .4 Section 04 22 00 – Concrete Unit Masonry.
- .5 Section 06 10 53 – Miscellaneous Rough Carpentry.
- .6 Section 07 26 00 – Vapour Retarders.
- .7 Section 07 62 00 – Sheet Metal Flashing and Trim.

1.2 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM).
 - .1 ASTM C1289, Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
- .2 Canadian Standards Association (CSA)
 - .1 CSA B149 PACKAGE, Consists of B149.1 Natural Gas and Propane Installation Code and B149.2, Propane Storage and Handling Code.
- .3 Canadian General Standards Board (CGSB).
 - .1 CGSB 71-GP-24M, Adhesive, Flexible, for Bonding Cellular polystyrene Insulation.
- .4 Underwriters Laboratories of Canada (ULC).
 - .1 CAN/ULC-S701, Standard for Thermal Insulation, Polystyrene, Boards and Pipe Coverings.
 - .2 CAN/ULC-S702, Standard for Thermal Insulation, Mineral Fibre, for Buildings.
 - .3 CAN/ULC-S704, Standard for Thermal Insulation Polyurethane and Polyisocyanurate, Boards, Faced.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data.
 - .2 Submit two copies of WHMIS MSDS - Material Safety Data Sheets. Indicate VOC's insulation products and adhesives.

- .2 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.

1.4 QUALITY ASSURANCE

- .1 Provide certificate of quality compliance from insulation manufacturer.

PART 2 - PRODUCTS

2.1 INSULATION

- .1 Expanded polystyrene (EPS): for use below grade and exterior walls: to CAN/ULC-S701 Type 2, RSI 0.70 per 25 mm, total thickness as indicated on drawings.
- .2 Urethane (Isocyanurate): Faced, to CAN/ULC-S704 foil facing, RSI 1.05 per 25 mm, total thickness as indicated on drawings.
- .3 Mineral fibre board: to CAN/ULC-S702, Type 2, semi-rigid, density 17.6 kg/m², flexible spinbonded olefin facing, RSI 0.70 per 25 mm, total thickness as indicated on drawings.
- .4 Extruded polystyrene (XPS): to CAN/ULC S701 Type 3, RSI 0.88 per 25 mm, total thickness as indicated on drawings.
- .5 Insulation types not indicated on drawings to be expanded polystyrene (EPS), Type 2 as a default, as per article 2.1.1.

2.2 ADHESIVE

- .1 Adhesive suitable for bonding polystyrene and mineral fibre insulation to substrates as indicated.

2.3 ACCESSORIES

- .1 Insulation clips: impale type, perforated 50 x 50 mm cold rolled carbon steel 0.8 mm thick, spindle of 2.5 mm diameter annealed steel, length to suit insulation, 25 mm diameter washers of self-locking type.
- .2 Joint sealing tape: air resistant pressure sensitive adhesive tape as recommended by insulation manufacturer.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions and data sheets.

3.2 WORKMANSHIP

- .1 Install insulation after building substrate materials are dry.
- .2 Install insulation to maintain continuity of thermal protection to building elements and spaces.

- .3 Fit insulation tight around electrical boxes, plumbing and heating pipes and ducts, around exterior doors and windows and other protrusions.
- .4 Keep insulation minimum 75 mm from heat emitting devices such as recessed light fixtures, and CSA B149.1 and CSA B149.2 type B and L vents.
- .5 Cut and trim insulation neatly to fit spaces. Butt joints tightly, offset vertical joints. Use only insulation boards free from chipped or broken edges. Use largest possible dimensions to reduce number of joints.
- .6 Offset both vertical and horizontal joints in multiple layer applications.
- .7 Do not enclose insulation until it has been inspected and approved by Consultant and Owner's Representative.

3.3 EXAMINATION

- .1 Examine substrates and immediately inform Owner's Representative in writing of defects.
- .2 Prior to commencement of work ensure:
 - .1 Substrates are firm, straight, smooth, dry, free of snow, ice or frost, and clean of dust and debris.

3.4 RIGID INSULATION INSTALLATION

- .1 Apply adhesive to insulation board in accordance with manufacturer's recommendations.
- .2 Imbed insulation boards into vapour barrier type adhesive, applied as specified, prior to skinning of adhesive.
- .3 In addition to adhesive install mineral fiber insulation boards with insulation clips and disk, 2 per 600 x 1200 mm board minimum, fit boards tight, cut off fastener spindle 3 mm beyond disk.
- .4 Leave insulation board joints unbonded over line of expansion and control joints. Bond a continuous 150 mm wide 0.15 mm modified bituminous membrane over expansion and control joints using compatible adhesive and primer before application of insulation.
- .5 Carefully inspect for continuity of air barrier prior to placement of insulation.

3.5 PERIMETER FOUNDATION INSULATION

- .1 Exterior application: extend boards vertically below bottom of finish floor slab to depth as indicated on drawings. Install on exterior face of perimeter foundation wall with adhesive.

3.6 CLEANING

- .1 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 51 00 - Temporary Utilities.
- .5 Section 07 26 00 –Vapour Retarders.
- .6 Section 07 27 00.01 – Air Barriers.
- .7 Section 08 11 00 – Metal Doors and Frames.
- .8 Section 08 90 00 – Louvers and Vents.

1.2 REFERENCES

- .1 Canadian Urethane Foam Contractors' Association Inc. (CUFCA)
- .2 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101, Fire Endurance Tests of Building Construction and Materials.
 - .2 CAN/ULC-S102, Surface Burning Characteristics of Building Materials and Assemblies.
 - .3 CAN/ULC-S705.1, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Material Specification.
 - .4 CAN/ULC-S705.2, Standard for Thermal Insulation Spray Applied Rigid Foam, Medium Density, Installer's Responsibilities-Specification.

1.3 TEST REPORTS

- .1 Submit test reports, verifying qualities of foam sealant meet or exceed requirements of this specification.
- .2 Submit test reports in accordance with CAN/ULC-S101 for fire endurance and CAN/ULC-S102 for surface burning characteristics.

1.4 QUALITY ASSURANCE

- .1 Applicators to conform to CUFCA Quality Assurance Program.

1.5 SAFETY REQUIREMENTS

- .1 Protect workers as recommended by CAN/ULC-S705.2 and manufacturer's recommendations:

- .1 Workers must wear gloves, respirators, dust masks, eye protection, protective clothing when applying foam sealant.
- .2 Workers must not eat, drink or smoke while applying foam sealant.

1.6 PROTECTION

- .1 Ventilate area in accordance with Section 01 51 00 - Temporary Utilities.
- .2 Ventilate area to receive insulation by introducing fresh air and exhausting air continuously during and 24 hours after application to maintain non-toxic, unpolluted, safe working conditions.
- .3 Provide temporary enclosures to prevent spray and noxious vapours from contaminating air beyond application area.
- .4 Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
- .5 Dispose of waste foam sealant daily in location designated by Owner's Representative and decontaminate empty drums in accordance with foam sealant manufacturer's instructions.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Apply foam sealant only when surfaces and ambient temperatures are within manufacturers' prescribed limits.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Low expanding, one-component, polyurethane foam sealant, curing to a semi-rigid, closed cell urethane foam providing a RSI of 0.9 per 25.4 mm. To meet the following physical properties:
 - .1 Density: 25.7 kg/m³
 - .2 Compressive Strength Parallel @ 10%: 69-96 psi
 - .3 Tensile Strength: 103 psi
 - .4 Water Vapour Transmission: 5.97 perms
 - .5 Flame Spread: 20
 - .6 Smoke Development: 70

PART 3 - EXECUTION

3.1 APPLICATION

- .1 Apply foam sealant to clean surfaces in accordance manufacturer's printed instructions. Surfaces to be free of dust, dirt, oil and other foreign materials.

- .2 Cover surfaces not intended to be foamed.
- .3 Apply foam sealant to perimeter of openings indicated and to thickness as recommended by manufacturer. Trim excess cured foam from finished area.
- .4 Cover exposed urethane foam sealants to protect from adverse effects from ultraviolet light (sunlight)

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 03 30 00 - Cast-in-Place Concrete.
- .4 Section 06 10 53 – Miscellaneous Rough Carpentry.
- .5 Section 07 21 13 – Board Insulation.

1.2 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet, for Use in Building Construction.
- .2 Underwriters Laboratories Canada (ULC)
 - .1 CAN/ULC S102, Method of Test for Surface Burning Characteristics of Building Materials and Assemblies.

1.3 SUBMITTALS

- .1 Submit manufacturer's printed product literature, specifications and datasheet and include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Limitations.
- .2 Submit two copies of Workplace Hazardous Materials Information System (WHMIS) Material Safety Data Sheets (MSDS).
- .3 Quality assurance submittals:
 - .1 Certificates: submit certificates certifying that materials comply with specified performance characteristics and physical properties.
 - .2 Instructions: submit manufacturer's installation instructions and comply with written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheet.

1.4 MOCK-UPS

- .1 Construct mock-up of sheet vapour barrier installation including one lap joint, one inside corner and at one electrical box. Mock-up may be part of finished work.

- .2 Mock-up will be used to judge workmanship, substrate preparation, and material application.
- .3 Allow two (2) working days for inspection of mock-up by Consultant and Owner's Representative before proceeding with vapour barrier work.
- .4 When accepted, mock-up will demonstrate minimum standard of quality required for this work.

PART 2 - PRODUCTS

2.1 SHEET VAPOUR RETARDER

- .1 Polyethylene film: to CAN/CGSB-51.34, minimum 0.15mm thick or otherwise indicated on drawings with a water vapour permeance of not greater than 45 ng/(P·s·m²), flame spread rating of less than 150 to CAN/ULC S102.

2.2 ACCESSORIES

- .1 Joint sealing tape: air resistant pressure sensitive adhesive tape, type recommended by vapour barrier manufacturer, 50 mm wide for lap joints and perimeter seals, 25 mm wide elsewhere.
- .2 Sealant: compatible with vapour retarder, recommended by vapour retarder manufacturer, to Section 07 92 00 - Joint Sealants.
- .3 Staples: minimum 6 mm leg.
- .4 Moulded box vapour barrier: factory-moulded polyethylene box for use with recessed electric switch and outlet device boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Ensure services are installed and inspected prior to installation of retarder.
- .2 Install sheet vapour retarder on warm side of exterior wall and ceiling space assemblies prior to installation of gypsum board to form continuous retarder.
- .3 Use sheets of largest practical size to minimize joints.
- .4 Inspect for continuity. Repair punctures and tears with sealing tape before work is concealed.

3.2 EXTERIOR SURFACE OPENINGS

- .1 Cut sheet vapour retarder to form openings and ensure material is lapped and sealed to frame.

3.3 PERIMETER SEALS

- .1 Seal perimeter of sheet vapour barrier as follows:
 - .1 Apply continuous bead of sealant to substrate at perimeter of sheets.

- .2 Lap sheet over sealant and press into sealant bead.
- .3 Install staples through lapped sheets at sealant bead into wood substrate.
- .4 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.4 LAP JOINT SEALS

- .1 Seal lap joints of sheet vapour barrier as follows:
 - .1 Attach first sheet to substrate.
 - .2 Apply continuous bead of sealant over solid backing at joint.
 - .3 Lap adjoining sheet minimum 150 mm and press into sealant bead.
 - .4 Install staples through lapped sheets at sealant bead into wood substrate.
 - .5 Ensure that no gaps exist in sealant bead. Smooth out folds and ripples occurring in sheet over sealant.

3.5 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Materials and installation methods providing primary air/vapour barrier materials and assemblies.
- .2 Air/vapour barrier materials to provide continuous seal between components of building envelope and building penetrations.

1.2 RELATED SECTIONS

- .1 Section 01 45 00 - Quality Control.
- .2 Section 01 51 00 - Temporary Utilities.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 04 22 00 – Concrete Unit Masonry.
- .5 Section 07 26 00 – Vapour Retarders.
- .6 Section 07 92 00 – Joint Sealants.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.13M, Sealing Compound, One Component, Elastomeric Chemical Curing.
 - .2 CAN/CGSB-19.18M, Sealing Compound, One Component, Silicone Base Solvent Curing.
 - .3 CAN/CGSB-19.24M, Multi-Component, Chemical Curing Sealing Compound.
 - .4 CGSB 19-GP-14M, Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .2 Ontario Building Code (OBC)
 - .1 OBC, Part 5 - Environmental Separation
- .3 Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification.

1.4 SUBMITTALS

- .1 Submit manufacturer's product data sheets.
- .2 Submit manufacturer's installation instructions.

1.5 QUALITY ASSURANCE

- .1 Perform Work in accordance with Sealant and Waterproofer's Institute - Sealant and Caulking Guide Specification requirements for materials and installation.
- .2 Perform Work in accordance with National Air Barrier Association - Professional Contractor Quality Assurance Program and requirements for materials and installation.
- .3 Manufacturer's Representative:
 - .1 Inspect substrate prior to commencement of work, twice during application of membrane and at commissioning to ascertain that air/vapour barrier system is installed according to membrane manufacturer's most current published specifications and details.
 - .2 Provide technical assistance to applicator and assist where required in correct installation of membrane.
 - .3 Provide certificate of quality compliance upon satisfactory completion of installation.
- .4 Maintain one copy of documents on site.

1.6 QUALIFICATIONS

- .1 Applicator: Company specializing in performing work of this section with minimum 5 years documented experience with installation of air/vapour barrier systems. Complete installation must be approved by the material manufacturer.
- .2 Applicator: Company who is currently licensed by certifying organization must maintain their license throughout the duration of the project.

1.7 MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Construct typical panel, 10 m² minimum, incorporating wall openings, insulation, building corner condition, illustrating materials interface and seals.
- .3 Locate where directed.
- .4 Mock-up may remain as part of the Work.
- .5 Allow two (2) working days for inspection of mock-up by Consultant and Owner's Representative before proceeding with air/vapour barrier Work.

1.8 PRE- INSTALLATION MEETINGS

- .1 Convene one week prior to commencing work of this section.

1.9 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.

- .2 Deliver, store and handle materials in accordance with manufacturer's written instructions. Deliver membrane materials in factory wrapped packaging indicating name of manufacturer and product.
- .3 Avoid spillage. Immediately notify Owner's Representative if spillage occurs and start clean up procedures.
- .4 Clean spills and leave area as it was prior to spill.
- .5 Store roll materials on end in original packaging.
- .6 Store primers at temperatures of 5°C and above to facilitate handling. Keep solvent away from open flame and excessive heat.

1.10 PROJECT ENVIRONMENTAL REQUIREMENTS

- .1 Do not install solvent curing sealants or vapour release adhesive materials in enclosed spaces without ventilation.
- .2 Ventilate enclosed spaces in accordance with Section 01 51 00 - Temporary Utilities.
- .3 Maintain temperature and humidity recommended by materials manufactures before, during and after installation.

1.11 WARRANTY

- .1 Provide a written warranty for work of this section from Manufacturer for failure due to defective materials and from contractor for failure due to defective installation workmanship for ten (10) years respectively from the date of Substantial Completion.
- .2 Include coverage of installed sealant and sheet materials which fail to achieve air tight and watertight seal, exhibit loss of adhesion or cohesion or do not cure.

PART 2 - PRODUCTS

2.1 SHEET MEMBRANE AIR BARRIER (TYPE 1)

- .1 Sheet Seal: Self-Adhesive bitumen laminated to high-density polyethylene film, nominal total thickness of 1.0 mm.
 - .1 Membrane Physical Properties
 - .1 Application min 5°C
 - .2 Service Temperature -40°C to 70°
 - .3 Elongation min 200%
 - .4 Tensile strength min 2.4 Mpa
 - .5 Puncture Resistance min 178 N
 - .6 Water vapour transmission 2.8mg/Pa.s.m² (0.05 perms)

.7	Moisture Absorption	0.1%
.8	Air Leakage at 75 Pa	0.02L/Sm ²
.9	Air Leakage of the 3000 Pa test	No change
.2	Sheet Seal: Self-Adhered Elastomeric Film Air Vapour Barrier Membrane with high tack acrylic adhesive, nominal total thickness of 0.25 mm. Primer not required on most construction surfaces.	
.1	Membrane Physical Properties	
.1	Application	min -18° C
.2	Service Temperature	-40° C to 80° C
.3	Elongation	ASTM D882 – min 700%
.4	Tensile Strength	min 12 Mpa
.5	Water Vapour Transmission	8 ng/Pa.s.m ² (0.14 perms)
.6	Moisture Absorption	0.1%
.7	Air Leakage at 75 Pa	0.01 L/Sm ²
.8	Air Leakage of the 3000 Pa Test	No Change

2.2 LIQUID MEMBRANE AIR/VAPOUR BARRIER (TYPE 2)

- .1 Single component, liquid applied, water-based, polymer-modified air barrier providing a seamless, elastomeric membrane when cured, wet film thickness 1.53 mm, cured film thickness 1.15 mm.
- .2 Liquid membrane Air/Vapour physical properties:
 - .1 Application Temperature: min. 4° C
 - .2 Service Temperature: -29° C to 49° C
 - .3 Elongation: 1500%
 - .4 Tensile Strength: 0.10 MPa
 - .5 Water Vapour Permeance: 0.03 perms
 - .6 Air Leakage at 75 Pa: < 0.02 L/s/m²

2.3 LIQUID MEMBRANE VAPOUR PERMEABLE AIR BARRIER (TYPE 3)

- .1 Water-based air-barrier providing a tough, seamless, elastomeric membrane when cured, allowing moisture vapour to pass through it, wet film thickness 2.3 mm, cured film thickness 1.15 mm.

.2 Liquid membrane vapour permeable air barrier physical properties:

- .1 Application Temperature: min. 4° C
- .2 Service Temperature: -29° C to 49° C
- .3 Elongation: 1500%
- .4 Water Vapour Permeance: 12 perms
- .5 Air Leakage at 75 Pa: < 0.02 L/s/m²

2.4 SHEET MEMBRANE VAPOUR PERMEABLE AIR BARRIER (TYPE 4)

.1 Self-adhering reinforced modified polyolefin tri-laminate water resistive, vapour permeable, air barrier membrane to the following properties:

- .1 Weight: 160 g/m²
- .2 Water Vapour Transmission: 202 g/m²
- .3 Tensile Strength: 182N MD and 129N CD
- .4 Water Vapour Permeance: 1658 ng/Pa.m².s
- .5 Air Leakage: <0.02 L/s/m²
- .6 Average Dry Breaking Force: 565N MD and 405N CD

2.5 SEALANTS

- .1 Sealants in accordance with Section 07 92 00 - Joint Sealants.
- .2 Primer: recommended by sealant manufacturer.
- .3 Primer for type 4 Air Barrier: quick setting, synthetic rubber based adhesive aerosol.

2.6 SCHEDULE

- .1 Type 1 Air Barrier: for installation on any solid surface.
- .2 Type 2 Air Barrier: for installation on masonry or concrete surfaces.
- .3 Type 3 Air Barrier: for installation on wood/gypsum board surfaces.
- .4 Type 4 Air Barrier: for installation on any solid surface approved by manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify that surfaces and conditions are ready to accept the Work of this section.

- .2 Ensure all surfaces are clean, dry, sound, smooth, continuous and comply with air barrier manufacturer's requirements.
- .3 Report any unsatisfactory conditions to Consultant and the Owner's Representative in writing.
- .4 Do not start work until deficiencies have been corrected.

3.2 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion of materials.
- .2 Ensure all substrates are clean of oil or excess dust; all masonry joints struck flush, and open joints filled; and all concrete surfaces free of large voids, spalled areas or sharp protrusions.
- .3 Ensure all substrates are free of surface moisture prior to application of membrane and primer.
- .4 Ensure metal closures are free of sharp edges and burrs.
- .5 Prime substrate surfaces to receive adhesive and sealants in accordance with manufacturer's instructions.

3.3 INSTALLATION (SHEET MEMBRANE)

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Over the properly prepared substrate surface apply primer, as per manufacturer's recommendations, with a roller and allow drying to a tacky surface. Prime only area to be covered in a working day. Re-prime area not covered with membrane within 24 hours.
- .3 After primer has dried, using a hand roller firmly press the entire membrane onto the primed surface, in strict accordance with membrane manufacturer's written instructions.
- .4 Ensure complete coverage of and adhesion of all substrates to receive membrane, including wall penetrations. Co-operate with other trades to ensure continuity of membrane.
- .5 Overlap membrane 50mm and carefully smooth out with a roller to ensure full continuous bond throughout overlaps without fissures or fishmouthing.
- .6 It is important that a complete air seal be achieved. Be responsible for the completeness of membrane wherever it is not specifically detailed. Consult with Owner's Representative if there is any doubt as to the integrity of membrane, whether detailed or not.
- .7 In order to ensure a complete seal, seal membrane to all penetrations in an approved manner.
- .8 Apply a trowelled bead of mastic to all terminations of the membrane at the end of a day's work.
- .9 Do not enclose membrane until it has been inspected and approved by Consultant and Owner's Representative. Inform Consultant and Owner's Representative two (2) working days prior to required inspection.

3.4 INSTALLATION (LIQUID MEMBRANE AIR/VAPOUR BARRIER)

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Prepare surfaces ensuring they are clean, structurally sound and smooth. Patch all cracks, small voids, irregularities and small deformities with manufacturer approved patch material.
- .3 Apply minimum 150 mm wide self-adhering air barrier strip between joints of dissimilar building materials.
- .4 Apply liquid membrane to substrate by spraying or nap roller as per manufacturer's instructions.
- .5 Ensure complete coverage of and adhesion of all substrates to receive liquid membrane, including wall penetrations. Co-operate with other trades to ensure continuity of membrane.
- .6 It is important that a complete air seal be achieved. Be responsible for the completeness of liquid membrane wherever it is not specifically detailed. Consult with Owner's Representative if there is any doubt as to the integrity of the liquid membrane, whether detailed or not.
- .7 In order to ensure a complete seal, seal liquid membrane to all penetrations in an approved manner.
- .8 Do not enclose membrane until it has been inspected and approved by Consultant and Owner's Representative. Inform Consultant and Owner's Representative two (2) working days prior to required inspection.

3.5 INSTALLATION (LIQUID MEMBRANE VAPOUR PERMEABLE AIR BARRIER)

- .1 Install materials in accordance with manufacturer's instructions.
- .2 Prepare surfaces ensuring they are clean, structurally sound and smooth. Patch all cracks, small voids, irregularities and small deformities with manufacturer approved patch material.
- .3 Joints in exterior sheeting of 6.4 mm or greater to be covered with tape or filled with mastic caulking compound prior to application of liquid membrane as per manufacturer's recommendations.
- .4 Apply minimum 150 mm wide self-adhering air barrier strip between joints of dissimilar building materials.
- .5 Apply liquid membrane to substrate by spraying or roller as per manufacturer's instructions.
- .6 Ensure complete coverage of and adhesion of all substrates to receive liquid membrane, including wall penetrations. Co-operate with other trades to ensure continuity of membrane.
- .7 It is important that a complete air seal be achieved. Be responsible for the completeness of liquid membrane wherever it is not specifically detailed. Consult with Owner's Representative if there is any doubt as to the integrity of the liquid membrane, whether detailed or not.
- .8 In order to ensure a complete seal, seal liquid membrane to all penetrations in an approved manner.

- .9 Do not enclose membrane until it has been inspected and approved by Consultant and Owner's Representative. Inform Consultant and Owner's Representative two (2) working days prior to required inspection.

3.6 PROTECTION OF WORK

- .1 Protect finished Work in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Do not permit adjacent work to damage work of this section.
- .3 Ensure finished Work is protected from climatic conditions.

3.7 INSPECTION

- .1 Carefully inspect for continuity of air barrier prior to placement of insulation.
- .2 Repair all deficient membrane areas.
- .3 Misaligned or inadequately lapped seams, punctures or other damage must be repaired with a patch of air barrier membrane extending 50mm in all directions from edge of damaged areas.
- .4 Cover membrane immediately after Owner's Representative's inspection to protect from damage by other trades.

3.8 TESTING

- .1 Air leakage testing as directed by Owner's Representative and paid for by contractor will be performed by professional testing agency for the locations selected at random for penetrations, laps, corners, etc.
- .2 Testing will be witnessed by Owner's Representative and test reports will be signed by tester, site representative and contractor.
- .3 Inform Owner's Representative two (2) working days prior to required testing.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 35 43 - Environmental Procedures.
- .3 Section 01 45 00 - Quality Control.
- .4 Section 01 61 00 - Common Product Requirements.
- .5 Section 01 74 00 - Cleaning.
- .6 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .7 Section 01 78 00 - Closeout Submittals.
- .8 Section 06 10 53 - Miscellaneous Rough Carpentry.
- .9 Section 07 62 00 - Sheet Metal Flashing and Trim.
- .10 Section 07 92 00 - Joint Sealants.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM C 1177/C1177M, Standard Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
- .2 Canadian General Standards Board (CGSB).
 - .1 CGSB 37-GP-19M, Cement, Plastic, Cutback Tar.
 - .2 CAN/CGSB-37.29, Rubber- Asphalt Sealing Compound.
 - .3 CAN/CGSB - 51.33 Vapour Barrier Sheet, Excluding Polyethylene, for Use in Building Construction.
- .3 Canadian's National Roofing Contractors Association (CRCA)
 - .1 CRCA Specification Manual.
- .4 Underwriters Laboratories' of Canada (ULC)
 - .1 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .2 CAN/ULC-S702.2, Standard for Mineral Fiber Thermal Insulation for Buildings.
 - .3 CAN/ULC-S704, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 SECTION INCLUDES

- .1 Provision of new deck sheathing, air/vapour barrier, insulation, membrane, membrane flashing and metal counter flashing.

1.4 SHOP DRAWINGS

- .1 Indicate in shop drawings flashings, control joints, tapered insulation details, roof scuppers and all required roofing materials.
- .2 Provide layout for tapered insulation.

1.5 STORAGE AND HANDLING

- .1 Refer to Section 01 61 00 - Common Product Requirements for storage and handling requirements.
- .2 Store materials off-ground in weatherproof storage.
- .3 Store materials in upright position. Store membrane rolls with selvage edge up, store as per manufacturer's requirements to meet warranty.
- .4 Remove only in quantities required for same day use.
- .5 Place plywood runways over work to protect work and enable work flow.
- .6 Store sealants at +5°C minimum.
- .7 Store insulation protected from daylight, weather and deleterious materials.

1.6 ENVIRONMENTAL REQUIREMENTS

- .1 Do not install roofing when temperature remains below -18°C for torch application, or to manufacturers' recommendations for mop application.
- .2 Minimum temperature for solvent-based adhesive is -5°C.
- .3 Install roofing on dry deck, free of snow and ice, use only dry materials and apply only during weather that will not introduce moisture into roofing system.

1.7 PROTECTION

- .1 Fire Extinguishers: maintain one stored pressure rechargeable type with hose and shut-off nozzle, ULC labeled for A, B and C class protection. Size 9 kg on roof per torch applicator, within 10 m of torch applicator.
- .2 Contractor to provide safety person on site at all times during the roofing process and shall remain on site two (2) hours after work has ceased or after torching has stopped. Safety person shall scan the perimeter and roof penetration details with a hand held infrared gun.
- .3 Remove only as much existing roofing as can be replaced by the end of each working day.
- .4 Contractor to verify existing under deck mounted electrical conduits prior to installing mechanically fastened roof assembly.

1.8 WARRANTY

- .1 Provide a written guarantee, signed and issued in the name of The Owner by the Roofing System Manufacturer, stating that roofing membrane is free from manufacturing defects and that the system will stay in place and remain leak proof for a period of ten (10) years from date of Substantial Certificate of Completion, subject to the standard limitations and conditions of the manufacturer.
- .2 Provide a written guarantee, signed and issued in the name of the Owner by the Contractor, stating that the roofing application has been performed in compliance with the plans and specifications, and for two (2) years from the date of Substantial Certificate of Completion, the Contractor shall repair, at no expense to the Owner, any defects which result of a failure to comply with the plans and specifications.
- .3 Defective work shall include, but not limited to: leaking, wind uplift, delamination of roofing materials, reduction of thermal value due to moisture in insulation, crazing and ridging.
- .4 Warranty to be non-prorated.

1.9 COMPATIBILITY

- .1 Compatibility between components of roofing system is essential. Provide written declaration to Consultant and Owner's Representative stating that materials and components, as assembled in system, meet this requirement.

1.10 QUALITY ASSURANCE

- .1 Membrane: applied by applicator acceptable to Consultant and Owner's Representative, and approved by manufacturer for application of its products.
- .2 Applicators: minimum 5 years proven experience.
- .3 Manufacturer's representative:
 - .1 Inspect roofing system at the start of construction, midway and as required for commissioning. Additional inspections may be carried out at the discretion of the Roofing System Manufacturer.
 - .2 Provide technical assistance where required to correct installation of roofing system.
- .4 Refer to Section 01 33 00 – Submittal Procedures and Section 01 45 00 - Quality Control for submission procedures.
- .5 Submit laboratory test reports certifying compliance of bitumen and membranes with specification requirements.

1.11 MOCK-UP

- .1 If requested construct mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 Mock up to be 10 m² minimum size showing typical membrane lap joint, one inside and one outside corner parapet flashing. Insulation and fastening method, air/vapour barrier lap, gypsum board and fastening method and workmanship.

- .3 Allow two (2) working days for inspection of mock-up by Consultant and Owner's Representative before proceeding with roofing work.
- .4 Accepted mock up may form part of completed work.

PART 2 - PRODUCTS

2.1 THERMAL BARRIER AND AIR/VAPOUR BARRIER

- .1 Thermal Barrier: Pre-primed glass mat faced gypsum panel non-asphaltic, highly filled proprietary heat-cured coating on one side, to ASTM C1177, 15.8 mm thick.
- .2 Air/Vapour Barrier: Self adhering peel and stick air/vapour barrier composed of Styrene-Butadiene-Styrene (SBS) modified bitumen reinforced with high density polyethylene film, anti-slip surface, minimum thickness 1.0 mm.

2.2 INSULATION AND COVER BOARD COMPONENTS

- .1 For flat roof decks or roof structures, provide custom designed tapered insulation with minimum slope of 2.0 mm in 100 mm (2%). Taper insulation to drain, minimum RSI value at drain to be 1.3.
- .2 Expanded Polystyrene Insulation (EPS), Cover Board and Asphalt Recover Board:
 - .1 Expanded Polystyrene Insulation (EPS):
 - .1 To CAN/ULC-S701, Type 1, square edged.
 - .2 Insulation value thickness per cm based on values listed in the latest edition of NRC - Evaluation Listings.
 - .3 Provide two layers of insulation installed with staggered joints.
 - .2 Cover Board: Nonstructural, glass mat faced gypsum panel with water-resistant core to ASTM C1177, 6.35 mm thick.
 - .3 Asphalt Recover Board: Semi-rigid asphalt roofing substrate composed of mineral core between glass fibre mats, 1200 x 1500mm sheets, minimum thickness 3.0 mm.
- .3 Extruded Polystyrene Insulation (XPS) and two layers of Asphalt Recover Board:
 - .1 Extruded Polystyrene Insulation (XPS):
 - .1 To CAN/ULC-S701, Type 2, square edged.
 - .2 Insulation value thickness per cm based on values listed in the latest edition of NRC - Evaluation Listings.
 - .3 Provide two layers of insulation installed with staggered joints.
 - .2 Two layers of Asphalt Recover Board: Semi-rigid asphalt roofing substrate composed of mineral core between glass fibre mats, 1200 x 1500mm sheets, minimum thickness 3.0 mm each.

- .4 Polyisocyanurate Insulation and Asphalt Recover Board:
 - .1 Polyisocyanurate Insulation:
 - .1 To CAN/ULC-S704, glass reinforced felt facers, square edged and containing no CFC.
 - .2 Insulation value thickness per cm based on values listed in the latest edition of NRC - Evaluation Listings.
 - .3 Provide two layers of insulation installed with staggered joints.
 - .2 Asphalt Recover Board: Semi-rigid asphalt roofing substrate composed of mineral core between glass fibre mats, 1200 x 1500mm sheets, minimum thickness 3.0 mm.
- .5 Total assembly RSI value:
 - .1 Minimum average RSI value of assembly insulation components to be 3.52. Insulation assembly components to consist of thermal barrier, insulation and cover board.

2.3 BASE SHEET

- .1 Base Sheet: Base sheet: to CGSB-37.56-M, Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, non-woven, polyester reinforcement, weighing 180 g/m².
 - .1 Type 2, fully adhered.
 - .2 Class P-plain surfaced.
 - .3 Grade 2.
 - .4 Top and bottom surfaces:
 - .1 Polyethylene/polyethylene.
 - .5 Base sheet membrane properties:
 - .1 Strain energy (longitudinal/transversal): 9.0/7.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 17.0/12.5 N/5 cm.
 - .3 Ultimate elongation (longitudinal/transversal): 60/65 %.
 - .4 Tear resistance: 60 N.
 - .5 Cold bending at -30 degrees C : no cracking.
 - .6 Static puncture resistance: > 400.
 - .7 Dimensional Stability: -0.3 / 0.3 %.

2.4 CAP SHEET

- .1 Cap sheet: to CGSB-37.56-M, Styrene-Butadiene-Styrene (SBS) elastomeric polymer, prefabricated sheet, glass, polyester reinforcement, weighing 250 g/m².
 - .1 Type 2, fully adhered.
 - .2 Class G-granule surfaced.
 - .3 Grade 2.
 - .4 Bottom surface polyethylene.
 - .5 Colour to be light grey unless otherwise indicated.
 - .6 Cap sheet membrane properties:
 - .1 Strain energy (longitudinal/transversal): 10.0/10.0 kN/m.
 - .2 Breaking strength (longitudinal/transversal): 18.0/10.0 kN/m.
 - .3 Ultimate elongation (longitudinal/transversal): 60/65 %.
 - .4 Tear resistance: 75 N.
 - .5 Cold bending at -30 degrees C: No cracking.
 - .6 Static puncture resistance: > 420.
 - .7 Dimensional Stability: -0.8 / -0.2 %.
- .2 Minimum total thickness if base sheet and cap sheet combined to be 5.8 mm. Cap sheet and base sheet to be of same manufacturer.
- .3 Install contrasting colour cap sheet, 2.0 m wide, along the entire perimeter of all roof sections. Contrasting colour cap sheet to be installed over cap sheet. Colour to be as per Owner's Representative selection from manufacturer's standard colour range.

2.5 BASE SHEET FLASHING

- .1 To CGSB-37.56-M, Type 2, Class C, Grade 2, non-woven polyester reinforced 180g/m², self-adhesive membrane with polyethylene top face and release film under face.

2.6 LIQUID APPLIED RESIN FLASHING MEMBRANE

- .1 Polymethylmethacrylate (PMMA) Primers: as recommended by the membrane manufacturer.
- .2 PMMA Roofing Flashing:
 - .1 Resin for flashing applications: a one-component polyurethane/bitumen resin for use in combination with fleece fabric to form a monolithic, reinforced flashing membrane; Alsan Flashing from Soprema or approved equivalent.

- .2 Fleece for flashing reinforcement: A woven, 100 g/m², polyester fabric reinforcement as supplied by the membrane system manufacturer; Flashing Reinforcement by Soprema or approved equivalent.

2.7 SEALERS

- .1 Mastic made of synthetic rubbers, plasticized with bitumen and solvents with aluminum pigments to provide greater resistance to U.V.

2.8 PRIMERS

- .1 For self-adhesive membranes: A blend of elastomeric bitumen, volatile solvents and adhesive enhancing resins used to prime porous and non-porous substrates such as gypsum board, wood, concrete or metal to enhance the adhesion of self-adhesive membranes at temperatures above -10°C.
- .2 For heat welded membranes: A blend of elastomeric bitumen, volatile solvents and adhesive enhancing additives used to prime concrete or metal substrates to enhance the adhesion of torch-applied membranes.

2.9 FASTENERS

- .1 Fasteners: minimum #14 mechanical fasteners made of case-hardened carbon steel with corrosion resistance coating, complying with FM standards. 75 mm diameter round or hexagon stress plates complying with CSA B35.3 and FM 4470 approval standards, diameter and lengths as required to suit total assembly thickness. Ensure fasteners have the following deck penetration:
 - .1 For concrete decks: minimum 25 mm.
 - .2 For wood decks: minimum 25 mm.
 - .3 For metal decks: minimum 19 mm and maximum 25 mm longer than assembly being secured. Fasteners to engage metal deck top flange. At gymnasium locations, fastener points of all fasteners to be removed.
- .2 Roofing adhesive: single-component, moisture cured, solvent free polyurethane adhesive, dispensed from a portable disposable pre-pressurized container.

PART 1 EXECUTION

2.10 WORKMANSHIP

- .1 Do roofing work in accordance with applicable, standard in Canadian Roofing Contractors Association (CRCA) Roofing Specifications Manual, except where specified otherwise.

2.11 PROTECTION

- .1 Cover walls and adjacent work where materials hoisted or used.
- .2 Use warning signs and barriers. Maintain in good order until completion of work.

- .3 Clean off drips and smears of bituminous material immediately.
- .4 Dispose of rain water off roof and away from face of building until roof drains or hoppers installed and connected. Refer to Section 01 35 43 - Environmental Procedures for site drainage requirements.
- .5 Protect roof from traffic and damage.
- .6 At end of each day's work or when stoppage occurs due to inclement weather, provide protection for completed work and materials out of storage.
- .7 Install insulation promptly to avoid possibility of condensation beneath vapour retarder.
- .8 Take necessary measures ensuring no penetration of the elements will occur to the building after commencement of work, including but not limited to water.
- .9 Only remove quantities of existing roofing material and install quantities of new roofing materials per day that can be covered with waterproofing membranes.

2.12 EXAMINATION ROOF DECKS

- .1 Examine roof decks and immediately inform Consultant and Owner's Representative in writing of defects.
- .2 Prior to commencement of work ensure:
 - .1 Decks are firm, straight, smooth, dry, and free of snow, ice or frost, and swept clean of dust and debris.
 - .2 Curbs have been built. Coordinate height of roof curbs with Section 06 10 53 – Miscellaneous Rough Carpentry.
 - .3 Roof scuppers have been installed at proper elevations relative to finished roof surface.
 - .4 Plywood and lumber nailer plates have been installed to deck, walls and parapets as indicated.
- .3 Do not install roofing materials during rain or snowfall.

2.13 EXPOSED MEMBRANE ROOFING APPLICATION (METAL ROOF DECK)

- .1 Thermal Barrier and Air/Vapour Barrier:
 - .1 Fasten laminated thermal barrier and air/vapour barrier in accordance with manufacturers illustrated specifications manual. **OR**, apply beads of roofing adhesive to metal deck in accordance with manufacturer's written instructions. Adhere thermal barrier in adhesive and walk-in thermal barrier to insure maximum contact with adhesive.
 - .2 Install boards by butting edges snugly and without warping, as level to each other as possible, and perfectly adhered to the substrate.

- .3 Because of the nature of the system, air/vapour barrier membrane joints can be aligned (no staggering) to facilitate the installation of the reinforcing band.
- .4 To avoid infiltrations, adhere the first 75 mm of the self-adhesive side laps using a roller, then heat-weld the last 25 mm.
- .5 Seal the end joints by welding a 300 mm wide protection band centered on the joint.
- .2 Insulation
 - .1 Apply beads of roofing adhesive to air/vapour barrier in accordance with manufacturer's written instructions. Adhere insulation in adhesive and walk-in insulation boards to insure maximum contact with adhesive.
 - .2 Place boards in parallel rows with ends staggered, and in firm contact with one another.
 - .3 Cut end boards to suit.
 - .4 Install tapered insulation in accordance with shop drawings.
- .3 Cover Board Components (Expanded Polystyrene (EPS)):
 - .1 Apply beads of roofing adhesive to insulation in accordance with manufacturer's written instructions. Adhere cover board in adhesive and walk-in cover boards to insure maximum contact with adhesive.
 - .2 Place boards in parallel rows with ends staggered and in firm contact with one another.
 - .3 Cut end boards to suit.
 - .4 Mechanically fasten asphalt recover board over cover board with plates and fasteners. **OR**, apply beads of roofing adhesive to cover board in accordance with manufacturer's written instructions. Adhere asphalt recover board in adhesive and walk-in asphalt recover boards to insure maximum contact with adhesive.
 - .5 Fit boards tight together. Stagger joints between asphalt recover board and cover board. Install fasteners/adhesive based on design wind uplift securement requirements, for the building site location, for insulation and cover board, in accordance with manufacturer's recommendations.

OR

Cover Board Components (Extruded Polystyrene (XPS)):

- .6 Cover XPS insulation with two layers of asphalt recover board.
- .7 Place boards in parallel rows with ends staggered and in firm contact with one another.
- .8 Cut end boards to suit.

- .9 Apply beads of roofing adhesive for each layer of asphalt recover board in accordance with manufacturer's written instructions. Adhere each layer of asphalt recover board in adhesive and walk-in asphalt recover boards to insure maximum contact with adhesive.
- .10 Fit boards tight together. Stagger joints between layers of asphalt recover board. Install fasteners/adhesive based on design wind uplift securement requirements, for the building site location, for insulation and cover board, in accordance with manufacturer's recommendations.

OR

Cover Board Components (Polyisocyanurate (Polyiso)):

- .11 Cover Polyiso insulation with one layer of asphalt recover board.
- .12 Place boards in parallel rows with ends staggered and in firm contact with one another.
- .13 Cut end boards to suit.
- .14 Apply beads of roofing adhesive to insulation in accordance with manufacturer's written instructions. Adhere asphalt recover board in adhesive and walk-in asphalt recover boards to insure maximum contact with adhesive.
- .15 Fit boards tight together. Install fasteners/adhesive based on design wind uplift securement requirements, for the building site location, for insulation and cover board, in accordance with manufacturer's recommendations.

.4 Base Sheet Application:

- .1 Starting at low point of roof, perpendicular to slope, unroll base sheet, align and reroll from both ends.
- .2 Unroll and torch base sheet onto recover board taking care not to burn membrane or its reinforcement.
- .3 Lap sheets 75 mm minimum for side and 150 mm minimum for end laps.
- .4 Application to be free of blisters, wrinkles and fishmouths.

.5 Cap Sheet Application:

- .1 Starting at low point on roof, perpendicular to slope, unroll cap sheet, align and reroll from both ends.
- .2 Unroll and torch cap sheet onto base sheet taking care not to burn membrane or its reinforcement.
- .3 Lap sheets 75 mm minimum for side laps and 150 mm minimum for end laps. Offset joints in cap sheet 300 mm minimum from those in base sheet.

- .4 Application to be free of blisters, fishmouths and wrinkles.
- .5 Do membrane application in accordance with manufacturer's recommendations.
- .6 Flashings:
 - .1 Complete installation of flashing base sheet stripping prior to installing membrane cap sheet.
 - .2 Torch, base and cap sheet onto substrate in 1 metre wide strips.
 - .3 Lap flashing base sheet to membrane base sheet minimum 150 mm and seal by torch welding.
 - .4 Lap flashing cap sheet to membrane cap sheet 250 mm minimum and torch weld.
 - .5 Provide 75 mm minimum side lap and seal.
 - .6 Properly secure flashings to their support, without sags, blisters, fishmouths or wrinkles.
 - .7 Do work in accordance with manufacturer's recommendations.

2.14 LIQUID APPLIED RESIN FLASHING MEMBRANE

- .1 .1 At all junctions where installation of membrane flashings is not possible, install new liquid applied resin flashing system.
- .2 Resin system shall be a layered application consisting of two coats of thixotropic catalyzed polymethylmethacrylate (PMMA) resin encapsulating a layer of polyester fleece reinforcement.
- .3 Installation of liquid applied flashing system to follow in STRICT ACCORDANCE with manufacturer's written instructions.
- .4 Ensure that substrates are free from gross irregularities, loose, unsound or foreign material such as dirt, ice, snow, water, grease, oil, bituminous products, release agents, laitance, paint, loose particles/friable matter, rust or any other material that would be detrimental to adhesion of the catalyzed primer and/or resin to the substrate.
- .5 Some surfaces may require scarification, shot-blasting, or grinding to achieve a suitable substrate. Wipe surfaces with a clean cloth saturated with the specified cleaner/solvent to remove grease, oils or dust that may affect adhesion and to cured PMMA surfaces to receive a subsequent coat of resin.
- .6 Preparation of Steel/Aluminum Substrates:
 - .1 Grind to generate a "white-metal" surface and remove loose particles. Extend preparation area a minimum of ½" (13mm) beyond the termination of the roofing/flashing system. Do not use cleaner/solvent after grinding. Notch steel surfaces to provide a rust-stop where detailed
- .7 Preparation of Cover Board Substrates:

- .1 Ensure that the insulation panels have been properly secured. Inspect the surface of the panel insulation system to ensure that edges are level and even between adjoining panels. Tape the panel joints and panel terminations at nailers, walls, perimeter and penetrations using the specified tape, centering the tape strips over the joints or panel edges.
- .8 Preparation/Mixing/Catalyzing Resin Products:
 - .1 Pour the desired quantity of resin into a clean container and using a spiral mixer or mixing paddle, stir the liquid for the time period specified by the resin manufacturer.
 - .2 Calculate the amount of catalyst powder needed using the manufacturer's guidelines and add the pre-measured catalyst to the resin component.
 - .3 Mix again for the time period specified by the resin manufacturer, ensuring that the product is free from swirls and bubbles.
 - .4 Ensure that air is not entrained into the product during the mixing process. To avoid aeration, do not use a spiral mixer unless the spiral section of the mixer can be fully contained in the liquid during the mixing process.
 - .5 Mix only enough product to ensure that it can be applied before expiration of resin pot life.
- .9 Primer Application:
 - .1 Apply primer resin using a roller or brush at the minimum rate specified by the primer manufacturer over poured reinforced concrete substrates.
 - .2 Apply primer resin using a roller or brush at the increased rate specified by the primer manufacturer over cover boards and granule surfaced membrane substrates.
 - .3 Increase application rates over other absorbent substrates. Do not let resin pool or pond. Do not under-apply or over-apply primers as this may interfere with proper primer catalyzation.
 - .4 Make allowances for saturation of roller covers and application equipment.
- .10 Base Flashing Application:
 - .1 Using masking tape, mask the perimeter of the area to receive the flashing system.
 - .2 Apply resin primer to substrates requiring additional preparation and allow primer to set.
 - .3 Pre-cut fleece to ensure a proper fit at transitions and corners prior to membrane application.
 - .4 Apply an even, generous base coat of flashing resin using a roller at the minimum rate specified by the resin manufacturer to prepared surfaces requiring flashing coverage.
 - .5 Work the fleece into the wet, catalyzed resin using a brush or roller to fully embed the fleece in the resin and remove trapped air.

- .6 Lap fleece layers a minimum of 51mm and apply an additional coat of catalyzed resin between layers of overlapping fleece.
- .7 Using a roller, apply an even top coat of catalyzed resin at the minimum rate specified by the resin manufacturer immediately following embedment of the fleece, ensuring full saturation of the fleece.
- .8 Ensure that the flashing resin is applied to extend a 6mm beyond the fleece. Remove the tape before the catalyzed resin sets. Make allowances for saturation of roller covers and application equipment.
- .9 Should work be interrupted for more than 12 hours or the surface of the catalyzed resin becomes dirty or contaminated by the elements, wipe the surface to be lapped with new flashing resin using the specified cleaner/solvent.
- .10 Allow the surface to dry for a minimum 20 minutes and a maximum 60 minutes before continuing work.

2.15 ROOF PENETRATIONS

- .1 Install roof penetration flashings and seal with membrane in accordance with the manufacturer's recommendations and as indicated on detail drawings.
- .2 Prime all metal flanges and allow to solvents to flash off prior to installation.
- .3 Set metal flange in full layer of rubberized sealing compound ensuring a positive bond.
- .4 Install an additional ply of base sheet membrane over the flange as per the manufacturer's written instruction prior to installing the field cap sheet membrane. The additional ply of membrane to extend a minimum of 152mm past the edge of the flange.
- .5 Install cap ply to the base ply flashing ensuring a full bond to the base ply and apply bead of sealing compound at the termination point.

2.16 METAL FLASHINGS

- .1 After the installation of the roof membrane and membrane flashings, new perimeter metal and metal flashings shall be installed as detailed in Section 07 62 00 - Sheet Metal Flashings and as indicated on detail drawings.

2.17 SEALANTS

- .1 As per Section 07 92 00 – Joint Sealants.

2.18 SCUPPER DRAIN INSTALLATION:

- .1 Install through-wall metal scupper drains as indicated on roof plan.
- .2 The scupper is to be fabricated from minimum 24 gauge galvanized metal to suit and complete with gravel stop edge on three sides. Solder all joints to make continuous water tight seal. Face of scupper to be encapsulated with pre-finished metal cover.
- .3 Install 127 x 127mm pre-finished metal downspouts at each scupper.

.4 The downspouts shall be smooth and have pipe-lock seams. Colour to be selected from manufacturer's standard colour selection by Consultant.

.5 At the base of the downspouts, install concrete paver on rigid insulation as splash pad.

2.19 CLEANING

.1 Perform in accordance with Section 01 74 00 - Cleaning.

.2 Check drains to ensure cleanliness and proper function, and remove debris, equipment and excess material from site.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .3 Section 03 30 00 – Cast-In-Place Concrete
- .4 Section 04 22 00 – Concrete Unit Masonry
- .5 Section 06 10 53 – Miscellaneous Rough Carpentry.
- .6 Section 07 52 00 – Modified Bituminous Membrane Roofing.
- .7 Section 07 92 00 – Joint Sealants.

1.2 REFERENCES

- .1 The Aluminum Association Inc. (AA)
 - .1 AA Aluminum Design Manual, Part VIII Guidelines for Aluminum Sheet Metal Work in Building Construction.
 - .2 AA DAF45, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials (ASTM International)
 - .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .3 ASTM D523, Standard Test Method for Specular Gloss.
- .3 Canadian Roofing Contractors Association (CRCA)
 - .1 Roofing Specifications Manual.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA A123.3, Asphalt Saturated Organic Roofing Felt.
 - .2 CSA B111, Wire Nails, Spikes and Staples.
- .5 Canadian Sheet Steel Building Institute (CSSBI)
 - .1 CSSBI S8, Quality and Performance Specification for Prefinished Sheet Steel Used for Building Products.

- .2 CSSBI B17, Barrier Series Prefinished Steel Sheet: Product Performance & Applications.
- .3 CSSBI Sheet Steel Facts #12, Fastener Guide for Sheet Steel Building Products.

1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature including product specifications and technical data sheets for sheet metal flashing fasteners and accessory materials. Include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit shop drawings for all sheet metal fabrications.
 - .2 Indicate sheet thickness, flashing dimensions and fastenings. Include anchorage, expansion joints and other provisions for thermal movement.
 - .3 Submit manufacturer's catalogue cut sheets for manufactured items.
- .4 Samples:
 - .1 Submit 50 x 50 mm samples of each type of sheet metal material, finishes and colour.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Handle and store flashing materials to prevent creasing, buckling, scratching, or other damage.

PART 2 - PRODUCTS

2.1 SHEET METAL MATERIALS

- .1 Provide sheet metal in base metal thickness specified. Where no thickness specified, provide base sheet metal in thickness recommended in SMACNA Architectural Sheet Metal Manual for type of item being fabricated, but not less than the thickness required by the authority having jurisdiction.
- .2 Aluminum-zinc alloy coated steel sheet: to ASTM A792/A792M, commercial quality, grade 33 with AZ150 coating, regular spangle surface, 0.60 mm base metal thickness. Pre-painted to CGSB –GP-71.

2.2 PREFINISHED STEEL SHEET

- .1 Prefinished sheet with factory applied polyvinylidene fluoride.

- .1 Class F1S
- .2 Colour as selected by Consultant from manufacturer's standard range.
- .3 Specular gloss: 30 units +/- 5 in accordance with ASTM D523.
- .4 Coating thickness: not less than 22 micrometres.
- .5 Resistance to accelerated weathering for caulk rating of 8, colour fade 5 units or less and erosion rate less than 20 % to ASTM D822 as follows:
 - .1 Outdoor exposure period 2500 hours.
 - .2 Humidity resistance exposure period 5000 hours.

2.3 ACCESSORIES

- .1 Isolation coating: alkali resistant bituminous paint.
- .2 Underlay for metal flashing: No. 15 perforated asphalt felt to CSA A123.3.
- .3 Sealants: Section 07 92 00 – Joint Sealants.
- .4 Cleats: of same material, and temper as sheet metal, minimum 50 mm wide. Thickness same as sheet metal being secured.
- .5 Fasteners: of same material as sheet metal, to CSA B111, ring thread flat head roofing nails of length and thickness suitable for metal flashing application.
- .6 Washers: of same material as sheet metal, 1 mm thick with rubber packings.
- .7 Touch-up paint: as recommended by prefinished material manufacturer.

2.4 FABRICATION

- .1 Fabricate metal flashings and other sheet metal work in accordance with applicable CRCA 'FL' series details as indicated.
- .2 Fabricate aluminum flashings and other sheet aluminum work in accordance with Aluminum Association Aluminum Sheet Metal Work in Building Construction.
- .3 Form pieces in 2400 mm maximum lengths. Make allowance for expansion at joints.
- .4 Hem exposed edges on underside 12 mm. Mitre and seal corners with sealant.
- .5 Form sections square, true and accurate to size, free from distortion and other defects detrimental to appearance or performance.
- .6 Apply isolation coating to metal surfaces to be embedded in concrete or mortar.

2.5 METAL FLASHINGS

- .1 Form flashings, copings and fascias to profiles indicated of 0.60 mm thick prefinished steel.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install sheet metal work in accordance with CRCA FL series details and as detailed.
- .2 Use concealed fastenings except where approved before installation.
- .3 Provide underlay under sheet metal. Secure in place and lap joints 100 mm.
- .4 Counterflash bituminous flashings at intersections of roof with vertical surfaces and curbs. Flash joints using S-lock forming tight fit over hook strips, as detailed.
- .5 Lock end joints and caulk with sealant.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .3 Section 06 10 53 – Miscellaneous Rough Carpentry.
- .4 Section 04 22 00 – Concrete Unit Masonry.
- .5 Section 07 52 00 – Modified Bituminous Membrane Roofing.
- .6 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .7 Section 07 92 00 – Joint Sealants.

1.2 REFERENCES

- .1 The Aluminum Association Inc. (AA)
 - .1 Aluminum Sheet Metal Work in Building Construction.
 - .2 AA DAF45, Designation System for Aluminum Finishes.
- .2 American Society for Testing and Materials (ASTM International)
 - .1 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM A792/A792M, Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 - .3 ASTM D523, Standard Test Method for Specular Gloss.
 - .4 ASTM D822, Standard Practice for Filtered Open-Flame Carbon-Arc Exposures of Paint and Related Coatings.
- .3 Canadian General Standards Board (CGBS)
 - .1 CAN/CGSB-37.5, Cutback Asphalt Plastic Cement.
- .4 Canadian Standards Association (CSA International)
 - .1 CSA B111, Wire Nails, Spikes and Staples.

1.3 SUBMITTALS

- .1 Submit duplicate 50 x 50 mm samples of each type of sheet metal material, colour and finish.
- .2 Clearly indicate bending, folding, jointing, fastening installation details.

1.4 DELIVERY AND STORAGE

- .1 Store products off ground and under cover in a dry, well ventilated enclosure.
- .2 Stack pre-formed material in manner to prevent twisting, bending and rubbing.
- .3 Provide protection for galvanized and pre-coated surfaces.
- .4 Prevent contact of dissimilar metals during storage. Protect from acids, flux, and other corrosive materials and elements.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Scupper Flange: minimum 0.64 mm thick aluminum sheet, size as indicated on drawings. Colour to be selected by Consultant from manufacturer's standard colours.
- .2 Downpipes: minimum 0.64 mm thick aluminum sheet, size as indicated on drawings. Colour to be selected by Consultant from manufacturer's standard colours.
- .3 Downpipe straps: 0.72 mm thick aluminum.
- .4 Sealant: As per Section 07 92 00 – Joint Sealants.
- .5 Elbows and tees: aluminum same as Downpipes.

2.2 FABRICATION

- .1 Fabricate sheet aluminum work in accordance with Aluminum Association Aluminum Sheet Metal Work in Building Construction.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install aluminum downpipes to a distance of 0.15 metres from the grade. Install aluminum straps 1200 mm o.c designed to match the pipe profile and fasten to building with aluminum or stainless steel screws.
- .2 Install sewer type downpiping from the aluminum downpiping to a point 300 mm above the grade or as specified and indicated by Civil. Install aluminum straps designed to suit the pipe profile and fasten to the wall with aluminum or stainless steel screws.
- .3 Install sealant as required to ensure all joints are watertight.
- .4 When work is completed, provide a water test to ensure there are no leaks and that all the water runs from the trough.

3.2 CLEANING

- .1 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

- .2 Leave works areas clean, free from grease, finger marks and stains.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED WORK

- .1 Fire stopping and smoke seals within mechanical assemblies (i.e inside ducts, dampers) and electrical assemblies (i.e. inside cable trays) are specified in Division 23 and 26 respectively.
- .2 Coordinate work of this section with other sections as required to properly execute the work and as necessary maintain satisfactory progress of the work of other sections.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 – Quality Control.
- .3 Section 04 22 00 – Concrete Unit Masonry.
- .4 Section 05 12 00 – Structural Steel.
- .5 Division 23 – HVAC.
- .6 Division 26 – Electrical.

1.3 REFERENCES

- .1 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN-S115, Fire Tests of Firestop Systems.

1.4 DEFINITIONS

- .1 Fire Stop Material: device intended to close off opening or penetration during fire or materials that fill openings in wall or floor assembly where penetration is by cables, cable trays, conduits, ducts and pipes and poke-through termination devices, including electrical outlet boxes along with their means of support through wall or floor openings.
- .2 Single Component Fire Stop System: fire stop material that has Listed Systems Design and is used individually without use of high temperature insulation or other materials to create fire stop system.
- .3 Multiple Component Fire Stop System: exact group of fire stop materials that are identified within Listed Systems Design to create on site fire stop system.
- .4 Tightly Fitted; (ref: NBC Part 3.1.9.1.1 and 9.10.9.6.1): penetrating items that are cast in place in buildings of noncombustible construction or have "0" annular space in buildings of combustible construction.
 - .1 Words "tightly fitted" should ensure that integrity of fire separation is such that it prevents passage of smoke and hot gases to unexposed side of fire separation.

1.5 SUBMITTALS

- .1 Prior to start of work submit the following:
 - .1 Duplicate 300 x 300 mm samples showing actual firestop material proposed for project.
 - .2 Shop drawings to show proposed material, reinforcement, anchorage, fastenings and method of installation. Construction details should accurately reflect actual job conditions.
 - .3 Manufacturer's engineering judgement identification number and drawing details when no ULC or cUL system is available. Engineering judgement must include both project name and contractor's name who will install firestop system as described in drawing.
 - .4 Manufacturer's product data for materials and prefabricated devices, providing descriptions are sufficient for identification at job site. Include manufacturer's printed instructions for installation. Include manufacturer's specifications, training letter, and technical data for each material including the composition and limitations, documentation of ULC or CUL firestop systems to be used.
 - .5 Material safety data sheets provided with product delivered to job site.

1.6 MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 – Quality Control.
- .2 Construct mock-up showing service penetrations, fire separation and floor assemblies. Mock-up may be part of finished work.
- .3 Allow two (2) working days for inspection of mock-up by Consultant and Owner's Representative before proceeding with membrane work.

1.7 MANUFACTURER'S REPRESENTATIVE

- .1 A manufacturer's representative is to be on site during initial installation of firestop systems to train appropriate contractor personnel in proper selection and installation procedures and at commissioning stage to certify acceptance completed installation. Training will be done as per manufacturer's written recommendations published in their literature and drawing details.

1.8 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Installer: person specializing in fire stopping installations with minimum five (5) years documented experience approved by the fire stopping manufacturer.
 - .2 Manufacturer: company with minimum five (5) years experience in producing of material used for work required for this project, with sufficient production capacity to produce and deliver required units without causing delay in work.
- .2 All fire stopping materials for this project to be supplied by a single manufacturer.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Use only firestop products that have been ULC or cUL tested for specific fire-rated construction conditions conforming to construction assembly type, penetrating item type, annular space requirements and fire-rating involved for each separate instance.
- .2 Fire stopping and smoke seal systems: in accordance with CAN-S115.
 - .1 Asbestos-free materials and systems capable of maintaining an effective barrier against flame, smoke and gases in compliance with requirements of CAN-S115 and not to exceed opening sizes for which they are intended.
 - .2 Firestop system rating: as indicated on drawings.
- .3 Service penetration assemblies: certified and tested by ULC or cUL in accordance with CAN-S115.
- .4 Service penetration firestop components: certified and tested by ULC or cUL in accordance with CAN-S115.
- .5 Fire-resistance rating of installed fire stopping assembly in accordance with OBC.
- .6 Non-curing, re-penetrable intumescent sealants, caulking or putty material for use with flexible cables or cable bundles.
- .7 Fire stopping and smoke seals at openings around penetrations for pipes, ductwork and other mechanical items requiring sound and vibration control: elastomeric seal. Consult with Owner's Representative and damper manufacturer prior to installation ULC or cUL firestop systems that might hamper the performance of fire dampers as it pertains to duct work.
- .8 Intumescent sealants or caulking materials for use with combustible items (penetrants consumed by high heat and flame) including insulated metal pipe, PVC jacketed, flexible cable or cable bundles and plastic pipe. No silicone based firestop are allowed to be applied on plastic pipes.
- .9 Primers: to manufacturer's recommendation for specific material, substrate, and end use.
- .10 Water (if applicable): potable, clean and free from injurious amounts of deleterious substances.
- .11 Damming and backup materials, supports and anchoring devices: to manufacturer's recommendations, and in accordance with tested assembly being installed as acceptable to authorities having jurisdiction.
- .12 Sealants for vertical joints: non-sagging.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Examine sizes and conditions of voids to be filled to establish correct thicknesses and installation of materials. Ensure that substrates and surfaces are clean, dry and frost free.

- .2 Prepare surfaces in contact with fire stopping materials and smoke seals to manufacturer's instructions.
- .3 Maintain insulation around pipes and ducts penetrating fire separation without interruption to vapour barrier.
- .4 Mask where necessary to avoid spillage and over coating onto adjoining surfaces; remove stains on adjacent surfaces.

3.2 INSTALLATION

- .1 Install fire stopping and smoke seal material and components in accordance with ULC certification or UL Products Certified for Canada (CUL) and manufacturer's instructions.
- .2 Seal holes or voids made by through penetrations, poke-through termination devices, and unpenetrated openings or joints to ensure continuity and integrity of fire separation are maintained.
- .3 Provide temporary forming as required and remove forming only after materials have gained sufficient strength and after initial curing.
- .4 Tool or trowel exposed surfaces to a neat finish.
- .5 Remove excess compound promptly as work progresses and upon completion.

3.3 INSPECTION

- .1 Notify Consultant and Owner's Representative when ready for inspection and prior to concealing or enclosing firestopping materials and service penetration assemblies.

3.4 SCHEDULE

- .1 Firestop and smoke seal at:
 - .1 Penetrations through fire-resistance rated masonry, concrete, and gypsum board partitions and walls.
 - .2 Perimeter of fire-resistance rated masonry and gypsum board partitions.
 - .3 Intersection of fire-resistance rated masonry and gypsum board partitions.
 - .4 Control and sway joints in fire-resistance rated masonry and gypsum board partitions and walls.
 - .5 Openings and sleeves installed for future use through fire separations.
 - .6 Around mechanical and electrical assemblies penetrating fire separations.
 - .7 Rigid ducts: greater than 129 cm²: fire stopping to consist of bead of fire stopping material between retaining angle and fire separation and between retaining angle and duct, on each side of fire separation.
- .2 TABLE A: THROUGH PENETRATION AND FIRE RESISTIVE JOINT SYSTEMS
SCHEDULE

.1 Table below indicates sample systems; equivalent listed assemblies from other approved alternates are acceptable.

MATERIAL: CONCRETE			
PENETRATING ITEM	DETAILS	F- RATING	UL/ULC TESTED SYSTEM NUMBER
METALLIC PIPE	30" STEEL IRON, 6" CONDUIT, COPPER TUBE, COPPER PIPE, 4" EMT; OPTIONAL SLEEVE, 3-1/2" MINERAL WOOL; W RATING (CLASS 1)	2, 3 & 4 HR	CAJ 1064
PLASTIC PIPE	4" PVC, 3"ccPVC, ABS, ccABS, FRPP; 50Pa	2 HR	TL/PHV 120-05
INSULATED METALLIC PIPE	8" STEEL, IRON, 6" COPPER TUBE, COPPER PIPE; W/1", 2" OR 3" FIBREGLASS, 3-1/2" MINERAL WOOL	2 & 3 HR	CAJ 5121
CABLE BUNDLES	CABLES (25% CROSS-SECTIONAL AREA OF OPENING)	4 HR	CAJ 3237
CABLE TRAY	24"x6" CABLE TRAY, CABLES (40% OF CROSS- SECTIONAL AREA)	2 HR	CAJ 4075
REPENETRABLE CABLE BUNDLES	TREMSTOP QUICKCOMM SLEEVE	2 HR	C-AJ-3270
REPENETRABLE CABLE TRAY	TREMSTOP QUICKCOMM	2 HR	F-A-4006
BLANK OPENING	24" BLANK OPENING, 3-1/2" MINERAL WOOL	2 HR	CAJ 0011
MULTIPLE ITEMS	MULTIPLE AND/OR COMBINATION OF PENETRANTS	2 HR	CAJ 8143
	8" ROUND DUCT; 4-1/4" MINERAL WOOL	2 HR	CAJ 7090 (UP TO 200mm DIA ROUND PROFILE)
SINGLE VENT DUCT	14"x18" DUCT; OPTIONAL BACKER ROD	3 HR	CAJ 7002 (UP TO 320 SQ.IN SQUARE PROFILE)
BUS DUCT	23" BUSWAY IN 330 IN ² OPENING; 4" MINERAL WOOL	2 & 3 HR	CAJ 6007
MATERIAL: GYPSUM			
PENETRATING ITEM	DETAILS	F- RATING	UL/cUL TESTED SYSTEM NUMBER
METALLIC PIPE	12" STEEL, IRON, 6" CONDUIT, 4" EMT, COPPER TUBE, COPPER PIPE; OPTIONAL BACKER ROD, OPTIONAL SLEEVE	1 & 2 HR	WL 1158
PLASTIC PIPE	4" PVC, ccPVC, ABS, ccABS, 3" FRPP; 2" CPVC; 50Pa		TLPV 120-06
INSULATED METALLIC PIPE	4" STEEL, IRON, COPPER TUBE, COPPER PIPE; W/ 3/4" AB/PVC, OPTIONAL BACKER ROD	1 & 2 HR	WL 5081
CABLE BUNDLES	CABLES (2% OF CROSS-SECTIONAL AREA) OVERSIZED OPENING	1 & 2 HR	WL 3043
CABLE TRAY	24"x6" CABLE TRAY, CABLES (31% CROSS- SECTIONAL AREA OF OPENING) AND OPTICAL FIBER RACEWAYS	1 & 2 HR	WL 4056
REPENETRABLE CABLE BUNDLES	TREMSTOP QUICKCOMM SLEEVE	2 HR	W-L-3318
REPENETRABLE CABLE TRAY	TREMSTOP QUICKCOMM SIZED TO ACCOMODATE TRAY OR OPENING	1 & 2 HR	W-L-4070
BLANK OPENING	TREMSTOP QUICKCOMM SLEEVE	2 HR	W-L-0025
MULTIPLE ITEMS	1" STEEL, IRON COPPER OR EMT SOME WITH 3/4" AB/PVC FOAM & CABLES, A/C LINESET	1 & 2 HR	WL 8036
SINGLE VENT DUCT	16" ROUND DUCT, 8"x8" RECTANGULAR DUCT; OPTIONAL BACKER ROD	1 & 2 HR	WL 7039
BUS DUCT			CAJ 6007 W/ENGINEERED JUDGEMENT OR

			PROPRIETARY PRODUCT FROM BUS DUCT MANUFACTURER
DETAIL: HEAD OF WALL	DETAIL	UL/ULC RATING FOR JOINT SYSTEM	
CONCRETE OR CMU TO METAL PAN	2" JOINT (± 25% MOVEMENT), CONC WALL TO CONC FLOOR, METAL DECK, CLASS I & II, 4" MINERAL WOOL	HWD 0251	

3.5 FIRE SEPARATIONS

- .1 Coordinate fire separation labelling/stenciling as per Sections 09 91 23 – Interior Painting.

3.6 CLEAN UP

- .1 Remove excess materials and debris and clean adjacent surfaces immediately after application.
- .2 Remove temporary dams after initial set of fire stopping and smoke seal materials.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Materials, preparation and application for caulking and sealants.
- .2 Text to complete other various Sections containing sealant or caulking specifications, including Section 07 52 00 - Modified Bituminous Membrane Roofing.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .5 Section 04 22 00 – Concrete Unit Masonry
- .6 Section 05 50 00 – Metal Fabrications
- .7 Section 07 26 00 – Vapour Retarders
- .8 Section 07 27 00 – Air Barriers
- .9 Section 07 62 00 – Sheet Metal Flashing and Trim
- .10 Section 08 11 00 – Metal Doors and Frames
- .11 Section 08 90 00 – Louvres

1.3 REFERENCES

- .1 American Society for Testing and Materials International, (ASTM)
 - .1 ASTM C321, Standard Test Method for Bond Strength of Chemical-Resistant Mortars.
 - .2 ASTM C834, Standard Specification for Latex Sealants.
 - .3 ASTM C882, Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - .4 ASTM C919, Standard Practice for Use of Sealants in Acoustical Applications.
 - .5 ASTM C920, Standard Specification for Elastomeric Joint Sealants.
 - .6 ASTM C1330, Standard Specification for Cylindrical Sealant Backing for use with Cold Liquid Applied Sealants.

- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-19.21, Sealing and Bedding Compound Acoustical.
- .3 Department of Justice Canada (Jus)
 - .1 Canadian Environmental Protection Act (CEPA).
- .4 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .5 Transport Canada (TC)
 - .1 Transportation of Dangerous Goods Act (TDGA).

1.4 SUBMITTALS

- .1 Manufacturer's product to describe.
 - .1 Caulking compound.
 - .2 Primers.
 - .3 Sealing compound, each type, including compatibility when different sealants are in contact with each other.
 - .4 Installation instructions, surface preparation and product limitations.
- .2 Submit duplicate samples of each type of material and colour.
- .3 Cured samples of exposed sealants for each color where required to match adjacent material.
- .4 Manufacturers' instructions to include installation instructions for each product used.

1.5 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: company engaged in the manufacturing of products specified in this section with a minimum of ten (10) years documented experience.
- .2 Applicator Qualifications: Experienced installer equipped and trained for application of joint sealant required for this project with record of successful completion of projects of similar scope.
 - .1 Applicator to be approved by sealant manufacturer.
 - .2 Applicator to submit documentation of a minimum three (3) successfully completed projects of similar size, scope and complexity.

1.6 MOCK-UP

- .1 Construct mock-up in accordance with Section 01 45 00 - Quality Control.

- .2 Construct mock-up to show location, size, shape and depth of joints complete with back-up material, primer, caulking and sealant. Mock-up may be part of finished work.
- .3 Allow two (2) working days for inspection of mock-up by Consultant and Owner's Representative before proceeding with sealant work.
- .4 Mock-up will be used:
 - .1 To judge workmanship, substrate preparation, operation of equipment and material application.
- .5 When accepted, mock-up will demonstrate minimum standard of quality required for this Work.

1.7 FIELD ADHESION/COHESION TESTS

- .1 Test Frequency:
 - .1 Perform a field test each type of sealant and substrate combination, for all interior and exterior sealants associated with the building envelope.
 - .2 Perform three (3) additional tests for each failed test.
- .2 Locate test joints as directed by Consultant and Owner's Representative. Tests to be performed in the presence of the Owner's Representative and/or manufacturer's representative.
- .3 Notify Consultant and Owner's Representative seven (7) days prior to dates tests are to be performed.
- .4 Test joint sealants by hand-pull methods #1 and # 2. Record test results in Field Adhesion/Cohesion Test Form.
 - .1 Test Method #1:
 - .1 Make a knife cut horizontally from one side of the joint to the other.
 - .2 Make two (2) vertical cuts (from the horizontal cut) approximately 75 mm long on each side of the joint.
 - .3 Pry out flap created from cuts.
 - .4 Firmly grasp flap and slowly pull at 90° from sealant plane.
 - .5 Pull flap until adhesive or cohesive failure occurs.
 - .1 Adhesive failure will be evidenced by the sealant pulling off clean from the substrate.
 - .2 Cohesion failure will be evidenced by the sealant ripping or failing within itself, leaving well-adhered sealant to the substrate.

(Cohesive failure is considered a positive result).

.2 Test Method # 2:

- .1 Follow steps one (1) through four (4) of Test Method # 1.
- .2 Mark a benchmark on the sealant 25 mm (1") from the plane of the installed sealant.
- .3 Firmly grasp the flap and pull slowly, while holding a ruler parallel to the sealant flap. Note the position of the benchmark on the ruler.
- .4 Refer to manufacturer's printed literature for each sealant tested for the required extension factor pass criteria; (i.e.: if the 25 mm (1") benchmark on the sealant can be pulled to 100 mm (4") and held with no failure of sealant, 400% elongation is achieved.)
- .5 If no failure occurs prior to the manufacturer's stated extension factor, the test is successful. Extension factor should be three (3) times the movement capability of the sealant.

.5 Inspect joints for:

- .1 Complete fill,
- .2 Absence of voids,
- .3 Primer,
- .4 Proper width/depth ratio, and
- .5 Back up material.

.6 Repair sealants pulled in test area by applying new sealants following same procedures used to original seal joints.

.7 Contractor shall repair test areas at no additional cost to the Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, handle, store and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in original wrappings and containers with manufacturer's seals and labels, intact. Protect from freezing, moisture, water and contact with ground or floor.
- .3 Condition products to approximately 16 to 20 degrees C for use in accordance with manufacturer's recommendations.
- .4 Handle all products with appropriate precautions and care as stated on the Material Safety Data Sheet.

1.9 PROJECT CONDITIONS

- .1 Environmental Limitations:

- .1 Do not proceed with installation of joint sealants under following conditions:
 - .1 When ambient and substrate temperature conditions are outside limits permitted by joint sealant manufacturer or are below 4°C.
 - .2 When joint substrates are wet.
- .2 Joint-Width Conditions:
 - .1 Do not proceed with installation of joint sealants where joint widths are less than those allowed by joint sealant manufacturer for applications indicated.
- .3 Joint-Substrate Conditions:
 - .1 Do not proceed with installation of joint sealants until contaminants capable of interfering with adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.1 SEALANT MATERIALS

- .1 Sealants and Caulking compounds must:
 - .1 Meet or exceed all applicable governmental and industrial safety and performance standards; and
 - .2 Be manufactured and transported in such a manner that all steps to the process, including the disposal of waste products arising therefrom, will meet the requirements of all applicable governmental acts, by laws and regulations including, for facilities located in Canada, the Fisheries Act and the Canadian Environmental Protection Act (CEPA).
- .2 Sealant and caulking compounds must not be formulated or manufactured with: aromatic solvents, fibrous talc or asbestos, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium, barium or their compounds, except barium sulphate.
- .3 Sealant and caulking compounds must not contain a total of volatile organic compound (VOC's) in excess of 100 grams per litre as calculated from records of the amounts of constituents used to make the product.
- .4 Sealant and caulking compounds must be accompanied by detailed instructions for proper application so as to minimize health concerns and maximize performance, and information describing proper disposal methods.
- .5 Do not use caulking that emits strong odours, contains toxic chemicals or is not certified as mould resistant in air handling units.
- .6 When low toxicity caulks are not possible, confine usage to areas which off-gas to exterior, are contained behind air barriers, or are applied several months before occupancy to maximize off-gas time.
- .7 Where sealants are qualified with primers use only these primers.

- .8 Sealants acceptable for use on this project must be listed on CGSB Qualified Products List issued by CGSB Qualification Board for Joint Sealants. Where sealants are qualified with primers use only these primers.

2.2 SEALANT MATERIAL DESIGNATIONS

- .1 Single component, low odor, moisture cure, medium modulus, low VOC sealant for use in sealing air/vapour barrier penetrations, to ASTM C920, Type S, Grade NS, Class 35.
- .1 ASTM C719: $\pm 35\%$.
 - .2 Ultimate Elongation: 450 - 550%.
 - .3 Modulus, 100%: 275 - 345 kPa.
 - .4 Shore A Hardness: 25 ± 5 .
 - .5 Tensile Strength: 1034 – 1378 kPa.
 - .6 Maximum VOC: 5 g/L.
- .2 Single component, medium modulus, high-performance, neutral-cure silicone sealant for general purpose exterior use, to ASTM C920, Type S, Grade NS, Class 35, Use NT, M, A and O.
- .1 ASTM C719: $\pm 25\%$.
 - .2 Ultimate Elongation: 550%.
 - .3 Modulus, 50% extension: 380 kPa.
 - .4 Shore A Hardness: 25 ± 5 .
 - .5 Tensile Strength: 1240 kPa.
 - .6 Maximum VOC: 35 g/L.
 - .7 Colour to be selected from manufacturer's standard range.
- .3 Single component, low modulus, neutral-cure silicone sealant for general purpose masonry use, to ASTM C920, Type S, Grade NS, Class 50, Use T, NT, M, G, A and O.
- .1 ASTM C719: $\pm 50\%$.
 - .2 Ultimate Elongation: 1600%.
 - .3 Modulus, 50% extension: 193 kPa.
 - .4 Shore A Hardness: 15.
 - .5 Tensile Strength: 690 kPa.
 - .6 Maximum VOC: 22 g/L.

- .7 Colour to be selected from manufacturer's standard range.
- .4 Single component, medium modulus, neutral-cure silicone sealant for general roofing applications, to ASTM C920, Type S, Grade NS, Class 50, Use NT, G, A and O.
 - .1 ASTM C719: $\pm 50\%$.
 - .2 Shore A Hardness: 35.
 - .3 Tensile Strength: 415 kPa.
 - .4 Maximum VOC: 28 g/L.
 - .5 Colour to be selected from manufacturer's standard range.
- .5 Single component, chemical cure, silicone rubber sealant, for use with plumbing fixtures, showers, sinks, tubs, and junction of counter tops and adjacent wall finishes, to ASTM C920, Type S, Grade NS, Class 25, Use NT.
 - .1 Shore A Hardness: 25.
 - .2 Tensile Strength: 2100 kPa.
 - .3 Maximum VOC: 36 g/L.
 - .4 Colour to be selected from manufacturer's standard range.
- .6 Single component, high-performance, elastomeric polyurethane sealant, paintable, for general purpose interior use, to ASTM C920, Type S, Grade NS, Class 35, Use NT, M, A, T, O and I.
 - .1 ASTM C719: 35%.
 - .2 Ultimate Elongation: 800%.
 - .3 Shore A Hardness: 25 - 30.
 - .4 Tensile Strength: 2400 kPa.
 - .5 Maximum VOC: 35 g/L.
 - .6 Colour to be selected from manufacturer's standard range.
- .7 Single component, non-skinning, non-hardening, synthetic rubber sealant for use in acoustical applications, to CAN/CGSB 19.21.
 - .1 Shrinkage: maximum 20%.
 - .2 Maximum VOC: 53 g/L.
 - .3 Sag: Maximum 4.0 mm.
- .8 Two-component, non-sag, tamper resistant, elastomeric polyurethane sealant, for use in interior joints, penetrations, doors, windows, perimeters of fixtures, where a flexible security

sealant is required due to idle tampering or vandalism, to ASTM C920, type M, Grade NS, Class 12.5, Use T₁, M and O.

- .1 Ultimate Elongation: 175 - 200%.
- .2 Shore A Hardness: 40 - 45.
- .3 Tensile Strength: 2000 to 2400 kPa.
- .4 Maximum VOC: Activator - < 25 g/L, Base - < 100 g/L.
- .5 Colour to be selected from manufacturer's standard range.

2.3 ACCESSORIES

- .1 Primer: Type as recommended by sealant manufacturer. Primer to be compatible with joint forming materials.
- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer and compatible with joint forming materials.
- .3 Preformed Compressible and Non-Compressible back-up materials.
 - .1 Polyethylene, Urethane, Neoprene or Vinyl Foam.
 - .1 Extruded closed cell foam backer rod.
 - .2 Size: oversize 30 to 50 %.
 - .2 Neoprene or Butyl Rubber.
 - .1 Round solid rod, Shore A hardness 70.
 - .3 High Density Foam.
 - .1 Extruded closed cell polyvinyl chloride (PVC), extruded polyethylene, closed cell, Shore A hardness 20, tensile strength 140 to 200 kPa, extruded polyolefin foam, 32 kg/m³ density, or neoprene foam backer, size as recommended by manufacturer.
 - .4 Bond Breaker Tape.
 - .1 Polyethylene bond breaker tape which will not bond to sealant.

PART 3 - EXECUTION

3.1 PROTECTION

- .1 Protect installed Work of other trades from staining or contamination.

3.2 SURFACE PREPARATION

- .1 Examine joint sizes and conditions to establish correct depth to width relationship for installation of backup materials and sealants.

- .2 Clean bonding joint surfaces of harmful matter substances including dust, rust, oil grease, and other matter which may impair work.
- .3 Do not apply sealants to joint surfaces treated with sealer, curing compound, water repellent, or other coatings unless tests have been performed to ensure compatibility of materials. Remove coatings as required.
- .4 Ensure joint surfaces are dry and frost free.
- .5 All joint forming materials to be primed prior to sealant installation.
- .6 Prepare surfaces in accordance with manufacturer's directions.

3.3 PRIMING

- .1 Where necessary to prevent staining, mask adjacent surfaces prior to priming and caulking.
- .2 Prime sides of joints in accordance with sealant manufacturer's instructions immediately prior to caulking.

3.4 BACKUP MATERIAL

- .1 Apply bond breaker tape where required to manufacturer's instructions.
- .2 Install joint filler to achieve correct joint depth and shape, with approximately 30% compression.

3.5 MIXING

- .1 Mix materials in strict accordance with sealant manufacturer's instructions.

3.6 APPLICATION

- .1 Sealant.
 - .1 Apply sealant in accordance with manufacturer's written instructions.
 - .2 Mask edges of joint where irregular surface or sensitive joint border exists to provide neat joint.
 - .3 Apply sealant in continuous beads.
 - .4 Apply sealant using gun with proper size nozzle.
 - .5 Use sufficient pressure to fill voids and joints solid.
 - .6 Form surface of sealant with full bead, smooth, free from ridges, wrinkles, sags, air pockets, embedded impurities.
 - .7 Tool exposed surfaces before skinning begins to give slightly concave shape.
 - .8 Remove excess compound promptly as work progresses and upon completion.
- .2 Curing.

- .1 Cure sealants in accordance with sealant manufacturer's instructions.
- .2 Do not cover up sealants until proper curing has taken place.
- .3 Cleanup.
 - .1 Clean adjacent surfaces immediately and leave Work neat and clean.
 - .2 Remove excess and droppings, using recommended cleaners as work progresses.
 - .3 Remove masking tape after initial set of sealant.

3.7 CLEANING

- .1 Clean adjacent surfaces immediately and leave Work neat and clean.
- .2 Remove excess and droppings, using recommended cleaners as work progresses.
- .3 Remove masking tape after initial set of sealant.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00- Common Product Requirements.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 03 30 00 – Cast-In-Place Concrete.
- .5 Section 04 22 00 – Concrete Unit Masonry.
- .6 Section 07 21 20 – Low Expanding Foam Sealant.
- .7 Section 07 92 00 - Joint Sealants.
- .8 Section 08 71 00 - Door Hardware.
- .9 Section 08 80 50 – Glazing.
- .10 Section 09 91 13 - Exterior Painting.
- .11 Section 09 91 23 - Interior Painting.
- .12 Division 26: Wiring for electronic hardware.
- .13 Division 28: Electronic Safety and Security.

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A653/A653M, Specification for Steel Sheet Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanized) by the Hot Dip Process.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19Ma, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA)
 - .1 G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .4 Canadian Steel Door Manufacturers' Association, (CSDMA).

- .1 CSDMA, Specifications for Commercial Steel Doors and Frames.
- .2 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Doors.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80, Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252, Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN4-S104M, Fire Tests of Door Assemblies.
 - .2 CAN4-S105M, Fire Door Frames Meeting the Performance Required by CAN4-S104.
 - .3 CAN/ULC-S701, Thermal Insulation, Polystyrene, Boards and Pipe Covering.
 - .4 CAN/ULC-S702, Thermal Insulation, Mineral Fibre, for Buildings.
 - .5 CAN/ULC-S704, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 DESIGN REQUIREMENTS

- .1 Design door assembly to withstand minimum 1,000,000 swing cycles in accordance with ANSI A151.1, with no failure of any design features of the door.
- .2 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.
- .3 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.
- .4 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104 and NFPA 252 for ratings specified or indicated.
- .5 Provide fire labelled frames for openings requiring fire protection ratings. Test products in conformance with CAN4-S104 and NFPA 252 and listed by nationally recognized agency having factory inspection services and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.

1.4 SUBMITTALS

- .1 Indicate each type of door, material, steel core thicknesses, mortises, reinforcements, location of exposed fasteners, openings, glazed, louvred, arrangement of hardware and fire rating and finishes.
- .2 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors and exposed fastenings and reinforcing fire rating and finishes.
- .3 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.

- .4 Submit one 300 x 300 mm top corner sample of each type door.
- .5 Submit one 300 x 300 mm corner sample of each type of frame.
- .1 Show butt cutout, glazing stops.

1.5 DELIVERY STORAGE AND HANDLING

- .1 Deliver, store, handle and protect doors and frames in accordance with Section 01 61 00-Common Product Requirements.
- .2 Deliver, handle and store doors and frames at the job site in such a manner as to prevent damage.
- .3 Store doors and frames under cover with doors stored in a vertical position on blocking, clear of floor and with blocking between doors to permit air circulation.

1.6 QUALITY ASSURANCE

- .1 Conform to requirements to ANSI A117.1
- .2 Company specializing in manufacturing products specified with a minimum of five (5) years documented experience.

1.7 WARRANTY

- .1 Provide a written warranty for work of this section from manufacturer for failure due to defective materials and from contractor for failure due to defective installation workmanship, for one (1) year respectively from the date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Hot dipped galvanized steel sheet: to ASTM A653/A653M, ZF75, minimum base steel thickness in accordance with CSDMA Table 1 - Thickness for Component Parts.
- .2 Reinforcement channel: to CSA G40.20/G40.21, Type 44W, coating designation to ASTM A653/A653M, ZF75.

2.2 DOOR CORE MATERIALS

- .1 Stiffened: face sheets welded insulated core.
 - .1 Expanded polystyrene: CAN/ULC-S701, density 16 to 32 kg/m³.
 - .2 Polyurethane: to CAN/ULC-S704 rigid, modified polyisocyanurate, closed cell board. Density 32 kg/m³.
- .2 Temperature rise rated (TRR): core composition to limit temperature rise on unexposed side of door to 250°C at 60 minutes. Core to be tested as part of a complete door assembly, in accordance with CAN4-S104, ASTM E152 or NFPA 252, covering Standard Method of Tests

of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

.3 Thermal Insulation material must:

- .1 Not require being labelled as poisonous, corrosive, flammable or explosive under the Consumer Chemical and Container Regulations of the Hazardous Products Act.
- .2 Be manufactured using a process that uses chemical compounds with the minimum zone depletion potential (ODP) available.

2.3 ADHESIVES

- .1 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.

2.4 PRIMER

- .1 Touch-up prime CAN/CGSB-1.181.

2.5 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Exterior top and bottom caps steel.
- .3 Fabricate glazing stops as formed channel, minimum 16 mm height, accurately fitted, butted at corners and fastened to frame sections with counter-sunk oval head sheet metal screws.
- .4 Door bottom seal: Section 08 71 00 – Door Hardware.
- .5 Metallic paste filler: to manufacturer's standard.
- .6 Fire labels: metal riveted.
- .7 Sealant: Section 07 92 00 – Joint Sealants.
- .8 Provide low expanding, single component polyurethane foam sealant installed at head and jamb perimeter of door frame for sealing to building air barrier, vapour retarder and door frame. Foam sealant width to be adequate to provide required air tightness and vapour diffusion control to building air barrier and vapour retarder foam interior. Refer to Section 07 21 20 – Low Expanding Foam Sealant.
- .9 Glazing: Section 08 80 50 – Glazing.
- .10 Make provisions for glazing as indicated and provide necessary glazing stops.
 - .1 Provide removable stainless steel glazing beads for dry glazing of snap-on type.
 - .2 Design exterior glazing stops to be tamperproof.
- .11 Finish Painting: to Section 09 91 13 – Exterior Painting and Section 09 91 23 – Interior Painting.

2.6 FRAMES FABRICATION GENERAL

- .1 Fabricate frames in accordance with CSDMA specifications.
- .2 Fabricate frames to profiles and maximum face sizes as indicated.
- .3 Exterior frames: 1.2 mm welded, thermally broken type construction.
- .4 Interior frames: 1.2 mm welded type construction.
- .5 Blank, reinforce, drill and tap frames for mortised, template hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .6 Protect mortised cut-outs with steel guard boxes.
- .7 Prepare frame for door silencers, 3 for single door, 2 at head for double door.
- .8 Manufacturer's nameplates on frames and screens are not permitted.
- .9 Conceal fastenings except where exposed fastenings are indicated.
- .10 Provide factory-applied touch up primer at areas where zinc coating has been removed during fabrication.
- .11 Insulate exterior frame components with polyurethane insulation.

2.7 FRAME ANCHORAGE

- .1 Shim and anchor new doors in accordance with CAN/CSA A440.4.
- .2 Provide appropriate anchorage to floor and wall construction.
- .3 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .4 Provide 2 anchors for rebate opening heights up to 1520 mm and 1 additional anchor for each additional 760 mm of height or fraction thereof.
- .5 Locate anchors for frames in existing openings not more than 150 mm from top and bottom of each jambs and intermediate at 660 mm o.c. maximum.

2.8 FRAMES: WELDED TYPE

- .1 Welding in accordance with CSA W59.
- .2 Accurately mitre or mechanically joint frame product and securely weld on inside of profile.
- .3 Cope accurately and securely weld butt joints of mullions, transom bars, centre rails and sills.
- .4 Grind welded joints and corners to a flat plane, fill with metallic paste and sand to uniform smooth finish.
- .5 Securely attach floor anchors to inside of each jamb profile.

- .6 Weld in 2 temporary jamb spreaders per frame to maintain proper alignment during shipment.

2.9 DOOR FABRICATION GENERAL

- .1 Doors: swing type, flush, with provision for glass and/or louvre openings as indicated.
- .2 Exterior doors: insulated, hollow steel construction. Interior doors: honeycomb hollow steel construction.
- .3 Fabricate doors with longitudinal edges locked seam. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .4 Doors: manufacturers' proprietary construction, tested and/or engineered as part of a fully operable assembly, including door, frame, gasketing and hardware in accordance with ASTM E330.
- .5 Blank, reinforce, drill doors and tap for mortised, templated hardware and electronic hardware.
- .6 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .7 Reinforce doors where required, for surface mounted hardware. Provide flush steel top caps to exterior doors. Provide inverted, recessed, spot welded channels to top and bottom of interior doors.
- .8 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .9 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4-S104 ASTM E152 NFPA 252 and list by nationally recognized agency having factory inspection service and construct as detailed in Follow-Up Service Procedures/Factory Inspection Manuals issued by listing agency to individual manufacturers.
- .10 Manufacturer's nameplates on doors are not permitted.

2.10 HOLLOW STEEL CONSTRUCTION

- .1 Form each face sheet for exterior doors from 1.2 mm sheet steel.
- .2 Form each face sheet for interior doors from 1.2 sheet steel.
- .3 Reinforce doors with vertical stiffeners, securely welded to each face sheet at 150 mm on centre maximum.
- .4 Fill voids between stiffeners of exterior doors with insulation as specified.
- .5 Fill voids between stiffeners of interior doors with honeycomb core.

2.11 THERMALLY BROKEN DOORS AND FRAMES

- .1 Fabricate thermally broken doors by using insulated core and separating exterior parts from interior parts with continuous interlocking thermal break.

- .2 Thermal break: rigid polyvinyl chloride extrusion conforming to CGSB 41-GP-19Ma.
- .3 Fabricate thermally broken frames separating exterior parts from interior parts with continuous interlocking thermal break.
- .4 Apply insulation.

PART 3 - EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install labelled steel fire rated doors and frames to NFPA 80 except where specified otherwise.
- .2 Install doors and frames to CSDMA Installation Guide.

3.2 FRAME INSTALLATION

- .1 Set frames plumb, square, level and at correct elevation.
- .2 Secure anchorages and connections to adjacent construction.
- .3 Brace frames rigidly in position while building-in. Install temporary horizontal wood spreader at third points of door opening to maintain frame width. Provide vertical support at centre of head for openings over 1200 mm wide. Remove temporary spreaders after frames are built-in.
- .4 Make allowances for deflection of structure to ensure structural loads are not transmitted to frames.
- .5 Caulk perimeter of frames between frame and adjacent material.
- .6 Maintain continuity of air barrier and vapour retarder.

3.3 DOOR INSTALLATION

- .1 Install doors and hardware in accordance with hardware templates and manufacturer's instructions and Section 08 71 00 - Door Hardware.
- .2 Provide even margins between doors and jambs and doors and finished floor as follows.
 - .1 Hinge side: 1.0 mm.
 - .2 Latch side and head: 1.5 mm.
 - .3 Finished floor: 13 mm.
- .3 Adjust operable parts for correct function.
- .4 Install louvres.

3.4 FINISH REPAIRS

- .1 Touch up with primer finishes damaged during installation.
- .2 Fill exposed frame anchors and surfaces with imperfections with metallic paste filler and sand to a uniform smooth finish.

3.5 GLAZING

- .1 Install glazing for doors and frames in accordance with Section 08 80 50 - Glazing.

3.6 COMMISSIONING

- .1 Contractor to instruct maintenance personnel in operation and maintenance of doors and hardware.
- .2 Confirm operation and function for all doors and hardware.
- .3 Commissioning will be witnessed by Owner's Representative and Certificate will be signed by Contractor and Owner's Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00- Common Product Requirements.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 03 30 00 – Cast-In-Place Concrete.
- .6 Section 04 22 00 – Concrete Unit Masonry.
- .7 Section 05 50 00 - Metal Fabrications.
- .8 Section 08 71 00 - Door Hardware.
- .9 Section 09 91 23 - Interior Painting.
- .10 Division 26: Wiring for electronic hardware
- .11 Division 28: Electronic Safety and Security

1.2 REFERENCES

- .1 Aluminum Association (AA).
 - .1 DAF 45, Designation System for Aluminum Finishes.
- .2 American Architectural Manufacturers Association (AAMA)
 - .1 AAMA 609/610, Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
- .3 ASTM International (ASTM):
 - .1 A36/A36M-14 - Carbon Structural Steel.
 - .2 A240/A240M-15b - Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
 - .3 A653/A653M-15 - Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .4 B209-14 - Aluminum and Aluminum-Alloy Sheet and Plate.
 - .5 B209M-14 - Aluminum and Aluminum-Alloy Sheet and Plate (Metric).

- .6 B221 -14 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .7 B221M -13 - Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).
- .8 D1187/D1187M-97 (2011)e1 - Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
- .4 Master Painters Institute (MPI):
 - .1 No. 18 - Primer, Zinc Rich, Organic.
 - .2 No. 76 - Primer, Alkyd, Quick Dry, for Metal.
- .5 National Association of Architectural Metal Manufacturers (NAAMM):
 - .1 AMP 500-06 - Metal Finishes Manual.
- .6 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB 1.198, Cementitious Primer for Galvanized Surfaces.
 - .2 CAN/CGSB-85.100, Painting.
- .7 Canadian Standards Association (CSA).
 - .1 CAN/CSA-O141, Softwood Lumber.
- .8 National Fire Protection Association (NFPA).
 - .1 NFPA 80, Standard for Fire Doors and Other Opening Protectives.
- .9 Underwriters' Laboratories of Canada (ULC).
 - .1 CAN4-S104, Standard Method for Fire Tests of Door Assemblies.
 - .2 CAN/ULC-S105, Standard Specification for Fire Door Frames.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.
 - .2 Submit two copies of WHMIS MSDS – Material Safety Data Sheets. Indicate VOC's:
 - .1 For caulking materials during application and curing.
 - .2 For door materials and adhesives.
- .2 Shop Drawings:

- .1 Indicate size, configuration, and type of coiling door, arrangement of hardware, operating mechanism and required clearances.
 - .3 Submit duplicate 300mm long pieces of coiling curtain slats, guides frame.
 - .4 Wiring diagrams for motors and controls, including wiring diagram for door, showing electrical interlock of motor with manually operated dead lock, and electrical rough-in.
 - .5 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
 - .6 Submit copies of manufacturer's field reports.
 - .7 Operation and Maintenance Data:
 - .1 Care instructions for each exposed finish product.
 - .2 Start-up, maintenance, troubleshooting, emergency, and shut-down instructions for each operational product.
 - .3 Parts list.
- 1.4 DELIVERY
 - .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver products in manufacturer's original sealed packaging.
 - .3 Mark packaging, legibly. Indicate manufacturer's name or brand, type, and manufacture date.
 - .4 Before installation, return or dispose of products within distorted, damaged, or opened packaging.
- 1.5 STORAGE AND HANDLING
 - .1 Store products indoors in dry, weathertight facility.
 - .2 Protect products from damage during handling and construction operations.
- 1.6 CLOSEOUT SUBMITTALS
 - .1 Provide operation and maintenance data for overhead coiling counter doors and hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.
- 1.7 QUALITY ASSURANCE
 - .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN/ULC -S104 and CAN/ULC -S105 for ratings specified or indicated.
 - .2 Fabricate and install fire rated coiling metal counter doors in accordance with NFPA 80 to suit fire protection rating required.

1.8 WARRANTY

- .1 Provide a written guarantee, signed and issued in the name of the owner, covering the coiling doors for both material and workmanship defects for a period of 5 (five) years from the date of Substantial Completion.
- .2 Areas which prove to be defective in any way shall be repaired or replaced and any damage to other work as a result of such defects shall be repaired at no cost to the Owner.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Galvanized steel sheet: commercial quality with Coating Designation Z275 mill phosphatized.
- .2 Sheet Steel: A653/A653M; G90 galvanized coating. Primer: to CAN/CGSB-85.100.
 - .1 For galvanized sheet steel: CGSB 1-GP-198, primer cementitious (for galvanized surfaces).
- .3 Curtain: roll formed galvanized steel.

2.2 COILING DOORS

- .1 Coiling doors spring counter balanced, overhead type, inside face mounted with guides at jambs set back at adequate distance to provide clear opening.
- .2 Where doors exceeding 7.4 sq. m (80 sq. ft.) are indicated as manually operated, provide design, fabrication, and installation permitting future electric motor operation.
- .3 Rivet continuous end locks to slat ends.
- .4 Doors: Interlocking slats of galvanized steel in manufacturer's standard profile, except exterior door slat profile to be flat.
 - .1 Slat Thickness: As required to resist specified loads.
 - .1 Galvanized Steel: Minimum thickness:
 - .1 Doors less than 4500 mm (15 feet) wide: 0.75 mm (0.030 inch).
 - .2 Doors from 4530 mm (15 feet 1 inch) to 6300 mm (21 feet) wide: 0.90 mm (0.036 inch).
 - .3 Doors wider than 6330 mm (21 feet): 1.2 mm (0.048 inch).
- .5 Bottom Rail: Two continuous angles of galvanized steel, minimum 3 mm (0.125 inch) thick, to receive safety device.
- .6 Hoods: Formed to fit contour of end brackets.
 - .1 Material: Sheet Steel: Minimum 0.6 mm (0.0239 inch) thick.

- .2 Reinforce at top and bottom edges with rolled beads, rods or angles. Provide intermediate supporting brackets for hoods greater than 3600 mm (12 feet) long.
- .3 Fasten hood to brackets with screws or bolts and provide for fastening to wall with bolts.
- .7 Counterbalance Assembly:
 - .1 Design door to coil on barrel supported at end of opening on brackets, counterbalanced by helical springs. Counterbalance minimum 80 percent of door weight at any position.
 - .2 Barrel: Steel pipe or commercial welded steel tubing of proper diameter and thickness for door size, to limit deflection with door rolled up, not to exceed 1 in 360 of span. Close barrel ends with cast iron plugs, machined to fit the opening.
 - .3 Spring: Oil-tempered, helically wound spring rotating on grease-sealed ball bearing or roller bearing units, capable of producing sufficient torque to ensure easy operation of door from any position, and adjustable from exterior of counterbalance assembly without removing hood or motor operator..
- .8 Brackets: Steel plate forming end closure and support for hood and end of barrel assembly.
 - .1 Screw end of barrel or shaft into bracket hubs fabricated of cast iron or steel. Equip bracket hubs or barrel plugs with pre-lubricated ball bearings, shielded or sealed.
- .9 Guides: Standard formed sections or angles of steel.
 - .1 Thickness: Minimum 5 mm (3/16 inch).
 - .2 Profile: Channel of sufficient depth to retain door in place under the horizontal pressure specified, and prevent ends of door from slipping out of guides. Flare guides at top to facilitate door installation.
 - .3 Provide stops to limit door // and grille // travel above top of guides.
 - .4 Provide aluminum guides with replaceable wear strips to prevent metal to metal contact.
 - .5 Provide mounting brackets for closure between guides and jambs.
- .10 Locking:
 - .1 Cylinder Locks: Accept standard screw in cylinders furnished under Section - 08 71 00 Door Hardware.
 - .2 Manually Operated Doors: Provide manufacturer's standard cylinder dead locking device on the inside at each door jamb, key operated from interior.
 - .3 Electrically Operated Doors: Provide manufacturer's standard cylinder dead locking device on inside, key operated from insides, interlocked with motor to prevent motor from operating when locks are activated.

2.3 SYSTEM PERFORMANCE

- .1 Design coiling doors complying with specified performance:

- .1 Operation Cycles: 20,000 minimum.

2.4 OPERATION

- .1 Provide operators complete with electric motor, machine cut reduction gears, steel chain and sprockets, magnetic brake, overload protection, brackets, push button controls, limit switches, magnetic reversing contactor, and other accessories necessary for proper operation including emergency manual operator.

- .2 Design:

- .1 Design operator so motor can be removed without disturbing limit-switch timing and without affecting emergency manual operators.
 - .2 Make provision for emergency manual operation by chain-gear mechanism.
 - .3 Arrange emergency manual operating mechanism so it can be immediately put into and out of operation from floor with electrical or mechanical device to disconnect motor from operating mechanism when emergency manual operating mechanism is engaged without affecting limit switch timing, in case of electrical power failure.
 - .4 Provide interlock with motor to prevent motor from operating when manual locks are activated.

- .3 Motors: NEMA MG1; TENV open drip-proof, maximum 3600 rpm.

- .1 Power Characteristics: as indicated on drawings.
 - .2 Single-phase motors: Maximum one starting contact without commutation.
 - .3 High starting torque, reversible type, of sufficient horsepower and torque output to operate door in both directions from any position, and produce door travel speed of 200 mm/s (8 inches/sec.), minimum, and 300 mm/s (12 inches/sec.), maximum, without exceeding rated capacity.

- .4 Controls: NEMA ICS 1 and NEMA ICS 2.

- .1 Enclosures: NEMA ICS 6, Type 12 or Type 4, except contractor enclosures may be Type 1.
 - .2 Provide each motor with an enclosed, across-the-line type, magnetic reversing contactor, thermal overload protection, solenoid operated brake, limit switches, and remote control switches at locations shown.
 - .3 Provide key activated switches on exterior requiring constant pressure to operate.
 - .4 Provide three-button type, push button switch on interior, unless noted to be key activated, with buttons marked, OPEN, CLOSE, and STOP.

- .1 Type: Fully guarded to prevent accidental operation.

- .2 OPEN and STOP Buttons: Momentary contact type.
- .3 CLOSE Button: Constant contact type.
- .4 When the door is in motion, pressing STOP button causes door to stop instantly and remain in stop position. From stop position, pressing OPEN or CLOSE buttons will operate door.
- .5 Provide field adjustable, limit switches to automatically stop doors at fully open and closed positions. Locate limit switches to be readily accessible for adjustment.
- .6 Safety device:
 - .1 Upon safety device and control system failure, immediately stop, reverse, and fully open doors // and grilles // and lock out electrical controls. Permit continued manual operation until electrical controls are repaired.
 - .2 Do not use safety device as limit switch.
- .7 Transformer: NEMA ST 20.
 - .1 Control transformer in power circuits as required to reduce Voltage on control circuits to 120 Volts or less.
- .8 Electrical Components: Comply with NFPA 70.
 - .1 Hazardous Locations: ULc Listed for specific hazard indicated on drawings.

2.5 FINISHES

- .1 Steel:
 - .1 Clean steel surfaces of scale, rust, oil, and grease.
 - .2 Apply light colored shop prime paint after fabrication.
- .1 Galvanized Steel: Apply phosphate treatment and corrosion inhibitive primer.

2.6 ACCESSORIES

- .1 Galvanizing Repair Paint: MPI No. 18.
- .2 Alkyd Metal Primer: MPI No. 76.
- .3 Barrier Coating: ASTM D1187/1187M.
- .4 Touch-Up Paint: Match shop finish.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Examine and verify substrate suitability for product installation.

- .2 Protect existing construction and completed work from damage.

3.2 INSTALLATION - GENERAL

- .1 Install products according to manufacturer's instructions and approved submittal drawings under direct supervision of manufacturer's representative or trained personnel.
- .2 Adjust operable parts for correct function and smooth operation.
- .3 Locate anchors and inserts for guides, brackets, motors, switches, hardware, and other accessories accurately.
- .4 Securely attach guides to adjoining construction with minimum 9 mm (3/8 inch) diameter bolts, spaced maximum 600 mm (24 inches) on center.
- .5 Locate control switches where shown.
 - .1 Locate control switches minimum 1500 mm (5 feet) above floor line, so operating personnel have complete view of door.
- .6 Install electric devices and wiring as specified in DIVISION 26, ELECTRICAL and DIVISION 28, ELECTRONIC SAFETY AND SECURITY.
- .7 Isolate aluminum in contact with dissimilar metal, concrete and masonry by painting with coat of bituminous paint.
- .8 Paint aluminum in contact with wood or other absorptive materials with barrier coating.
- .9 Touch up damaged factory finishes.
- .10 Lubricate and adjust units to operate freely.
- .11 Touch up damaged factory finishes.
 - .1 Galvanized Surfaces: Apply galvanizing repair paint.
 - .2 Primed Surfaces: Apply touch up paint.

3.3 CLEANING

- .1 Clean exposed doors surfaces. Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking; clean doors and frames.
- .3 Upon completion of installation remove surplus materials, rubbish, tools and equipment barriers.

3.4 PROTECTION

- .1 Protect coiling doors from construction operations.
- .2 Remove protective materials immediately before acceptance.

.3 Repair damage.

3.5 COMMISSIONING

.1 Contractor to instruct maintenance personnel in operation and maintenance of doors and hardware.

.2 Confirm operation and function for all doors and hardware.

.3 Commissioning will be witnessed by Owner's Representative and certificate will be signed by Contractor and Owner's Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 21 00 – Allowances.
- .2 Section 01 33 00 - Submittal Procedures.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 08 11 00- Metal Doors & Frames.
- .7 Section 08 33 00 – Coiling Door.
- .8 Division 26 - Electrical wiring for magnetic strikes, electric releases, electric locks.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI) / Builders Hardware Manufacturers Association (BHMA)
 - .1 ANSI/BHMA A156.1, American National Standard for Butts and Hinges.
 - .2 ANSI/BHMA A156.2, Bored and Preassembled Locks and Latches.
 - .3 ANSI/BHMA A156.3, Exit Devices.
 - .4 ANSI/BHMA A156.4, Door Controls - Closers.
 - .5 ANSI/BHMA A156.5, Cylinders and Input Devices for Locks.
 - .6 ANSI/BHMA A156.6, Architectural Door Trim.
 - .7 ANSI/BHMA A156.8, Door Controls - Overhead Stops and Holders.
 - .8 ANSI/BHMA A156.12, Interconnected Locks and Latches.
 - .9 ANSI/BHMA A156.13, Mortise Locks and Latches Series 1000.
 - .10 ANSI/BHMA A156.14, Sliding and Folding Door Hardware.
 - .11 ANSI/BHMA A156.15, Release Devices - Closer Holder, Electromagnetic and Electromechanical.
 - .12 ANSI/BHMA A156.16, Auxiliary Hardware.
 - .13 ANSI/BHMA A156.17, Self-closing Hinges and Pivots.

- .14 ANSI/BHMA A156.18, Materials and Finishes.
- .15 ANSI/BHMA A156.19, Power Assist and Low Energy Power - Operated Doors.
- .16 ANSI/BHMA A156.21, Thresholds.
- .17 ANSI/BHMA A156.22, Door Gasketing and Edge Seal Systems.
- .18 ANSI/BHMA A156.26, Continuous Hinges.
- .19 ANSI/BHMA A156.28, Keying Systems.
- .20 ANSI/BHMA A156.31, Electronic Strikes.
- .2 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA)
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction).
 - .2 CSDFMA Recommended Dimensional Standards for Commercial Steel Doors and Frames.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet.
- .2 Samples:
 - .1 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .2 After approval samples will be returned for incorporation in the Work.
- .3 Hardware List:
 - .1 Submit contract hardware list.
 - .2 Indicate specified hardware, including make, model, material, function, size, finish and other pertinent information.
- .4 Manufacturer's Instructions:
 - .1 Submit manufacturer's installation instructions.
- .5 Closeout Submittals
 - .1 Provide operation and maintenance data for door closers, locksets, door holders electrified hardware and fire exit hardware for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Supply two sets of wrenches for door closers, locksets and fire exit hardware.

1.5 WARRANTY

- .1 Provide a written manufacturer's warranty for work of this Section for failure due to defective materials for ten (10) years, dated from substantial completion certificate.
- .2 Provide a written Contractor's warranty for work of this Section for failure due to defective installation workmanship for one (1) year, dated from submittal completion certificate.

1.6 QUALITY ASSURANCE

- .1 Regulatory Requirements:
 - .1 Hardware for doors in fire separations and exit doors certified by a Canadian Certification Organization accredited by Standards Council of Canada.
- .2 Only products certified in accordance with ANSI/BHMA standards are acceptable. Items that are equal in design, function and quality will be accepted upon approval of the Consultant and Owner's Representative.
- .3 Only recognized contract hardware distributors will be considered for the work of this section. The distributor shall have on staff a qualified Architectural Hardware Consultant recognized by the Door and Hardware Institute or a person with equivalent qualifications to assist installers and direct detailing, processing and delivery of material, and certify installation acceptance.
- .4 Upon completion of finish hardware installation, hardware supplier shall inspect work and shall certify in writing that all items and their installation are in accordance with requirements of Contract Documents and are functioning properly.

1.7 DELIVERY, STORAGE, AND HANDLING

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Store finishing hardware in locked, clean and dry area.
- .3 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.

PART 2 - PRODUCTS

2.1 HARDWARE ITEMS

- .1 Only door locksets and latches listed on ANSI/BHMA Standards list are acceptable for use on this project.
- .2 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

.1 Locks and latches:

- .1 Bored and preassembled locks and latches: to ANSI/BHMA A156.2, 4000 bored lock, grade 1, designed for function and keyed as stated in Door and Hardware Schedule.
- .2 Mortise locks and latches: to ANSI/BHMA A156.13, Schlage L series mechanical lock with IC core (to match Owner standard), designed for function and keyed as stated in Door and Hardware Schedule.
- .3 Lever handles: design as indicated in hardware groups.
- .4 Roses: round.
- .5 Normal strikes: box type, lip projection not beyond jamb.
- .6 Cylinders: key into keying system as directed by Owner.
- .7 All corresponding cylinders to be removable.
- .8 Finished as indicated in Hardware Groups.

.2 Butts and hinges:

- .1 Butts and hinges: to ANSI/BHMA A156.1, designated by letter A and numeral identifiers, followed by size and finish, listed in Door and Hardware Schedule.
- .2 Interior hinges of steel, unless otherwise indicated.
- .3 Continuous hinges shall be heavy duty as indicated, full height, complete with installation aids and fasteners to suit door and frame conditions. Hinge to have access to electrical items without removing hinge.
- .4 Quantity, size and width of hinges in accordance with manufacturer's recommendations and ANSI/BHMA 156.1.

.3 Exit devices:

- .1 To ANSI/BHMA A156.3, function, grade and finish as per schedule. Rim type with push pad design.

.4 Door Closers and Accessories:

- .1 Door controls (closers): to ANSI/BHMA A156.4, listed in Door and Hardware Schedule, size in accordance with ANSI/BHMA A156.4. Table A1.
- .2 Closers of narrow, slim line design complete with backcheck, rack and pinion hydraulic action.
- .3 Closers equipped with full cover, as noted in Hardware Groups, complete with secure and concealed mounting screws

- .4 Adapter plates for added reinforcing shall be added to any opening if required to suit field conditions or door design.
- .5 Closers shall include all necessary arm brackets, cushion arm supports and blade stop spacers to suit door swing, frame reveals or stop conditions.
- .6 Closers capable of field adjustments of at least fifteen (15) percent.
- .7 Finish as indicated in Hardware Groups.
- .5 Auxiliary locks and associated products: to ANSI/BHMA A156.5.
 - .1 Key into keying system as directed by Owner.
- .6 Architectural door trim: to ANSI/BHMA A156.6, as listed in Door and Hardware Schedule.
 - .1 Door protection plates: 1.27 mm thick stainless steel, finished to BMHA 630.
 - .2 Push plates: 1.27 mm thick stainless steel finished to BMHA 630.
 - .3 Push/Pull units: type stainless steel finished to BMHA 630.
 - .4 Fastened with through bolts or concealed bolts depending on application.
 - .5 Where pull has back plate, fasteners will be countersunk and bevelled with no sharp edges.
 - .6 Where bolts cannot be concealed under the push plate they shall have a grommet washer finished to match other hardware.
- .7 Auxiliary hardware: to ANSI/BHMA A156.16, as listed in Door and Hardware Schedule.
 - .1 Combination stop and holder, floor mounted: finished to BMHA 626.
 - .2 Surface bolt lever extension flush bolt: finish to BMHA 626.
- .8 Door bottom seal: heavy duty, door seal of extruded aluminum frame and hollow closed cell neoprene weather seal, surface mounted with drip cap closed ends, clear anodized finish.
- .9 Thresholds:
 - .1 To ANSI/BHMA A156.21 extruded aluminum mill finish, serrated surface, with lip and vinyl door seal insert, thermally broken.
 - .2 Thresholds of aluminum material. Provide 50 mm longer than opening to allow fitting on site.
 - .3 When mullion is used, increase length of threshold to fit around mullion.
 - .4 Fasteners of countersink type suitable to properly install to floor/sill conditions. Supply complete with screw anchors.
- .10 Weatherstripping:

.1 Head and jamb seal:

.1 Extruded aluminum frame and solid closed cell neoprene insert, clear anodized finish.

.11 Astragal: overlapping, extruded aluminum frame with vinyl insert, finished to match doors.

2.3 KEY CABINET

.1 Provide one wall mounted steel key cabinet with capacity for 1.5 times the number of keys with an indexed key control system to ANSI/BHMA A156.5.

2.4 FASTENINGS

.1 Use only fasteners provided by manufacturer. Failure to comply may void warranties and applicable licensed labels.

.2 Supply screws, bolts, expansion shields and other fastening devices required for satisfactory installation and operation of hardware.

.3 Exposed fastening devices to match finish of hardware.

.4 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners.

.5 Use fasteners compatible with material through which they pass.

2.5 KEYING

.1 Doors, padlocks and cabinet locks to be master keyed as directed. Prepare detailed keying schedule in conjunction with Owner.

.2 Provide keys in triplicate for every lock in this Contract.

.3 Provide six master keys for each MK or GMK group. Allow for six (6) levels of sub master keying.

.4 Stamp keying code numbers on keys and cylinders.

.5 Provide construction cores.

.6 Provide all permanent cores and keys to Owner's Representative.

.7 Supply fifty (50) blanks for each sub master group used.

2.6 FINISHES

.1 Following finishes are indicated in hardware groups.

BHMA	CAN MATERIAL	FINISH
626	C26D Brass/Bronze	Satin Chrome
628	C28 Aluminum	Satin Alum, Anodized

630	C32D Stainless Steel	Satin Stainless Steel
652	C26D Steel	Plated Satin Chrome
689	Al All	Painted Aluminum
	Alum Aluminum	Mill Finish
	TMDFF (to match door and frame finish).	

2.7 ABBREVIATIONS

HMD	Hollow Metal Door and Frame
ATMS STMS	Arm/strike To Template with Machine Screws
ASB	Arm Complete with Sex Bolts
BC	Back Check
C to C, C/L	Centerline to Centerline
Cyl	Cylinder (of a lock)
CMK	Construction Master Key
Deg.	Degree (of opening)
DEL	Delayed Action
FBF or BB	Ball bearing hinge

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.
- .2 Furnish metal door and frame manufacturers with complete instructions and templates for preparation of their work to receive hardware.
- .3 Furnish manufacturers' instructions for proper installation of each hardware component.

3.2 INSTALLATION

- .1 Install door hardware in accordance with manufacturer's instructions, using special tools and jigs. Fit accurately and apply securely. Ensure that hardware is installed correctly.
- .2 Install hardware to standard hardware location dimensions in accordance with Canadian Metric Guide for Steel Doors and Frames (Modular Construction) prepared by Canadian Steel Door and Frame Manufacturers' Association.
- .3 No operating hardware shall be installed at a height of more than 1200mm above the finished floor (OBC 3.4.6.16).
- .4 Installation to be done by a qualified tradesman. Technical assistance provide by door hardware supplier where required.

- .5 Closers shall be installed according to manufacturer's templates and installation instructions. Unless required otherwise, installation shall be on pull side of door. Outswing doors shall be on push side using top jamb or parallel arm installation.
- .6 Where closer or arm is installed on door, sex bolts will be used, finished to match other hardware.
- .7 Where pull is scheduled on one side of door and push plate on other side, supply fastening devices, and install so pull can be secured through door from reverse side. Install push plate to cover fasteners. Plates drilled to accept through bolts will not be acceptable.
- .8 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .9 Install key control cabinet.
- .10 Use only manufacturer's supplied fasteners. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.
- .11 Remove construction cores and locks when directed by Owner's Representative; install permanent cores and check operation of locks.
- .12 Installation of Access Control items to be performed by manufacturer certified authorized personnel, including connections to hardware products installed by others.
- .13 Wiring Diagrams:
 - .1 Provide any special information, voltage requirements and wiring diagrams to other trades requiring such information.

3.3 EXAMINATION

- .1 Visit site prior to start of installation of hardware.
- .2 Visit will include examination of openings, site conditions and materials for conditions that prevent proper application of finish hardware.
- .3 Report to General Contractor, in writing, defects of work prepared by other trades and other unsatisfactory site conditions. Commencement of installation will imply acceptance of prepared work by others.

3.4 FIELD QUALITY CONTROL

- .1 Hardware contractor to have a qualified AHC representative from the manufacturer/supplier on site at Substantial Completion Inspection and at commissioning of the finished hardware. Cost of the visits to be included in contract.
- .2 Provide an inspection report 6 (six) months after Substantial Completion, completed by a qualified Architectural Hardware Consultant, to note any deficiencies. The inspection should include checking each lock against the key schedule to make sure the correct locks and cylinders are on the proper doors.
- .3 Fire Rated Door Assemblies On-Site Inspection:

- .1 Upon completion of the installation, inspect each fire rated door assembly to confirm proper operation of its closing device, confirming it meets the criteria of NFPA 80.
- .2 Provide a written report to the Consultant and Owner's Representative listing each fire rated door assembly for the project including:
 - .1 Each door number,
 - .2 An itemized list of hardware set components for each door opening, and
 - .3 Each door location in the facility.

3.5 ADJUSTING

- .1 Adjust door hardware, operators, closures and controls for optimum, smooth operating condition, safety and for weather tight closure.
- .2 Lubricate hardware, operating equipment and other moving parts.
- .3 Adjust door hardware to provide tight fit at contact points with frames.
- .4 Where hardware is found defective, repair or replace or correct as desired by inspection reports.

3.6 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Clean hardware with damp rag and approved non-abrasive cleaner, and polish hardware in accordance with manufacture's instructions.
- .3 Remove protective material from hardware items where present.
- .4 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.7 PROTECTION

- .1 All hardware shall be protected against damage from paint, plaster or other defacing materials. Whenever possible manufacturers protective covering when applied, shall not be removed until final project cleaning takes place. Material not protected by manufacture shall be covered or removed from door during painting or any other adjustments that can cause damage to hardware.

3.8 HARDWARE GROUPS

- .1 Provide hardware as specified in the previous articles in sets according to the following groups:
 - .1 Single, Exterior
 - .2 Pairs, Exterior

.3 Single, Interior, Rated

.4 Coiling, Exterior

3.9 DEMONSTRATION

.1 Keying System Setup and Cabinet:

.1 Set up key control system with file key tags, duplicate key tags, numerical index, alphabetical index and key change index, label shields, control book and key receipt cards.

.2 Place file keys and duplicate keys in key cabinet on their respective hooks.

.3 Lock key cabinet and turn over key to Owner's Representative.

.2 Designated Staff Briefing:

.1 Brief designated staff regarding:

.1 Proper care, cleaning, and general maintenance of projects complete hardware.

.2 Description, use, handling, and storage of keys.

.3 Use, application and storage of wrenches for door closers, locksets, and fire exit hardware.

.3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.10 COMMISSIONING

.1 Site inspection or visit at Substantial Completion and training follow up and inspection at commissioning as directed by Owner's Representative.

.2 Provide 10 month warranty service.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 01 78 00 - Closeout Submittals.
- .5 Section 08 11 14 – Metal Doors & Frames.

1.2 REFERENCES

- .1 American National Standards Institute (ANSI).
 - .1 ANSI/ASTM E330, Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference.
- .2 American Society for Testing and Materials (ASTM)
 - .1 ASTM C542, Specification for Lock-Strip Gaskets.
 - .2 ASTM D2240, Test Method for Rubber Property – Durometer Hardness.
- .3 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-12.1, Tempered or Laminated Safety Glass.
 - .2 CAN/CGSB-12.3, Clear Float Glass
 - .3 CAN/CGSB-12.5, Mirrors, Silvered.
 - .4 CAN/CGSB-12.8, Insulating Glass Units.
 - .5 CAN/CGSB-12.11, Wired Safety Glass.
- .4 Canadian Standards Association (CSA).
 - .1 CSA A440.2, Energy Performance Evaluation of Windows and Sliding Glass Doors.
 - .2 CSA Certification Program for Windows and Doors.
- .5 Glass Association of North American (GANA)
 - .1 GANA Glazing Manual.
 - .2 GANA Laminated Glazing Reference Manual.

1.3 SYSTEM DESCRIPTION

.1 Performance Requirements:

- .1 Provide continuity of building enclosure vapour and air barrier using glass and glazing materials as follow:
 - .1 Utilize inner light of multiple light sealed units for continuity of air and vapour seal.
- .2 Size glass to withstand wind loads, dead loads and positive and negative live loads as measured in accordance with ANSI/ASTM E330 and NBC latest edition.
- .3 Limit glass deflection to 1/200 with full recovery of glazing materials.

1.4 SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's printed product literature, specifications and data sheet.

.2 Manufacturer's Instructions:

- .1 Submit manufacturer's installation instructions.

.3 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.

.4 Samples:

- .1 Submit for review and acceptance of each unit.
- .2 Samples will be returned for inclusion into work.
- .3 Submit duplicate 300 mm size samples of glass and sealant material.

.5 Closeout Submittals:

- .1 Provide maintenance data including cleaning instructions for incorporation into manual specified in Section 01 78 00 - Closeout Submittals

1.5 QUALITY ASSURANCE

- .1 Perform work in accordance with GANA Glazing Manual and Laminated Glazing Reference Manual for glazing installation methods. Provide shop inspection and testing for glass.
- .3 Provide certificate of quality compliance from manufacturer.

1.6 WARRANTY

- .1 Provide ten (10) year warranty for glazing units from the date of Substantial Completion.

1.7 ENVIRONMENTAL REQUIREMENTS

- .1 Install glazing when ambient temperature is 10°C minimum. Maintain ventilated environment for 24 hours after application.
- .2 Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

PART 2 - PRODUCTS

2.1 MATERIALS: FLAT GLASS

- .1 Wired glass: to CAN/CGSB-12.11, 6 mm thick.
 - .1 Type 1- Polished both sides (transparent)
 - .2 Wire mesh style 3 – square.
- .2 Glass for cabinet and millwork: to CAN/CGSB-12.5, transparent, minimum 4.0 mm thick, unless otherwise indicated.
 - .1 Type 2 - Tempered.

2.2 MATERIALS

- .1 Sealant: 07 92 00 – Joint Sealants.

2.3 ACCESSORIES

- .1 Setting blocks: Neoprene, 80-90 Shore A durometer hardness to ASTM D2240, minimum 100 mm x width of glazing rabbet space minus 1.5 mm x height.
- .2 Spacer shims: Neoprene, 50-60 Shore A durometer hardness to ASTM D2240, 75 mm long x one half height of glazing stop x thickness to suit application. Self-adhesive on one face.
- .3 Glazing tape:
 - .1 Preformed butyl compound with integral resilient tube spacing device, 10-15 Shore A durometer hardness to ASTM D2240; coiled on release paper; black colour.
- .4 Glazing splines: resilient polyvinyl chloride, extruded shape to suit glazing channel retaining slot, colour as selected.
- .5 Glazing clips: manufacturer's standard type.
- .6 Lock-strip gaskets: to ASTM C542.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

- .1 Compliance: Comply with manufacturer's written data, including product technical bulletins, product catalogue installation instructions, product carton installation instructions, and data sheets.

3.2 EXAMINATION

- .1 Verify that openings for glazing are correctly sized and within tolerance.
- .2 Verify that surfaces of glazing channels or recesses are clean, free of obstructions, and ready to receive glazing.

3.3 PREPARATION

- .1 Clean contact surfaces with solvent and wipe dry.
- .2 Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- .3 Prime surfaces scheduled to receive sealant.

3.4 INSTALLATION: INTERIOR DRY METHOD (TAPE AND TAPE)

- .1 Perform work in accordance with GANA Glazing Manual and GANA Laminated Glazing Reference Manual for glazing installation methods.
- .2 Cut glazing tape to length and set against permanent stops, projecting 1.6 mm above sight line.
- .3 Place setting blocks at 1/4 with edge block maximum 150 mm from corners.
- .4 Rest glazing on setting blocks and push against tape with sufficient pressure to attain full contact at perimeter of light or glass unit.
- .5 Place glazing tape on free perimeter of glazing in same manner described in 3.4.3. Apply heel bead of sealant along intersection of permanent stop with frame ensuring full perimeter seal between glass and frame to complete continuity of air and vapour seal.
- .6 Install removable stop without displacement of tape. Exert pressure on tape for full continuous contact.
- .7 Knife trim protruding tape.

3.5 CLEANING

- .1 Perform cleaning after installation to remove construction and accumulated environmental dirt.
- .2 Remove traces of primer, caulking.
- .3 Remove glazing materials from finish surfaces.
- .4 Remove labels after work is complete.
- .5 Clean glass and mirrors using approved non-abrasive cleaner in accordance with manufacturer's instructions.
- .6 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

3.6 PROTECTION OF FINISHED WORK

- .1 After installation, mark light with an "X" by using removable plastic tape or paste. Do not mark heat absorbing or reflective glass units.
- .2 Repair damage to adjacent materials caused by glazing installation.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 All requirements of Division 01 apply to this section and are to be read in conjunction.
- .2 Section 03 30 00 – Cast-in-place Concrete.
- .3 Section 04 22 00 – Concrete Unit Masonry.
- .4 Section 05 50 00 – Metal Fabrications.
- .5 Section 07 21 20 – Low Expanding Foam Sealant.
- .6 Section 07 27 00 – Air Barriers.
- .7 Section 07 62 00 – Sheet Metal Flashing and Trim.

1.2 SECTION 07 92 00 – JOINT SEALANTS REFERENCES

- .1 The Aluminum Association Inc. (AAI)
 - .1 AAI DAF-45-[2003], Designation System for Aluminum Finishes - 9th Edition.
- .2 Air Movement and Control Association International (AMCA)
 - .1 AMCA 500-D-[98], Laboratory Methods of Testing Dampers for Rating.
 - .2 AMCA 500-L-[99], Laboratory Methods of Testing Louvers for Rating.
 - .3 AMCA 501-[03], Application Manual for Air Louvers.
 - .4 AMCA 511-[99(R2004)], Certified Ratings Program for Air Control Devices.
- .3 American National Standards Institute (ANSI)
 - .1 ANSI H35.1/H35.1M-[06], Alloy and Temper Designation Systems for Aluminum.
- .4 American Society for Testing and Materials International (ASTM)
 - .1 ASTM A167-[99(2004)], Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .2 ASTM A653/A653 M-[05a], Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .3 ASTM A1008/A1008M-[05b], Standard Specification for Steel, Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, Solution Hardened and Bake Hardenable.
 - .4 ASTM B32-[04], Standard Specification for Solder Metal.

- .5 ASTM B209-[04], Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
- .6 ASTM B221-[05a], Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
- .7 ASTM B370-[03], Standard Specification for Copper Sheet and Strip for Building Construction.
- .8 ASTM D523-[89(1999)], Standard Test Method for Specular Gloss.
- .9 ASTM D822-[01], Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings.
- .5 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.213-[2004], Etch Primer (Pretreatment Coating of Tie Coat) for Steel and Aluminum.
 - .2 CAN2-93.1-[M85], Sheet Aluminum Alloy, Prefinished, Residential.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario, Canada.
 - .2 Indicate fabrication and erection details, including anchorage, accessories, and finishes.
- .4 Samples:
 - .1 Submit duplicate samples of each type of louvre showing colour and finish.
 - .2 Show frame detail, screening and finish.
 - .3 Where colour is not indicated, submit manufacturer's standard colours to Consultant for selection.
- .5 Quality Assurance Submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

- .6 Closeout Submittals:
 - .1 Provide operation and maintenance data for manual or motorized operated louvres for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Packing, shipping, handling and unloading:
 - .1 Deliver, store and handle in accordance with Section 01 61 00 - Common Product Requirements.
 - .2 Deliver, store and handle materials in accordance with manufacturer's written instructions.
 - .3 Deliver materials to the site in undamaged condition.
- .2 Storage and Protection:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Protect louvres from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.
- .3 Waste Management and Disposal:
 - .1 Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Weather resistant louvres, with bird screens made to withstand a wind load of not less than 1.44 kilopascals.
- .2 Wall louvers: complete with AMCA certified ratings program seal for air performance and water penetration in accordance with AMCA 500-D, AMCA 500-L, AMCA 511.
- .3 Ratings to indicate water penetration of 0.06 kilograms or less per square meter of free area at free velocity of 244 meters per minute.
- .4 Galvanized steel sheet: commercial quality to ASTM A653/A653M with Z275 zinc coating.
- .5 Steel sheet: commercial quality to ASTM A1008/A1008M with Class I matte finish.
- .6 Aluminum extrusions: to AAI DAF-45, AA6063-T5, ANSI H35.1/H35.1M. ASTM B221 alloy 6063- T5
- .7 Solder: to ASTM B32, 50% tin and 50% lead.
- .8 Flux: suitable for materials to be soldered.

- .9 Nails and fasteners: same material as fabricated items.
- .10 Gaskets: vinyl.
- .11 Primer: to CAN/CGSB-1.213 aluminum surfaces.
- .12 Screens:
 - .1 Insect screens: 0.3 mm diameter aluminum wire 18 x 14 mesh with 60% free area, secured to aluminum frame.
 - .2 Bird screens: crimped aluminum wire cloth secured to 2 mm thick extruded aluminum frame mitered at corners and secured with corner locks, 13mm size mesh with minimum 50% free area.
- .13 Extruded aluminum louvres:
 - .1 Construct louvres from aluminum extrusions of minimum 3 mm thickness to sizes and shapes indicated.
 - .2 Arrange blades, mullions and frame extrusions as indicated.
 - .3 Install concealed vertical stiffeners spaced to meet required loads.
 - .4 Complete louver assembly to have minimum 50 % free area.
- .14 Closure angles and closure plates:
 - .1 Fabricate from 2 mm (0.074-inch) galvanized steel.
 - .2 Provide continuous closure angles and closure plates on inside head, jambs and sill of exterior wall louvers.
 - .3 Secure angles and plates to louver frames with screws, and to masonry or concrete with fasteners as specified.

2.2 FINISHES

- .1 Finish exposed surfaces of aluminum components in accordance with AAI DAF-45, ANSI H35.1/H35.1M for Aluminum Finishes.
- .2 Appearance and properties of anodized finishes designated by the Aluminum Association as Architectural Class 1, Architectural Class 2, and Protective and Decorative.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Install louvres where indicated.

- .2 Set adjustable louver blades for uniform alignment in open and closed positions.
- .3 Adjust louvres so moving parts operate smoothly.
- .4 Attach bird/insect screen to inside face of louver.
- .5 Repair damage to louvres to match original finish.
- .6 Install wall louvers using stops, flanges, and jamb fasteners as appropriate for wall construction and in accordance with manufacturer's recommendations.

3.3 CLEANING

- .1 Proceed in accordance with Section 01 74 00 - Cleaning.
- .2 All movable parts, including hardware, shall be cleaned and adjusted to operate as designed without binding or deformation of the members, so as to be centered in the opening of frame, and where applicable, to have all contact surfaces fit tight and even without forcing or warping the components.
- .3 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

3.4 PROTECTION

- .1 Paint copper or copper-bearing alloys in contact with dissimilar metal with heavy-bodied bituminous paint or separate with inert membrane.
- .2 Where aluminum contacts metal other than zinc, paint dissimilar metal with primer and two coats of aluminum paint.
- .3 Paint metal in contact with mortar, concrete, or other masonry materials with alkali-resistant coatings such as heavy-bodied bituminous paint.
- .4 Paint wood or other absorptive materials that may become repeatedly wet and in contact with metal with two coats of aluminum paint or coat of heavy-bodied bituminous paint.

3.5 SCHEDULE

- .1 Refer to Architectural Louver Schedule, and also Mechanical drawings.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 61 00 - Common Product Requirements.
- .3 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .4 Section 03 30 00 – Cast-In-Place Concrete.
- .5 Section 04 22 00 – Concrete Unit Masonry.
- .6 Section 05 55 00 – Metal Fabrications.
- .7 Section 07 84 00 – Firestopping.
- .8 Section 07 92 00 – Joint Sealants.

1.2 REFERENCES

- .1 American Society for Testing and Materials, (ASTM)
 - .1 ASTM C126-96, Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units
 - .2 ASTM D570-95, Water Absorption of Plastics
 - .3 ASTM D638-M96, Tensile Properties of Plastics
 - .4 ASTM D696-91, Coefficient of Linear Thermal Expansion of Plastics between -30°C and 30°C
 - .5 ASTM D905-94, Strength Properties of Adhesive Bonds in Shear by Compression Loading
 - .6 ASTM D1044-94, Resistance of Transparent Plastic to Surface Abrasion
 - .7 ASTM D1308-87(1993)e1, Effect of Household Chemicals on Clear and Pigmented Organic Finishes
 - .8 ASTM D2337-84(R1996)e1, Freeze-Thaw Stability of Multicolor Lacquers
 - .9 ASTM E84a-96a, Surface Burning Characteristics of Building Materials
 - .10 CGSB 1-GP-71, Methods of Testing Paints and Pigments

1.3 PRODUCT OPTIONS AND SUBSTITUTIONS

- .1 Refer to Division 1 for requirements pertaining to product options and substitutions.

1.4 QUALIFICATIONS

- .1 The work of this Section shall be applied only by experienced applicators of the specified products.

1.5 SAMPLES

- .1 Submit 300 mm x 300 mm representative sample of flooring in selected colour. Identify sample by project name including material and colour identification.
- .2 Site apply sample installation to minimum 2 m2 area, to surface as directed, for approval by Consultant. Retain approved sample until work is completed and accepted.

1.6 MANUFACTURER'S LITERATURE

- .1 Make available copies of the material literature, clearly indicating conditions of acceptance for surfaces and methods of application on site before, and during, period of application of the work of this Section.

1.7 DELIVERY

- .1 Deliver, store, handle and protect materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver materials undamaged, in original containers, with manufacturer's labels and seals intact.

1.8 ENVIRONMENTAL CONDITIONS

- .1 For exterior coatings: Comply with coating manufacturer's recommendations. Do not apply under adverse weather conditions which could affect coating performance.
- .2 For interior coatings: Ensure minimum surface temperature 10°C 24 hours before, during and 24 hours after application or until cured; adequate controlled ventilation; bright, uniform lighting; broom clean; reasonably dust free.

1.9 PROTECTION

- .1 Protect adjacent surfaces from damage or overspray resulting from work of this Section. Mask and/or cover adjacent surfaces. Make good any damage at own expense, to the Minister's satisfaction.
- .2 Post "Wet Coatings" and "No Smoking" signs, while work is in progress and curing.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Two-component, solvent-free and low-VOC containing, epoxy binder and coating meeting the following requirements:

Property	Test Method	Requirement
Viscosity (A+B)	ASTM D2393	1400 cps
Shore D Hardness	ASTM D2240	85
Tensile Strength	ASTM D638	45 MPa (6527 psi)
Elongation	ASTM D638	6.5 %
Abrasion Resistance	ASTM D4060	120 mg (0.0042 oz)
Bond Strength	ASTM D4541	2.7 MPa (392 psi) Concrete failure

2.2 COLOURS

- .1 Standard: RAL 7038 Agate Grey.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine all surface conditions to which the work of this Section is to be applied. Report unacceptable surfaces to General Contractor and Consultant.

3.2 PREPARATION

- .1 The surface must be clean, dry and sound. Remove dust, laitance, grease, oil, dirt, curing compounds, impregnations, waxes, foreign particles, coatings and disintegrated particles by any appropriate mechanical means, in order to achieve a profile equivalent to ICRI-CSP 3-4. Concrete compressive strength should be as directed by the manufacturer's literature at the time of application.

3.3 APPLICATION

- .1 Match finished work to approved samples. Maintain uniform thickness, sheen, colour, texture and free from defects detrimental to appearance of performance.
- .2 Apply coating as directed by the manufacturer's literature.
- .3 Limitations: as directed by the manufacturer's literature.
- .4 Cured thickness of applied material: Minimum 3 mm.

3.4 CLEANING

- .1 Clean all tools and equipment immediately after use with cleaner as recommended by the manufacturer. Once hardened, the product can only be removed mechanically. Wash soiled hands and skin thoroughly in hot soapy water.
- .2 Promptly, as the work proceeds and upon completion, clean up excess materials and rubbish.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 – Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 – Closeout Submittals.
- .6 Section 05 50 00 – Metal Fabrications.
- .7 Section 05 51 29 – Metal Stairs and Ladders.
- .8 Section 07 62 00 – Sheet Metal Flashing and Trim.
- .9 Section 07 92 00 – Joint Sealants.
- .10 Section 08 11 00 – Metal Doors and Frames.
- .11 Section 08 90 00 – Louvres and Vents.
- .12 Section 09 91 23 – Interior Painting.
- .13 Section 32 17 23 - Pavement Marking.

1.2 REFERENCES

- .1 Environmental Protection Agency (EPA)
 - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).
- .2 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual
- .3 Society for Protective Coatings (SSPC).
 - .1 SSPC Painting Manual, Systems and Specifications Manual.
- .4 National Research Council (NRC).
 - .1 National Fire Code of Canada

1.3 QUALITY ASSURANCE

- .1 Contractor shall have a minimum of five years proven satisfactory experience. When requested, provide a list of last three comparable jobs including, job name and location, specifying authority, and project manager.
- .2 Qualified journeyperson shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyperson in accordance with trade regulations.
- .3 Conform to latest MPI requirements for exterior painting work including preparation and priming.
- .4 Materials (primers, paints, coatings, varnishes, stains, lacquers, fillers, thinners, solvents, etc.) shall be in accordance with MPI Painting Specification Manual "Approved Products" listing and shall be from a single manufacturer for each system used.
- .5 Other paint materials such as linseed oil, shellac, turpentine, etc. shall be the highest quality product of an approved manufacturer listed in MPI Painting Specification Manual and shall be compatible with other coating materials as required.
- .6 Retain purchase orders, invoices and other documents to prove conformance with noted MPI requirements when requested by Owner's Representative.
- .7 Standard of Acceptance:
 - .1 Walls: No defects visible from a distance of 1000 mm at 90° to surface.
 - .2 Ceilings: No defects visible from floor at 45° to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.
- .8 Mock-Ups:
 - .1 When requested by Owner's Representative or Paint Inspection Agency, prepare and paint designated surface, area, room or item to requirements specified herein, with specified paint or coating showing selected colours, number of coats, gloss/sheen, textures and quality of work to MPI Painting Specification Manual standards for review and approval.
 - .2 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
 - .3 Mock-up will be used to judge quality of work, substrate preparation, operation of equipment and material application and skill to MPI Architectural Painting Specification Manual standards.
 - .4 Locate as directed by Consultant and Owner's Representative.
 - .5 Allow two (2) working days for inspection of mock-up before proceeding with Work.
 - .6 When accepted, mock-up will demonstrate minimum standard of quality required for this work. Approved mock-up may remain as part of finished work.

1.4 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

- .1 Provide paint products meeting MPI "Environmentally Friendly" E2 or E3 ratings based on VOC (EPA Method 24) content levels.

1.5 SCHEDULING OF WORK

- .1 Submit work schedule for various stages of painting to Consultant and Owner's Representative for approval. Submit schedule minimum of two (2) working days in advance of proposed operations.
- .2 Obtain written authorization from Owner's Representative for changes in work schedule.
- .3 Schedule painting operations to prevent disruption of occupants in and about the building.

1.6 SUBMITTALS

- .1 Submit product data and manufacturer's installation/application instructions for paints and coating products to be used.
- .2 Submit WHMIS - MSDS - Material Safety Data Sheets.
- .3 Upon completion, submit records of products used, records to be included in Operation and Maintenance Manuals. List products in relation to finish system and include the following:
 - .1 Product name, type and use.
 - .2 Manufacturer's product number.
 - .3 Colour numbers.
 - .4 Manufacturer's Material Safety Data Sheets (MSDS).
 - .5 MPI Environmentally Friendly classification system rating.
- .4 Submit manufacturer's application instructions for each product specified.
- .5 Submit duplicate 200 x 300 mm sample panels of each paint, stain, clear coating, with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:
 - .1 3 mm plate steel for finishes over metal surfaces.
 - .2 13 mm birch plywood for finishes over wood surfaces.
 - .3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
 - .4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
- .6 When approved, samples shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.
- .7 Submit full range of available colours where colour availability is restricted.

1.7 EXTRA MATERIALS

- .1 Submit maintenance materials in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Submit 1 - 4 litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.
- .3 Deliver to Owner's Representative and store where directed.

1.8 DELIVERY, HANDLING AND STORAGE

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in original containers, sealed, with labels intact.
- .3 Labels shall clearly indicate:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .4 Remove damaged, opened and rejected materials from site.
- .5 Provide and maintain dry, temperature controlled, secure storage.
- .6 Observe manufacturer's recommendations for storage and handling.
- .7 Store materials and supplies away from heat generating devices.
- .8 Store materials and equipment in a well ventilated area with temperature range 7°C to 30°C.
- .9 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .10 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Consultant. After completion of operations, return areas to clean condition to approval of Consultant.
- .11 Remove paint materials from storage only in quantities required for same day use.
- .12 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
- .13 Fire Safety Requirements:
 - .1 Provide one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.

- .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
- .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.
- .14 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials.

1.9 SITE REQUIREMENTS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Where required, provide continuous ventilation for seven days after completion of application of paint.
 - .4 Provide temporary ventilating and heating equipment where permanent facilities are not available.
 - .5 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless specifically pre-approved by Owner's Representative and, applied product manufacturer, perform no painting work when:
 - .1 Ambient air and substrate temperatures are below 10°C.
 - .2 Substrate temperature is over 32°C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is above 85% or when dew point is less than 3°C variance between air/surface temperatures.
 - .5 Rain or snow are forecast to occur before paint has thoroughly cured or when it is foggy, misty, raining or snowing at site.
 - .2 Perform no painting work when maximum moisture content of substrate exceeds:
 - .1 12% for concrete and masonry (clay and concrete brick/block).

- .2 15% for wood.
- .3 12% for plaster and gypsum board.
- .3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
 - .1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
 - .3 Apply paint only when previous coat of paint is dry or adequately cured.
 - .4 Apply paint finishes only when conditions forecast for entire period of application fall within manufacturer's recommendations.
 - .5 Do not apply paint when:
 - .1 Temperature is expected to drop below 10°C before paint has thoroughly cured.
 - .2 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's limits.
 - .3 Surface to be painted is wet, damp or frosted.
 - .6 Provide and maintain cover when paint must be applied in damp or cold weather. Heat substrates and surrounding air to comply with temperature and humidity conditions specified by manufacturer. Protect until paint is dry or until weather conditions are suitable.
 - .7 Schedule painting operations such that surfaces exposed to direct, intense sunlight are scheduled for completion during early morning.
 - .8 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Ensure emptied containers are sealed and stored safely.

- .5 Unused paint, coating materials must be disposed of at official hazardous material collections site as approved by Owner's Representative.
- .6 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal.
- .7 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
- .8 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.
- .9 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
 - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
 - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
 - .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
- .10 Empty paint cans are to be dry prior to disposal or recycling (where available).

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Paint materials listed in the latest edition of the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Paint materials for each coating formula to be products of a single manufacturer.
- .3 Low odour products: whenever possible, select products exhibiting low odour characteristics. If two products are otherwise equivalent, select the product with the lowest odour. Only qualified products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this project.
- .4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:
 - .1 Be water-based, water soluble, water clean-up.
 - .2 Be non-flammable
 - .3 Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
 - .4 Be manufactured without compounds which contribute to smog in the lower atmosphere.

- .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .5 Water-borne surface coatings must be manufactured and transported in a manner that steps of processes, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).
- .6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .7 Water-borne surface coatings must have a flash point of 61.0°C or greater.
- .8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
 - .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
 - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .9 Water-borne paints and stains, and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.

2.2 COLOURS

- .1 Consultant will provide Colour Schedule after Contract award.
- .2 Selection of colours will be from manufacturer's full range of colours.
- .3 Where specific products are available in a restricted range of colours, selection will be based on the limited range.
- .4 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.
- .5 For deep and ultra-deep colours 4 coats may be required.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Owner's Representative written permission.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- .3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Owner's Representative.

- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level /Category	Units @ 60E/	Units @ 85°
G1 - matte finish	0 to 5	max. 10
G2 - velvet finish	0 to 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 – gloss finish	70 to 85	
G7 - high gloss finish	> 85	

- .2 Gloss level ratings of painted surfaces shall be as specified herein.

2.5 EXTERIOR PAINTING SYSTEMS

- .1 The following paint formulas requires a three coat finish as indicated in the MPI Architectural Painting Specifications Manual.
- .2 Asphalt Surfaces: zone/traffic marking for drive and parking areas, etc.
- .1 EXT 2.1B Alkyd zone/traffic marking finish.
- .3 Structural Steel and Metal Fabrications:
- .1 EXT 5.1B – Water based light industrial G5 finish (over inorganic zinc primer).
- .2 EXT 5.1C - Water based light industrial G5 finish (over alkyd primer).
- .4 Galvanized Metal: not chromate passivated; doors, frames, railings, misc. steel, pipes, overhead decking, ducts, gutters, flashing, etc.
- .1 EXT 5.3B - Alkyd G5 finish.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Perform preparation and operations for exterior painting in accordance with MPI Painting Specifications Manual except where specified otherwise.
- .2 Apply all paint materials in accordance with paint manufacturer's written application instructions.

3.2 EXISTING CONDITIONS

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant and Owner's Representative damages, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Consultant and Owner's Representative. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
 - .1 Concrete: 12%.
 - .2 Clay and Concrete Block/Brick: 12%.
 - .3 Wood: 15%.

3.3 PROTECTION

- .1 Protect existing building surfaces and adjacent structures from paint splatters, markings and other damage by suitable non-staining covers or masking. If damaged, clean and restore such surfaces as directed by Consultant and Owner's Representative.
- .2 Cover or mask windows and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.
- .3 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .4 Protect factory finished products and equipment.
- .5 Protect passing pedestrians, building occupants and general public in and about the building.
- .6 Remove electrical cover plates, light fixtures, surface hardware on doors, and all other surface mounted fittings, equipment and fastenings prior to undertaking any painting operations. Store for re-installation after painting is completed.
- .7 Cover or move exterior furniture and portable equipment around building as necessary to carry out painting operations. Replace as painting operations progress.
- .8 As painting operations progress, place "WET PAINT" signs in areas of work to approval of Owner's Representative.

3.4 CLEANING AND PREPARATION

- .1 Clean and prepare exterior surfaces in accordance with MPI Painting Specification Manual requirements. Refer to the MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by wiping with dry, clean cloths or compressed air.

- .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.
 - .7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.
-
- .2 Prevent contamination of cleaned surfaces before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
 - .3 Where possible, prime surfaces of new wood surfaces before installation. Use same primers as specified for exposed surfaces.
 - .1 Apply vinyl sealer to MPI #36 over knots, pitch, sap and resinous areas.
 - .2 Apply wood filler to nail holes and cracks.
 - .3 Tint filler to match stains for stained woodwork.
 - .4 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
 - .5 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes or blowing with clean dry compressed air.
 - .6 Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated material.
 - .7 Do not apply paint until prepared surfaces have been accepted by Consultant and Owner's Representative.

3.5 APPLICATION

- .1 Method of application to be as approved by Owner's Representative. Apply paint by brush roller, air sprayer, and airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.

- .2 Work paint into cracks, crevices and corners.
- .3 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
- .4 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple.
- .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray Application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
 - .4 Brush out immediately runs and sags.
 - .5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.
 - .6 Concrete, cement masonry units CMU's and brick; if sprayed, must be back rolled.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Owner's Representative.
- .5 Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish surfaces both above and below sight lines as specified for surrounding surfaces, including such surfaces as projecting ledges.
- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.

3.6 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 Unless otherwise specified, paint exterior exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.
- .2 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.

- .3 Paint fire protection piping red.
- .4 Do not paint over nameplates.
- .5 Paint steel electrical light standards. Do not paint outdoor transformers and substation equipment.

3.7 FIELD QUALITY CONTROL

- .1 Field inspection of exterior painting operations to be carried out by independent inspection firm as designated by Owner and Consultant.
- .2 Advise Consultant and Owner's Representative when each applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .3 Co-operate with inspection firm and provide access to areas of work.
- .4 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer to provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost.
- .5 Painted surfaces will be considered as deficient if any of the following defects are apparent at time of field review, regardless of viewing distance.
 - .1 Damage due to touching before paint is sufficiently dry or any other contributory cause.
 - .2 Damage due to application on moist surfaces or caused by inadequate protection from the weather.
 - .3 Damage or contamination of paint due to windblown contaminants (dust, sand blast materials, salt spray, etc.)
- .6 Painted surfaces found as unacceptable shall be replaced or repaired at no cost to the Owner or Consultant.
 - .1 Small affected areas may be touched up
 - .2 Large affected areas or areas without sufficient dry film thickness of paint shall be repainted.
 - .3 Runs, sags or damaged paint shall be removed by scraper or by sanding before application of new paint coats.
- .7 Manufacturer's Field Services:
 - .1 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.

3.8 CLEANING

- .1 Proceed in accordance with Section 01 74 00 – Cleaning.
 - .1 Remove paint where spilled, splashed, splattered or sprayed as work progresses using means and materials that are not detrimental to affected surfaces.
 - .2 Keep work area free from an unnecessary accumulation of tools, equipment, surplus materials and debris.
 - .3 Remove combustible rubbish materials and empty paint cans each day and safely dispose of it in accordance with requirements of authorities having jurisdiction.
 - .4 Clean equipment and dispose of wash water or solvents, and other cleaning and protective materials (rags, drop cloths, masking papers, etc.), paints, thinners, paint removers and strippers in accordance with the safety requirements of authorities having jurisdiction.

3.9 RESTORATION

- .1 Clean and re-install all hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect surfaces from paint droppings and dust to approval of Owner's Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Consultant and Owner's Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 45 00 - Quality Control.
- .3 Section 01 61 00 - Common Product Requirements.
- .4 Section 01 74 21 – Construction/Demolition Waste Management and Disposal.
- .5 Section 01 78 00 - Closeout Submittals.
- .6 Section 04 22 00 – Concrete Unit Masonry.
- .7 Section 05 12 00 – Structural Steel.
- .8 Section 05 31 00 – Steel Deck.
- .9 Section 05 50 00 – Metal Fabrications.
- .10 Section 07 92 00 – Joint Sealants.
- .11 Section 08 11 00 – Metal Doors and Frames.
- .12 Section 09 91 13 – Exterior Painting.

1.2 REFERENCES

- .1 Environmental Protection Agency (EPA)
 - .1 EPA Test Method for Measuring Total Volatile Organic Compound Content of Consumer Products, Method 24 (for Surface Coatings).
 - .2 SW-846, Test Methods for Evaluating Solid Waste: Physical/Chemical Methods.
- .2 Master Painters Institute (MPI)
 - .1 MPI Architectural Painting Specifications Manual.
- .3 Society for Protective Coatings (SSPC)
 - .1 SSPC Painting Manual, Volume Two, Systems and Specifications Manual.
- .4 National Fire Code of Canada.

1.3 QUALITY ASSURANCE

- .1 Contractor shall have a minimum of five years proven satisfactory experience. When requested, provide a list of last three comparable jobs including, job name and location, specifying authority, and project manager.

.2 Qualified journeymen shall be engaged in painting work. Apprentices may be employed provided they work under the direct supervision of a qualified journeyman in accordance with trade regulations.

.3 Conform to latest MPI requirements for interior painting work including preparation and priming.

1.4 ENVIRONMENTAL PERFORMANCE REQUIREMENTS

.1 Provide paint products meeting MPI "Environmentally Friendly" E2 or E3 ratings based on VOC (EPA Method 24) content levels.

.2 Where indoor air quality (odour) is a problem, use only MPI listed materials having a minimum E2 or E3 rating.

1.5 SCHEDULING

.1 Submit work schedule for various stages of painting to Consultant and Owner's Representative for approval. Submit schedule minimum of two (2) working days in advance of proposed operations.

.2 Obtain written authorization from Owner's Representative for any changes in work schedule.

.3 Schedule painting operations to prevent disruption of occupants in and about the building.

1.6 SUBMITTALS

.1 Submit product data and manufacturer's installation/application instructions for each paint and coating product to be applied.

.2 Submit product data for the use and application of paint thinner.

.3 Submit WHMIS MSDS - Material Safety Data Sheets. Indicate VOCs during application and curing.

.4 Upon completion, submit records of products used, records to be included in Operating and Maintenance Manuals. List products in relation to finish system and include the following:

.1 Product name, type and use

.2 Manufacturer's product number

.3 Colour numbers

.4 MPI Environmentally Friendly Classification System Rating

.5 Manufacturer's Material Safety Data Sheets (MSDS)

.5 Submit full range colour sample chips to indicate where colour availability is restricted.

.6 Submit duplicate 200 x 300 mm sample panels of each paint with specified paint or coating in colours, gloss/sheen and textures required to MPI Painting Specification Manual standards submitted on the following substrate materials:

- .1 3 mm steel plate for finishes over metal surfaces.
- .2 13 mm birch plywood for finishes over wood surfaces.
- .3 50 mm concrete block for finishes over concrete or concrete masonry surfaces.
- .4 13 mm gypsum board for finishes over gypsum board and other smooth surfaces.
- .7 When approved, sample panels shall become acceptable standard of quality for appropriate on-site surface with one of each sample retained on-site.

1.7 QUALITY CONTROL

- .1 Provide mock-up in accordance with Section 01 45 00 - Quality Control.
- .2 When requested by Consultant and Owner's Representative, prepare and paint designated surface, area, room or item (in each colour scheme) to requirements specified herein, with specified paint or coating showing selected colours, gloss/sheen, textures and workmanship to MPI Painting Specification Manual standards for review and approval. When approved, surface, area, room and/or items shall become acceptable standard of finish quality and workmanship for similar on-site work.

1.8 EXTRA MATERIALS

- .1 Submit maintenance materials from same product run as products installed in accordance with Section 01 78 00 - Closeout Submittals. Package products with protective covering and identify with descriptive labels.
- .2 Submit one - four litre can of each type and colour of finish coating. Identify colour and paint type in relation to established colour schedule and finish formula.
- .3 Deliver to Owner's Representative and store where directed.
- .4 Provide certificate signed by staff that extra materials have been received in order.

1.9 DELIVERY, HANDLING AND STORAGE

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements.
- .2 Deliver and store materials in original containers, sealed, with labels intact.
- .3 Labels shall clearly indicate:
 - .1 Manufacturer's name and address.
 - .2 Type of paint or coating.
 - .3 Compliance with applicable standard.
 - .4 Colour number in accordance with established colour schedule.
- .4 Remove damaged, opened and rejected materials from site.

- .5 Provide and maintain dry, temperature controlled, secure storage.
- .6 Observe manufacturer's recommendations for storage and handling.
- .7 Store materials and supplies away from heat generating devices.
- .8 Store materials and equipment in a well ventilated area with temperature range 7° C to 30° C.
- .9 Store temperature sensitive products above minimum temperature as recommended by manufacturer.
- .10 Keep areas used for storage, cleaning and preparation, clean and orderly to approval of Owner's Representative. After completion of operations, return areas to clean condition to approval of Consultant.
- .11 Remove paint materials from storage only in quantities required for same day use.
- .12 Comply with requirements of Workplace Hazardous Materials Information System (WHMIS) regarding use, handling storage, and disposal of hazardous materials.
- .13 Fire Safety Requirements:
 - .1 Provide minimum one 9 kg Type ABC dry chemical fire extinguisher adjacent to storage area.
 - .2 Store oily rags, waste products, empty containers and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis.
 - .3 Handle, store, use and dispose of flammable and combustible materials in accordance with the National Fire Code of Canada.

1.10 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for reuse and recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.
- .2 Remove from site and dispose of packaging materials at appropriate recycling facilities.
- .3 Place materials defined as hazardous or toxic in designated containers.
- .4 Ensure emptied containers are sealed and stored safely.
- .5 Unused paint, coating materials must be disposed of at official hazardous material collections site as approved by Owner's Representative.
- .6 Paint, stain and wood preservative finishes and related materials (thinners, and solvents) are regarded as hazardous products and are subject to regulations for disposal.
- .7 Material which cannot be reused must be treated as hazardous waste and disposed of in an appropriate manner.
- .8 Place materials defined as hazardous or toxic waste, including used sealant and adhesive tubes and containers, in containers or areas designated for hazardous waste.

- .9 To reduce the amount of contaminants entering waterways, sanitary/storm drain systems or into ground follow these procedures:
 - .1 Retain cleaning water for water-based materials to allow sediments to be filtered out.
 - .2 Retain cleaners, thinners, solvents and excess paint and place in designated containers and ensure proper disposal.
 - .3 Return solvent and oil soaked rags used during painting operations for contaminant recovery, proper disposal, or appropriate cleaning and laundering.
 - .4 Dispose of contaminants in approved legal manner in accordance with hazardous waste regulations.
 - .5 Empty paint cans are to be dry prior to disposal or recycling (where available).

1.11 SITE CONDITIONS

- .1 Heating, Ventilation and Lighting:
 - .1 Ventilate enclosed spaces.
 - .2 Perform no painting work unless adequate and continuous ventilation and sufficient heating facilities are in place to maintain ambient air and substrate temperatures above 10°C for 24 hours before, during and after paint application until paint has cured sufficiently.
 - .3 Where required, provide continuous ventilation for seven days after completion of application of paint.
 - .4 Perform no painting work unless a minimum lighting level of 323 Lux is provided on surfaces to be painted. Adequate lighting facilities shall be provided by General Contractor.
- .2 Temperature, Humidity and Substrate Moisture Content Levels:
 - .1 Unless specifically pre-approved by the specifying body, Paint Inspection Agency and the applied product manufacturer, perform no painting work when:
 - .1 Ambient air and substrate temperatures are below 10°C.
 - .2 Substrate temperature is over 32°C unless paint is specifically formulated for application at high temperatures.
 - .3 Substrate and ambient air temperatures are expected to fall outside MPI or paint manufacturer's prescribed limits.
 - .4 The relative humidity is above 60% or when the dew point is less than 3°C variance between the air/surface temperatures.
 - .2 Perform no painting work when the maximum moisture content of the substrate exceeds:
 - .1 12% for concrete and masonry (clay and concrete brick/block).

- .2 15% for wood.
- .3 12% for plaster and gypsum board.
- .3 Conduct moisture tests using a properly calibrated electronic Moisture Meter, except test concrete floors for moisture using a simple "cover patch test".
- .4 Test concrete, masonry and plaster surfaces for alkalinity as required.
- .3 Surface and Environmental Conditions:
 - .1 Apply paint finish only in areas where dust is no longer being generated by related construction operations or when wind or ventilation conditions are such that airborne particles will not affect quality of finished surface.
 - .2 Apply paint only to adequately prepared surfaces and to surfaces within moisture limits noted herein.
 - .3 Apply paint only when previous coat of paint is dry or adequately cured.
- .4 Additional Interior Application Requirements:
 - .1 Apply paint finishes only when temperature at location of installation can be satisfactorily maintained within manufacturer's recommendations.
 - .2 Apply paint in occupied facilities during silent hours only. Schedule operations to approval of Owner's Representative such that painted surfaces will have dried and cured sufficiently before occupants are affected.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Paint materials listed in the MPI Approved Products List (APL) are acceptable for use on this project.
- .2 Paint materials for paint systems shall be products of a single manufacturer.
- .3 Low odor products. Whenever possible, select products exhibiting low odor characteristics. If two products are otherwise equivalent, select the product with the lowest odor. Only qualified products with E2 or E3 "Environmentally Friendly" rating are acceptable for use on this project.
- .4 Paints, coatings, adhesives, solvents, cleaners, lubricants, and other fluids, shall:
 - .1 Be water-based, water soluble, water clean-up.
 - .2 Be non-flammable.
 - .3 Be manufactured without compounds which contribute to ozone depletion in the upper atmosphere.
 - .4 Be manufactured without compounds which contribute to smog in the lower atmosphere.

- .5 Do not contain methylene chloride, chlorinated hydrocarbons, toxic metal pigments.
- .5 Water-borne surface coatings must be manufactured and transported in a manner that steps of process, including disposal of waste products arising therefrom, will meet requirements of applicable governmental acts, by-laws and regulations including, for facilities located in Canada, Fisheries Act and Canadian Environmental Protection Act (CEPA).
- .6 Water-borne surface coatings must not be formulated or manufactured with aromatic solvents, formaldehyde, halogenated solvents, mercury, lead, cadmium, hexavalent chromium or their compounds.
- .7 Water-borne surface coatings must have a flash point of 61.0°C or greater.
- .8 Both water-borne surface coatings and recycled water-borne surface coatings must be made by a process that does not release:
 - .1 Matter in undiluted production plant effluent generating a 'Biochemical Oxygen Demand' (BOD) in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
 - .2 Total Suspended Solids (TSS) in undiluted production plant effluent in excess of 15 mg/L to a natural watercourse or a sewage treatment facility lacking secondary treatment.
- .9 Water-borne paints and stains, and water borne varnishes must meet a minimum "Environmentally Friendly" E2 rating.

2.2 COLOURS

- .1 Consultant will provide Colour Schedule after contract award.
- .2 Selection of colours will be from manufacturer's full range of colours.
- .3 Where specific products are available in a restricted range of colours, selection will be based on the limited range.
- .4 Second coat in a three coat system to be tinted slightly lighter colour than top coat to show visible difference between coats.
- .5 For deep and ultra-deep colours; 4 coats may be required.

2.3 MIXING AND TINTING

- .1 Perform colour tinting operations prior to delivery of paint to site. On-site tinting of painting materials is allowed only with Owner's Representative written permission.
- .2 Paste, powder or catalyzed paint mixes shall be mixed in strict accordance with manufacturer's written instructions.
- .3 Where thinner is used, addition shall not exceed paint manufacturer's recommendations. Do not use kerosene or any such organic solvents to thin water-based paints.
- .4 Thin paint for spraying according in strict accordance with paint manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide copy of instructions to Owner's Representative.

- .5 Re-mix paint in containers prior to and during application to ensure break-up of lumps, complete dispersion of settled pigment, and colour and gloss uniformity.

2.4 GLOSS/SHEEN RATINGS

- .1 Paint gloss shall be defined as the sheen rating of applied paint, in accordance with the following values:

Gloss Level Category	Units @ 60E	Units @ 85E
G1 - matte finish	max. 5	max. 10
G2 - velvet finish	max. 10	10 to 35
G3 - eggshell finish	10 to 25	10 to 35
G4 - satin finish	20 to 35	min. 35
G5 - semi-gloss finish	35 to 70	
G6 - gloss finish	70 to 85	
G7 - high gloss finish	> 85	

- .2 Gloss level ratings of painted surfaces shall be as specified herein.

2.5 INTERIOR PAINTING SYSTEMS

- .1 The following paint formulas requires a three coat finish as indicated in the MPI Architectural Painting Specifications Manual.
- .2 Concrete Vertical Surfaces: including horizontal soffits
- .1 INT 3.1F Epoxy (tile-like) finish (for smooth concrete)
- .3 Concrete Horizontal Surfaces: floors and stairs
- .1 INT 3.2C Epoxy finish.
- .4 Clay Masonry Units: pressed and extruded brick
- .1 INT 4.1A Latex G5 finish.
- .5 Concrete Masonry Units: smooth and split face block and brick.
- .1 INT 4.2A Latex G5 finish.
- .6 Structural Steel and Metal Fabrications: columns, beams, joists, etc.
- .1 INT 5.1E Alkyd G5 finish.
- .7 Galvanized Metal: doors, frames, railings, misc. steel, pipes, overhead decking, ducts, etc.
- .1 INT 5.3A Latex G5 finish.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 GENERAL

- .1 Perform preparation and operations for interior painting in accordance with MPI Painting Specifications Manual except where specified otherwise.
- .2 Apply all paint materials in accordance with paint manufacturer's written application instructions.

3.3 PROTECTION

- .1 Protect existing building surfaces and adjacent structures from paint spatters, markings and other damage. If damaged, clean and restore such surfaces as directed by Owner's Representative.
- .2 Cover or mask floors, windows, louvres and other ornamental hardware adjacent to areas being painted to prevent damage and to protect from paint drops and splatters. Use non-staining coverings.
- .3 Protect items that are permanently attached such as Fire Labels on doors and frames.
- .4 Protect factory finished products and equipment.
- .5 Protect passing pedestrians, building occupants and general public in and about the building.
- .6 Remove electrical cover plates, light fixtures, surface hardware on doors, door stops, bath accessories and other surface mounted fittings and fastenings prior to undertaking any painting operations. Store for re-installation after painting is completed.
- .7 As painting operations progress place "WET PAINT" signs in occupied areas to approval of Owner's Representative.

3.4 EXAMINATION

- .1 Investigate existing substrates for problems related to proper and complete preparation of surfaces to be painted. Report to Consultant and Owner's Representative all damage, defects, unsatisfactory or unfavourable conditions before proceeding with work.
- .2 Conduct moisture testing of surfaces to be painted using a properly calibrated electronic moisture meter, except test concrete floors for moisture using a simple "cover patch test" and report findings to Consultant and Owner's Representative. Do not proceed with work until conditions fall within acceptable range as recommended by manufacturer.
- .3 Maximum moisture content as follows:
 - .1 Plaster and wallboard: 12%
 - .2 Masonry/Concrete: 12%

.3 Concrete Block/Brick: 12%

.4 Wood: 15%

3.5 CLEANING AND PREPARATION

- .1 Clean and prepare surfaces in accordance with MPI Painting Specification Manual requirements. Refer to MPI Manual in regard to specific requirements and as follows:
 - .1 Remove dust, dirt, and other surface debris by vacuuming, wiping with dry, clean cloths or compressed air.
 - .2 Wash surfaces with a biodegradable detergent and bleach where applicable and clean warm water using a stiff bristle brush to remove dirt, oil and other surface contaminants.
 - .3 Rinse scrubbed surfaces with clean water until foreign matter is flushed from surface.
 - .4 Allow surfaces to drain completely and allow to dry thoroughly.
 - .5 Prepare surfaces for water-based painting, water-based cleaners should be used in place of organic solvents.
 - .6 Use trigger operated spray nozzles for water hoses.
 - .7 Many water-based paints cannot be removed with water once dried. However, minimize the use of kerosene or any such organic solvents to clean up water-based paints.
- .2 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats. Apply primer, paint, or pretreatment as soon as possible after cleaning and before deterioration occurs.
- .3 Sand existing surfaces with intact, smooth, high gloss coatings to provide adequate adhesion for new finishes.
- .4 Sand and dust between coats as required to provide adequate adhesion for next coat and to remove defects visible from a distance up to 1000 mm.
- .5 Clean metal surfaces to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with MPI requirements. Remove traces of blast products from surfaces, pockets and corners to be painted by brushing with clean brushes blowing with clean dry compressed air, or vacuum cleaning.
- .6 Touch up of shop primers with primer as specified in applicable section. Major touch-up including cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas, shall be by supplier of fabricated material.
- .7 Do not apply paint until prepared surfaces have been accepted by Consultant and Owner's Representative.

3.6 APPLICATION

- .1 Method of application to be as approved by Consultant and Owner's Representative. Apply paint by brush, roller, air sprayer, airless sprayer. Conform to manufacturer's application instructions unless specified otherwise.
- .2 Brush and Roller Application:
 - .1 Apply paint in a uniform layer using brush and/or roller of types suitable for application.
 - .2 Work paint into cracks, crevices and corners.
 - .3 Brush and/or roll out runs and sags, and over-lap marks. Rolled surfaces shall be free of roller tracking and heavy stipple.
 - .4 Paint surfaces and corners not accessible to brush using spray, daubers and/or sheepskins. Paint surfaces and corners not accessible to roller using brush, daubers or sheepskins.
 - .5 Remove runs, sags and brush marks from finished work and repaint.
- .3 Spray application:
 - .1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.
 - .2 Keep paint ingredients properly mixed in containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.
 - .3 Apply paint in a uniform layer, with overlapping at edges of spray pattern.
 - .4 Brush out immediately all runs and sags.
 - .5 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray.
- .4 Use dipping, sheepskins or daubers only when no other method is practical in places of difficult access and only when specifically authorized by Consultant and Owner's Representative.
- .5 Apply coats of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Allow surfaces to dry and properly cure after cleaning and between subsequent coats for minimum time period as recommended by manufacturer.
- .7 Sand and dust between coats to remove visible defects.
- .8 Finish tops of cabinets and projecting ledges, both above and below sight lines as specified for surrounding surfaces.

- .9 Finish top, bottom, edges and cutouts of doors after fitting as specified for door surfaces.
- .10 Concrete, concrete masonry units and brick; if sprayed, must be back rolled.

3.7 MECHANICAL/ELECTRICAL EQUIPMENT

- .1 In finished areas: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment with colour and finish to match adjacent surfaces, except as noted otherwise.
- .2 In boiler room, mechanical and electrical rooms: paint exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment.
- .3 In other unfinished areas: leave exposed conduits, piping, hangers, ductwork and other mechanical and electrical equipment in original finish and touch up scratches and marks.
- .4 Touch up scratches and marks on factory painted finishes and equipment with paint as supplied by manufacturer of equipment.
- .5 Do not paint over nameplates.
- .6 Keep sprinkler heads free of paint.
- .7 Paint inside of ductwork where visible behind grilles, registers and diffusers with primer and one coat of matt black paint.
- .8 Paint disconnect switches for fire alarm system and exit light systems in red enamel.
- .9 Paint all fire protection piping red.
- .10 Paint both sides and edges of backboards for telephone and electrical equipment before installation. Leave equipment in original finish except for touch-up as required, and paint conduits, mounting accessories and other unfinished items.
- .11 Do not paint interior transformers and substation equipment.

3.8 FIRE SEPARATIONS

- .1 Contractor to stencil on both sides of fire rated partitions the fire rating for that assembly (i.e.: **1 HR FIRE SEPARATION**).
- .2 Stenciled fire ratings to be minimum 100 mm high **RED** letters, maximum 200 mm below structural steel deck, and minimum 2400 mm o.c. along partition.

3.9 FIELD QUALITY CONTROL

- .1 Field inspection of interior painting operations to be carried out by an independent Paint Inspection Agency (inspector) as designated Owner and Consultant, and acceptable to the local Painting Contractor's Association. Painting contractor shall notify Paint Inspection Agency a minimum of one week prior to commencement of work and provide a copy of project painting specification, plans and elevation drawings (including pertinent details) as well as a Room Finish Schedule. Interior surfaces requiring painting shall be inspected by Paint Inspection Agency who shall notify Owner and Consultant and General Contractor in writing of defects or problems, prior to commencing painting work, or after prime coat shows defects in substrate.

- .2 Where "special" painting, coating or decorating system applications (i.e. elastomeric coatings) or non-MPI listed products or systems are to be used, paint or coating manufacturer shall provide as part of this work, certification of surfaces and conditions for specific paint or coating system application as well as on site supervision, inspection and approval of their paint or coating system application as required at no additional cost to Owner and Consultant.
- .3 Advise Consultant and Owner's Representative when each applied coating is ready for inspection. Do not proceed with subsequent coats until previous coat has been approved.
- .4 Co-operate with Paint Inspection Agency and provide access to all areas of the work.
- .5 Standard of Acceptance:
 - .1 Walls: no defects visible from a distance of 1000 mm at 90 degrees to surface.
 - .2 Ceilings: no defects visible from floor at 45 degrees to surface when viewed using final lighting source.
 - .3 Final coat to exhibit uniformity of colour and uniformity of sheen across full surface area.

3.10 RESTORATION

- .1 Clean and re-install all hardware items removed before undertaken painting operations.
- .2 Remove protective coverings and warning signs as soon as practical after operations cease.
- .3 Remove paint splashings on exposed surfaces that were not painted. Remove smears and spatter immediately as operations progress, using compatible solvent.
- .4 Protect freshly completed surfaces from paint droppings and dust to approval of Consultant and Owner's Representative. Avoid scuffing newly applied paint.
- .5 Restore areas used for storage, cleaning, mixing and handling of paint to clean condition as approved by Owner's Representative.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-In-Place Concrete

1.2 REFERENCE STANDARDS

- .1 CSA Group (CSA)
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CAN/CSA-O86, Engineering Design in Wood.
 - .3 CSA O121, Douglas Fir Plywood.
 - .4 CSA O151, Canadian Softwood Plywood.
 - .5 CSA O153, Poplar Plywood.
 - .6 CAN/CSA-O325.0, Construction Sheathing.
 - .7 CSA O437 Series, Standards for OSB and Waferboard.
 - .8 CSA S269.1, Falsework and Formwork.
 - .9 CAN/CSA-S269.3, Concrete Formwork.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure site supervisor, Consultant, specialty contractor - finishing, forming, concrete producer, testing laboratories attend.
 - .1 Verify project requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for proprietary materials used in formwork liners and coatings and include product characteristics, performance criteria, physical size, finish, and limitations.
- .2 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 forms.
- .4 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.
- .5 Indicate sequence of erection and removal of formwork and falsework.
- .6 Include the following information on falsework Shop Drawings:
 - .1 Longitudinal, lateral, vertical, dead, live and impact loads used in design.
 - .2 Safe bearing capacity of soil underneath mud sills.
 - .3 Maximum column, post and support loads.
 - .4 Deflection diagrams for beams with deflection of 10 mm or more.
 - .5 Deflection diagrams indicating initial and final elevation of deck surfaces, roofs and soffits.
 - .6 Grade of structural steel.
 - .7 Indicate steel posts, girders, beams, connections, bracing and welding, providing sufficient detail for safe performance of falsework.
 - .8 Fully detailed steel frame shoring.
 - .9 Species, grades and sizes of wood.
 - .10 Type and weight of equipment (moving or stationary) supported by falsework.
 - .11 Sequence, methods and rate of concrete placement.
 - .12 Proprietary equipment, adequately identified for checking purposes.
 - .13 Full details and locations of splices.

1.5 QUALITY ASSURANCE

- .1 Retain a professional engineer registered or licensed in Ontario, Canada, with experience in formwork and falsework design of comparable complexity and scope, to perform 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 and prepare and submit inspection reports verifying this part of Work is in accordance with Contract Documents and reviewed Shop Drawings. Perform inspections a minimum of once per month.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store, and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect formwork from damages.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Formwork materials:
 - .1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, CSA O437 Series, and CSA-O153.
 - .2 For concrete with special architectural features, use formwork materials to CSA-A23.1/A23.2.
 - .3 Rigid insulation board: to CAN/ULC-S701.
- .2 Pan forms: removable or permanent steel or reinforced plastic free of bends, dents, and residual concrete; having a high potential for reuse as indicated.
- .3 Form ties:
 - .1 For concrete not designated 'Architectural': removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes minimum 25 mm diameter in concrete surface.
 - .2 For Architectural concrete; snap ties complete with plastic cones and light grey concrete plugs.
- .4 Form liner:
 - .1 Plywood: high density overlay or medium density overlay, Douglas Fir to CSA O121, Canadian Softwood Plywood to CSA O151, Poplar to CSA O153
 - .2 Waferboard: to CAN/CSA-O325.0.
- .5 Form release agent: Proprietary, non-volatile material not to stain concrete or impair subsequent application of finishes or coatings to surface of concrete, derived from agricultural sources, non-petroleum containing, non-toxic, biodegradable.

- .6 Falsework materials: to CSA-S269.1.

PART 3 - EXECUTION

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels, and centres before proceeding with formwork/falsework and ensure dimensions agree with drawings.
- .2 Obtain Consultant's approval for use of earth forms framing openings not indicated on drawings.
- .3 Hand trim sides and bottoms and remove loose earth from earth forms before placing concrete.
- .4 Fabricate and erect falsework in accordance with CSA S269.1.
- .5 Refer to architectural drawings for concrete members requiring architectural exposed finishes.
- .6 Do not place shores and mud sills on frozen ground.
- .7 Provide site drainage to prevent washout of soil supporting mud sills and shores.
- .8 Fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .9 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .10 Use 25 mm chamfer strips on external corners and 25 mm fillets at interior corners, joints, unless specified otherwise.
- .11 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .12 Construct forms for architectural concrete, and place ties as indicated.
 - .1 Joint pattern not necessarily based on using standard size panels or maximum permissible spacing of ties.
- .13 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.
- .14 Line forms for following surfaces:
 - .1 Outer face of outside, girders, beams,
 - .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 and align joints to obtain uniform pattern.
- .4 Secure lining taut to formwork to prevent folds.
- .5 Pull down lining over edges of formwork panels.
- .6 Ensure lining is new and not reused material.
- .7 Ensure lining is dry and free of oil when concrete is poured.
- .8 Application of form release agents on formwork surface is prohibited where drainage lining is used.
- .9 If concrete surfaces require cleaning after form removal, use only pressurized water stream so as not to alter concrete's smooth finish.
- .10 Cost of textile lining is included in price of concrete for corresponding portion of Work.
- .15 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place for following minimum periods of time after placing concrete.
 - .1 2 days for walls and sides of beams.
 - .2 2 days for columns.
 - .3 2 days for footings and abutments.
- .2 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.
- .3 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.
- .4 Space reshoring in each principal direction at not more than 3000 mm apart.
- .5 Re-use formwork and falsework subject to requirements of CSA-A23.1/A23.2.

3.3 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 30 00 - Cast-In-Place Concrete.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A143/A143M, Standard Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - .2 ASTM A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .3 ASTM A775/A775M, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
 - .4 ASTM A 884/A 884M Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Reinforcement.
 - .5 ASTM A 1064/A 1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete.
- .2 CSA Group
 - .1 CSA-A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.3, Design of Concrete Structures.
 - .3 CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA-G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.
 - .6 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC, Reinforcing Steel Manual of Standard Practice.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure site supervisor, Consultant, specialty contractor - finishing, forming, testing laboratories, concrete producer attend.

- .1 Verify project requirements.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

.1 Product Data:

- .1 Submit manufacturer's instructions, printed 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 Shop Drawings:

- .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario of Canada.

- .1 Prepare reinforcement drawings in accordance with RSIC Manual of Standard Practice.

.2 Indicate placing of reinforcement and:

- .1 Bar bending details.

- .2 Lists.

- .3 Quantities of reinforcement.

- .4 Sizes, spacings, locations of reinforcement and mechanical splices if approved by Consultant with identifying code marks to permit correct placement without reference to structural drawings.

- .5 Indicate sizes, spacings and locations of chairs, spacers and hangers.

- .3 Detail lap lengths and bar development lengths to CAN/CSA-A23.3, unless otherwise indicated.

- .1 Provide type B.

- .4 Indicate position and size of openings in slabs and walls. Coordinate with trades requiring openings.

.3 Quality Assurance Submittals:

- .1 Submit Mill Test Report to Consultant, certified copy of mill test report of reinforcing steel, minimum 4 weeks prior to beginning reinforcing work.

- .2 Upon request submit in writing to Consultant proposed source of reinforcement material.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions

- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by designer.
- .2 Reinforcing steel: billet steel, grade 400, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Reinforcing steel: weldable low alloy steel deformed bars to CSA-G30.18.
- .4 Cold-drawn annealed steel wire ties: to ASTM 1064/A 1064M.
- .5 Deformed steel wire for concrete reinforcement: to ASTM 1064/A 1064M.
- .6 Welded steel wire fabric:
 - .1 Plain in accordance ASTM A 1064/A 1064M, fabricated from as drawn steel wire into flat sheets; sizes as indicated on Drawings.
 - .2 Finish:
 - .1 Galvanized: Fabricated from galvanized wire having Class A coating in accordance with ASTM A641.
 - .3 Provide in flat sheets only.
- .7 Galvanizing of non-prestressed reinforcement: to CAN/CSA-G164, minimum zinc coating 610 g/m².
 - .1 Protect galvanized reinforcing steel with chromate treatment to prevent reaction with Portland cement paste.
 - .2 If chromate treatment carried out immediately after galvanizing, soak steel in aqueous solution containing minimum 0.2% by weight sodium dichromate or 0.2% chromic acid.
 - .1 Temperature of solution minimum 32 degrees and galvanized steels immersed for minimum 20 seconds.
 - .3 If galvanized steels at ambient temperature, add sulphuric acid as bonding agent at concentration of 0.5% to 1%.
 - .1 No restriction applies to temperature of solution.

.4 Chromate solution sold for this purpose may replace solution described above, provided if of equivalent effectiveness.

.8 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

.9 Tie wire: 1.5 mm diameter annealed wire.

.10 Mechanical splices: subject to approval of design Engineer.

.11 Plain round bars: to CSA-G40.20/G40.21.

2.2 FABRICATION

.1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2.

.2 Obtain Consultant's written approval for locations of reinforcement splices other than those shown on placing drawings.

.3 Upon approval of Consultant, weld reinforcement in accordance with CSA W186.

.4 Ship bundles of bar reinforcement, clearly identified in accordance with bar bending details and lists.

2.3 SOURCE QUALITY CONTROL

.1 Upon request, provide Consultant with certified copy of mill test report of reinforcing steel, showing physical and chemical analysis, minimum 4 weeks prior to beginning reinforcing work.

.2 Upon request, inform Consultant of proposed source of supplied material.

PART 3 - EXECUTION

3.1 PREPARATION

.1 Galvanizing to include chromate treatment.

.1 Duration of treatment 1 hour per 25 mm of bar diameter.

.2 Conduct bending tests to verify galvanized bar fragility in accordance with ASTM A143/A143M.

3.2 FIELD BENDING

.1 Do not field bend or field weld reinforcement except where indicated or authorized by Consultant.

.2 When field bending authorized, bend without heat, applying slow and steady pressure.

.3 Replace bars, which develop cracks or splits.

3.3 PLACING REINFORCEMENT

- .1 Cutting or puncturing vapour retarder is not permitted; repair damage and reseal vapour retarder before placing concrete.
- .2 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.
- .3 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 Apply thick even film of mineral lubricating grease when paint is dry.
- .4 Prior to placing concrete, obtain Consultant's approval of reinforcing material and placement.
- .5 Maintain cover to reinforcement during concrete pour.

3.4 FIELD TOUCH-UP

- .1 Touch up damaged and cut ends of galvanized reinforcing steel with compatible finish to provide continuous coating.

3.5 FIELD QUALITY CONTROL

- .1 If requested, inspection and testing of reinforcing and reinforcing materials carried out by testing laboratory designated by Consultant for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory certified to CSA A283.
- .2 Ensure test results distributed for discussion at pre-pouring concrete meeting between testing laboratory and Consultant.

3.6 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 03 20 00 - Concrete Reinforcing.
- .2 Section 03 10 00 - Concrete Forming and Accessories.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM C260/C260M, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C 881/C881M, Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - .5 ASTM C1017/C1017M, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .6 ASTM C C1059/C1059M, Standard Specification for Latex Agents for Bonding Fresh To Hardened Concrete.
 - .7 ASTM D412, Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
 - .8 ASTM D624, Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
 - .9 ASTM D1751, Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types).
 - .10 ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction.
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-51.34, Vapour Barrier, Polyethylene Sheet for Use in Building Construction.
- .3 CSA Group
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

- .2 CSA A283, Qualification Code for Concrete Testing Laboratories.
- .3 CSA A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005),

1.3 ABBREVIATIONS AND ACRONYMS

- .1 Portland Cement: hydraulic cement, blended hydraulic cement (XXb - b denotes blended) and Portland-limestone cement types:
 - .1 GU, GUb and GUL - General use cement.
 - .2 MS and MSb - Moderate sulphate-resistant cement.
 - .3 MH, MHb and MHL - Moderate heat of hydration cement.
 - .4 HE, HEb and HEL - High early-strength cement.
 - .5 LH, LHb and LHL - Low heat of hydration cement.
 - .6 HS and HSb - High sulphate-resistant cement.
- .2 Fly ash types:
 - .1 F - with CaO content maximum 8%.
 - .2 CI - with CaO content 15 to 20%.
 - .3 CH - with CaO minimum 20%.
- .3 GGBFS - Ground, granulated blast-furnace slag.

1.4 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation Meetings: convene pre-installation meeting one week prior to beginning concrete works.
 - .1 Ensure site supervisor, Consultant, speciality contractor - finishing, forming, concrete producer, testing laboratories attend.
 - .1 Verify project requirements.

1.5 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for materials used in Cast-In-Place Concrete and additives and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Site Quality Control Submittals:

- .1 Provide testing, inspection results reports for review by Consultant and do not proceed without written approval when deviations from mix design or parameters found.
- .2 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .3 Concrete hauling time: provide for review by design Engineer deviations exceeding maximum allowable time of 120 minutes for concrete delivered to site of Work and discharged after batching.

1.6 QUALITY ASSURANCE

- .1 Provide Consultant, minimum 4 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
 - .1 Provide test data and certification by qualified independent inspection and testing laboratory that materials and mix designs used in concrete mixture meet specified requirements.
- .2 Minimum 4 weeks prior to starting concrete work, provide proposed quality control procedures for review by Consultant on following items:
 - .1 Falsework erection.
 - .2 Hot weather concrete.
 - .3 Cold weather concrete.
 - .4 Curing.
 - .5 Finishes.
 - .6 Formwork removal.
 - .7 Joints.
- .3 Quality Control Plan: provide written report to Consultant verifying compliance that concrete in place meets performance requirements of concrete as established in PART 2 - PRODUCTS.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
- .2 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Deviations submitted for review by design Engineer.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.

1.8 SITE CONDITIONS

- .1 Placing concrete during rain or weather events that could damage concrete is prohibited.
- .2 Protect newly placed concrete from rain or weather events in accordance with CSA A23.1/A23.2.
- .3 Cold weather protection:
 - .1 Maintain protection equipment, in readiness on Site.
 - .2 Use such equipment when ambient temperature below 5°C, or when temperature may fall below 5°C before concrete cured.
 - .3 Placing concrete upon or against surface at temperature below 5°C is prohibited.
- .4 Hot weather protection:
 - .1 Protect concrete from direct sunlight when ambient temperature above 27°C.
 - .2 Prevent forms of getting too hot before concrete placed. Apply accepted methods of cooling not to affect concrete adversely.
- .5 Protect from drying.

PART 2 - PRODUCTS

2.1 DESIGN CRITERIA

- .1 Alternative 1 - Performance: to CSA A23.1/A23.2, and as described in MIXES of PART 2 - PRODUCTS.

2.2 PERFORMANCE CRITERIA

- .1 Quality Control Plan: ensure concrete supplier meets performance criteria of concrete as established by Consultant and provide verification of compliance as described in PART 1 - QUALITY ASSURANCE.

2.3 MATERIALS

- .1 Portland Cement: GU.
 - .1 Reduction in cement from Base Mix to Actual Supplementary Cementing Materials (SCMs) Mix, as percentage.
- .2 Blended hydraulic cement: Type GUb to CSA A3001.
- .3 Portland-limestone cement: Type GUL to CSA A3001.
- .4 Water: to CSA A23.1.
- .5 Aggregates: to CSA A23.1/A23.2.
- .6 Admixtures:

- .1 Air entraining admixture: to ASTM C260.
- .2 Chemical admixture: to ASTM C494. Consultant to approve accelerating or set retarding admixtures during cold and hot weather placing.
- .7 Shrinkage compensating grout: premixed compound consisting of non-metallic aggregate, Portland cement, water reducing and plasticizing agents to CSA A23.1/A23.2.
 - .1 Compressive strength: 35MPa 28 days.
 - .2 Net shrinkage at 28 days: maximum
- .8 Non premixed dry pack grout: composition of non metallic aggregate Portland cement with sufficient water for mixture to retain its shape when made into ball by hand and capable of developing compressive strength of 35MPa.
- .9 Curing compound: to CSA A23.1/A23.2 white.
- .10 Premoulded joint fillers:
 - .1 Bituminous impregnated fibre board: to ASTM D1751.
 - .2 Sponge rubber: to ASTM D1752, Type I, flexible grade.
- .11 Weep hole tubes: plastic.
- .12 Dovetail anchor slots: minimum 0.6 mm thick galvanized steel with insulation filled slots.
- .13 Concrete Bonding Agents: Epoxy to ASTM C881/C881M, Type V, Latex to ASTM C1059/C1059M.

2.4 MIXES

- .1 Alternative 1 - Performance Method for specifying concrete: to meet Consultant performance criteria to CSA A23.1/A23.2.
 - .1 Ensure concrete supplier meets performance criteria as established below and provide verification of compliance as in Quality Control Plan.
 - .2 Provide concrete mix to meet following hard state requirements:
 - .1 Durability and class of exposure: C-1, C-2, N.
 - .2 Compressive strength at 28 days: 35 Mpa minimum.

PART 3 - EXECUTION

3.1 PREPARATION

- .1 Obtain Consultant's written approval before placing concrete.
 - .1 Provide 24 hours minimum notice prior to placing of concrete.
- .2 Place concrete reinforcing in accordance with Section 03 20 00- Concrete Reinforcing.

- .3 During concreting operations:
 - .1 Development of cold joints not allowed.
 - .2 Ensure concrete delivery and handling facilitate placing with minimum of re-handling, and without damage to existing structure or Work.
- .4 Pumping of concrete permitted only after approval of equipment and mix.
- .5 Disturbing reinforcement and inserts during concrete placement is prohibited.
- .6 Prior to placing of concrete obtain Consultant's approval of proposed method for protection of concrete during placing and curing in adverse weather.
- .7 Protect previous Work from staining.
- .8 Clean and remove stains prior to application for concrete finishes.
- .9 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, workability, air content, temperature and test samples taken.

3.2 INSTALLATION/APPLICATION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 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 design Engineer.
 - .2 Where approved by design Engineer, 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 not indicated reviewed by design Engineer.
 - .4 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, obtain written approval of modifications from design Engineer before placing of 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.
- .3 Anchor bolts:
 - .1 Set anchor bolts to templates in co-ordination with appropriate trade prior to placing concrete.
 - .2 Grout anchor bolts in preformed holes or holes drilled after concrete has set only after receipt of written approval from design Engineer.

- .1 Formed holes: 100 mm minimum diameter.
- .2 Drilled holes: to manufacturers' recommendations.
- .3 Protect anchor bolt holes from water accumulations, snow and ice build-ups.
- .4 Set bolts and fill holes with shrinkage compensating grout.
- .5 Locate anchor bolts used in connection with expansion shoes, rollers and rockers with due regard to ambient temperature at time of erection.
- .4 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 used, remove them after concrete has set.
 - .2 Install weep hole tubes and drains as indicated.
- .5 Grout under base plates and machinery using procedures in accordance with manufacturer's recommendations which result in 100% contact over grouted area.
- .6 Finishing and curing:
 - .1 Finish concrete to CSA A23.1/A23.2.
 - .2 Use procedures as reviewed by design Engineer or those noted in CSA A23.1/A23.2 to remove excess bleed water. Ensure surface not damaged.
 - .3 Use curing compounds compatible with applied finish on concrete surfaces.
 - .4 Provide screed, float finish unless otherwise indicated.
 - .5 Rub exposed sharp edges of concrete with carborundum to produce 3 mm minimum radius edges unless otherwise indicated.
- .7 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 field splice waterstops.
 - .5 Tie waterstops rigidly in place.
 - .6 Use only straight heat sealed butt joints in field.
 - .7 Use factory welded corners and intersections unless otherwise approved by design Engineer.
- .8 Joint fillers:

- .1 Furnish filler for each joint in single piece for depth and width required for joint, unless otherwise authorized by design Engineer.
- .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 construction, 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 within 12 mm of finished slab surface unless indicated otherwise.

3.3 SURFACE TOLERANCE

- .1 Concrete tolerance to CSA A23.1 Straightedge Method.

3.4 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.
 - .1 Concrete pours.
 - .2 Slump.
 - .3 Air content.
 - .4 Compressive strength at 7 and 28 days.
 - .5 Air and concrete temperature.
- .2 Inspection and testing of concrete and concrete materials carried out by testing laboratory designated by Consultant for review to CSA A23.1/A23.2.
 - .1 Ensure testing laboratory certified to CSA A283.
- .3 Ensure test results are distributed for discussion at pre-pouring concrete meeting between testing laboratory and design Engineer.
- .4 Non-Destructive Methods for Testing Concrete: to CSA A23.1/A23.2.
- .5 Inspection or testing by Consultant not to augment or replace Contractor quality control nor relieve Contractor of contractual responsibility.

3.5 CLEANING

- .1 Progress Cleaning: Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 04 05 13 – Masonry Mortar and Grout.
- .2 Section 04 05 19 – Masonry Anchorage and Reinforcing.
- .3 Section 04 22 00 – Concrete Unit Masonry.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units (Consists of A165.1, A165.2 and A165.3).
 - .2 CAN/CSA-A179, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A371, Masonry Construction for Buildings.
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specification for Cold Weather Masonry Construction.

1.3 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-installation meetings: Conduct pre-installation meeting one week prior to commencing on-site installations work of this Section to:
 - .1 Verify project requirements, including mock-up requirements.
 - .2 Verify substrate conditions.
 - .3 Co-ordinate products, installation methods and techniques.
 - .4 Sequence work of related sections.
 - .5 Co-ordinate with other building subtrades.
 - .6 Review manufacturer's installation instructions.
 - .7 Review masonry cutting operations, methods and tools and determine worker safety and protection from dust during cutting operations.
 - .8 Review warranty requirements.
- .2 Sequencing: sequence with other work in accordance with Construction Progress Schedules. Comply with manufacturer's written recommendations for sequencing construction operations.
- .3 Scheduling: schedule with other work in accordance with Construction Progress Schedules.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedure].
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Submit shop drawings detailing temporary bracing required, designed to resist wind pressure and lateral forces during installation.
- .4 Samples:
 - .1 Provide samples as follows:
 - .1 Two (2) samples of exterior architectural finish concrete unit specified, including special shapes.
- .5 Certificates: submit manufacturer's product certificates certifying materials comply with specified requirements.
- .6 Test and Evaluation Reports:
 - .1 Submit certified test reports in accordance with Section 01 29 83 - Payment Procedures for Testing Laboratory Services.
 - .2 Test reports to certify compliance of masonry units and mortar ingredients with specified performance characteristics and physical properties.
 - .3 Submit data for masonry units, in addition to requirements set out in referenced CSA and ASTM Standards, indicating initial rates of absorption.
- .7 Installer Instructions: provide manufacturer's written installation instructions, including storage, handling, safety and cleaning.
- .8 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.

1.5 CLOSEOUT SUBMITTALS

- .1 Submit manufacturer's instructions for care, cleaning and maintenance of prefaced masonry units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

1.6 QUALITY ASSURANCE

.1 Mock-ups:

- .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control.
- .2 Construct mock-up panel of exterior masonry wall construction 1200 x 1800 mm showing masonry colours and textures, use of reinforcement, ties, through-wall flashing, weep holes, jointing, pointing, coursing, mortar and quality of work.
- .3 Mock-up used:
 - .1 To judge quality of work, substrate preparation, operation of equipment and material application.
 - .2 For testing to determine compliance with performance requirements.
- .4 Construct mock-up where directed by Consultant and Owner Representative.
- .5 Allow 24 hours for inspection of mock-up by Consultant and Owner Representative before proceeding with work.
- .6 When accepted by Consultant and Owner Representative, mock-up to demonstrate minimum standard for this work. Mock-up may remain as part of finished work.
- .7 Start work only upon receipt of written acceptance of mock-up by Consultant.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in dry location off ground and in accordance with manufacturer's written recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect material packages from nicks, scratches, blemishes and damage.
 - .3 Keep materials dry until use.
 - .4 Store under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.
 - .5 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan and Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of crates, packaging materials and pallets.

1.8 SITE CONDITIONS

- .1 Ambient Conditions: assemble and erect components when temperatures are above 10 degrees C.
- .2 Weather Requirements: to CAN/CSA-A371 and to IMIAC - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.
- .3 Cold weather requirements:
 - .1 To CAN/CSA-A371 with following requirements.
 - .1 Maintain temperature of mortar between 5 degrees C and 50 degrees C until batch is used or becomes stable.
 - .2 Maintain ambient temperature of masonry work and constituent materials between 10 degrees C and 50 degrees C and protect site from windchill.
 - .3 Maintain temperature of masonry above 0 degrees C for minimum of 14 days, after mortar is installed.
 - .4 Preheat unheated wall sections in enclosure for minimum 72 hours above 10 degrees C, before applying mortar.
 - .2 Hot weather requirements:
 - .1 Protect freshly laid masonry from drying too rapidly, by means of waterproof, non-staining coverings.
 - .2 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until masonry work is completed and protected by flashings or other permanent construction.
 - .3 Spray mortar surface at intervals and keep moist for maximum of 3 days after installation.

1.9 WARRANTY

- .1 For Work in this Section, 12 months warranty period is extended to 24 months.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Masonry materials are specified elsewhere in related Sections:
 - .1 Section 04 05 19 – Masonry Anchorage and Reinforcing.

PART 3 - EXECUTION

3.1 INSTALLERS

- .1 Experienced and qualified masons to carry out erection, assembly and installation of masonry work.

3.2 EXAMINATION

- .1 Examine conditions, substrates and work to receive work of this Section.
- .2 Examine openings to receive masonry units. Verify opening size, location, and that opening is square and plumb, and ready to receive work of this Section.
 - .1 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation after unacceptable conditions have been remedied.
- .3 Verification of Conditions:
 - .1 Verify that:
 - .1 Substrate conditions which have been previously installed under other sections or contracts, are acceptable for product installation in accordance with manufacturer's instructions prior to installation of concrete block.
 - .2 Site conditions are acceptable and are ready to receive work.
 - .3 Built-in items are in proper location, and ready for roughing into masonry work.
 - .2 Commencing installation means acceptance of existing substrates and conditions.

3.3 PREPARATION

- .1 Surface Preparation: prepare surface in accordance with manufacturer's written recommendations.
- .2 Establish and protect lines, levels, and coursing.
- .3 Protect adjacent materials from damage and disfiguration.

3.4 INSTALLATION

- .1 Do masonry work in accordance with CAN/CSA-A371 except where specified otherwise.
- .2 Build masonry plumb, level, and true to line, with vertical joints in alignment, respecting construction tolerances permitted by CAN/CSA-A371.
- .3 Layout coursing and bond to achieve correct coursing heights, and continuity of bond above and below openings, with minimum of cutting.

3.5 CONSTRUCTION

- .1 Exposed masonry:
 - .1 Remove chipped, cracked, and otherwise damaged units, in exposed masonry and replace with undamaged units.
- .2 Jointing:
 - .1 Allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, joints true to line, compressed, uniformly concave joints where concave joints are indicated.
 - .2 Strike flush joints concealed in walls and joints in walls to receive plaster, tile, insulation, or other applied material except paint or similar thin finish coating.
- .3 Cutting:
 - .1 Cut out for electrical switches, outlet boxes, and other recessed or built-in objects.
 - .2 Make cuts straight, clean, and free from uneven edges.
- .4 Building-In:
 - .1 Build in items required built into masonry.
 - .2 Prevent displacement of built-in items during construction. Check plumb, location and alignment frequently, as work progresses.
 - .3 Brace door jambs to maintain plumb. Fill spaces between jambs and masonry with mortar.
- .5 Support of loads:
 - .1 Use grout to CAN/CSA-A179 where grout is used instead of solid units.
 - .2 Install building paper below voids to be filled with grout; keep paper 25 mm back from faces of units.
- .6 Provision for movement:
 - .1 Leave 3 mm space below shelf angles.
 - .2 Leave 50mm space between top of non-load bearing walls and partitions and structural elements. Do not use wedges.
 - .3 Built masonry to tie in with stabilizers, with provision for vertical movement.
- .7 Loose steel lintels:
 - .1 Install loose steel lintels. Center over opening width.
- .8 Control joints:

- .1 Construct continuous control joints as indicated.
- .9 Movement joints:
 - .1 Build-in continuous movement joints as indicated.
- .10 Interface with other work:
 - .1 Cut openings in existing work as indicated.
 - .2 Make good existing work. Use materials to match existing.
- 3.6 SITE TOLERANCES
 - .1 Tolerances in notes to CAN/CSA-A371 apply.
- 3.7 SITE QUALITY CONTROL
 - .1 Site Tests, Inspection:
 - .1 Perform site inspection and testing in accordance with Section 01 45 00 - Quality Control.
 - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.
 - .3 Schedule site visits to review work as installation is about to begin.
- 3.8 CLEANING
 - .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
 - .2 Waste Management: separate waste materials for reuse and.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.
- 3.9 PROTECTION
 - .1 Temporary Bracing:
 - .1 Provide temporary bracing of masonry work during and after erection until permanent lateral support is in place.
 - .2 Brace masonry walls as necessary to resist wind pressure and lateral forces during construction.
 - .2 Moisture Protection:
 - .1 Keep masonry dry using waterproof, non-staining coverings that extend over walls and down sides sufficient to protect walls from wind driven rain, until completed and protected by flashing or other permanent construction.

- .2 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 04 05 00 – Common Work Results for Masonry.
- .2 Section 04 05 19 – Masonry Anchorage and Reinforcing.
- .3 Section 04 22 00 – Concrete Unit Masonry.

1.2 REFERENCE STANDARDS

- .1 CSA Group
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A179, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A371, Masonry Construction for Buildings.
 - .4 CAN/CSA-A3000, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).
- .2 International Masonry Industry All-Weather Council (IMIAC)
 - .1 Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for masonry mortar and grout and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Submit copy of WHMIS MSDS, indicating VOC's mortar, grout, parging, colour additives and admixtures. Expressed as grams per litre (g/L).
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations.
 - .2 Store and protect masonry mortar and grout packages from nicks, scratches, blemishes and weather.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Waste Reduction Workplan and Construction Waste Management Plan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of pallets, packaging materials and crates.

1.6 SITE CONDITIONS

- .1 Ambient Conditions: maintain materials and surrounding air temperature to:
 - .1 Minimum 10 degrees C prior to, during, and 48 hours after completion of masonry work.
 - .2 Maximum 32 degrees C prior to, during, and 48 hours after completion of masonry work.
- .2 Weather Requirements: CAN/CSA-A371 and International Masonry Industry All-Weather Council (IMIAC) - Recommended Practices and Guide Specifications for Cold Weather Masonry Construction.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Use same brands of materials and source of aggregate for entire project.
- .2 Cement:

- .1 Portland Cement: to CAN/CSA-A3000, Type GU - General use hydraulic cement (Type 10).
- .2 Masonry Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
- .3 Mortar Cement: to CAN/CSA-A3002 and CAN/CSA-A179, Type S.
- .4 Packaged Dry Combined Materials for mortar: to CAN/CSA-A179, Type S, using gray colour cement.
- .3 Aggregate: supplied by one supplier.
 - .1 Fine Aggregate: to CAN/CSA-A179.
 - .2 Course Aggregate: to CAN/CSA-A179.
- .4 Water: clean and potable.
- .5 Lime:
 - .1 Quick Lime: to CAN/CSA-A179.
 - .2 Hydrated Lime: to CAN/CSA-A179.
- .6 Bonding Agent: latex type.
- .7 Polymer Latex: organic polymer latex admixture of butadiene-styrene type non-emulsifiable bonding admixture.

2.2 MORTAR MIXES

- .1 Mortar for exterior masonry above grade:
 - .1 Load Bearing: type S based on property specifications.
 - .2 Non-Load Bearing: S based on property specifications.
- .2 Mortar for interior masonry:
 - .1 Load Bearing: type S based on property specifications.
 - .2 Non-Load Bearing: N based on proportion specifications.
- .3 Following applies regardless of mortar types and uses specified above:
 - .1 Mortar for grouted reinforced masonry: type S based on property specifications.

2.3 MORTAR MIXING

- .1 Use pre-blended, pre-coloured mortar prepackaged under controlled factory conditions. Ingredients batching limitations to within 1% accuracy.
- .2 Exterior pre-coloured mortar: colour to be selected by Consultant and Owner Representative.

- .3 Mix mortar ingredients in accordance with CAN/CSA-A179 in quantities needed for immediate use.
- .4 Maintain sand uniformly damp immediately before mixing process.
- .5 Add mortar colour or admixtures in accordance with manufacturer's instructions. Provide uniformity of mix and colouration.
- .6 Using anti-freeze compounds including calcium chloride or chloride based compounds is prohibited.
- .7 Adding air entraining admixture to mortar mix is prohibited.
- .8 Use a batch type mixer in accordance with CAN/CSA-A179.
- .9 Pointing mortar: prehydrate pointing mortar by mixing ingredients dry, then mix again adding just enough water to produce damp unworkable mix that will retain its form when pressed into ball. Allow to stand for not less than 1 hour no more than 2 hours then remix with sufficient water to produce mortar of proper consistency for pointing.
- .10 Re-temper mortar only within two hours of mixing, when water is lost by evaporation.
- .11 Use mortar within 2 hours after mixing at temperatures of 32 degrees C, or 2-1/2 hours at temperatures under 10 degrees C.

2.4 GROUT MIXES

- .1 Bond Beams: grout mix 10 to 12.5 MPa strength at 28 days.
- .2 Lintels: grout mix 10 to 12.5 MPa strength at 28 days.
- .3 Grout: Minimum compressive strength of 12.5 MPa at 28 days. Maximum aggregate size and grout slump: CAN/CSA-A179.

2.5 GROUT MIXING

- .1 Mix batched and delivered grout in accordance with CSA A23.1/A23.2 transit mixed.
- .2 Mix grout ingredients in quantities needed for immediate use in accordance with CAN/CSA-A179 coarse grout.
- .3 Add admixtures in accordance with manufacturer's instructions; mix uniformly.
- .4 Using calcium chloride or chloride based admixtures is prohibited.

2.6 MIX TESTS

- .1 Testing Mortar Mix:
 - .1 Test mortar in accordance with CAN/CSA-A179, for proportion specification and mortar based on property specification. Test during construction for:
 - .1 Compressive strength.

- .2 Consistency.
- .3 Mortar aggregate ratio.
- .4 Sand/cement ratio.
- .5 Water content and water/cement ratio.
- .2 Testing Grout Mix:
 - .1 Test grout in accordance with CAN/CSA-A179, for grout based on property specification. Test during construction for:
 - .1 Compressive strength.
 - .2 Sand/cement ratio.
 - .3 Water content and water/cement ratio.
 - .4 Slump.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for masonry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Apply bonding agent to existing concrete surfaces.
- .2 Plug clean-out holes. Brace masonry for wet grout pressure.

3.3 CONSTRUCTION

- .1 Do masonry mortar and grout work in accordance with CAN/CSA-A179 except where specified otherwise.
- .2 Apply parging in uniform coating not less than 10 mm thick.

3.4 MIXING

- .1 Pointing mortar can be mixed using a regular paddle mixer. Only electric motor mixers are permissible. Mixers run on hydrocarbons are not permitted, due to fumes.
- .2 Clean mixing boards and mechanical mixing machine between batches.

- .3 Mortar: weaker than units it is binding.
- .4 Contractor to appoint one individual to mix mortar, for duration of project. In event that this individual is changed, mortar mixing must cease until new individual is trained, and mortar mix is tested.

3.5 MORTAR PLACEMENT

- .1 Install mortar to manufacturer's written instructions.
- .2 Install mortar to requirements of CAN/CSA-A179.
- .3 Remove excess mortar from grout spaces.

3.6 GROUT PLACEMENT

- .1 Install grout in accordance with manufacturer's written instructions.
- .2 Install grout in accordance with CAN/CSA-A179.
- .3 Work grout into masonry cores and cavities to eliminate voids.
- .4 Installing grout in lifts greater than 400 mm, without consolidating grout by rodding is prohibited.
- .5 Displacing reinforcement while placing grout is prohibited.

3.7 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection: in accordance with:
 - .1 Test and evaluate mortar during construction in accordance with CAN/CSA-A179.
 - .2 Test and evaluate grout during construction to CAN/CSA-A179; test in conjunction with masonry unit sections specified.

3.8 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Remove droppings and splashings using clean sponge and water.
- .3 Clean masonry with low pressure clean water and soft natural bristle brush.
- .4 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .5 Waste Management: separate waste materials for recycling and/or reuse.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.9 PROTECTION

- .1 Cover completed and partially completed work not enclosed or sheltered with waterproof covering at end of each work day. Anchor securely in position.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 04 05 00 – Common Work Results for Masonry.
- .2 Section 04 05 13 – Masonry Mortar and Grout.
- .3 Section 04 22 00 – Concrete Unit Masonry.

1.2 REFERENCE STANDARDS

- .1 American Society for Testing and Materials (ASTM)
 - .1 ASTM A36/A36M, Standard Specification for Carbon Structural Steel.
 - .2 ASTM A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
 - .3 ASTM A307, Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - .4 ASTM A580/A580M, Standard Specification for Stainless Steel Wire.
 - .5 ASTM A641/A641M, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire.
 - .6 ASTM A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar.
 - .7 ASTM A1022, Standard Specification for Deformed and Plain Stainless Steel Wire and Welded Wire for Concrete Reinforcement.
- .2 Canadian Standards Association (CSA)
 - .1 CSA A23.1/A23.2, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A179, Mortar and Grout for Unit Masonry.
 - .3 CAN/CSA-A370, Connectors for Masonry.
 - .4 CAN/CSA-A371, Masonry Construction for Buildings.
 - .5 CSA G30.18, Carbon Steel Bars for Concrete Reinforcement.
 - .6 CSA S304, Design of Masonry Structures.
 - .7 CSA W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .3 Reinforcing Steel Institute of Canada (RSIC)

- .1 Reinforcing Steel Manual of Standard Practice.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for anchorage and reinforcing materials and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada.
 - .2 Submit drawings detailing bar bending details, anchorage details lists and placement drawings
 - .3 On placement drawings, indicate sizes, spacing, location and quantities of reinforcement and connectors.
- .4 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Reduction Workplan and Waste Management Plan highlighting recycling and salvage requirements.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports including sand gradation tests in accordance with CAN/CSA-A179 showing compliance with specified performance characteristics and physical properties.
- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.5 SITE MEASUREMENTS

- .1 Make site measurements necessary for proper fit of members.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations.

- .2 Store and protect anchorage and reinforcing materials from nicks, scratches, and damage.
- .3 Replace defective or damaged materials with new.
- .4 Packaging Waste Management: remove for reuse by manufacturer and return of pallets, crates, packaging materials.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Bar reinforcement: Steel to CAN/CSA-A371 and CSA G30.18, Grade 400.
- .2 Connectors: to CAN/CSA-A370 and CSA S304.1.
- .3 Corrosion protection: galvanized to CSA S304.1 and CAN/CSA-A370.
- .4 Fasteners: installed post-construction:
 - .1 Screw Shields and Plugs: plastic, nylon, lead install in mortar joints or placed directly into solid masonry units.
 - .2 Bolts and Screws: size and type to suit application, locate where indicated.
 - .3 Nails: case-hardened cut or spiral nails, size and type to suit fastening application.
 - .4 Powder-Driven Fasteners: pin styles and lengths to suit fastening application in accordance with manufacturers use, load and hold recommendations.
 - .5 Adhesives: epoxies, mastics and contact cements for fastening applications, use in accordance with manufacturers' recommendations.
- .5 Ties: hot dip galvanized to CAN/CSA-A370 Table 5.2.
 - .1 Unit ties, to CAN/CSA-A370: Z style or rectangular, fabricated from cold-drawn steel or wire stainless steel, size to suit application.
 - .2 Adjustable Unit Ties: to CAN/CSA-A370: proprietary type ties, type, style and size to suit application in accordance with manufacturer's recommendations.
 - .3 Joint Reinforcement Ties: CSA A371 with corrosion protection to CSA S304 and CSA A370:
 - .1 Single Wythe Joint Reinforcement: ladder or truss type:
 - .1 Steel wire, hot dip galvanized: to ASTM A641.
 - .2 Cold drawn steel wire.
 - .3 Stainless steel conforming to ASTM A580, Type 304, 4.8 mm side rods.

- .2 Multiple Wythe Joint Reinforcement: ladder or truss type:
 - .1 Steel wire, hot dip galvanized: to ASTM A641.
 - .2 Cold drawn steel wire.
 - .3 Stainless steel conforming to ASTM A580 Type 304, 4.8 mm side rods.
- .6 Anchors: to CAN/CSA-A370:
 - .1 Conventional Anchors: steel bolts with bent bar anchors, through bolts and plate anchors sized to suit application.
 - .2 Wedge Anchors: expansion anchors type wedge and bolt, sized to suit application.
 - .3 Anchor Bolts: conventional anchors, steel, stainless steel, or galvanized finish.
- .7 Conventional Bolts:
 - .1 Plate anchors: steel to ASTM A36, weld square of circular steel plate perpendicular to axis of steel bar threaded on opposite end.
 - .2 Through bolt rods: to ASTM A307 threaded rod or threaded ASTM A36 bar stock.
- .8 Adhesive Anchors: Hilti Products.

2.2 FABRICATION

- .1 Fabricate reinforcing in accordance with CSA A23.1/A23.2 and Reinforcing Steel Manual of Standard Practice by Reinforcing Steel Institute of Canada.
- .2 Fabricate connectors in accordance with CAN/CSA-A370.
- .3 Obtain Consultant's approval for locations of reinforcement splices other than shown on placing drawings.
- .4 Ship reinforcement and connectors, clearly identified in accordance with drawings.

2.3 SOURCE QUALITY CONTROL

- .1 Provide Consultant with certified copy of mill test report of reinforcement steel and connectors, showing physical and chemical analysis.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for anchorage and reinforcing materials installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.

.2 Inform Consultant of unacceptable conditions immediately upon discovery.

.3 Proceed with installation only after unacceptable conditions remedied.

3.2 PREPARATION

.1 Direct and coordinate placement of metal anchors for masonry supplied to other Sections or trades.

3.3 INSTALLATION

.1 Supply and install masonry connectors and reinforcement in accordance with CAN/CSA-A370, CAN/CSA-A371, CSA A23.1/A23.2 and CSA S304.1 unless indicated otherwise.

3.4 BONDING AND TYING

.1 Bond walls of two or more wythes using metal connectors in accordance with CSA S304.1, CAN/CSA-A371 and as indicated.

.2 Tie masonry veneer to backing in accordance with National Building Code of Canada (NBC), CSA S304.1, CAN/CSA-A371 and as indicated.

.3 Install unit, adjustable, single wythe and multiple wythe joint reinforcement where indicated and in accordance with CAN/CSA-A370 and CAN/CSA-A371 and manufacturer's written instructions.

.1 Bond walls of two or more wythes using metal connectors in accordance with CAN/CSA-A371 and as indicated.

.2 Install horizontal joint reinforcement 400 mm on centre.

.3 Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 400 mm each side of opening.

.4 Place joint reinforcement continuous in first and second joint below top of walls.

.5 Lap joint reinforcement ends minimum 150 mm.

3.5 REINFORCED LINTELS AND BOND BEAMS

.1 Reinforce masonry beams, masonry lintels and bond beams as indicated.

.2 Place and grout reinforcement in accordance with CSA S304.1, CAN/CSA-A371, and CAN/CSA-A179.

.3 Support and position reinforcing bars in accordance with CAN/CSA-A371.

3.6 GROUTING

.1 Grout masonry in accordance with CSA S304.1, CAN/CSA-A371 and CAN/CSA-A179 and as indicated.

3.7 ANCHORS

- .1 Supply and install metal anchors in accordance with CAN/CSA-A370 and CAN/CSA-A371.

3.8 LATERAL SUPPORT AND ANCHORAGE

- .1 Supply and install lateral support and anchorage in accordance with CSA S304.1 and as indicated.

3.9 MOVEMENT JOINTS

- .1 Reinforcement not continuous across movement joints unless otherwise indicated.

3.10 FIELD BENDING

- .1 Do not field bend reinforcement and connectors except where indicated or authorized by Consultant.
- .2 When field bending authorized, bend without heat, applying slow and steady pressure.
- .3 Replace bars and connectors with cracks or splits.

3.11 FIELD QUALITY CONTROL

- .1 Obtain Consultant approval of placement of reinforcement and connectors, prior to placing grout.

3.12 CLEANING

- .1 Progress Cleaning:
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.
- .3 Waste Management: separate waste materials for reuse and recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

PART 1 - GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 04 05 00 – Common Work Results for Masonry.
- .2 Section 04 05 13 – Masonry Mortar and Grout.
- .3 Section 04 05 19 – Masonry Anchorage and Reinforcing.

1.2 REFERENCE STANDARDS

- .1 ASTM International
 - .1 ASTM E336, Standard Test Method for Measurement of Airborne Sound Attenuation Between Rooms in Buildings.
- .2 CSA Group
 - .1 CAN/CSA-A165 Series, CSA Standards on Concrete Masonry Units consists: A165.1, A165.2, A165.3.
 - .2 CAN/CSA-A371, Masonry Construction for Buildings.
 - .3 CSA S304.1, Design of Masonry Structures.
- .3 Underwriters Laboratories of Canada (ULC)
 - .1 CAN/ULC-S101, Standard Methods of Fire Endurance Tests of Building Construction and Materials.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete masonry units and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan and Waste Reduction Workplan highlighting recycling and salvage requirements.

1.4 QUALITY ASSURANCE

- .1 Test Reports: submit certified test reports showing compliance with specified performance characteristics and physical properties.

- .2 Certificates: submit product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .3 Mock-ups:
 - .1 Construct mock-ups in accordance with Section 01 45 00 - Quality Control and supplemented as follows:
 - .1 Construct mock-up panel of exterior concrete unit masonry construction, size: 1200 x 1800 mm.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
 - .1 Offload concrete unit masonry packages using equipment that will not damage the surfaces.
 - .2 Do not use brick tongs to move or handle masonry.
- .3 Storage and Handling Requirements:
 - .1 Store materials off ground and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Do not double stack cubes of concrete unit masonry.
 - .3 Cover masonry units with non-staining waterproof membrane covering.
 - .4 Allow air circulation around units.
 - .5 Installation of wet or stained masonry units is prohibited.
 - .6 Keep concrete unit masonry in individual cardboard packaging provided by manufacturer until units are ready to be installed.
 - .7 Store and protect concrete unit masonry from damage.
 - .8 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan and Waste Reduction Workplan related to Work of this Section.
- .5 Packaging Waste Management: remove for reuse and return by manufacturer of packaging materials, crates and pallets as specified in Waste Reduction Workplan and Construction Waste Management.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Standard concrete block units: to CAN/CSA-A165 Series (CAN/CSA-A165.1).
 - .1 Classification: H/15/A
 - .2 Dimensions Nominal: 240 mm wide x 200 mm high x 400 mm long and 200 mm wide x 200 mm high x 400 mm long.
 - .3 Special shapes: provide bull-nosed, square units for exposed corners. Provide purpose-made shapes for lintels, beams and bond beams. Provide additional special shapes as indicated.
 - .4 Profile/Texture for Architectural Concrete Unit Masonry:
 - .1 Split faced: full split units.
 - .5 Colour:
 - .1 Two (2) integrally coloured, pre-finished architectural concrete blocks with one or more faces ground to expose variegated colours of natural aggregates. The colours of the two (2) pre-finished architectural concrete blocks to be selected by Consultant and Owner Representative.
 - .6 Classification: SF/15/A
 - .7 Dimensions - Nominal: 90 mm wide x 200 mm high x 400 mm long.
 - .8 Special Shapes:
 - .1 Provide square units for exposed corners.

2.2 REINFORCEMENT

- .1 Reinforcement in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.3 CONNECTORS

- .1 Connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

2.4 FLASHING

- .1 Flashing: in accordance with drawings.

2.5 MORTAR MIXES

- .1 Mortar and mortar mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.6 GROUT MIXES

- .1 Grout and grout mixes in accordance with Section 04 05 12 - Masonry Mortar and Grout.

2.7 CLEANING COMPOUNDS

- .1 Use low VOC products.
- .2 Compatible with substrate and acceptable to masonry manufacturer for use on products.
- .3 Cleaning compounds compatible with concrete unit masonry and in accordance with manufacturer's written recommendations and instructions.

2.8 TOLERANCES

- .1 Tolerances for standard concrete unit masonry tolerances in accordance with CAN/CSA-A165.1, supplemented as follows:
 - .1 Maximum variation between units within specific job lot not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.
- .2 Tolerances for architectural concrete masonry units in accordance with CAN/CSA-A165.1, supplemented as follows:
 - .1 Maximum variation in length or height between units within specific job lot for specified dimension not to exceed 2 mm.
 - .2 No parallel edge length, width or height dimension for individual unit to differ by more than 2 mm.
 - .3 Out of square tolerance not to exceed 2 mm.
 - .4 Maximum variation in width between units within specific job lot for specified dimension not to exceed 2 mm.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for concrete unit masonry installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied.

3.2 PREPARATION

- .1 Protect adjacent finished materials from damage due to masonry work.

3.3 INSTALLATION

- .1 Concrete block units:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or other finish coating is specified.
- .2 Architectural concrete unit masonry:
 - .1 Bond: running.
 - .2 Coursing height: 200 mm for one block and one joint.
 - .3 Jointing: concave where exposed or where paint or finish coating is specified.
- .3 Special Shapes:
 - .1 Install special units to form corners, returns, offsets, reveals and indents without cut ends being exposed and without losing bond or module.
 - .2 Install reinforced concrete block lintels over openings in masonry where steel or reinforced concrete lintels are not indicated.
 - .3 End bearing: not less than 200 mm or as indicated on drawings.
 - .4 Install special site cut shaped units.

3.4 REINFORCEMENT

- .1 Install reinforcing in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.5 CONNECTORS

- .1 Install connectors in accordance with Section 04 05 19 - Masonry Anchorage and Reinforcing.

3.6 FLASHING

- .1 Install flashings: in accordance with drawings.

3.7 MORTAR PLACEMENT

- .1 Place mortar in accordance with Section 04 05 12 - Masonry Mortar and Grout.

3.8 GROUT PLACEMENT

- .1 Place grout in accordance with Section 04 05 12 - Masonry Mortar and Grout.

3.9 CONSTRUCTION

- .1 Build in miscellaneous items such as bearing plates, steel angles, bolts, anchors, inserts, sleeves and conduits.
- .2 Construct masonry walls using running bond unless otherwise noted.
- .3 Build around frames previously set and braced. Fill behind hollow frames within masonry walls with mortar or grout and embed anchors.
- .4 Fit masonry closely against electrical and plumbing outlets so collars, plates and covers overlap and conceal cuts.
- .5 Install movement joints and keep free of mortar where indicated.
- .6 Hollow Units: spread mortar setting bed from outside edge of face shells. Gauge amount of mortar on top and end of unit to create full joints, equivalent to shell thickness. Avoid excess mortar.
- .7 Solid Units: apply mortar over entire vertical and horizontal surfaces. Avoid bridging of airspace between brick veneer and backup wall with mortar.
- .8 Ensure compacted head joints. Use full or face-shell joint as indicated.
- .9 Tamp units firmly into place.
- .10 Do not adjust masonry units after mortar has set. Where resetting of masonry is required, remove, clean and reset units in new mortar.
- .11 Tool exposed joints concave, strike concealed joints flush.
- .12 After mortar has achieved initial set up, tool joints.
- .13 Do not interrupt bond below or above openings.

3.10 REPAIR/RESTORATION

- .1 Upon completion of masonry, fill holes and cracks, remove loose mortar and repair defective work.

3.11 FIELD QUALITY CONTROL

- .1 Site Tests, Inspection as follows:
 - .1 Concrete masonry units will be sampled and tested by independent testing agency appointed and paid by Owner in accordance with CSA S304.1.
 - .2 Notify inspection agency minimum of 24 hours in advance of requirement for tests.

3.12 CLEANING

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

.2 Standard Concrete Unit Masonry:

- .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.

.3 Architectural Concrete Unit Masonry:

- .1 Allow mortar droppings on masonry to partially dry then remove by means of trowel, followed by rubbing lightly with small piece of block. Clean wall surface with suitable brush or burlap.

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

- .3 Waste Management: separate waste materials for recycling and reuse.

- .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

3.13 PROTECTION

- .1 Brace and protect concrete unit masonry as required until work complete.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Design, labour, Products, equipment and services necessary for the structural steel Work in accordance with the Contract Documents.

1.2 REFERENCES

- .1 ASTM A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
- .2 ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.
- .3 ASTM A325M, Standard Specification for Structural Bolts, Steel, Heat Treated 830 MPa Minimum Tensile Strength (Metric).
- .4 ASTM A563M, Standard Specification for Carbon and Alloy Steel Nuts (Metric).
- .5 ASTM C1107/C1107M, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
- .6 ASTM F436, Standard Specification for Hardened Steel Washers.
- .7 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .8 CSA S16, Design of Steel Structures.
- .9 CISC, Handbook of Steel Construction.
- .10 CISC/CPMA 2-75, A Quick-drying Primer for Use on Structural Steel.
- .11 CSA S136 PACKAGE, 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.
- .12 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .13 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .14 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .15 CWB, Canadian Welding Bureau.
- .16 SSPC-SP6/NACE No. 3, The Society for Protective Coatings, Commercial Blast Cleaning.
- .17 SSPC-SP10/NACE No. 2, The Society for Protective Coatings, Near-White Blast Cleaning.

1.3 DESIGN REQUIREMENTS

- .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 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.
 - .2 Standard connections such as connections for shear only:
 - .1 Select shear connections from the CISC, Handbook of Steel Construction.
 - .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.
 - .3 Connections: Designed and stamped by a Professional Engineer, licensed in the Province of Ontario.
- .2 Structural design to accommodate active loads including live, dead, lateral, wind, seismic, handling, transportation and erection loads.
- .3 Design Connections:
 - .1 To safely withstand the combined effects of shear, moment and torque at applicable design stresses.
 - .2 Not to interfere with architectural clearance lines or finishes.
 - .3 Of base plate and cap plate bearing on column to column section by welding or grinding column to bear.
 - .4 Taking into account any eccentricity.

1.4 SUBMITTALS

- .1 Submit in accordance with Submittals Section.
- .2 Shop Drawings:
 - .1 Submit in accordance with Submittal Section indicating:
 - .1 Shop and field splices, cuts, copes, camber, connection details, holes, reinforcements, bearing plates, welds, anchors, identification marks, surface preparation, and finishes.
 - .2 Indicate welds in accordance with CSA W59 welding symbols standard.
 - .3 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, if required.

- .2 Reproduction of the Contract Drawings for use as Shop Drawings is not permitted.
- .3 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada
- .3 Quality Assurance Submittals:
 - .1 Four 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.
 - .2 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.
 - .3 Submit confirmation by the Professional Engineer that fabrication and erection complies with the Contract Documents.

1.5 QUALITY ASSURANCE

- .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, as described in this Section, to perform the following services:
 - .1 Design of structural members and connections.
 - .2 Stamp and sign Shop Drawings.
 - .3 Review and report on manufacturer's and fabricator's quality control tests and reports for compliance with the Contract Documents.
 - .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 Exercise care in handling primer finished materials.
- .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.
- .3 Schedule and sequence the Work so a minimum of handling occurs prior to erection.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Rolled structural steel shapes and flat hot-rolled steel Products: In accordance with CSA G40.20/G40.21, Grade 350W.

- .2 Hollow structural sections (HSS): In accordance with CSA G40.20/G40.21, Grade 350W, Class H.
- .3 Beam connections, columns, base plates, beams, purlins, girts and sag rods: In accordance with CSA G40.20/G40.21.
- .4 Surface preparation: Remove moisture, oil, grease, dirt, excessive rust, loose mill scale.
- .5 Shop paint primer: In accordance with CISC/CPMA 2-75.
- .6 Hot-dip galvanizing: In accordance with ASTM A123/A123M; minimum zinc coating of 600 g/m².
- .7 Welding materials: In accordance with CSA W59 and certified by the CWB.
- .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.
- .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.
 - .1 Lock washers, lock nuts, burr thread to prevent bolts from working loose.
 - .2 In accordance with ASTM A563M; hexagon semi-finished nuts.
 - .3 In accordance with ASTM F436; flat, smooth hardened washers, quenched and tempered.
- .10 Field touch-up primer (prime painted steel): In accordance with CISC/CPMA 2-75.
- .11 Field touch-up primer (galvanized steel): Galvanox by Carboline, Galvafruid by W.R. Meadows of Canada, Zinc Clad 5 by Sherwin Williams. Minimum 80% zinc content.

2.2 FABRICATION

- .1 Fabricate structural steel in accordance with CSA S16 and CISC, Handbook of Steel Construction fabrication tolerances except as indicated otherwise.
- .2 Splicing of members is not permitted except as indicated on the Contract Drawings.
- .3 Clean, prepare surfaces and shop prime structural steel in accordance with CSA S16.
- .4 Prime interior structural steel in shop except if galvanized finish is indicated. Galvanize exterior, exposed structural steel unless indicated otherwise.
- .5 Do not paint surfaces which will be embedded in concrete.
- .6 Continuously weld structural steel members, where indicated. Galvanize vent/weep holes for structural steel members.
- .7 Grind shop fabrication welds smooth.

- .8 Fabricate structural steel members true and without twists or open joints.
- .9 Weld in accordance with CSA W59.
- .10 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.
- .11 Fabricate HSS members with sufficient holes to prevent the accumulation of water.

2.3 STRUCTURAL GROUT

- .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.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends. Commencement of Work means acceptance of existing conditions.
- .2 Obtain written approval from Consultant prior to field cutting or altering of structural members.

3.2 MARKING

- .1 Mark materials in accordance with CSA G40.20/G40.21.
- .2 Match marking: Mark bearing assemblies and splices in shop for fit and match.

3.3 STRUCTURAL STEEL ERECTION

- .1 Supply and coordinate the location and placement of anchor bolts and base plates.
- .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 Splicing of members is not permitted except as indicated on the Contract Drawings.
- .4 Set steel accurately to lines and elevations as indicated. Set column bases and shim to proper elevations. Install structural grouting in accordance with details and the manufacturer's recommendations.
- .5 Assemble structural steel members true, plumb and level, free of twists and open joints.
- .6 Make high strength bolted connections in accordance with CSA S16.
- .7 Weld in accordance with CSA W59.

3.4 FIELD TOUCH-UP PAINTING

- .1 Upon completion of erection, mechanically brush clean bolts, rivets, welds and burned or scratched surfaces.
- .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

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Design, labour, Products, equipment and services necessary for the steel deck Work in accordance with the Contract Documents.

1.2 REFERENCES

- .1 ASTM A307, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60000 PSI Tensile Strength.
- .2 ASTM A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
- .3 ASTM D1187/D1187M, Standard Specification for Asphalt-Based Emulsions for Use as Protective Coatings for Metal.
- .4 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .5 CSA S16, Design of Steel Structures.
- .6 CSA S136, Package - 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.
- .7 CSA W47.1, Certification of Companies for Fusion Welding of Steel.
- .8 CSA W48, Filler Metals and Allied Materials for Metal Arc Welding.
- .9 CSA W55.3, Certification of Companies for Resistance Welding of Steel and Aluminum.
- .10 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .11 CISC/CPMA 1-73a, A Quick-drying One-coat Paint for Use on Structural Steel.
- .12 CSSBI, Canadian Sheet Steel Building Institute.
- .13 CSSBI 10M, Standard for Steel Roof Deck.
- .14 CSSBI 12M, Standard for Composite Steel Deck.
- .15 CSSBI S3, Criteria for the Design of Composite Slabs.
- .16 CSSBI B13, Design of Steel Deck Diaphragms.
- .17 OBC, Ontario's Building Code.
- .18 NBC, National Building Code.
- .19 User's Guide NBC Structural Commentaries (Part 4 of Division B).

1.3 DESIGN REQUIREMENTS

- .1 Design steel deck to carry loads indicated on Contract Drawings in accordance with CSA S16, CSA S136, OBC and CSSBI 10M.
- .2 Design the steel deck to carry loads indicated on Contract Drawings in accordance with CSA S16, CSA S136 and OBC.
- .3 Design steel deck to depth and base steel nominal thickness, not less than those indicated on Contract Drawings.
- .4 Design composite steel deck with reinforced concrete slab in accordance with CSSBI 12M and CSSBI S3.
- .5 Design mechanical fastener or weld to anchor steel deck to the supporting structural steel to resist wind uplift.
- .6 Design framing for openings or holes through deck over 450 mm width, measured perpendicular to span of deck.

1.4 SUBMITTALS

- .1 Submit in accordance with Submittals Section.
- .2 Shop Drawings:
 - .1 Submit in accordance with Submittal Section indicating:
 - .1 Deck plan, design loads, profiles, material specifications, spans, dimensions, base steel thickness, metallic coating designation, types and spacing of connections to supports and at side laps, lapping details, projections, openings, flashing and closure plates, edge details, reinforcement details, and accessories.
 - .2 Submit drawings stamped and signed by professional engineer registered or licensed in Ontario, Canada
 - .3 Include design calculations indicating steel deck profile and dimensions, steel grade and resistance, coating, embossments and perforations in deck, load design criteria, specified and factored member loads, span, stresses, deflection, and floor vibration under various loading combinations for each panel.
 - .1 Include connectors design calculation at support and side lap.
 - .4 Sequence of installation, location of various sheet lengths, sheet quantities, sheet thicknesses, metallic coating designations, and details of temporary shoring of steel deck, such as location, time and duration of placement, and removal of shoring.
 - .1 If welds are used, indicate welds in accordance with CSA W59.
- .3 Quality Assurance Submittals:

- .1 If welding is used, submit certifications for welding companies in accordance with CSA W47.1 for fusion welding of steel structures and CSA W55.3 for resistance welding of structural components.
- .2 Execute Work of this Section only by steel deck manufacturer fully accredited and current member in good standing with CSSBI. Submit copy of accreditation.
- .3 Submit copies of Site inspection reports.

1.5 QUALITY ASSURANCE

- .1 Retain a Professional Engineer, licensed in the Province of Ontario, with experience in steel deck work of comparable complexity and scope, as described in this Section, to perform the following services:
 - .1 Review, stamp, and sign Shop, shoring and erection Drawings, design calculations, and any revisions required.
 - .2 Conduct on-site inspections. Prepare and submit written inspection reports verifying the Work is in accordance with the Contract Documents and reviewed Shop Drawings.
 - .3 Monitor supplier's and fabricator's quality control tests and reports in accordance with Contract Documents.

1.6 DELIVERY, STORAGE, AND HANDLING

- .1 Stockpile panels tilted for water run-off, free from ground contact on firm, level, non-staining, full-width supports spaced not more than 900 mm apart. Cover components with vented opaque, polyethylene sheet.
- .2 After installation, protect steel deck from extended exposure to moisture at all times until roofing is in place.

PART 2 - PRODUCTS

2.1 STEEL DECK AND ACCESSORIES

- .1 Steel deck and composite steel deck manufacturers:
 - .1 VicWest Corporation.
 - .2 Canadian Metal Rolling Mills.
 - .3 Canam Group.
 - .4 Vulcraft Group.
 - .5 Agway Metals Inc.
- .2 Formed steel sheet in accordance with the following:
 - .1 CSSBI 10M for roof steel deck.

- .2 ASTM A653/A653M, SS Grade 230.
- .3 With Z275 galvanized coating.
- .4 With minimum yield strength 230 MPa.
- .5 With minimum base steel thickness and profile depth as indicated on Contract Drawings.
- .3 Steel deck: Non-cellular with interlocking side laps.
- .4 Composite deck flute closures, pour stops, and flashings: Supplied of similar material and metallic coating designation to the deck.
- .5 Flute closures: Profile notched metal to match deck.
- .6 Metal cants and curbs: 1.9 mm base steel thickness, Z275 galvanized, formed sheet steel.
- .7 Structural shapes, plates, and similar items: In accordance with CSA G40.20/G40.21, Grade 300W.
- .8 Shop finish: In accordance with CISC/CPMA 1-73a.
- .9 Welding materials: In accordance with CSA W48 and CSA W59.

2.2 FABRICATION

- .1 Fabricate steel deck in accordance with CSA S136, CSSBI 10M for steel deck.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Erect in accordance with CSA S16, CSA S136, and CSSBI 10M for roof steel deck.
- .2 Weld in accordance with CSA W59, except where indicated otherwise.

3.2 EXAMINATION

- .1 Verify condition and dimensions of previously installed Work upon which this Section depends.
- .2 Commencement of Work means acceptance of existing conditions.
- .3 Obtain Consultant's written approval prior to field cutting or altering of structural members.

3.3 STEEL DECK

- .1 Erect steel deck in accordance with manufacturer's written instructions, and as indicated on reviewed Shop Drawings.
- .2 Place and adjust steel deck units to final position on the supporting structure before being permanently fastened.

- .3 Adequately fasten steel deck units to structural supports by 19 mm fusion welds or powder actuated fasteners, or screws. Maximum fastenings spacing along bearing supports in accordance with Contract Drawings and reviewed Shop Drawings.
- .4 Weld or mechanically fasten at additional locations in accordance with reviewed Shop Drawings where deck is designed for diaphragm action.
- .5 End laps including edges, and bearing: Minimum 50 mm and form over supports.
- .6 Side laps adjacent deck units with button punch or #10 screws or 25 mm long seam welds or Hilti side lap connectors at intervals as determined by design for diaphragm action and indicated on reviewed Shop Drawings. For base steel thicknesses 0.91 mm and greater, do not use button punch for side lap connections.
- .7 Install end closures, concrete retaining closures, in accordance with reviewed Shop Drawings.
- .8 After deck is permanently secured in place, touch-up steel deck immediately at weld and stud shear connectors with compatible primer.
- .9 Clean deck free of dirt, scale, foreign matter, and debris.
- .10 Install steel deck sheet with full end bearing. Patching with less than full sheets is unacceptable.
- .11 Replace steel deck if dented, damaged, dished, deformed, or not fully interlocked.
- .12 Provide deck edge supports for high deck flutes which run parallel to structural steel at building face.
- .13 Align metal deck sheets accurately with sections end-to-end parallel, level, and straight.

3.4 CUTS, OPENINGS, AND REINFORCEMENT FRAMING

- .1 Field cut openings in steel deck to accommodate and coordinate with other parts of the Work, such as columns, supports, projections, and penetrations. Cut steel deck to a tolerance of 3 mm.
- .2 Reinforce steel deck with reinforcement framing, at opening maximum 450 mm in any dimension and in accordance with the following requirements:
 - .1 Openings smaller than 125 mm square or diameter: No reinforcement is required when 1 or 2 vertical webs are removed.
 - .2 Openings with dimensions between 150 to 450 mm:
 - .1 Unless indicated otherwise on Contract Drawings, provide a minimum L65 mm x 65 mm x 5 mm angle reinforcement to frame across each side of the opening in the direction perpendicular to the flutes.
 - .2 Fasten angles to a minimum of two flutes on each side of the opening.
 - .3 Alternatively, design reinforcing in accordance with steel deck manufacturer's recommendation.

- .3 Openings with any dimension greater than 450 mm and for areas of concentrated load:
Reinforce in accordance with framing details as indicated on Contract Drawings.
Alternatively, reinforce in accordance with reviewed Shop Drawings based on structural analysis of the loads involved.

3.5 FIELD TOUCH-UP PAINTING

- .1 Upon erection completion, mechanically brush clean bolts, rivets, welds, and burned or scratched surfaces.
- .2 For galvanized steel surface with damage and without shop coat, repair with field touch-up primer.

END OF SECTION

MECHANICAL SPECIFICATIONS

ONTARIO SHORES NEW POWER HOUSE

700 GORDON STREET

WHITBY, ON

ISSUED FOR TENDER: JUNE 13, 2019

MHL # 1802218

Suite 300, 125 Commerce Valley Rd. West
Markham, Ontario
L3T 7W4

T. (1) 416.499.3110

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1. GENERAL

1.1 Scope

.1 The work of the Contract is specified in the Sections listed below.

2. SPECIFICATIONS - MECHANICAL (DIV. 20 - 25)

2.1 Division 20 - Mechanical Common Work

00 01 01	Cover Page
00 01 10	Table of Contents
20 01 01	Mechanical General Requirements
20 05 01	Basic Materials & Methods
20 05 13	Motors, Starters, Wiring and Electric Pipe Heating
20 05 24	Pipe Welding
20 05 29	Hangers and Supports
20 05 53	Mechanical Identification
20 07 13	Mechanical Insulation
20 08 05	Testing Adjusting and Balancing
20 08 15	Mechanical Commissioning
20 08 19	Project Close-Out

2.2 Division 23 - HVAC

23 11 13	Fuel Oil Systems
23 24 16	Diesel Exhaust Systems
23 33 14	Dampers - Operating
23 33 15	Dampers Fire
23 33 19	Acoustic Silencers
23 34 23	Exhaust Fans
23 82 39	Unit Heaters & Electric Baseboard Heaters

2.3 Division 25 - Controls and Automation

25 05 01	Building Automations Systems General
25 05 13	B.A.S. Alternate Prices
25 51 00	Fuel Monitoring System (includes Chipkin Bacnet Gateway Cutsheets)
25 90 01	B.A.S. Sequence of Operations

END OF SECTION

PART 1 - GENERAL REQUIREMENTS

1.1 GENERAL CONTRACT DOCUMENTS

- .1 Comply with General Conditions of Contract, Supplementary Conditions and Division 1 - General Requirements.

1.2 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 21, 22, 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.

1.3 DIVISION 20, AS IT APPLIES TO DIVISIONS 21, 22, 23 AND 25

- .1 Articles that are of a general nature, applicable to each Section of these Divisions.
- .2 Articles specifying materials, equipment, installation techniques and workmanship that are applicable to more than one Section of these Divisions.
- .3 Articles that are to be read in context with and form part of relevant Sections of these Divisions.

1.4 DEFINITIONS

- .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 The words "approved", "satisfactory", "as directed", "submit", "permitted", "inspected", or similar words or phrases used in this Specification, mean that material or item referred to is to be "approved by", "satisfactory to", "as directed by", "submitted to", "permitted by", "inspected by", Consultant.
- .3 Instructions using any form of word "provide" involves Contractor in furnishing labour, materials and services to supply and install referenced item.

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 list follows a semi-colon (;) the punctuation is for clarity, where 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 EXAMINATION

- .1 Examine any existing buildings, 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 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 Examine work of other Divisions before commencing this work, and report any defect or interference.

1.7 DESIGN SERVICES

.1 Provide design services for elements of the Work where specified in other sections of Division 20, sealed by a professional engineer licensed in the applicable jurisdiction.

1.8 STANDARD OF MATERIAL AND EQUIPMENT

.1 Materials and equipment:

.1 New and of uniform pattern throughout work,

.2 Of North American manufacture where obtainable,

.3 Standard products of approved manufacture.

.4 Labeled or listed as required by Code and/or Inspection Authorities,

.5 Registered in accordance with the requirements of TSSA Boilers and Pressure Vessels Safety Division Guidelines for the Registration of Non-nuclear Fittings in the Province of Ontario.

.6 In compliance with Standards and Regulations with respect to;

.1 chemical and physical properties of materials,

.2 design,

.3 performance characteristics, and

.4 methods of construction and installation.

.7 Identical units of equipment to be of same manufacture.

.8 Identical component parts of same manufacture in similar units of equipment, but various component parts of each unit need not be from one manufacturer.

.2 Materials and equipment are described to establish standards of construction and workmanship.

.1 Where a manufacturer or manufacturers' products are identified in lists with the phrase "Standard of Acceptance", these are manufacturers and/or products which meet required standards with regard to performance, quality of material and workmanship.

.2 Manufacturers and or products used are to be chosen from these lists.

.3 Select materials and equipment in accordance with manufacturer's recommendations and install in accordance with manufacturer's instructions.

.4 Materials and equipment not satisfying these selection criteria will be condemned.

.5 Remove condemned materials from job site and provide properly selected and approved materials.

1.9 SUBMITTALS

.1 SHOP DRAWINGS AND PRODUCT DATA SHEET

.1 Submit shop drawings, manufacturers and product data and samples in accordance with Section 01 33 00 and as specified herein.

.1 Submit shop drawings in the same unit of measure as are used on the drawings. Both metric and imperial measures may be included.

- .2 Include a shop drawing cover sheet form prepared for this project, for each shop drawing, or, include the same information on the contractors submittal cover sheet:
 - .1 Information required on each submission:
 - .1 Client/Architect name
 - .2 Project Name
 - .3 MHL project number
 - .4 Date
 - .5 Contractor name
 - .6 Contractor reference No.
 - .7 Manufacturer name
 - .8 Product type
 - .9 Specification section number
 - .10 Contractor trade: mechanical, electrical, elevators, or general trades
 - .11 If a re-submission, the previous submission MHL reference number.
- .3 Submit shop drawings in reproducible form;
 - .1 Preferred format : as e-mail attachments in Portable Document Format (PDF)
 - .2 As letter, or 11 x 17, black and white originals of graphic quality suitable for photocopying,
 - .3 for each item of equipment in following list (but not limited to);
 - .1 air moving units,
 - .2 motor starters
 - .3 BAS
 - .4 Fuel system
 - .5 Leak detection
 - .6 Unit heaters
 - .7 Fuel Tanks
 - .8 Fuel Transfer Pumps
 - .9 Silencers
 - .10 Dampers & actuators
 - .11 Fuel Monitoring System
 - .12 Fuel Polisher
 - .13 ULC Vent system for generator
- .4 Manufacturer's letter sized printed data sheets, as black and white originals of graphic quality suitable for photocopying, are acceptable in place of shop drawings for standard production items.
- .5 Submit with manufacturers data sheets, typed schedules listing manufacturer's and supplier's name and catalogue model number for;
 - .1 valves,
 - .2 expansion joints,
 - .3 pipe hangers
 - .4 insulation and jacketing
 - .5 equipment, piping, ductwork and accessory identification
- .6 Shop drawings and product data to show;
 - .1 dimensioned outlines of equipment

- .2 dimensioned details showing service connection points.
- .3 elevations illustrating locations of visible equipment such as gauges, pilot lights, breakers and their trip settings, windows, meters, access doors.
- .4 description of operation.
- .5 single line diagrams.
- .6 general routing of bus ducts and connecting services.
- .7 mounting and fixing arrangements.
- .8 operating and maintenance clearances, and
- .9 access door swing spaces.
- .7 Shop drawings and product data to be accompanied by;
 - .1 detailed drawings of bases, supports and anchor bolts,
 - .2 sound power data, where applicable, and
 - .3 performance curves for each piece of equipment marked with point of operation.
- .8 Shop drawing and data sheet submission is taken as certification;
 - .1 that units are from Manufacturer's current production and
 - .2 that the units are in compliance with applicable Codes, Standards, and Regulations.
- .9 Do not submit drawings showing internal construction details, component assemblies or interior piping and wiring diagrams. These may be necessary to understand correct functioning of equipment and should be submitted with operating and maintenance data.
- .10 Check and stamp each shop drawing as being correct before submission. Shop drawings without such stamps will be rejected and returned.
- .11 Keep one copy of each reviewed shop drawing and product data sheet on site available for reference purposes.
- .12 Where equipment is delivered without reviewed shop drawing available on site, equipment will be condemned and is to be removed from site and replaced with new equipment after shop drawing has been submitted and reviewed.

.2 FIELD, FABRICATION, OR INSTALLATION DRAWINGS

- .1 Contractor field, 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.
- .2 Maintain a copy on site of such drawings for reference by the Consultant.
- .3 Provide a copy of such drawings to the Consultant for general information purpose only, upon request.

1.10 REFERENCE CODES STANDARDS AND REGULATIONS

.1 CODES, STANDARDS AND REGULATIONS

- .1 Latest current versions in force at time of Tender.
- .2 Where relevant documents applicable to this work exist, follow these criterion, recommendations, and requirements as minimum standards.
- .3 In event of conflict between codes, 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 most demanding requirements.

.2 CONFINED SPACES

- .1 Unless otherwise proscribed by the Constructor's / Owner's workplace safety program, treat spaces not designed and constructed for continuous human occupancy as "confined spaces", including but not limited to:
 - .1 horizontal and vertical service spaces and shafts,
 - .2 inside of equipment that permits entry of the head and/or whole body, and
 - .3 ceiling spaces that are identified as containing a hazardous substance.
- .3 PERMITS, TESTS AND CERTIFICATES
 - .1 Arrange and pay for permits, tests, and Certificates of Inspection required by Authorities having jurisdiction.
 - .2 Submit applications requiring Owner's signature before commencing work.
 - .3 Obtain and submit Inspection Certificates as required for
 - .1 Electrical Inspection.
 - .2 Plumbing Inspection.
 - .3 Pressure Vessel Inspection.
 - .4 Piping and Boiler Inspection.
 - .5 Fuel safety Inspection.
 - .6 Technical Standards and Safety Authority Inspection.
 - .4 Certificates to be renewed as to remain in force for guarantee period.
 - .5 Co-ordinate and perform testing required by Authorities having jurisdiction in accordance with Clause TESTING in this Section

1.11 EQUIPMENT

- .1 MANUFACTURERS NAMEPLATES
 - .1 Provide metal nameplate with raised or recessed lettering, mounted on each piece of equipment.
 - .2 On insulated equipment, mechanically fasten plates on metal stand-off bracket arranged to clear insulation and mount Underwriters Laboratories and/or CSA registration plates on same stand-off brackets.
 - .3 Manufacturer's nameplate to indicate equipment size, capacity, model designation, manufacturer's name, serial number, voltage, cycle, phase and power rating of motors.
- .2 FACTORY APPLIED FINISH PAINTING
 - .1 Apply prime and final paint coats to equipment and materials where specifically detailed in Sections of these Divisions.
 - .2 Apply prime and final paint coats factory to pumps, air moving units, un-insulated pressure vessels and bare metal equipment items in boiler, mechanical and fan rooms and equipment installed outdoor on the roof.
 - .3 Use heat resistant paint where conditions require.
 - .4 Protect factory finished equipment during construction, and clean at completion of work.
- .3 FACTORY APPLIED PRIME PAINTING

- .1 Have prime paint factory applied to other equipment fabricated from iron or steel including access doors, registers, grilles, diffusers, dampers, metal radiation enclosures and fire hose cabinets.
- .4 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 painting under Finishes, Division 9.
 - .3 In "un-occupied" areas of the building such as mechanical equipment rooms, boiler rooms, fan rooms, crawl spaces, penthouses and for all rooftop installations:
 - .1 paint exposed galvanized metal surfaces with one coat of zinc dust galvanized primer and one coat of 100% Alkyd base enamel in an approved colour.
 - .2 paint exposed iron or steel work with one coat of chrome oxide phenolic base primer and one coat of 100% Alkyd base enamel in an approved colour.
- .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.
- .6 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.
- 1.12 OFFICE, STORAGE AND TOOLS
 - .1 OFFICE AND STORAGE
 - .1 Provide temporary office, workshop and tools and material storage space.
 - .2 Assume responsibility for security of these facilities and provide heat, light and telephone.
 - .3 Buildings to conform in appearance to those erected for similar purposes under other Divisions of Specification.
 - .2 APPLIANCES AND TOOLS
 - .1 Provide tools, equipment, scaffolding, extension cords, lamps and miscellaneous consumable materials, required to carry out work.
- 1.13 CO-ORDINATION
 - .1 GENERAL
 - .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 all 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. Section 20 is intended to define and take all the responsibilities for coordination with all other sections.
- .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.
- .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 works 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.
 - .4 Submit drawings to other trades involved in each area and include note in drawing title block as follows;
 - .1 "This drawing was prepared and circulated for review and mark-up to related subcontractors as noted and initialed in the table below. Corrections and concerns identified through this coordination process have been addressed on this drawing. Areas that incorporate significant changes from layouts shown on Contract Drawings have been circled for Consultants' review"
- .3 ANCHORS AND INSERTS
 - .1 Supply anchor bolts and locating templates for installation in advance of concrete pouring.

1.14 PROTECTION OF WORK AND PROPERTY

- .1 GENERAL
 - .1 Protect this work and work of other trades from damage.
 - .2 Cover floors with tarpaulins and provide plywood and other temporary protection.

- .3 Assume responsibility for repairing damage to floor and wall surfaces resulting from failure to provide adequate protection.
- .4 Protect equipment, pipe and duct openings from dirt, dust and other foreign materials.

1.15 WORK IN EXISTING BUILDING

.1 GENERAL

- .1 Work includes changes to existing building and changes at junction of old and new construction.
- .2 Route pipes, ducts, conduits and other services to avoid interference with existing installation.
- .3 Relocate existing pipes, ducts, conduits, bus ducts and any other equipment or services required for proper installation of new work.
- .4 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.
- .5 Plumbing fixtures, piping, ductwork, conduit and wiring shown to be removed and not shown relocated, to become property of Contractor and to be taken from site.
- .6 Lighting fixtures shown to be removed will remain Owner's property and will be turned over to Owner's representative as directed.
- .7 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.

.2 CONTINUITY OF SERVICES

- .1 Connections to existing systems to be made at approved times with minimum length shutdown periods.
 - .1 Obtain written approval of time and length of shut-down periods.
 - .2 Arrange work so that physical access to existing buildings is not unduly interrupted.
 - .3 Make good damage to existing systems resulting from connection process.

1.16 MOVING AND SETTING IN PLACE OF OWNER'S EQUIPMENT

.1 S.B.O. (SUPPLIED BY OWNER)

- .1 Items marked SBO on drawings will be;
 - .1 purchased by Owner.
 - .2 received, checked, and stored and
 - .3 subsequently unpacked, uncrated, assembled and located by Contractor under Division 20
- .2 Connect mechanical and electrical services to this equipment.

.2 E.R. OR EX. REL. (EXISTING RELOCATED) OR OTHERWISE SO IDENTIFIED

- .1 Items so marked on drawings will be;
 - .1 moved from their present location and reinstalled by Contractor under Division 20.
- .2 Disconnect and reconnect mechanical and electrical services to accommodate this equipment relocation.

1.17 TEMPORARY HEATING**.1 DURING CONSTRUCTION**

- .1 Temporary heating required while building is under construction will be provided under Division 1.
- .2 Permanent heating system may be used for temporary heating, when this equipment is installed in its permanent location and 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 and approved chemical water treatment is in operation.
- .4 Permanent heating equipment used for temporary heating to be thoroughly cleaned and put in first class approved operating condition and appearance at completion of job.

1.18 CLEANING AND FINAL ADJUSTMENTS**.1 GENERAL**

- .1 Thoroughly clean piping, and vacuum ducts and air handling units. Clean strainers in piping systems and install clean filters in air handling systems.
- .2 Remove tools and waste materials on completion of work and leave work in clean and perfect condition.
- .3 Calibrate components and controls and check function and sequencing of systems under operating conditions.
- .4 Supply lubricating oils and packing for proper operation of equipment and systems until work has been accepted.

1.19 RECORD DRAWINGS**.1 SITE RECORDS**

- .1 A set of design drawings in AutoCad on CD or DVD ROM will be provided by the Consultant. Make sets of white prints for each phase of Work, and as Work progresses and changes occur mark white prints in coloured inks to show revisions. Dimension 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.
- .2 Survey information from excavation and backfill of site services to be held on site, after approval, and to be similarly transferred to white prints.
- .3 Retain these drawings and make available to Consultant for periodic review.
- .4 On a weekly basis, scan marked-up drawings to Adobe .pdf format. Where a project has a FTP site, post these files on a weekly basis.

.2 AS-BUILT DRAWINGS

- .1 Prior to testing, balancing and adjusting, transfer site record drawing information to AutoCad files, to record final as-built condition. Obtain a current set of CAD files from the Consultant.
 - .1 Drawings are to remain set to and follow Consultants AutoCad Standards. Do not alter drawing scales, X-refs, colours, layers or text styles.
 - .2 The Consultant's CAD files may not reflect all or any construction changes.
- .2 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.

- .3 Show on mechanical as-built drawings final location of piping, ductwork, switches, starters, Motor Control Centres, thermostats, and equipment.
- .4 Show on site services as-built drawings survey information provided by Ontario Land Surveyor (OLS) monitoring services installation.
- .5 Show on electrical as-built drawings final location of conduit, outlets, panels, branch wiring, system wiring, pull boxes, bus ducts, and equipment.
- .6 Identify each drawing in lower right hand corner in letters at least 12 mm (½ in) high as follows "AS BUILT DRAWINGS. This drawing has been revised to show systems as installed" (Signature of Contractor) (Date). The site services drawings are to include (Signature and Stamp of OLS) attached to note.
- .7 Submit one (1) set of white prints of the draft as-built Cad files for Consultants's review.
- .8 Once "AS BUILT DRAWINGS" white prints are reviewed, transfer Consultant's comments to the CAD files. Return AutoCad drawings modified to "As Built" condition to Consultants on CD or DVD Rom.
- .9 Submit three (3) sets of white prints and three (3) copies of CAD files with Operating and Maintenance Manuals.

1.20 OPERATING AND MAINTENANCE INSTRUCTIONS

.1 START-UP AND TESTING

- .1 Supply services of skilled mechanic for minimum of two consecutive months, to start systems in proper sequence, and test and calibrate controls, PRV'S, instrumentation and relief valves and dampers and to set-up systems.

.2 TRAINING

- .1 During this procedure thoroughly explain operation and maintenance of each system, incorporating specialized instruction by manufacturers as described under other Sections in these Divisions.
- .2 Arrange suitable time for instructions with Owner's operating and maintenance personnel.
- .3 Keep record of date and duration of each instruction period together with names of persons attending. Submit signed records at completion of instruction.

.3 OPERATING AND MAINTENANCE MANUALS

- .1 Provide operation and maintenance data bound in 210 mm x 300 mm x 50mm thick (8½ in x 11 in x 2 in thick) size, vinyl covered, hard back, three-ring covers. Organize material in volumes generally grouped by Trade Section; Site services, Plumbing, Fire Protection, Heating and Cooling Plant and Distribution, Air Handling, and Controls and Instrumentation, Title sheet in each volume to be labeled "Operating and Maintenance Manual" and to bear Project Name, Project Number, Date, Trade Section, and List of Contents.
- .2 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 Valves schedule and flow diagram.
 - .7 Service piping identification chart.
- .3 Maintenance data to include

- .1 Manufacturer's literature covering, servicing, maintenance, operating and trouble-shooting instructions for each item of equipment.
- .2 Manufacturer's parts list.
- .3 Approved shop drawings.
- .4 Name and address of closest service organization and spare part source.
- .5 Equipment manufacturer's performance sheets.
- .6 Equipment performance verification test results.
- .7 Voltage and ampere rating for each item of electrical equipment.
- .4 Approval procedure
 - .1 Submit two sets of first draft of Operating and Maintenance Manuals for approval.
 - .2 Make corrections and resubmit as directed.
 - .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 copies of Operating and Maintenance Manuals to Owner's operating staff and obtain written confirmation of delivery.
- .4 SPECIAL TOOLS AND SPARE PARTS
 - .1 Furnish spare parts as follows
 - .1 One set of packing for each pump gland.
 - .2 One casing joint gasket for each size pump.
 - .3 One head gasket for each heat exchanger.
 - .4 One glass for each gauge glass.
 - .5 One set of V-belts for each drive.
 - .6 One filter cartridge or set of filter media for each filter or filter bank installed.
- 1.21 TESTING
 - .1 GENERAL
 - .1 Methods to comply with following documents;
 - .1 The Ontario Building Code
 - .2 Installation Code for Oil-burning Equipment
 - .3 CSA B149.1 Natural Gas and Propane Installation Code
 - .2 Conduct tests, during progress of Work and at its completion to show equipment and systems meet contract. 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, the Inspection Authority and personnel witnessing tests.
 - .5 Conduct tests before application of external insulation and before any portion of pipes, ducts or equipment is concealed.
 - .6 Do not subject expansion joints, flexible pipe connections, meters, control valves, convertors, and fixtures, to test pressures, greater than 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.

-
- .7 Should section of pipe or duct fail under test, replace faulty fittings or duct with new fittings, pipe or duct, repair and retest. Do not repair screwed joints by caulking nor welded joints by peening. Repeat tests until results are satisfactory.
 - .8 Where it is necessary to test portions of duct or piping system before system is complete, overlap successive tests so that no joint or section of duct or pipe is missed in testing.
 - .9 Upon completion of work and testing of same, submit logs to demonstrate that tests have been carried out satisfactorily. Repeat any tests if requested.
- .2 TESTING - POTABLE WATER PIPING
- .1 Test potable water systems with water or air as required by The Ontario Building Code, Part 7.
 - .2 For water service pipes 100mm (4") and larger, disinfect the pipe with chlorine from the street valve to the first shut-off valve inside the building. Provide testing laboratory certificate confirming water contaminants are below the threshold values in O.Reg. 248/06.
- .3 TESTING - OTHER PIPING
- .1 Hydraulically test other water piping systems at 1½ times system design pressure (relief valve setting) or 1000 kPa (150 psi), whichever is greater, for 24 hours. Pressure must remain essentially constant throughout test period without pumping. Make allowance for correction of pressure readings for variations in ambient temperature between start and finish of test. Hammer test welded joints during hydrostatic test.
 - .2 Test natural gas system to CSA B149.1
 - .3 Test fuel oil systems to CSA B139-15
 - .4 Test drainage, waste and vent piping for tightness and grade as required by The Ontario Building Code, Part 7.
 - .5 Test special service piping as detailed.
 - .6 Test high pressure steam piping and compressed air piping in accordance with requirements of local and Provincial Authorities.
- .4 TESTING - VENTILATION
- .1 Test ductwork in accordance with procedures detailed.
 - .2 Test low pressure ductwork with an air pressure of 1 Kpa (4 in wg) for 10 minutes.
 - .3 Test medium pressure ductwork with an air pressure of 2 Kpa (8 in wg) for 10 minutes.
 - .4 Test high pressure ductwork with an air pressure of 3 Kpa (12 in wg) for 10 minutes.
 - .5 Examine construction joints for damage or weakening. Reduce pressure to maximum working pressure or 1 Kpa (4 in wg), whichever is larger, and check joints for audible leaks. Mark each leak and repair after pressure is released. Retest repaired section of duct.
- .5 TESTING - ELECTRICAL
- .6 Make tests of equipment and wiring.
 - .7 Tests to include meggered insulation values, voltage and current readings to determine balance of panels and feeders under full load and examination of each piece of equipment for correct operation.
 - .8 Test electrical work to standards and function of Specification and applicable Codes.

- .9 Replace defective equipment and wiring with new material.
- .10 Connect single phase loads to minimize unbalance of supply phases.

1.22 TEMPORARY AND TRIAL USAGE

.1 GENERAL

- .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.
- .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 tests.
- .3 No claims for damages will be entertained for injury to or failure of any parts of such work 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 guarantee.

1.23 CONSULTANT REVIEWS

.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 the local authority have jurisdiction.

.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, deficiencies may be recorded where the 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.
- .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.

.3 MILESTONE REVIEWS

- .1 Specific milestone reviews are 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 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. Any noted deficiencies are to be

corrected and reviewed again by the Consultant before being concealed. Failure to provide notification can result in the Work being exposed for review at the Contractor's cost.

.4 WARRANTY

- .1 At completion, submit written warranty undertaking to remedy defects in work for a period of one year from date of substantial completion. This warranty is not to supplant other warranties of longer period called for on certain equipment or materials.
- .2 Warranty to encompass replacement of defective parts, materials or equipment, and to include incidental fluids, gaskets, lubricants, supplies, and labour for removal and reinstallation work.
- .3 Submit similar guarantee for one year from date of acceptance for any part of work accepted by Owner, before completion of whole work.

.5 FINAL REVIEW

- .1 At project completion submit written request for final review of mechanical and electrical systems.
- .2 Refer to section 20 08 19 Project Close-Out.

1.24 QUALIFICATIONS AND AUTHORITIES

.1 SCOPE

- .1 Qualification requirements for tradesmen in the province of Ontario.
- .2 Registration and inspection of systems.

.2 QUALIFICATIONS

.1 TRADES QUALIFICATION AND APPRENTICESHIP ACT

.1 Tradesmen to hold certification of applicable trades:

- .1 Construction Millwright, O.Reg. 1048
- .2 Electrician, O.Reg. 1051
- .3 Plumber, O.Reg. 1073
- .4 Sheet metal worker, O.Reg. 1077

.2 TECHNICAL STANDARDS AND SAFETY AUTHORITY ACT 2000

- .1 Manufacturers and installers of regulated pressure piping parts and systems regulated to hold certificates of authorization under Boilers and Pressure Vessels O.Reg. 220/01, for;
 - .1 pressure piping systems, CSA B51 Boiler, Pressure Vessel and Pressure Piping Code
 - .2 refrigeration piping systems, CSA B52 Mechanical Refrigeration Code
- .2 Installers to hold certificates of authorization made under Fuel Industry Certificates O.Reg. 215/01 for;
 - .1 Gaseous Fuels, O.Reg. 212/01
 - .2 Fuel Oil, O.Reg. 213/01

.3 AUTHORITIES, REGISTRATION AND INSPECTION

.1 ONTARIO BUILDING CODE

- .1 Application for Building Permit including plumbing and HVAC has been made by the Design Built Contractor. Arrange and coordinate for required municipal inspections as required under the Ontario Building Code.

.4 TECHNICAL STANDARDS AND SAFETY AUTHORITY

- .1 Arrange, provide documentation, and pay for registration and inspection of the following systems:
 - .1 Boiler, pressure vessel and pressure piping
- .2 Arrange, provide documentation, and pay for variance approvals and field inspections of the following systems:
 - .1 Fuel safety, gas and/or oil, where Variance approval is required.

.5 ELECTRICAL SAFETY AUTHORITY

- .1 Provide, arrange and pay for permits and inspection of electrical systems in accordance with the Ontario Electrical Safety Code.

.6 APPLICABLE CODES AND STANDARDS

- .1 Conform to;
 - .1 SMACNA (Sheet Metal and Air Conditioning Contractors National Association): IAQ Guideline for Occupied Buildings Under Construction, 1995, Chapter 3
- .2 For any adhesives, sealants, paintings, coatings, carpet systems, composite wood and laminate adhesives refer to Division 01 specifications for Low VOC materials.

.7 REPORTING

- .1 Prior to construction:
 - .1 Provide a methodology report detailing compliance to the scheduling, filtration, and use of VOC materials.
- .2 During construction:
 - .1 Provide weekly progress reports detailing compliance to Construction Management Plan
- .3 Post construction:
 - .1 Provide a signed letter stating that the Construction IAQ Management Plan had been developed and implemented. Contractor to list each air filter used during and at the end of construction including the MERV value, manufacturer name and model number.
 - .2 Provide either:
 - .1 18 photographs taken in groups of six, documenting three different occasions during construction, along with identification of the SMACNA approach featured by each photograph, in order to show consistent adherence to the Credit Requirements, or,
 - .2 documentation declaring the five Design Approaches of SMACNA IAQ Guideline for Occupied Buildings under Construction, 1995, Chapter 3, which were used during building construction. Include a brief listing of some of the important design approaches employed.

PART 2 - PRODUCTS

2.1 N/A

PART 3 - EXECUTION

- .1 HOUSEKEEPING

-
- .1 Provide contamination control through cleaning activities in the building spaces during construction and prior to occupancy, including;
 - .1 protect porous materials from moisture and store in a clean area prior to installation,
 - .2 vacuum cleaners with high efficiency filters,
 - .3 increasing the cleaning frequency and utilizing wetting agents for dust, and
 - .4 use of low VOC cleaning supplies.

 - .2 SCHEDULING
 - .1 Schedule construction activities to minimize or eliminate disruption of operations in the occupied portions of the building.
 - .2 Complete construction activities that include high pollution potential during off-hours, such as on the weekends or evenings.
 - .3 Prior to occupancy, replace all filtration media on supply air handling systems, and remove temporary filters on return and exhaust ducts.

END OF SECTION

PART 1 - GENERAL

1.1 GENERAL

- .1 Comply with the Contract Documents which include, but are not necessarily limited to, the General Conditions, the Supplementary General Conditions, the General Requirements, Specifications, Drawings, all Addenda and any Change Orders.

1.2 DESCRIPTION OF WORK

- .1 Articles that are of a general nature, applicable to each Section of Division 20.

1.3 RELATED WORK

- .1 General Instructions Section 01 10 10
- .2 Submittal Procedures Section 01 33 00
- .3 Quality Control and Testing Section 01 40 00
- .4 Temporary Facilities and Controls Section 01 50 00
- .5 Execution Requirements Section 01 70 00
- .6 Closeout Procedures Section 01 77 00

1.4 DIELECTRIC COUPLINGS

- .1 Provide dielectric isolation between pipes of dissimilar metals with suitable couplings, insulating dielectric unions, insulating flanges, or insulating gaskets between flanges.
- .2 Insulating unions for pipe sizes NPS 2 and under
 - .1 Standard of Acceptance
 - .1 Epco - Dielectric
 - .2 Watts
- .3 Insulating flanges for pipe or tube from NPS 2 to NPS 4
 - .1 Standard of Acceptance
 - .1 Watts No. 3100 or 3200
- .4 Insulating gaskets for flanges NPS 5 and over:
 - .1 compatible with pressure and temperature service,
 - .2 flange bolts run in insulating sleeves with insulating washers under nuts.

1.5 DRAIN VALVES

- .1 Provide drain points for piping systems with drain valves at low points and at section isolating valves.
- .2 Drain valves: minimum NPS ½ straight pattern bronze with hose end male thread, cap and chain.

1.6 V-BELT DRIVES

- .1 Provide V-belt drive for each motor driven device which is not direct connected. Keep overhung loads on prime mover shafts within manufacturer's design guidelines.
- .2 Sheaves for motors to 7.5 kW (10 hp) 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 over 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 based on 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 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.

1.7 DRIVE AND COUPLING GUARDS

- .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 (1-1/2") 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.
- .6 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.
- 1.8 SLEEVES
 - .1 General
 - .1 Sleeve pipes, ducts and conduits passing through masonry walls.
 - .2 Maintain fire rating integrity where pipes and ducts pass through fire rated walls and partitions.
 - .2 Wall Sleeves
 - .1 Sleeves in fire separations:
 - .1 sized to suit fire stopping methods employed for bare pipes, conduits, and insulated pipes, and
 - .2 sized to suit conditions of approval given in manufacturers installation instructions for ducts with fire and smoke dampers.
 - .2 Sleeves in other construction:
 - .1 sized to clear insulated pipes and ducts by 13 mm (½ in) all round, and
 - .2 sized to clear conduits, bare pipes, and bare ducts by 6 mm (¼ in) all round.
 - .3 Sleeves for pipes, conduits and ducts smaller than 0.4 m² (4 sq ft) through solid walls:
 - .1 Schedule 40 steel pipe or 1 mm (20 ga) (minimum) sheet metal, lapped and spot welded.
 - .4 Sleeves for ducts 0.4 m² (4 sq ft) and larger through walls:
 - .1 1.6 mm (16 ga) minimum sheet metal, lapped and spot welded with 20 mm (¾ in) lip flange at one end.
 - .3 Waterproof sleeves
 - .1 Applications:
 - .1 where pipes and ducts pass through walls and floors in areas subject to water, in mechanical rooms, and in washing area.
 - .2 Waterproof sleeves for pipes and conduits:
 - .1 Schedule 40 pipe, with 75 mm (3 in) wide annular fin continuously welded at midpoint, hot dip galvanized after fabrication.

- .3 Waterproof sleeves for ducts less than 0.4 m² (4 sq ft):
 - .1 1 mm (20 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint.
- .4 Waterproof sleeves for ducts 0.4 m² (4 sq ft) and larger and openings with multiple ducts:
 - .1 1.6 mm (16 ga) galvanized steel, with 40 mm (1½ in) flange at midpoint, or,
 - .2 form opening with wood (removed after concrete is set) and trim opening with welded steel angle frame 75 mm (3 in) high, bolted to slab and caulked, or,
 - .3 trim opening with 75 mm x 75 mm (3 in x 3 in) continuous concrete curb doweled to slab.
- .5 Modifications for existing construction:
 - .1 annular fins and flanges attached to sleeve at point equivalent to surrounding floor level or curb.
- .4 Installation
 - .1 Place and secure sleeves in concrete form work.
 - .2 Supply sleeves to be set in concrete and masonry walls with installation detail drawings.
 - .3 Regular sleeves;
 - .1 terminate flush with surfaces of concrete and masonry walls.
 - .4 Waterproof sleeves in new construction;
 - .1 extend 75 mm (3 in) above finished floor.
 - .2 with flange embedded within concrete floor.
 - .5 Sleeves in existing concrete and masonry walls;
 - .1 installed in neatly cut or drilled holes in existing construction,
 - .2 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 Patching" below.
 - .3 terminate sleeves flush with surfaces of concrete and masonry walls,
 - .4 fill opening between sleeve and wall with 2 hour fire rated 3M fire barrier mortar.
- .5 Fill future-use sleeves with weak concrete, gypsum plaster or similar material.
- .6 Coat exposed exterior surfaces of un-galvanized ferrous sleeves with heavy application of zinc rich paint to CGSB 1 GP-181M + Admt-Mar-78.
- .7 At fire separations and smoke separations, pack and seal void between sleeve and pipe, duct, conduit, or insulation in accordance with Article "Fire Stopping and Smoke Seals" in this Section.
- .8 At other locations, pack void between sleeve and pipe, conduit, duct or insulation for full depth of sleeve, with mineral wool and seal with silicone-free caulking compound.
- .9 Install fire dampers in accordance with conditions of approval given in manufacturer's instructions.
- 1.9 FIRE STOPPING AND SMOKE SEALS
 - .1 General
 - .1 Provide silicone-free fire stopping and smoke seals where ducts, pipes or conduits penetrate fire separations. Fire stopping to be of rating that matches the fire rating of the wall. Materials to be supplied, worker training to be arranged, and installation to be supervised, by a specialist firm with an established reputation in this field.

- .2 Products
 - .1 Materials to form ULC listed or cUL listed/classified assemblies.
 - .1 Standard of Acceptance
 - .1 3M
 - .2 Nelson Firestop Products
 - .3 Hilti Firestop Systems
 - .4 Royal Quickstop
 - .2 Other manufacturers having products with explicitly similar characteristics, listings or classifications and approvals are acceptable.
- .3 Installation
 - .1 Seal space between penetrating service and sleeve or opening in slab with firestop and smoke sealing system in strict accordance with terms and conditions of original ULC or cUL listing and manufacturers recommended procedures.
 - .2 Select thickness and arrangement of back-up materials to suit size of service, length of sleeve and anticipated movement.
 - .3 Select firestopping system to allow insulation and vapour barrier to pass un-broken through assembly.
 - .4 Surfaces to be clean, dry and free from dust, oil, grease, loose or flaking paint and foreign materials at time of application of materials
 - .5 Do not apply fire stopping materials to fire or smoke dampers.

1.10 WALL PLATES

- .1 Fit pipes passing through walls in finished areas with escutcheon or wall plates.
- .2 Plates:
 - .1 at walls ;two piece split type with hinge and set screw to fasten plate to pipe, coloured to match finished wall
- .3 Installation
 - .1 Plates:
 - .1 sized to cover sleeves
 - .2 secured tight against finished surfaces, and
 - .3 fitted to cover sleeve extensions where sleeves extend beyond finish.

1.11 CUTTING AND PATCHING

- .1 Forming, cutting and patching of new and existing general trades work to accommodate work of this Division, will be arranged and paid for by this Division.
- .2 Each trade is responsible for prompt installation of work in advance of concrete pouring, masonry, roofing, finishing trades and similar work, where possible.
- .3 Should any cutting or repairing of either unfinished or finished new work of these trades be required because of failure to co-ordinate work, trade responsible for the failure to employ and pay particular trade contractor whose work is involved, to do cutting and patching.
- .4 Repair openings, cuts or damaged surfaces with materials and finishes to match existing.

- .5 Neatly cut or drill holes in existing construction to accommodate piping, ductwork or conduits.
 - .6 Layout cutting of structural elements, such as floors slabs, roofs, walls, columns or beams and obtain approval before starting work. Conduct an electromagnetic scan of reinforcing rods, such as Hilti PS200 Ferroskan, and review with Structural Engineer. Based on these results, arrange and pay for supplemental x-ray examination to locate concrete reinforcement and embedment. Submit x-rays and obtain approval before starting work.
- 1.12 PLATFORMS, LADDERS, COVERS, PIPE SUPPORTS, EQUIPMENT SUPPORTS, AND BASES
- .1 Supports for mechanical and electrical work
 - .1 Fabricate platforms, gratings, ladders, piping and equipment supplementary supporting steel, and trench and pit covers, from steel and provided by this Division.
 - .2 Concrete housekeeping bases for mechanical and electrical equipment which are in direct contact with floor slabs, to be provided by this Division.
 - .3 Concrete bases for equipment supported on vibration isolation materials (inertia pads), to be provided by this Division.
 - .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 to practice in the Province
 - .2 Applicable codes and standards;
 - .1 Ministry of Labour
 - .1 Engineering Data Sheets
 - .2 Health and Safety Guidelines
 - .3 Industrial Alert Bulletins
 - .2 Regulations made under the Occupational Health and Safety Act;
 - .1 Regulations for Industrial Establishments
 - .2 Regulations for Health Care and Residential Facilities
 - .3 The National Building Code
 - .4 American Society for Testing and Materials (ASTM)
 - .1 ASTM A 53/A53M, Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless.
 - .2 ASTM A 269, Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.
 - .3 ASTM A 307, Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
 - .5 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB 1.40, Anti corrosive Structural Steel Alkyd Primer.
 - .2 CAN/CGSB 1.108, Bituminous Solvent Type Paint.
 - .3 CAN/CGSB 1.181, Ready Mixed, Organic Zinc Rich Coating.
 - .6 Canadian Standards Association (CSA)
 - .1 CAN/CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel.
 - .2 CAN/CSA G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

- .3 CAN/CSA S16.1, Limit States Design of Steel Structures.
- .4 CSA W59, Welded Steel Construction (Metal Arc Welding).
- .3 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.
 - .4 Submit shop drawings for steel work, prepared by Professional Engineers, licensed to practice in the Province
- .4 Platforms, Ladders, and gratings
 - .1 Vertical ladders:
 - .1 fabricated with steel sides, 50 mm x 10 mm (2 in x ½ in) and 350 mm (14 in) apart with 20 mm (¾ in) round bars 300 mm (12 in) on centres secured to sides.
 - .2 designed to carry live load of 7.5 kPa (150 lb./sq. ft.) uniformly distributed.
 - .3 Submit shop drawings prepared by Professional Engineers, licensed to practice in Province.
 - .2 Sleeves through grating:
 - .1 mild steel pipe sleeves of sufficient size for pipe and insulation.
 - .2 welded to adjacent bars of platform so that platform strength is maintained.
 - .3 extend up at least 75 mm (3 in) above top of grating.
 - .3 Equipment openings through gratings:
 - .1 fitted with toe angles around equipment, framed to support grating and extending up at least 75 mm (3 in) above top of grating.
 - .4 Finish - Outdoor:
 - .1 Hot-dipped galvanized after fabrication for outdoor installations.
 - .5 Finish - Indoor:
 - .1 Apply one shop coat of primer to metal items, with exception of galvanized or concrete encased items.
 - .2 Use primer unadulterated, as prepared by manufacturer.
 - .3 Paint on dry surfaces, free from rust, scale, grease.
 - .4 Do not paint when temperature is lower than 7°C.
 - .5 Clean surfaces to be field welded; do not paint.
- .5 Concrete bases for housekeeping pads:
 - .1 Constructed using plywood form work and 20 Mpa (3000 lb.) concrete, in accordance with Section 03 10 00 – Concrete Forming and Accessories, and Section 03 30 00 – Cast-in-Place Concrete.
 - .2 Doweled to concrete floor slab with not less than 13 mm (½ in) diameter steel rods.
 - .3 75 mm (3 in) larger all around than base of apparatus, and finished to make smooth, neat surfaces with corners chamfered 25 mm (1 in), and

- .4 Height conforming to following table;

Equipment	Thickness of Housekeeping Pad mm (in)
Stationary, not motorized	minimum of 100 (4)
Motorized, up to 7.5kW (10 HP)	150 (6) (max. for fans)
Motorized, 11 to 19kW (15 to 25 HP)	250 (10)
Motorized, 22kW (30 HP) and over	300 (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 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .6 Provide anchorage, dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.
- .7 Make field connections with bolts to CAN/CSA S16.1, or weld.
- .8 Supply items for casting into concrete or building into masonry to appropriate trades together with setting templates.
- .9 Touch up field welds, bolts and burnt or scratched surfaces after completion of erection with primer.
- .10 Where gratings are cut in field or damaged, touch up with zinc rich paint.

- .7 Installation - Equipment subject to thermal expansion

- .1 Applicable to hot equipment which is not supported on spring vibration isolators.
- .2 Fasten equipment to building structure to accommodate thermal expansion in accordance with manufacturer's instructions. In the absence of such instructions, fasten equipment support legs as follows unless otherwise shown;
 - .1 rigidly fasten one support point which is closest to piping connections,
 - .2 for supports located on the same transverse or longitudinal axis, provide guides with vertical restraint tabs, aligned in direction of fixed support point,
 - .3 for other support points, do not fasten or guide.
- .3 Provide 3mm (1/8") thick PTFE (teflon) glide pads beneath each support leg.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide motors for electrically driven equipment supplied under Division 20.
- .2 Provide starters or Variable Frequency Drives (VFD's) for electrically driven equipment supplied under Division 20.
- .3 Electrical wiring for Mechanical Trades work to be performed by specialist firm with an established reputation in this field, retained and paid for by this Division 20.

1.2 APPLICABLE CODES AND STANDARDS

- .1 Ontario Electrical Safety Code, including;
 - .1 CSA Standard C22.1 Canadian Electrical Code
- .2 National Electrical Manufacturers Association (NEMA) Standards relating to;
 - .1 single and three phase motors
 - .2 wiring and
 - .3 motor control
- .3 MOTORS
 - .1 Motors to be designed, manufactured, and tested in accordance with standards of:
 - .1 NEMA, ANSI, IEEE, and ASTM,
 - .2 conform with applicable sections of NEMA Standard No. MG 1 Motors and Generators.
- .4 POWER FACTOR CORRECTION EQUIPMENT – LOW VOLTAGE
 - .1 Power factor correction equipment to be designed and tested in accordance with latest standards of:
 - .1 NEMA, NEC, IEC, IEEE and ANSI.
 - .2 CAN3 C155 Shunt Capacitors for AC Power Systems.
 - .3 C22.2 No. 190 Capacitors for Power Factor Correction.
 - .4 EEMAC 6G 1 Shunt Capacitors.
- .5 ELECTRIC PIPE HEATING SYSTEM
 - .1 Ontario Electrical Safety Code
 - .2 National Electrical Manufacturers Association (NEMA) Standards relating to;
 - .1 wiring and
 - .2 control

1.3 STANDARD DETAILS

- .1 Device legends with list of abbreviations, schematic wiring diagrams for single and three phase motor starters and supplementary schematics are included at the end of this section.

- .2 This material is to be used in interpretation of specification and schedule requirements for starters and motor control centres (MCC's), accessories within starter enclosures, motor and wiring protection components, and ancillary elements for power wiring and electrical control of Mechanical Trades equipment.

1.4 SHOP DRAWINGS

- .1 Submit control wiring diagrams for electrical equipment provided under this Division.
- .2 Wiring diagrams:
 - .1 in ladder diagram form with 215 mm (8½ in) space between 120 volt energized conductor on left and grounded conductor on right,
 - .2 in JIC format with individual horizontal lines numbered sequentially starting from 100 and every conductor terminal matching identifying terminal numbers, and
 - .3 electrical contacts, relays, thermostats, timers and components in control circuits shown.
- .3 Motors
 - .1 Provide dimensioned shop drawings and additional motor information in form of "Motor Data Sheets".
 - .2 In addition to dimensioned motor prints, information collected and collated on Motor Data Sheets to be furnished as follows;
 - .1 Equipment number, and motor number to be used to identify motor, motor drawings and data sheets
 - .2 Motor model/catalogue numbers with applicable letter and/or number modifiers
 - .3 Motor full load current and rated voltage.
 - .4 Max KVAR allowed for power factor correction.
 - .5 kW/RPM/frame data.
 - .6 Induction motor time constants.
 - .7 Motor weight.
 - .8 Sliding base dimensioned drawings
 - .9 Bearing data.
 - .10 Guaranteed efficiency and power factor at full load, 75% load, 50% load, 25% load and 0%.
 - .11 Acceleration time with maximum inertia
 - .12 Internal winding connection diagram.
 - .13 Speed torque performance data for across line start, from stand-still to synchronous speed.
 - .14 "A Scale" weighted sound power levels.
 - .15 Installation and maintenance instructions.
- .4 Power Factor Correction Equipment
 - .1 Submit:
 - .1 Specifically prepared drawings showing;
 - .1 Front view elevation
 - .2 Floor plan
 - .3 Top view
 - .4 Nameplate schedule

- .5 Conduit entry/exit locations
- .2 Equipment ratings including;
 - .1 Short circuit rating
 - .2 Voltage
 - .3 Continuous current
- .3 Major component ratings including;
 - .1 Voltage
 - .2 Continuous current
 - .3 Interrupting capacity
 - .4 Cable terminal sizes
- .4 Product datasheets
- .5 Electric Pipe Heating System
 - .1 Submit with product literature:
 - .1 Copy of manufacturer installation instructions with shop drawings.
 - .2 Cable schedule indicating approximate length of cable per pipe run, including for valves, flanges, etc. and power requirements per cable.

PART 2 - PRODUCTS

2.1 MOTORS

- .1 Motor nameplate rating:
 - .1 not less than input brake horsepower of driven equipment at specified operating condition,
 - .2 not less than minimum horsepower shown (non-overloading).
- .2 Motor characteristics;
 - .1 Frequency: 60/50 Hz
 - .2 Voltage:
 - .1 120/230 volt, for single phase motors
 - .2 480/208 volt, for three phase motors,
 - .3 Speed: 1750 RPM or as indicated.
- .3 Motors less than 375 W ($\frac{1}{2}$ HP):
 - .1 single phase,
 - .2 continuous duty,
 - .3 resilient mount, and
 - .4 built-in overload protection.
- .4 Motors of 375 W ($\frac{1}{2}$ HP):
 - .1 three phase squirrel cage induction type,

- .2 NEMA B:
 - .1 continuous duty,
 - .2 drip proof,
 - .3 ball bearing,
 - .4 Class B insulation, 40 degrees C (104 degrees F) ambient temperature.
- .5 Motors up to 2250 W (3 hp) shall be E.C. type motors (A.K.A. brushless DC motors, electrically commutated motors, or ECM motors with permanent magnet rotors where specified)
- .6 Motors 750 W (1 HP) and larger:
 - .1 General
 - .1 test performance equal to or better than level required by Table 12-10 of NEMA MG-1 Energy Efficiency regulations when tested to CSA 390 M Energy Efficiency Test Methods for Three Phase Induction Motors, or IEE 112b Standard Test Procedure for Polyphase Induction Motors and Generators.
 - .2 Motors for General Service:
 - .1 General:
 - .1 open drip proof, NEMA T frame assembly
 - .2 premium efficiency, severe duty type,
 - .3 suitable for horizontal, vertical or belt driven mounting
 - .4 NEMA Design B (normal starting torque, full voltage starting), squirrel cage, induction type
 - .5 class B insulation, at 40 deg C (104 deg F) ambient temperature.
 - .6 wound for 480/208 volt, three phase, 60 Hz supply,
 - .7 1.15 service factor,
 - .8 3 leads for single voltage service.
 - .9 Two speed motors: six (6) lead motors.
 - 1. Five lead motors not acceptable.
 - .3 Motors for Service with Solid Start Starters and VFD's:
 - .1 General:
 - .1 TEFC, NEMA T frame assembly
 - .2 premium efficiency, severe duty type,
 - .3 suitable for horizontal, vertical or belt driven mounting
 - .4 NEMA Design C, squirrel cage, induction type
 - .5 nameplated in accordance with NEMA MG-1 for;
 - 1. 200% of full load starting torque
 - 2. Class F triple build winding insulation
 - 3. continuous duty
 - 4. 40 deg C (104 deg F) ambient temperature
 - .6 wound for 480/208 volt, three phase, 60 Hz supply,
 - .7 1.25 service factor,
 - .8 3 leads for single voltage service.

- .4 Enclosure, All Motors:
 - .1 Construction:
 - .1 cast iron, aluminum, or rolled steel construction,
 - .2 drain openings,
 - .3 shouldered lifting eye bolts,
 - .4 bi directional, spark proof, abrasion and corrosive resistant fan keyed to shaft,
 - .5 compression type grounding lug or double ended cap screw of silicon bronze, mounted in conduit box by drilling and tapping into motor frame
 - .2 Motor nameplate:
 - .1 Type 316 stainless steel,
 - .2 mounted on enclosure with stainless steel fastening pins,
 - .3 information as described in NEMA Standard MG 1 20.60,
 - .4 motor bearing part numbers and motor wiring diagram indicated.
 - .3 Protective coating;
 - .1 primer and 4 5 mils epoxy overcoat on external surfaces, and corrosion resistant coating of epoxy paint on internal surfaces, shaft, rotor, stator iron, and end bells.
 - .2 shaft extension protected with rust preventive strippable coating capable of being peeled off or unwrapped.
 - .4 Motor termination boxes/leads:
 - .1 cast iron diagonally split, pipe tapped for conduit,
 - .2 attached to motor frame with cadmium plated hex head cap screws,
 - .3 arranged for conduit entry from either side or bottom,
 - .4 gaskets between box and motor frame and between halves of box,
 - .5 cover secured with cadmium plated hex head cap screws,
 - .6 box assembled to motor,
 - .7 motor leads in conduit box;
 - 1. identified in accordance with ANSI C6.1 ,
 - 2. with same insulation class as windings,
 - 3. sized in accordance with EASA recommended minimum ampacity values.
 - .8 motor leads between motor frame and termination box to pass through tight fitting neoprene rubber seal.
- .5 Motor Construction
 - .1 Motor stator winding:
 - .1 made up with copper magnet wire coated with moisture resistant Class F, non-hygroscopic varnish with thermal rating of not less than 150 deg C for 30,000 hours life when tested in accordance with IEEE No. 57.
 - .2 insulation resistance greater than 100 megohms when measured at 25 deg C with 1000 volt direct current megohm bridge.
 - .3 held in stator slots that have had sharp edges and burs removed prior to winding insertion.
 - .4 coils phase insulated using Nomex paper, laced down.
 - .5 connection leads mechanically secured and silver soldered.
 - .6 designed for operation in either direction of rotation.
 - .2 Motor bearings:

- .1 anti friction single shield, vacuum degassed steel ball bearings with;
 - 1. extended pipe zerk fitting, and ½ lb relief fitting for external lubrication while machine is in operation.
 - 2. bearing shield on motor winding side of bearing.
 - 3. rated fatigue life of L' 10 (B 10) 150,000 hours for direct coupled applications and 50,000 hours for belted applications.
 - 4. belted rating based on radial loads and pulley sizes from NEMA MG1 14.43.
 - 5. high quality bearing seal or Forsheda shaft slinger on outer or shaft end of bearing.
- .2 lubricated at factory, after assembly, using zerk fittings to fill grease chamber and pipe extension
- .3 Motor shafts and rotors
 - .1 Shafts:
 - 1. precision machined from high strength carbon steel
 - 2. "standard long" for units 200 hp and smaller, for both direct connected drive duty and V belt drives.
 - .2 rotor assemblies to be die cast aluminum, keyed, and shrunk or pressed to shaft using full shaft diameter for full length of rotor.
 - .3 shaft extension run out not to exceed 0.001" dial indicator reading measuring at right angles to shaft axis.
- .6 Motor Over Temperature Protection
 - .1 Motors less than 37 kW (50 HP) mounted in air ducts, plenum chambers or in air stream inside air handling equipment:
 - .1 protected by Klixon motor winding thermostats,
 - .2 designated pilot light on starter that is illuminated on shut down of motor through over-temperature condition and reset button inside starter enclosure that must be pushed before motor can be restarted.
 - .3 Wire between Klixon unit mounted on motor, and starter safety circuit to shut down motor when winding overheats.
 - .2 Motors 37 kW (50 HP) and larger:
 - .1 provided with winding over-temperature protection by temperature sensors in each motor winding wired to compatible tripping unit and connected in starter safety circuit to disconnect motor when winding overheats.
 - .2 designated pilot light on starter that is illuminated on shut down of motor through over-temperature condition.
 - .3 reset button inside starter enclosure that must be pushed before motor can be restarted.
 - .3 Motor manufacturer to provide sensing devices in motor and supply compatible control unit for installation in starter enclosure.
 - .1 Standard of Acceptance
 - 1. Siemens - PTC Thermistor with 3-UN2 tripping unit.
- .7 Sliding Base for Motors With V-Belt Drives:
 - .1 Construction:
 - .1 fabricated from steel as a single unit with double supported slide and two adjusting bolts.
 - .2 finished with coating as specified above for motor exterior.
- .8 Permissible Vibration

- .1 Vibration velocity to be not more than 0.05 inches/second measured at bearing housing.
- .9 Sound Pressure Level:
 - .1 Not more than 85dbA, measured at 3 metres in accordance with IEEE publication No. 85.
 - .2 Motor manufacturer to ensure that motor is compatible with type of adjustable frequency generation to be supplied, and that system will be capable of providing rated torque over frequency range from 15 to 60 hz while operating within motor temperature rise specification.
 - .3 Motor to be capable of operating between 60 Hz and 90 Hz with torque reducing at drive frequency above 60 Hz.
- .10 Testing
 - .1 Test motor in accordance with IEEE 112 "Polyphase Induction Motors and Generators" to conform with NEMA MG 1.
 - .2 Additional tests may be performed on a random sampling of units supplied for the project as follows;
 - .1 insulation test to establish capability to withstand continuous phase to ground rms voltage of 1000 volts minimum for 30 minutes.
 - .2 winding to withstand 2500 volt AC phase to ground for one second.
 - .3 surge comparison test using 3000 volts AC phase to phase with submission of detailed comparison wave forms.
 - .4 shaft runout tests with results taken after motor is completely assembled.
 - .5 measurement of full load amperes, watts, power factor, RPM, and locked rotor current at rated voltage.
 - .6 verification of vibration status through velocity readings in inches/second taken at both ends of motor.

2.2 MAGNETIC AND MANUAL MOTOR STARTERS

- .1 General:
 - .1 Rating: NEMA
 - .2 Supply three phase starters from one manufacturer.
 - .3 size starters for rated for motor load plus additional 25 VA at 120 VAC for damper operator power supply.
 - .4 Where three or more starters are shown grouped together and not shown mounted in Motor Control Centre, use wall mounted grouped Motor Control rack.
 - .5 Provide wiring diagrams for control circuits where control wiring extends beyond starter enclosure in accordance with General Motors of Canada Standards .
- .2 Starters for single phase motors:
 - .1 2 pole manual type, or 2 or modified 3 pole magnetic type.
 - .1 where control elements for single phase motors are not rated for motor starting duty, provide separate 120 VAC control circuit and magnetic contactor rated for motor starting duty.
 - .2 combination switch with;
 - .1 overload relay,
 - .2 pilot light, and
 - .3 control device terminations.

- .4 NEMA 1 enclosure.
- .3 Starters for three phase motors:
 - .1 Up to 45 kW (60 HP):
 - .1 combination magnetic type,
 - .2 magnetic contactor
 - .3 HRC fused disconnect and fuses molded case circuit breaker
 - .4 tin plated copper buswork.
 - .2 Larger than 56 kW (75 HP):
 - .1 combination magnetic type,
 - .2 solid state controller,
 - .3 series magnetic contactor,
 - .4 HRC fused disconnect and fuses molded case circuit breakers
 - .5 tin plated copper buswork, and
 - .6 manual isolation and bypass switch with handle inside enclosure.
 - .3 Overload system:
 - .1 solid state, adjustable setting,
 - .2 wired with normally closed contact ahead of contactor holding coil,
 - .3 with manual reset button, and
 - .4 sized and set to suit characteristics of motor.
 - .4 Enclosure:
 - .1 CSA Standard C22.1 Type 2 enclosure, with flange mounted disconnect handles on starter compartment.
 - .5 Provided with;
 - .1 auxiliary contacts or auxiliary relays to satisfy interlocking and automatic control requirements,
 - .2 120 volt fused control transformers inside starter enclosure, sized for starter requirements plus an additional 25 VA for remote damper or valve actuator.
 - .3 one cover mounted pilot light (green) to indicate motor running, three cover mounted pilot lights arranged for Fault (red), Ready (amber), and Running (green) ,
 - .4 engraved lamicon nameplate identifying load served.
 - .6 Pilot lights:
 - .1 120 VAC, push-to-test LED type.
 - .7 Starters for motors equipped with temperature sensing devices in winding:
 - .1 compatible control unit supplied by motor manufacturer, installed in starter enclosure and connected into starter circuitry with relays, reset buttons, and pilot lights.
- .4 Starters for multi-speed and/or reversing motors:
 - .1 motor starter control type as shown, with control interlocking to prevent simultaneous operation in multi-speeds or direction,
 - .2 adjustable time delay relays minimum 15 seconds between high-to-low-high speed, and between forward-reverse-forward direction, for operation in both BAS-Auto mode and local-Hand mode,

- .3 two-speed single winding for 2:1 speed ratios, unless otherwise shown,
- .4 two-speed, two-winding for speed ratios which are not 2:1.

2.3 MOTOR THERMAL PROTECTION

- .1 Single phase motors mounted in air ducts, plenum chambers or in air stream inside air handling equipment:
 - .1 motor winding thermostats, normally closed contact, phenolic snap-acting disc thermal switch, temperature calibrated,
 - .2 automatic reset type.
 - .1 Standard of Acceptance
 - .1 Texas Instruments - Klixon Phenolic Motor Protectors
- .2 Three phase motors less than 37 kW (50 HP) mounted in air ducts, plenum chambers or in air stream inside air handling equipment:
 - .1 Winding sensors:
 - .1 three (3) Positive Temperature Coefficient (PTC) temperature sensors, one in each motor winding, wired in series, type compatible to control unit.
 - .2 Control unit:
 - .1 electronic motor protection module, single channel, 3 sensors per channel,
 - .2 120 VAC line power,
 - .3 manual reset.
 - .1 Standard of Acceptance
 - 1. Texas Instruments - Klixon model 42AA100E
 - .3 Starter control wiring:
 - .1 control unit mounted inside starter enclosure,
 - .2 120 VAC power to control unit,
 - .3 momentary normally-closed reset button located inside of starter enclosure,
 - .4 auxiliary output relay for safety interlock to motor contactor,
 - .5 red pilot light indicating high-winding temperature,
 - .6 1 N.O. contact for remote alarm monitoring
- .3 Three phase motors 37 kW (50 HP) and larger:
 - .1 Winding sensors:
 - .1 three (3) Positive Temperature Coefficient (PTC) temperature sensors, one in each motor winding, wired in series, type compatible to control unit.
 - .2 Control unit:
 - .1 temperature monitoring relay, single channel, 3 sensors per channel,
 - .2 120 VAC line power,
 - .3 unit holds relay contacts on power supply failure,
 - .4 automatic/manual reset, with remote reset
 - .1 Standard of Acceptance
 - 1. Siemens - 3RN10 12
 - .3 Starter control wiring:

- .1 control unit mounted inside starter enclosure,
- .2 120 VAC power to control unit,
- .3 momentary normally-closed reset button located inside of starter enclosure,
- .4 test and test-reset button located on front of starter enclosure,
- .5 auxiliary output relay for safety interlock to motor contactor,
- .6 red pilot light indicating high-winding temperature,
- .7 1 N.O. contact for remote alarm monitoring.

2.4 SOLID STATE CONTROLLER MOTOR STARTER

.1 General

- .1 Control and logic module consisting of power supply, silicon control rectifier (SCR) firing circuitry, I/O circuitry, digital programming keypad, backlit LCD display (two line 16 characters per line), serial communication port and auxiliary contacts.
- .2 Power module consisting of three back to back SCR pairs mounted on heat sinks with minimum thermal capacity of 600% of unit current rating for 10 seconds.
- .3 Protection from transients through a combination of MOV's and capacitors rated for minimum 300 joules.

.2 Power factor correction capacitors within enclosure with:

- .1 status lights mounted on enclosure faceplate
- .2 capacitors brought on line and connected ahead of solid state starter by dedicated power factor correction capacitor contactor
- .3 bypass arrangement for full HP rating of unit with;
- .4 combination across-the-line magnetic starter ahead of solid state starter,
- .5 bypass switch on enclosure face plate to simultaneously disconnect input and output of solid state starter and provide total isolation of solid state starter in OFF and BYPASS positions,
- .6 motor controlled, in bypass position, through external dry run contact in magnetic starter control circuit and protected, from current overload, by conventional relaying in combination magnetic starter.

.3 Logic circuitry to incorporate;

- .1 latch for three wire control
- .2 adjustable acceleration ramp time
- .3 adjustable starting current limit
- .4 monitoring through LCD display of;
 - .1 phase to phase supply voltage
 - .2 line current in each phase
 - .3 power input in kW
 - .4 kWH
 - .5 elapsed time
 - .6 power factor
 - .7 motor thermal capacity used

- .5 protection and diagnostic routines for
 - .1 power loss
 - .2 single phasing
 - .3 line fault (shorted SCR, missing load connection)
 - .4 voltage unbalance
 - .5 phase reversal
 - .6 undervoltage
 - .7 overvoltage
 - .8 stall and jam
 - .9 overload and under load
 - .10 excessive starts per hour
 - .11 controller over temperature
 - .12 automatic reset of non critical faults. System to accept five automatic resets of recurring non critical fault within any ten minute interval. If frequency of fault occurrence exceeds this limit, fault to be automatically upgraded to critical status, and on recurrence of fault, system to initiate motor shut down requiring manual reset.
- .6 overload protection :
 - .1 approval as motor thermal protective device
 - .2 current sensing on three phases
 - .3 electronic memory to predict motor temperature condition
 - .4 isolated with power connection to SCR section of controller in bypass mode

2.5 MOTOR CONTROL CENTRES (MCC'S)

- .1 Provide MCC's as shown with front connected plug-in type starters incorporating features described in this Section.
 - .1 Standard of Acceptance
 - .1 Siemens
 - .2 Klockner Moeller
 - .3 Square D
 - .4 Allen Bradley
 - .5 Cutler Hammer (Eaton Electrical)
- .2 MCC's throughout project :
 - .1 supplied by one manufacturer,
 - .2 Class II, Type 'B' construction, with load and control connections to be made at unit terminal blocks adjacent to vertical wiring channel.
 - .3 CSA Standard C22.1 Type 2 enclosure,
 - .4 made up from vertical sections with;
 - .1 full height vertical wiring trough with cable supports for unit wiring,
 - .2 insulated vertical bus connecting control units to non-insulated main horizontal bus at top of sections,
 - .3 cable lugs or bus duct terminals on main bus to match feeder provided under Electrical Division 26 .
 - .4 ground bus for full height of each section.

- .5 bus work of 98% conductivity tin plated copper, suitably braced to withstand an available short circuit current of 65,000 ampere RMS asymmetrical, joined to adjacent section by horizontal bus;
 - .1 suitable for extension and
 - .2 sized for minimum 750 ampere capacity at 1000 ampere per square inch density.
- .3 Power distribution panel and transformer provided in each MCC:
 - .1 for single phase motors shown fed from MCC's, and other miscellaneous mechanical loads.
 - .2 minimum 12 circuit NLAB type 115/230 volt, single phase, 3 wire, lighting panels with suitably sized bolt-on breakers.
 - .3 Panels mounted in MCC behind separate hinged doors, and
 - .4 fed by 115/230 volt, single phase transformers:
 - .1 constructed with standard taps and Class 'B' or 'H' insulation,
 - .2 sized for connected loads, but not less than 5 kVA, and
 - .3 provided with suitable primary protection.
- .4 Provide one full section for future starters, and include rails, blank covers and hardware to accommodate starters.
- .5 Provide spare full height section fitted with hinged access door to house;
 - .1 adjustable frequency drives,
 - .2 automatic temperature control relays,
 - .3 fire alarm shutdown relays,
 - .4 smoke evacuation wiring terminals and accessories.
- .6 Treat casings of MCC's with rust inhibiting metal treatment, and paint;
 - .1 interior with white enamel.
 - .2 exterior with enamel, colours according to service;
 - .1 Normal power MCC's: Sherwin Williams colour F65L7 (blue).
 - .2 Emergency power MCC's: Sherwin Williams colour F65EG9 (International orange).
- .7 Location of MCC panels shown is diagrammatic. Submit coordinated field drawing showing final location, orientation and clearances for access.

2.6 VARIABLE FREQUENCY DRIVES (VFD)

- .1 General:
 - .1 Electronic design for speed control of NEMA motors as specified above,
 - .2 CSA listed,
 - .3 mounted in CSA Standard C22.1 Type 2 enclosure with door flange mounted disconnect and by-pass switch handles on compartment, and
 - .4 voltage: as per associated equipment.

- .5 network communications certified to Lonmark functional profile 6010, for both mandatory and optional items. This is in addition to the real I/O specified below.
- .2 Construction:
 - .1 Power conditioning:
 - .1 input harmonic filters to limit total harmonic distortion (THD) measured at filter input terminals to values set out in IEEE 519; voltage distortion to be 5% 3% as set out in Table 10.2 of IEEE 519; AND total current demand distortion to be as set out in Table 10.3 of IEEE 519 for ratio of available short circuit current to AFD demand load current (Isc/Iline) of
 - .2 RFI filter, input transient protection 5% impedance input line reactor output LC load reactor .
 - .2 equipment and motor protection:
 - .1 under and over voltage protection, phase loss protection and phase unbalance protection,
 - .2 ground fault protection,
 - .3 inherent short circuit protection for line to line and line to ground faults giving safe shut down without damage to power circuit devices,
 - .4 instantaneous electronic over current-protection,
 - .5 internal over-temperature protection,
 - .6 motor stall protection.
 - .3 control functions:
 - .1 current limiting device adjustable from 70% to 100% of rated motor current,
 - .2 minimum speed setting adjustable from 0 to 70%,
 - .3 maximum speed setting adjustable from 50 to 110%,
 - .4 acceleration/deceleration ramp adjustable from 10 to 100 seconds for 0 to 100% speed,
 - .5 automatic restart after inverter fault trip, (3 attempts before lock-out)
 - .6 rotating motor restart routine to match frequency and actual speed before accelerating to set speed.
 - .4 I/O external interface:
 - .1 input;
 - .1 external dry contact closure for start/stop,
 - .2 external dry contact for remote fault reset,
 - .3 external dry contact for fireman's bypass,
 - .4 4-20 mA or 0-10 VDC input for speed setting from BAS or standalone instrumentation.
 - .2 output;
 - .1 4-20 mA or 0-10 VDC speed current value,
 - .2 dry contact for drive run status,
 - .3 dry contact for drive fault status.
 - .5 Door mounted controls for;
 - .1 adjustment and diagnostics through key pad and display,
 - .2 indication of speed/load values and set points,
 - .3 run/stop selection,
 - .4 auto/manual selection and

- .5 manual speed selection through potentiometer.
 - .1 Standard of Acceptance
 - 1. ABB
 - 2. Siemens
 - 3. Cutler Hammer (Eaton Electric)
 - 4. Reliance Electric
 - 5. Graham (Danfoss)
- .3 Bypass Starter:
 - .1 Install unit with a combination across-the-line magnetic starter ahead of VFD.
 - .2 By-pass switch to:
 - .1 Off and Bypass position: simultaneously disconnect input and output of VFD and provide total isolation of VFD in off and by-pass positions
 - .2 Test and Bypass: disconnect VFD output contacts, and run motor on bypass, to permit diagnostic testing of VFD.
 - .3 In bypass position motor will be controlled from external dry run contact in magnetic starter control circuit and protected from current overload by conventional relaying in combination magnetic starter.
- .4 System operation:
 - .1 With auto/manual selector in "auto" the drive/motor will start and run if run/stop selector switch is in "run" and external dry run contact is closed. Speed is set from externally generated 4-20 mA or 0-10 VDC input signal.
 - .2 With auto/manual selector in "manual" position the drive/motor will start and run if the run/stop selector switch is in the "run" position. Speed is set from the manual on-board speed control setpoint.
 - .3 Fireman's Bypass: when external dry contact is closed, the VFD goes into either full-speed bypass operation, or, to pre-programmed speed setpoint; external setpoint values are ignored.
- .5 Confirmation Statement:
 - .1 For all motor/drives 25 hp and larger,
 - .2 Provide written confirmation that Total Harmonic Distortion (THD) of voltage waveform at input terminals of the equipment measured in factory tests does not exceed 10% from 3rd to 21st harmonic and individual harmonic distortion does not exceed 15% as defined in IEEE 519.
- .6 Provide service and maintenance manuals, wiring and interconnection diagrams and the services of a qualified technician to start-up and adjust drives and instruct Owners operators.
- 2.7 DISCONNECT SWITCHES, FUSED AND UN-FUSED
 - .1 General:
 - .1 Fusible and non-fusible disconnect switch in sprinkler proof EEMAC 3 enclosure, sized to suit equipment.
 - .2 2 pole or 3 pole as required for single phase or three phase circuits,
 - .3 2 pole with solid neutral or 3 pole with solid neutral for three wire and four wire circuits with neutral,
 - .4 6 pole for two speed motor applications,

- .5 provision for padlocking in off switch position,
- .6 mechanically interlocked door to prevent opening when handle in ON position,
- .7 fuses: sized in accordance with connected equipment manufacturer's requirements,
- .8 fuseholders: suitable without adaptors, for type and size of fuse indicated.
- .9 heavy Duty, quick make, quick break action,
- .10 ON OFF switch position indication on switch enclosure cover.
- .2 Special requirements:
 - .1 for separate disconnect switches installed on load side of Variable Speed Drive;
 - .1 disconnect switch status switch, to open contacts when disconnect switch is Not-Closed.
- .3 Ratings:
 - .1 IEC 90 deg rotary switch for motors up to 18.6 kW (25 HP),
 - .2 NEMA flange mount for all ratings.
 - .1 Standard of Acceptance
 - .1 Square "D" Company (Canada) Ltd.
 - .2 Cutler Hammer
 - .3 Siemens Canada Ltd.
 - .4 Federal Pioneer Ltd.
 - .5 Klockner Moeller
 - .6 Allan Bradley

2.8 FUSES FOR MOTOR PROTECTION

- .1 Fuses in starters to be CSA certified Form 1, current and energy limiting, time delay type, 200,000 ampere interrupting capacity with NEMA Class "J" rejection type mountings
 - .1 Standard of Acceptance
 - .1 Ferraz Shawmut - Amp-Trap 2000-AJT
 - .2 Littelfuse-JTD_ID Series
 - .3 Bussmann-LPJ-SPI
 - .2 Size fuses installed in starters or in disconnect switches used in conjunction with magnetic starters, for branch 8circuit in accordance with Table D16 of Ontario Electrical Safety Code for time delay fuses and motor protection at not less than 175% of motor full load current and fuse manufacturer's recommendations.
 - .3 Provide one spare set of three fuses for each rating and type of fuse used.

2.9 CIRCUIT BREAKERS FOR MOTOR PROTECTION

- .1 General
 - .1 Bolt on moulded case circuit breaker: quick make, quick break type, for manual and automatic operation.

- .2 Circuit breakers which are part of a combination motor starter to be motor circuit protector type instantaneous magnetic only trip units. Feeder circuit breakers to be thermal magnetic or solid state LSI type as noted. Minimum frame size to be 100A.
- .3 Common trip breakers: with single handle for multi pole applications.
- .4 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 3 8 times current rating. Fixed instantaneous type to be minimum 8 times current rating.
- .5 Circuit breakers with interchangeable trips over 150 A.
- .6 Include:
 - .1 on/off locking device.
 - .2 handle mechanism.
- .2 Thermal Magnetic Breakers
 - .1 To operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .3 Solid State Trip Breakers
 - .1 To operate by means of a solid state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and separately adjustable long time, short time, and instantaneous time delay and pickup settings for phase, ground fault and short circuit protection.
- .4 Circuit Breaker Ratings
 - .1 120 / 208 V: 50,000 Amps symmetrical interrupting rating.
 - .2 480 V: 65,000 Amps symmetrical interrupting rating.

2.10 EQUIPMENT SERVICE LIGHTS (MARINE LIGHTS)

- .1 Pyrex globe, wire guard and 100 watt I.F. lamp
 - .1 Standard of Acceptance
 - .1 Crouse Hinds - Type ARB-31
 - .2 Killark - Type VOBG-100
- .2 Switches: 20 ampere, single pole, with neon pilot light, installed in cast metal conduit box.
 - .1 Standard of Acceptance
 - .1 Smith & Stone - No. 4-4901
- .3 Mount switches in accessible location on outside of plenum. Provide one switch for each fan system.
- .4 Provide minimum of one marine light per 3 m (10 ft) width of plenum.

2.11 WIRE TYPE AND SIZE:

- .1 Wire:
 - .1 RW-90 copper X-link type 1000V insulation 600V insulation installed in conduit, sized to carry 125% of full load running current in accordance with Electrical Code:
 - .1 Minimum no. 12 gauge for power.
 - .2 Colour coded no. 14 gauge for control.

- .2 Conduit :
 - .1 EMT and Rigid.
 - .3 Grounding:
 - .1 Provide insulated green bonding conductor in each power and control conduit sized per Table 16 of the Electrical Safety Code. Minimum bonding conductor size #12AWG copper.
 - .4 Mineral Insulated Copper Cable (MICC):
 - .1 ULC listed 2 hour fire rating,
 - .2 shipped with ends temporarily sealed and stored under dry conditions,
 - .3 capacities and types noted on drawings and terminated using suitable terminating hardware,
 - .4 PVC jackets for embedded cables.
 - .1 Standard of Acceptance
 - .1 Pyrotenax
- 2.12 VFD DRIVE TO MOTOR WIRING:
- .1 Wiring from VFD to motor : liquid tight flexible steel conduit and cable to be specifically manufactured for this duty.
 - .1 Standard of Acceptance
 - .1 NEXANS - Drive Rx - Variable speed drive cable
 - .2 LAPP USA - OLFLEX® VFD SLIM; Severe duty power cable for VFD drives
 - .3 ShawCor - Shawflex VFD cable
 - .4 Rockbestos-Suprenant Cable - EXANE - VFD sheathed armoured power cable.
- 2.13 CAPACITORS FOR POWER FACTOR CORRECTION
- .1 General:
 - .1 Provide capacitors and capacitor control systems in Motor Control Centres and for individual motors 7 kW (10 HP) and larger which are controlled from individually mounted starters.
 - .2 Where total motor kW (hp) controlled from single MCC exceeds 100 kW (160 hp), subdivide MCC into two approximately equal portions, and provide capacitors, contactor and control system for each half.
 - .2 Capacitors:
 - .1 non-PCB type using Di-isononyl phthalate with minimum fire point of 257 deg C and flash point of 221 deg C,
 - .2 internal discharge resistors,
 - .3 wiring sized for minimum 135% of capacitor current rating.
 - .3 Contactor control system:
 - .1 built into Motor Control Centre to be similar to standard combination starter plug-in unit,
 - .2 circuit breaker with control circuit wiring connected to close capacitor contactor whenever larger motors in MCC are running,

- .3 contactor rating to be not less than 135% of capacitor current rating and circuit breaker over-current protection to be not greater than 250% of same current rating.

2.14 POWER FACTOR CORRECTION EQUIPMENT – LOW VOLTAGE

.1 General

- .1 Equipment to be UL listed and CSA certified.

.2 Ratings

- .1 System operating voltage and kVAR of each capacitor to be as shown.
- .2 Capacitors to be rated for continuous duty at 40 degrees C (104 degrees F) ambient at 1,000 m (3,300 ft.) and below.
- .3 Total Harmonic Distortion (THD) of 5% of voltage waveforms to not affect life of capacitors, contactors or controller.
- .4 +/- 10% variation in line voltage to not affect life of capacitor.

.3 Power Factor Correction Units

- .1 Tuned air core reactor/capacitor design with four individual tuned switching stages,
- .2 Connected capacitor control unit with current transformers and potential transformers for automatic switching of capacitor stages to maintain power factor within adjustable pre-set limits of 0.90 to 0.99.
- .3 Of tuned circuit design to suit harmonic profile of building distribution system and to minimize resonance conditions.
- .4 Manufactured to CAN3 C155, and EEMAC 6G 1
 - .1 Standard of Acceptance
 - .1 Cutler Hammer
 - .2 Freeborn Industries Ltd.
 - .3 Square D.

.4 Capacitors

- .1 450 kVAR, with switching stages of 50/100/100/200 kVAR, or as noted,
- .2 1000 V insulation class.
- .3 600 V, 3 phase, 60 Hz, 4 wire, wye connected, grounded neutral.
- .4 Rated for minimum 690 V nominal voltage and 200% of nominal current.
- .5 Operated at no more than 90% of voltage rating.
- .6 Rack mounted with bus, connectors, enclosing plates, screens.
- .7 Non-propagating liquid insulation of non-PCB type, low dissipation factor, computer grade polypropylene, suitable for high order harmonics,
- .8 Internal resistor to discharge residual capacitor voltages to 50 volts or less within 1 minute or less of de-energization.

- .9 Internal pressure sensitive interrupter switch to disconnect fault capacitor when measurable pressure is detected.
 - .1 Standard of Acceptance
 - .1 GE Gemfoil 61L series
- .5 Protective Fuses
 - .1 Installed in each phase of each capacitor and to not exceed 250% of capacitor rated current
 - .2 Current limiting type with 200,000 Amp interrupting capacity.
 - .3 Equipped with indicating device for blown fuse condition to Section 26 28 13 Fuses.
- .6 Contactor Control System
 - .1 Contactors rated at minimum 150% of capacitor rating.
 - .2 Built into power factor correction system with fused switch section, control transformer, HOA selector switch and push-to-test pilot light on cover.
- .7 Enclosure
 - .1 Indoor enclosure, EEMAC 12 dustproof.
- .8 Finish
 - .1 Apply finishes in accordance with Section 20 05 13 Motors Starters and Wiring.
- .9 Wiring
 - .1 Wiring to capacitors or capacitor banks to be minimum of 150% of capacitor rated current.

2.15 ELECTRIC PIPE HEATING SYSTEM

- .1 heating cable
 - .1 Manufactured specifically for trace heating of insulated piping.
 - .1 Standard of Acceptance.
 - .1 Raychem
 - .2 Nelson
 - .3 3M - Thermon
 - .4 Pyrotenax
 - .2 Suitable for minimum continuous pipe surface temperature: 121 degrees C (250 degrees F)
 - .3 Sized to maintain 4 degrees C (40 degrees F) in piping system at an ambient air temperature of -25 degrees C (-10 degrees F).
 - .4 Field measured for length.
- .2 Thermostat Controlling Heating Cable
 - .1 Remote bulb type with 3 m (10 ft) long capillary tube,
 - .2 Setting range between -1 degrees C to 50 degrees C (30 degrees F to 120 degrees F) and
 - .3 Contacts rated at 30 ampere, 115/230 V that close when temperature falls below setting.

PART 3 - EXECUTION

3.1 WIRING FOR MECHANICAL – GENERAL

- .1 Electrical materials, equipment and installation procedures under Mechanical Division 20 to conform to Canadian Electrical Code as amended to date.
- .2 Wiring methods and standards to conform with those specified in Electrical Division 26 for area of building in which installation is to be made.
- .3 Use MICC cable for power and control wiring to motors and dampers, including local control devices such as limit switches, etc., comprising the following systems:
 - .1 stair pressurization systems,
 - .2 smoke venting, smoke evacuation, and aid to firefighting ventilation systems, and
 - .3 smoke dampers, combination smoke dampers.
- .4 Conduit:
 - .1 EMT : Use thin wall conduit up to and including 32 mm (1 ¼ in) size for wiring in ceilings, furred spaces, in hollow walls and partitions and where not exposed to mechanical injury.
 - .2 Rigid : Use rigid galvanized steel conduit for wiring in poured concrete, where exposed, and for conduit 40 mm (1½ in) size and larger. All wiring to be installed in conduit or approved raceway.
- .5 Provide separate conduit for power wiring for each motor or starter. Do not install control wiring in the same conduit as power wiring.

3.2 GROUNDING

- .1 Ground electrical equipment and wiring in accordance with Canadian Electrical Code and Local Authority's Rules and Regulations.
- .2 Install grounding conductors, outside electrical rooms and electrical closets, in conduit and concealed.
- .3 Make connections to neutral and equipment with brass, copper or bronze bolts and connectors.
- .4 Ground all motors with separate green insulated copper ground conductor installed in power feeder conduit, wired from ground terminal in starter to a ground lug bolted directly to motor frame inside terminal box of motor. Size ground conductor per Table 16 of the Canadian Electrical Code. Minimum conductor size to be #12 AWG.

3.3 DISCONNECT SWITCHES

- .1 Motors:
 - .1 Provide disconnect switches for motor driven equipment provided under Division 20;
 - .1 unfused : where line feeder is provided directly by Division 26,
 - .2 fused : where line feeder is provided by Division 20 from a splitter box, motor starter rack, or MCC.
 - .2 Location:
 - .1 Within 9 meters and line-of-site of motors serving non-refrigeration equipment.
 - .2 Within 3 meters and line-of-site of equipment containing refrigeration compressors, and equipment serving refrigeration compressors such as air-cooled condensers.
- .2 Non-Motor Equipment:

- .1 Provide disconnect switch for the following type of equipment provided under Division 20;
 - .1 VAV terminal boxes
 - .2 BAS field control panels
 - .3 Control panels associated with Leak Detection and Electric Pipe Heating System
 - .2 Location:
 - .1 Immediately adjacent to equipment served.
 - .3 Disconnects for the above equipment may be provided by the equipment manufacturer.
- 3.4 SEISMIC RESTRAINT
- .1 Provide seismic restraints for electrical conduit greater than 63 mm (2½ in) trade size, for cable trays, or for busducts. Restraints may be omitted where hanger rods are less than 300 mm (12 in) from top of conduit, tray or busduct to bottom of support for hanger and where rod hangers and anchorage are not subject to bending moments.
- 3.5 MOTOR WINDING TEMPERATURE PROTECTION
- .1 Provide control wiring between PTC sensors in three phase motors and control units in starters.
- 3.6 VARIABLE FREQUENCY DRIVES
- .1 Install variable frequency drives in accordance with manufacturer's requirements.
 - .2 Where a separate disconnect is installed between the drive and the controlled equipment, provide interlock wiring between disconnect status contact switch, and VFD, to prevent drive from operating if disconnect switch is open.
 - .3 Conduct impact vibration test to determine first natural harmonic of equipment, and program VFD skip speed function to prevent operation at this speed.
 - .1 nominal skip speed range equal to ± 10% of measured harmonic frequency, or as determined on site.
- 3.7 EQUIPMENT SERVICE LIGHTS (MARINE LIGHTS)
- .1 Mount switches in accessible location on outside of plenum. Provide one switch for each fan system.
 - .2 Provide minimum of one marine light per 3 m (10 ft) width of plenum.
- 3.8 CAPACITORS FOR POWER FACTOR CORRECTION
- .1 The following schedules lists capacitor ratings to be provided alongside individually mounted starters and wired to line side of overload relays and after starter main contacts.

kW (HP)	KVAR
7.46 (10)	3
11.2 (15)	4
14.9 (20)	5
18.6 (25)	6
22.4 (30)	7
29.8 (40)	9
37.3 (50)	11

kW (HP)	KVAR
44.7 (60)	14
55.9 (75)	16
74.6 (100)	21
93.2 (125)	26
111.8 (150)	30
149.1 (200)	37.5

- .2 Following schedule lists capacitor ratings to be provided in MCC's for various motor kW (hp) loadings.

kW (HP)	KVAR
37.2 (50)	12
44.7 (60)	15
59.7 (80)	20
74.6 (100)	24
82.0 (110)	26
89.5 (120)	30
96.9 (130)	33
104.3 (140)	35
111.8 (150)	37
119.3 (160)	40

3.9 DIVISION OF RESPONSIBILITY - PROVIDED BY MECHANICAL DIVISION 20:

- .1 Provide the following work under Division 20.
- .2 Trades providing or supplying equipment is responsible for termination of wiring in equipment.
- .3 Motor starters:
 - .1 motor starters, and/or disconnect switch as required, together with remote "push-to-test" pilot lights and switches, for each motor or electrically connected item supplied under Mechanical Division 20,
 - .2 where starters and/or disconnects are grouped together, without MCC or Motor Control rack, provide and mount starters and/or disconnects on back board or panel,
 - .3 power wiring, conduit and fittings from load side of starters and or disconnects to motor or electrically connected item provided under Mechanical Division 20,
 - .1 for two speed starters, size both high and low speed conductors for capacity of high speed motor rating.
 - .4 wire final 300 mm to 450 mm (12 in to 18 in) of motor connections in flexible liquid tight conduit, with insulated throat connectors.
- .4 Distributed equipment:
 - .1 power wiring from adjacent junction box to electric reheat coils, electric pipe heating systems, electric plumbing fixtures and trap seal primers, fan powered boxes, fan coil units, unit heaters and cabinet unit heaters,

- .2 wiring and conduit from this junction box to connect starter, thermostat or other operating control and device being electrically powered,
- .3 in mechanical rooms, penthouse and on roof feed miscellaneous equipment from MCC 120 VAC distribution panels, unless otherwise shown.
- .5 Terminal unit boxes:
 - .1 120 VAC power wiring from adjacent junction box, serving each group of 12 terminal boxes, and extend and connect to each terminal unit controller.
 - .2 exception: 3 phase, 208 V and higher voltages, provided by Division 26 direct to terminal unit box.
- .6 Control power:
 - .1 control power including wire and conduit,
 - .2 in service rooms:
 - .1 control power fed from normal and emergency 120 VAC distribution panels provided in each MCC dedicated normal and emergency power breaker panels which are provided by Division 26 in each main mechanical room ,
 - .2 provide breaker protection and power wiring from breaker panels to controllers.
 - .3 in all other areas:
 - .1 control power fed from four (4) dedicated designated power breakers which are provided by Division 26 in each electrical distribution closet or adjacent junction boxes to group of control devices being electrically powered .
 - .2 control wiring, conduit and relays to interlock starters and connect safety and operating controls as shown.
- .7 Equipment service lights (marine lights):
 - .1 Wiring and conduit from adjacent junction boxes, and switches and fixtures.
- .8 Smoke management/control of fans and dampers:
 - .1 By division 26.
- 3.10 DIVISION OF RESPONSIBILITY - PROVIDED BY ELECTRICAL DIVISION 26:
 - .1 The following work is provided under Division 26.
 - .2 Motor starters;
 - .1 Conduit and power wiring to line side of remotely located starters and to line terminals of Motor Control Centres (MCC).
 - .2 For starters grouped together, without MCC or Motor Control rack: conduit, power wiring and splitters, and branch circuit wire and conduit up to line terminals in disconnect switches and/or starters.
 - .3 Distributed equipment;
 - .1 Power wiring to electric reheat coils, electric pipe heating systems, leak detection system, electric plumbing trap seal primers, fan powered boxes, fan coil units, unit heaters and cabinet unit heaters, terminated in a junction box installed adjacent to motor or device being connected, and
 - .2 junction boxes for above.

- .4 Terminal unit boxes, supply and return;
 - .1 120 Volt, single phase power supply with a junction box for each group of terminal boxes with maximum of 12 terminal boxes fed from one junction box.
 - .2 3 phase, 208 V and higher voltages: separate feed and connection to each terminal unit controller.
- .5 Control power for Division 20;
 - .1 dedicated 6 @ 15 A normal, and 6@15 A emergency power breaker panels, complete with breakers, are provided in each main mechanical room.
 - .2 four (4) dedicated normal and emergency power breakers are provided in each electrical distribution closet, or equivalent circuits provided in a junction box within 10m of a group of loads/devices,
 - .3 120 Volt, single phase power supply with a junction box at each control device,
 - .4 junction boxes for above.
- .6 Wiring to equipment service lights (marine lights):
 - .1 120 VAC power terminated in an outlet box on an adjacent wall, column or ceiling, and
 - .2 junction boxes for above.
- .7 Fire Alarm System control of fans and dampers:
 - .1 FAS control modules located at/near each fan starter or damper actuator, and wiring between control module and damper motor and fan starter,
 - .2 FAS control modules located at each applicable BAS controller, and wiring between control module and BAS controller,
 - .3 termination in BAS control unit by Division 20.
- .8 Power wiring to smoke dampers and combination smoke fire dampers:
 - .1 Provide emergency or normal power as shown to each motorized smoke or combination smoke and fire damper.

3.11 WIRING DIAGRAMS

- .1 Attached device legend and wiring diagrams to be read in conjunction with equipment specifications, control sequences, and motor/starter schedules for implementation of control sequences and identification of components required in each starter or AFD.
- .2 Wiring from MCC or distribution panel to each AFD to be in individual, separate, rigid steel conduit. Do not combine wiring from any other source within AFD conduit.
- .3 Wiring diagrams:
 - .1 Division Interface Coordination Diagram
 - .2 Device Legend
 - .3 Type "A" Start/Stop 3 Phase
 - .4 Type "B" Hand-Off-Auto 3 Phase
 - .5 Type "F3" Auto-Test 3 Phase, Dedicated Smoke Exhaust Fans

- .6 Motor Winding Temperature Protection
- .7 Type "L" and "E" 1 Phase starters
- .8 Type "F1" Auto-Test 1 Phase, Dedicated Smoke Exhaust Fans

3.12 SHIPPING

- .1 Ship motors from factory;
 - .1 packed in Styrofoam or similar material or
 - .2 fastened to hardwood skid or pallet for fork truck handling
 - .3 protected against dirt and moisture during transit and outdoor storage.
 - .4 clearly identified with permanent ink marking on packing.
- .2 Motors attached to equipment:
 - .1 protected against dirt and moisture during transit and outdoor storage.
 - .2 rotated by hand at one month intervals.

3.13 POWER FACTOR CORRECTION EQUIPMENT – LOW VOLTAGE

- .1 installation
 - .1 Arrange and pay for 100 mm (4 in) reinforced concrete pad with bevelled edges under floor mounted power factor correction units, sealed with paint or concrete sealer.
 - .2 Set channels and anchor bolts for equipment on concrete pad.
 - .3 Connect power and control wiring
- .2 Field Quality Control
 - .1 Arrange and pay for services of manufacturers field service representative;
 - .1 to supervise installation and ensure equipment is properly set up prior to energization.
 - .2 to calibrate and test instruments and meters,
 - .3 to ensure voltage and current are balanced and within capacity rating.
 - .4 to measure operating kVAR.
 - .5 to determine that terminal to case resistance is greater than 1000 megohm for two bushing capacitors.
 - .6 to check that discharge time constant for one bushing capacitors is less than 60 s and residual capacitor voltage is reduced from crest value of nominal rated voltage to less than 50 V.
 - .7 to verify harmonic profile and retune to meet specification where .
 - .2 Submit certified test results to Engineer Consultant.

3.14 ELECTRIC PIPE HEATING SYSTEM

- .1 installation of heating cables
 - .1 Size total length of cable in accordance with manufacturer's installation requirements.
 - .2 Use manufacturer's approved terminating devices.

- .3 Secure heating cables to pipes, fittings, valves using cable ties or straps, before application of insulation.
- .4 Install thermostat inside building, with capillary tube strapped to pipe before application of insulation.
- .5 Check each length of cable for continuity, short circuits and grounds, before and after application of pipe insulation.
- .6 Replace damaged or faulty cable.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Weld or braze pipe and fittings for work of Division 20.
- .2 In this section, the term "weld, welder, welding" or similar word or phrase is an expression which includes both welding or brazing.
- .3 All aboveground fuel oil piping shall be socket welded.

1.2 REGISTRATION AND INSPECTION

- .1 Before commencing work, make arrangements and pay for registration and inspection by Technical Standards & Safety Authority (TSSA), for the following pressure piping systems:

- .1 Fuel oil piping

1.3 APPLICABLE STANDARDS:

- .1 O.Reg. 220/01 made under the TSSA Act
- .2 CSA B51 Boiler, Pressure Vessel, and Pressure Piping Code
- .3 CSA B52 Mechanical Refrigeration Code
- .4 Piping standards to:
 - .1 ASME B31.1 Code for Pressure Piping, for registered pressure piping systems.
 - .2 ASME B31.9 Code for Building Service Piping.
- .5 ASME Boiler and Pressure Vessel Code, Section VIII Division 1
- .6 ASME Boiler and Pressure Vessel Code, Section IX

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 WELDER QUALIFICATION AND WELDING PROCEDURES

- .1 Welding of piping carrying hot water or compressed air at pressures greater than 100 kPa (15 psi) to be carried out using approved procedures by welders certified for pressure piping by TSSA.
- .2 Welding, both shop and field, to be electric arc in accordance with recommendations of Canadian Welding Bureau.
- .3 Welders certificates and welding procedures used on job to be available for inspection during pipe welding operations. Each weld to be stamped with welder's identifying number.

3.2 WELD QUALITY

- .1 Welds to be solid homogeneous part of metals joined and free from pits and incorporated slag and scale.

- .2 Weld surfaces to be smooth and regular and weld metal deposition to achieve full penetration with groove filled with weld metal, fused to the base metal throughout joint thickness.
- .3 Conduct visual examination of welds in accordance with the applicable piping standard and submit copy of examination report for review. For registered pressure piping systems, include copies of TSSA field inspection reports.

3.3 RADIOGRAPHY

- .1 Magnetic particle and liquid penetrant examination methods may be employed for weld test inspections for fuel oil and other types of piping.
- .2 Arrange and pay for services of an Inspection Company specializing in making and interpreting x-rays of pipe welds.
- .3 Radiographically examine welds in piping carrying fuel throughout entire length of piping system.
- .4 Radiographically examine 20% of welds throughout the entire length of every other piping system.
- .5 Submit copy of radiograph for every weld examined.
- .6 Radiography to be in accordance with ASME Boiler and Pressure Vessel Code, Section VIII, Division 1 para. UW-51, "Technique for Radiographic Examination of Welded Joints".
- .7 Welds are unacceptable with imperfections as detailed in para. UW-51, clause (M)1 to (M)4 inclusive of same Code.
- .8 Repairs to be carried out as provided in para. UW-38 of same Code.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide pipe hangers and supports, for piping, ducts, conduits, mufflers, mechanical equipment, fans and silencers.

1.2 SHOP DRAWINGS

- .1 Product data to show:
 - .1 upper attachment.
 - .2 hanger rods.
 - .3 pipe attachment.
 - .4 riser clamps.
 - .5 shields and saddles.
 - .6 inserts.
- .2 Submit design drawings for custom fabricated trapeze hangers, sealed by a professional engineer licensed in the project location jurisdiction.
 - .1 Shop drawing details:
 - .1 construction detail drawings for each loading condition,
 - .2 span deflection calculations,
 - .3 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.

1.3 APPLICABLE CODES AND STANDARDS;

- .1 ASME B31.1 Pressure Piping Code
- .2 ASME B31.9 Building Service Piping
- .3 Manufacturers Standardization Society of Valve and Fittings Industry (MSS)
 - .1 MSS SP-58 Pipe Hangers and Supports - Materials Design and Manufacture
 - .2 MSS SP-69 Pipe Hangers and Supports - Selection and Application
 - .3 MSS SP-77 Guidelines for Pipe Support Contractual Relationships
 - .4 MSS SP-90 Guidelines for Terminology for Pipe Hangers and Supports
- .4 The Ontario Building Code

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Hangers, supports, sway braces, to be made up from stock or production parts, manufactured and fabricated in accordance with ASME B31.1 and MSS SP-58, SP-69, and SP-90.
- .2 Select elements of pipe support systems to provide adequate factors of safety under loads applied by gravity, by temperature induced expansion and contraction, by internal pressure in mechanically jointed plain end pipe, by change of momentum in fluid flow.

2.2 PRODUCT IDENTIFICATION

- .1 Pipe support products to be selected from manufacturers' standard product line
 - .1 Standard of Acceptance
 - .1 Anvil
 - .2 Unistrut
 - .3 Myatt
 - .4 Hunt Erico
 - .5 Taylor
 - .6 National Concrete Accessories - Acrow Richmond
 - .7 Pipe Shields
 - .8 Portable Pipe Hangers
 - .9 Hilti
 - .2 Model designations from these manufacturer's catalogue are used to establish quality standards and construction details to permit assessment of products from other manufacturers.

2.3 UPPER ATTACHMENTS

- .1 Cast-in-place concrete:
 - .1 single or double pipe runs up to and including 300 mm (12 in) diameter:
 - .1 galvanized wedge inserts to MSS SP-58, type 18.
 - .2 ULC listed for pipe NPS ¾ through NPS 8.
 - .1 Standard of Acceptance
 - 1. Anvil - Model 281
 - 2. Unistrut - Model P-3245
 - .2 pipe runs of three or more pipes:
 - .1 multiple inserts, spaced to suit smallest pipe in group.
 - .1 Standard of Acceptance
 - .2 Unistrut of Canada Limited
 - .3 pipes runs 350 mm (14 in) diameter and over use special inserts.
 - .1 Standard of Acceptance
 - .1 National Concrete Accessories - Acrow Richmond - Type EC-2 with ferrule
- .2 Surface mount on concrete:
 - .1 carbon steel plate with clevis and malleable iron socket and expansion case and bolt with minimum of two expansion cases and bolts for each hanger.

- .1 Standard of Acceptance
 - .1 Anvil plate, Fig. 49 socket, Fig. 290 expansion case
 - .2 Myatt cut plate, double angle clip, Fig. 535 socket, Fig. 480 expansion case
- .2 Do not use explosive drive pins in any section of Work without obtaining prior approval.
- .3 Piping or equipment supported from existing concrete construction:
 - .1 drill and install threaded inserts.
 - .1 Standard of Acceptance
 - .1 Hilti - HDI, Kwick Bolt, HSL
- .4 Steel framed construction:
 - .1 steel beam (bottom flange) and cold piping NPS 2 and under:
 - .1 beam clamp to MSS SP-58, type 30, ULC listed.
 - .1 Standard of Acceptance
 - 1. Anvil Fig. 218
 - 2. Myatt Fig. 500
 - .2 steel beam (bottom flange) and cold piping NPS 2½ and larger and hot piping:
 - .1 heavy beam clamp assembly to MSS SP-58, type 28 or 29, or
 - .2 fabricated equivalent, ULC listed.
 - .1 Standard of Acceptance
 - 1. Anvil Fig. 228 or 292
 - 2. Myatt Fig. 510 X-HEAVY, or 511 X-HEAVY.
 - .3 steel beam (top flange) and cold piping and hot piping NPS 2 and under:
 - .1 steel jaw, hook rod with nut, spring washer and plain washer, to MSS SP-58, type 25, ULC listed.
 - .1 Standard of Acceptance
 - 1. Anvil Fig. 227
 - 2. Myatt Fig. 506
 - .4 steel joists and cold piping NPS 2 and under:
 - .1 steel washer plate with double locking nuts.
 - .1 Standard of Acceptance
 - 1. Anvil Fig. 60
 - 2. Myatt Fig. 545
 - .5 steel joists and cold piping NPS 2½ and larger and hot piping:
 - .1 steel washer plates with double locking nut, carbon steel clevis and malleable iron socket.
 - .1 Standard of Acceptance
 - 1. Anvil washer plate - Fig. 60, clevis - Fig. 66, socket - Fig. 290.
 - 2. Myatt washer plate - Fig. 545, clevis - Fig. 530, socket - Fig. 480.

2.4 HANGER ROD

- .1 Carbon steel threaded rod;
 - .1 electro-galvanized finish in mechanical rooms and outdoors.
 - .2 black steel finish in other areas.
 - .1 Standard of Acceptance
 - .1 Anvil Fig. 146
 - .2 Myatt Fig. 432

2.5 HORIZONTAL PIPE SUPPORT - SUSPENDED

- .1 Hot or cold suspended piping, including conduits, where horizontal movement is 25 mm (1 in) or less and hanger rod is longer than 300 mm (12 in).
 - .1 steel or cast iron piping:
 - .1 adjustable clevis to MSS SP-58, type 1, ULC listed, sized for outside dimension of pipe and insulation.
 - .1 Standard of Acceptance
 - 1. Anvil Fig. 260
 - 2. Myatt Fig. 124
 - .2 opening clevis, ULC listed, sized for outside dimension of pipe and insulation.
 - .1 Standard of Acceptance
 - 1. Hilti SLC Speed Lock
 - .2 copper piping:
 - .1 adjustable clevis to MSS SP-58, type 1, copper plated.
 - .1 Standard of Acceptance
 - 1. Anvil Fig CT-65
 - 2. Myatt 151 CT
- .2 Suspended hot steel or copper piping having horizontal movement in excess of 25 mm (1 in) or hot steel piping with hanger rod 300 mm (12 in) or less:
 - .1 trapeze or yoke style pipe roller to MSS SP-58, type 43.
 - .1 Standard of Acceptance
 - .1 Anvil Fig. 171 or fig. 181
 - .2 Myatt Fig. 261 or fig. 258
- .3 Glass drainage piping:
 - .1 galvanized, padded, adjustable swivel ring to MSS SP-69.
 - .1 Standard of Acceptance
 - .1 Kimax No. 7290

2.6 HORIZONTAL PIPE SUPPORT - BOTTOM SUPPORTED

- .1 Hot and cold steel and copper piping:
 - .1 adjustable pipe roller stand to MSS SP-58, type 44.
 - .1 Standard of Acceptance

- .1 Anvil Fig. 177
- .2 Myatt Fig. 262

2.7 TRAPEZE HANGERS

- .1 Performance:
 - .1 Manufactured:
 - .1 to product load listings.
 - .2 Custom fabricated:
 - .1 maximum deflection between supports: 1/250 (0.4%) of span
 - .2 minimum factor of safety: 5 times load to ultimate tensile or compressive strength.
- .2 Construction:
 - .1 Carbon steel shapes, to suit load application:
 - .1 hollow steel section,
 - .2 equal leg EI section, or
 - .3 double C channel "strong-back", with welded clips.
 - .2 Hanger rods:
 - .1 as specified above, and
 - .2 minimum two support rods,
 - .3 rods selected for minimum factor of safety of 5 times load to ultimate tensile or compressive strength of rod.
- .3 Pipe restraint:
 - .1 restrain pipes from lateral movement with:
 - .1 bolt-on angle brackets or pipe U-bolts for manufactured hangers,
 - .2 welded-on angles for fabricated hangers.
- .4 Finish:
 - .1 electro-galvanized finish in mechanical rooms and outdoors.
 - .2 black steel finish in other areas.
 - .1 Standard of Acceptance
 - .1 Anvil Fig 45, 46, 50

2.8 VERTICAL PIPE SUPPORTS:

- .1 Steel or cast iron pipe:
 - .1 floor supported, galvanized carbon steel riser clamps to MSS SP-58, type 42, ULC listed, field-welded pipe lugs.
 - .1 Standard of Acceptance
 - .1 Anvil Fig. 261
 - .2 Myatt Fig. 182 or 183
 - .2 suspended, galvanized carbon steel riser clamps to MSS SP-58, type 42, ULC listed, 4 or 6 bolt pattern, field-welded pipe lugs.
 - .1 Standard of Acceptance

- .1 Anvil fig. 40
- .2 Myatt fig. 190 or 191

.2 Copper pipe:

- .1 carbon steel, copper finished, riser clamps to MSS SP-58, type 8.
 - .1 Standard of Acceptance
 - .1 Anvil Fig. CT-121
 - .2 Myatt Fig. 150CT

2.9 RODDING FOR MECHANICAL JOINT PIPE

- .1 Plain end cast iron and asbestos cement drain waste and vent pipe, NPS 5 and over,
 - .1 bell clamps and rodding at each joint
 - .1 Standard of Acceptance
 - .1 Myatt Fig. 175 in configuration Fig. 176
 - .2 Anvil Fig. 595 with Fig. 594 washers
 - .3 Taylor Fig. 35
 - .2 bell clamp and rodding at each tee branch
 - .1 Myatt Fig. 175 in configuration Fig. 180
 - .2 Anvil Fig. 595 with Fig. 594 washers
 - .3 Taylor Fig. 35

2.10 SADDLES AND SHIELDS AT PIPE SUPPORTS

- .1 Cold steel piping, and copper, stainless and plastic piping, NPS 1½ and over:
 - .1 galvanized steel protection shield, with foam glass or calcium silicate insulation or high density insert.
 - .1 Standard of Acceptance
 - .1 Anvil Fig. 167
 - .2 Myatt Fig. 251
- .2 Hot steel piping NPS 1½ and over:
 - .1 protective saddle welded to pipe with insulation inserted between saddle and pipe.
 - .1 Standard of Acceptance
 - .1 Anvil Fig. 160 to 166
 - .2 Myatt Fig. 210 to 240

PART 3 - EXECUTION

3.1 COORDINATION WITH CONCRETE WORK

- .1 Supply and deliver inserts to site in ample time to be built into work.
- .2 Set and correctly locate inserts for pipes and equipment hangers. Secure inserts firmly to formwork before concrete is poured.

3.2 HANGER INSTALLATION

- .1 Install hangers for steel pipe with spacing and hanger rod diameter in accordance with table 1.
 - .1 Exception: fuel oil and natural gas piping.
- .2 Install hangers for copper pipe with spacing and hanger rod diameter in accordance with table 2.
 - .1 Exception: natural gas piping.
- .3 Install hangers for cast iron soil pipe with hanger spacing and hanger rod diameter in accordance with table 3.
 - .1 In addition, provide a hanger at or adjacent to each hub or joint.
- .4 Refer to Section 23 11 13 for hanger spacing for Fuel Oil Piping.
- .5 Refer to Section 23 11 23 for hanger spacing for Natural Gas Piping.

Table 1: Hanger Spacing for Steel Piping

Pipe Size NPS	Rod Diameter	Maximum Spacing
½	10 mm (3/8 in)	1.8 m (6 ft)
¾ to 1¼	10 mm (3/8 in)	2.1 m (7 ft)
1½	10 mm (3/8 in)	2.7 m (9 ft)
2	10 mm (3/8 in)	3.0 m (10 ft)
2½	13 mm (½ in)	3.3 m (11 ft)
3	13 mm (½ in)	3.3 m (12 ft)
4	16 mm (5/8 in)	4.2 m (14 ft)
6	16 mm (¾ in)	5.1 m (17 ft)
8	22 mm (¾ in)	5.7 m (19 ft)
10	22 mm (7/8 in)	6.7 m (22 ft)
12	22 mm (7/8 in)	7.0 m (23 ft)

Table 2: Hanger Spacing for Copper Piping

Pipe Size NPS	Rod Diameter	Maximum Spacing (Copper)
½	10 mm (3/8 in)	1.5 m (5 ft)
¾ to 1¼	10 mm (3/8 in)	1.8 m (6 ft)
1½	10 mm (3/8 in)	2.4 m (8 ft)
2	10 mm (3/8 in)	2.7 m (9 ft)
2½	13 mm (½ in)	3.0 m (10 ft)
3	13 mm (½ in)	3.0 m (10 ft)
4	16 mm (5/8 in)	3.0 m (10 ft)

Table 3: Hanger Spacing for Cast Iron Soil Piping

Pipe Size NPS	Rod Diameter	Maximum Spacing (CI Soil Pipe)
3	13 mm (½ in)	1.5 m (5 ft)
4	16 mm (5/8 in)	1.5 m (5 ft)
6	16 mm (¾ in)	1.5 m (5 ft)
8	22 mm (¾ in)	1.5 m (5 ft)
10	22 mm (7/8 in)	1.5 m (5 ft)

- .6 Hanger spacing and hanger rod diameter for steel or copper flexible joint roll groove pipe to be as shown in table above for appropriate pipe material with not less than one hanger between joints and with anchors and guides located to maintain piping true to line and grade.
- .7 Plastic, and other special piping to be supported, anchored and guided to pipe manufacturer's requirements.
- .8 In steel framed construction, support piping from structural members. Where structural members are not suitably located for upper hanger attachments and inserts of adequate capacity cannot be installed in floor slabs over, provide supplementary steel framing members;
 - .1 fabricate supplementary steel from standard HSS sections, single EL section, double C "strongback" sections, or pipe rolls,
 - .2 size supporting steel to limit span deflection to 1/250 (0.4%) between support points,
 - .3 mechanically fasten supplementary steel to structural steel.
- .9 Offset hangers so that rods are vertical in operating position.
- .10 Provide hanger within 300 mm (12 in) of each horizontal elbow and tee.
- .11 Clamp and rod tees, elbows, and joints, in plain end mechanical joint pipe NPS 5 and over.
- .12 Riser clamps:
 - .1 Weld lugs onto steel piping.
 - .2 Solder copper pipe to copper riser clamps.

.13 Trapeze hangers

- .1 Shim pipes on common trapeze hangers to slope each pipe in required direction.
- .2 Mechanical fasten shim plates to hanger. Shim plates and pipe lateral restraints may be fastened as one unit.

3.3 SADDLES AND SHIELDS

- .1 On cold insulated piping, provide insulation shields between insulation and pipe support.
- .2 On hot insulated piping, weld protective saddles to pipe at pipe support locations.
- .3 No saddles or shields are required on un-insulated piping.

3.4 LOAD NUT RETENTION REQUIREMENTS

- .1 Adhere fastening nuts, including top and bottom load nuts, and clevis bolt nuts, to threaded rods or fittings with Loctite 266.
- .2 For steel framed buildings, industrial buildings, and areas subject to high structure born vibration, provide double-nutting on pipe and equipment hangers in addition to use of Loctite 266, as follows:
 - .1 Double-nut the top load nut on the building attachment point.
 - .2 Double-nut the lower load nut on the pipe, duct or equipment hanger.
 - .3 Double-nut the clevis bolt nuts.

3.5 INSULATION SHIELD RETENTION REQUIREMENTS

- .1 For areas subject to high structure born vibration. Provide insulation shields by punching two slots 6mm x 12mm (1/4" x 1/2") near each corner of one end of the shield. Provide stainless steel bandclamps to secure the insulation shield to the pipe (outside of the insulation).

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide equipment nameplates, piping and duct identification, and valve tags.
- .2 Provide signage for tank fill

1.2 SHOP DRAWINGS

- .1 Submit list of nameplates, with proposed wording, prior to engraving.
- .2 Submit sample board with pipe and duct identification materials.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Manufactured identification systems:
 - .1 laminated vinyl or polyester,
 - .2 resistant to chemical, ultraviolet,
 - .3 minimum operating temperature: -25 degrees C (-12 degrees F)
 - .4 maximum operating temperature: 121 degrees C (250 degrees F)
 - .1 Standard of Acceptance
 - .1 Brady - identification tapes, bands, and markers.
 - .2 Seton - Setmark Pipe Markers.
 - .3 Smillie McAdams Summerlin.
 - .4 Craftmark Identification Systems.

2.2 EQUIPMENT IDENTIFICATION NAMEPLATES

- .1 Identification plates are in addition to manufacturers plates.
- .2 Identification plates:
 - .1 provided for equipment identified with number designations in schedules and equipment selection sheets.
 - .2 marked with equipment type, number and service following wording and numbering used in contract documents. Examples:
 - .1 F-1 Auditorium Supply Fan
 - .2 P-3 Condenser Water Pump
- .3 laminated plastic
- .4 white face and black centre
- .5 minimum size 90mmx40mmx2.5mm (3 in x 1½ in x 1/10 in),
- .6 engraved with 10mm (1/2 in) high lettering.

2.3 PIPING IDENTIFICATION

- .1 Self-adhesive manufactured pipe markers and colour bands:
 - .1 50mm (2 in) wide tape wrapped around pipe or covering with ends overlapping one pipe diameter but not less than 25mm (1 in) for colour bands,
 - .2 minimum 20 mm (3/4") high lettering,
 - .3 colour band tape with flow direction arrows,
 - .4 waterproof and heat resistant plastic marker tags for pipes and tubing 20mm (3/4 in) nominal and smaller.
 - .5 applicable WHIMS pictogram for identification of material hazard
- .2 Flexible coil-wrap manufactured markers::
 - .1 plastic coated markers with integral printing, or
 - .2 plastic cover with field applied self-adhesive markers
 - .3 applicable WHIMS pictogram for identification of material hazard
- .3 applicable WHIMS pictogram for identification of material hazard

2.4 BURIED PIPING AND CONDUIT

- .1 Materials:
 - .1 Stretchable polyethylene or metallized ribbon, labelled in accordance with piping above, at maximum 800 mm intervals.
 - .2 Provide trace tape for all buried piping

2.5 DUCTWORK IDENTIFICATION

- .1 Paint stenciled letters 25mm (1 in) high showing;
 - .1 duct service,
 - .2 fan number, and
 - .3 arrows showing direction of flow,

2.6 VALVE IDENTIFICATION

- .1 Brass valve tags:
 - .1 brass with stamped numbers and letters filled with black enamel
 - .2 approximately 25mm (1") square for plumbing valves and 25mm (1") diameter for heating or chilled water systems.
 - .3 non-ferrous chain or S-hook,
 - .4 indicating valve type and size

PART 3 - EXECUTION

3.1 EQUIPMENT IDENTIFICATION

- .1 Locate nameplates to be easily read.
- .2 Do not paint over plates.
- .3 Fasten securely with mechanical fasteners.
- .4 Provide standoffs on insulated equipment.

3.2 PIPING IDENTIFICATION

- .1 Provide manufactured tape markers:
 - .1 self-adhesive type on indoor piping,
 - .2 flexible coil-wrap on outdoor piping..
 - .3 Install markers on cleaned and prepared surfaces.
- .2 Locations:
 - .1 maximum every 15m (50 ft) along length of pipe, except for medical gas, natural gas and fuel oil,
 - .2 maximum every 6 m (20 ft) along length of pipe for natural gas and fuel oil,
 - .3 before and after barriers, floors and walls,
 - .4 within 1 m (3 ft) of and behind access doors ,
 - .5 within 1 m (3 ft) of piping termination point.

3.3 PIPING IDENTIFICATION - BURIED PIPING AND CONDUIT

- .1 Provide tracer tape 150 mm below top of grade.

3.4 DUCTWORK IDENTIFICATION

- .1 Paint stenciled letters 25mm (1 in) high showing;
 - .1 duct service,
 - .2 fan number, and
 - .3 arrows showing direction of flow,
- .2 Locations:
 - .1 exposed ducts,
 - .2 concealed ducts next to access doors, and
 - .3 throughout length of ducts at intervals not exceeding 15m (50 ft).
- .3 Stencil indication on prepared surfaces, and locate on both sides of any penetration.

3.5 VENTILATION DIAGRAMS

- .1 Prepare line diagrams of ventilating systems showing supply, return, and exhaust air quantities in each room, Supply, return, and exhaust air quantities from each floor and location of air handling equipment.
- .2 Submit two copies of ventilation diagrams, encased in clear plastic, bound in vinyl covered, hardbacked 210mmx297mm (8½ inx11 in) three-ring binders.

3.6 VALVE IDENTIFICATION

- .1 Provide every valve on job, except where located in fire hose cabinets, on radiation, unit heaters, fixture stops or within site of equipment or apparatus they control, with a numbered tag showing valve type and size, attached to valve stem or wheel handle with non ferrous chain or S-hook. Consecutively number valves in each system, use a letter designation for valve type, and size designation to be NPS as a number. (c.f. tag marked 22 B 2 would be valve tag #22 on ball valve, size 2 NPS)
- .2 Tags to be brass with stamped numbers and letters filled with black enamel, approximately 25mm (1 in) square for plumbing valves and 25mm (1 in) diameter, round, for valves on heating or chilled water systems.
- .3 Prepare flow diagrams for each system showing pumps, heat transfer equipment, schematic piping and tagged valves. Include tag schedule for each system, designating number, service, function, size, and location of each tagged item and normal operating position of each valve.
- .4 Submit two copies of valve tag schedules, encased in clear plastic, bound in vinyl covered, hardbacked 210mm x 297mm (8½ in x 11 in) three ring binders.

3.7 PIPE AND VALVE IDENTIFICATION CLASSIFICATION

- .1 Colour coding and service identifiers to be in accordance with CGSB-24.3-92 Identification of Piping Systems.
- .1 Use colour coding system schedule as follows:

Primary Classification	Secondary Classification	Legend Type and Direction Arrows
Yellow 505-101	Orange 508-102	Black 512-101
Green 503-107	Purple 511-101	White 513-101
Blue 202-101	Black 512-101	
Red 509-102	Yellow 505-101	
White 513-101		

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazard Classification	Background Colour	Legend Colour
City Water	CI.W	Low	Green	White
Cold Water	C.W.	Low	Green	White
Deionized Water	DI.W	Low	Green	White
Domestic Cold Water Supply	D.C.W.	Low	Green	White
Dom Hot Water Supply	D.H.W.S.	Low	Green	White
Dom Hot Water Recirc	D.H.W.R.	Low	Green	White
Hot Water Heating Supply				

Pipe and Valve Identification				
Pipe Marker Legend	Valve Tag Legend	CGSB Hazard Classification	Background Colour	Legend Colour
up to 120°C	H.W.H.S.	Hazardous	Yellow	Black
Hot Water Heating Return				
up to 120°C	H.W.H.R	Hazardous	Yellow	Black
Make-up Water	M.U.W.	Low	Green	White
Storm Sewer	S.S.	Low	Green	None
Sanitary Sewer	SAN.S.	Low	Green	None
Refrigerant Suction				
(include refrigerant No.)	REF.S. (No.)	Hazardous	Yellow	Black
Engine Exhaust	E.E.	Hazardous	Yellow	Black
Fuel Oil (show type No.)				
	F.P. (No.)	Hazardous	Yellow	Black
Instrument Air	I.A.	Hazardous	Green	White
Natural Gas	N.G.	Hazardous	Yellow	Black
Nitrogen Pressure 700 kPa and lower	NIT.	Low	Green	White
Compressed air gauge				
Pressure 700 kPa and lower	C.A. kPa	Low	Green	White
Pressure over 700 kPa	C.A. kPa	Hazardous	Yellow	Black
Fire Protection Water	F.P.W.	Fire Protection	Red	White
Sprinkler Water	S.W.	Fire Protection	Red	White
Urea	U.	Low	Green	White
Vent (plumbing)	V.P.	Low	Green	White
Vent	V.	Hazardous	Yellow	Black

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Insulate and finish: ducts, casings, and plenums; valves, pipe and fittings; and equipment.
- .2 Provide fire rated insulation on engine exhaust muffler and appliance vent piping as shown.

1.2 RELATED WORK

- .1 The following Work is specified in other Sections of Division 20.
 - .1 Section 23 31 13: fire protection of ventilation ductwork.

1.3 QUALITY

- .1 Manufacturers and products are listed in this Section to establish quality and manufacturing standards. Products from other manufacturers with explicitly similar characteristics are acceptable.

1.4 QUALIFICATIONS

- .1 Provide insulation and covering by recognized specialist applicator with an established reputation for this type of work.

1.5 SAMPLE BOARDS

- .1 Submit sample assembly of each type of insulation and covering. Mount samples on PVC coroplast board with typewritten label beneath each sample indicating service and material specification.

1.6 MATERIAL TEST CRITERIA

- .1 Insulation, adhesives, coatings, sealers, and tapes:
 - .1 maximum flame spread rating of 25, and
 - .2 maximum smoke developed rating of 50.

1.7 APPLICABLE CODES AND STANDARDS

- .1 Material and method of application to comply with or be tested in accordance with following Standards;
 - .1 NFPA 90-A Installation of Air-Conditioning and Ventilating Systems
 - .2 ASHRAE/IES 90.1 Energy Standard for Buildings Except Low-Rise Residential Buildings
 - .3 NFPA 255 Test of Surface Burning Characteristics of Building Materials
 - .4 CAN/ULC-S102 Standard Method of Test for Surface Burning Characteristics of Flooring, Floor Covering, and Miscellaneous Materials and Assemblies
 - .5 ASTM C411 Standard Test Method for Hot Surface Performance of High Temperature Thermal Insulation
 - .6 ASTM C518 Standard Test Method for Steady State Thermal Transmission Properties by Means of Heat Flo Meter Apparatus
 - .7 ASTM C533 Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation
 - .8 ASTM C534 Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form

- .9 ASTM C547 Standard Specification for Mineral Fiber Pipe Insulation
- .10 ASTM C552 Standard Specification for Cellular Glass Thermal Insulation
- .11 ASTM C553 Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications
- .12 ASTM C612 Standard Specification for Mineral Fiber Block and Board Thermal Insulation
- .13 ASTM C1126 (Gr.1) Standard Specification for Faced and Unfaced Rigid Cellular Phenolic Thermal Insulation
- .14 ASTM C1290 Standard Specification for Flexible Fibrous Glass Blanket Insulation Used to Externally Insulate HVAC Ducts.
- .15 CGSB 51-GP-52MA Vapour Barrier, Jacket and Facing Material for Pipe, Duct, and Equipment Thermal Insulation.
- .16 CGSB 51.53-95 Poly(Vinyl Chloride) Jacket Sheeting, for Insulated Pipes Vessels and Round Ducts.

1.8 DEFINITIONS

- .1 In this Section;
 - .1 "Concealed": as applied to mechanical services and equipment located in space above hung ceilings, and within trenches, pipe and/or duct shafts, non-accessible chases and furred spaces.
 - .2 "Exposed": as applied to remainder of mechanical services and equipment which are not "concealed" as defined above. For greater certainty, the following locations are Exposed:
 - .3 "Conditioned air": HVAC air supplied from air handling units with chilled water or refrigerant cooled coils.
 - .4 "Unconditioned space": rooms or spaces that are not supplied with conditioned air, including ceiling spaces which are not part of a ceiling return plenum system
 - .5 "Outdoor": mechanical services and equipment located outside of the building envelope including services located beneath overhangs and soffits, and exposed to any outdoor condition including temperature, sun exposure, or precipitation.
 - .6 "Mastic": heavy consistency waterproof compound for outdoor applications used in conjunction with reinforcing fabric that remains adhesive and generally pliable with age, to provide either a breathable or vapour barrier finish to insulation.
 - .7 "Coating": light-consistency compound used to provide either a breathable or vapour barrier finish to insulation, used in conjunction with reinforcing fabric.
 - .8 "Lagging" or "Jacket": final finish protective layer for insulation, including mastics, coatings, adhesive films, PVC, and metal finishes; provides breathable, vapour barrier, and weather-protective finish depending on application.
 - .9 "Surface temperature" for purpose of equipment temperature, is equal to the gas or vapour design operating temperature, or the liquid supply operating temperature.

PART 2 - PRODUCTS

2.1 PIPE INSULATION

- .1 Type P-1 rigid glass fibre:
 - .1 meeting ASTM C547,

-
- .2 moulded or scored and folded from boards,
 - .3 jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn,
 - .4 noncombustible,
 - .5 thermal performance: 0.033 W/m/C°s @ 24 °C (0.23 btu/hr/in/sq ft/F° @ 75 °F)
 - .6 suitable for service with jacket at: 66 °C (150 °F) and un-jacketed material at 454 °C (850 °F)
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville Micro-Lok
 - .2 Manson Alley-K
 - .3 Owens Corning
 - .4 Knauf Fiberglass
 - .2 Type P-2 calcium silicate:
 - .1 meeting ASTM C533,
 - .2 moulded or block type,
 - .3 asbestos-free,
 - .4 thermal performance: 0.058 W/m/C° @ 149 °C (0.40 btu/hr/in/sq ft/F° @ 300 °F),
 - .5 suitable for service at: 649 °C (1200 °F).
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville Thermo-12/Blue
 - .2 Owens Corning
 - .3 Knauf Fiberglass
 - .3 Type P-3 cellular glass :
 - .1 meeting ASTM C552,
 - .2 moulded or block type,
 - .3 density 128 kg/m3 (8 lb/cu ft),
 - .4 thermal performance: 0.043 W/m/C° @ 0 °C (0.32 btu/hr/in/sq ft/F° @ 75 °F),
 - .5 suitable for service at: 482 °C (900 °F).
 - .1 Standard of Acceptance
 - .1 Pittsburgh Corning Foamglas
 - .4 Type P-4 flexible elastomeric closed cell foam:
 - .1 meeting ASTM C534,
 - .2 tubular with self sealing seams,
 - .3 thermal performance: 0.04 W/m/C° @ 24 °C (0.28 btu/hr/in/sq ft/F° @ 75 °F),
 - .4 suitable for service at: 82 °C (180 °F).

- .1 Standard of Acceptance
 - .1 ARMACELL - AP Armaflex SS Pipe Insulation
 - .2 Rubatex
- .5 Type P 5 phenolic rigid:
 - .1 meeting ASTM C1126 (Gr.1),
 - .2 moulded,
 - .3 kraft jacket bonded to 1 mil aluminum foil reinforced with glass fibre yarns,
 - .4 meeting 25/50 flame spread/smoke developed when tested to ASTM E84,
 - .5 thermal performance: 0.019 W/m/C° @ 24°C (0.13 btu/hr/in/sq ft/F° @ 75°F),
 - .6 suitable for service at: 73°C to +121 °C (100°F to 250°F).
 - .1 Standard of Acceptance
 - .1 Kingspan Koolphen K
- .6 Type P-6 fire-rated pipe insulation:
 - .1 WH, ULC, or UL classified inorganic material, non-combustible, listed for protection of metallic piping,
 - .2 meeting ASTM C518,
 - .3 flexible blanket, 2 hour fire rating,
 - .4 foil encapsulated,
 - .5 suitable for service between:-173 °C to 1260 °C (-280 °F to 2300 °F).
 - .1 Standard of Acceptance
 - .1 Royal Quickstop Quickwrap

2.2 EQUIPMENT INSULATION

- .1 Type E-1 low temperature mineral fibre blanket:
 - .1 meeting ASTM C553,
 - .2 flexible (for irregular curved surfaces),
 - .3 jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn,
 - .4 thermal performance: 0.035 W/m/C° @ 24 °C (0.24 btu/hr/in/sq ft/F° @ 75 °F),
 - .5 suitable for service with jacket at: 121 °C (250 °F) and un-jacketed material at 177 °C (350 °F).
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville 812 Spin-Glas
 - .2 Owens Corning
 - .3 Knauf Fiberglass
- .2 Type E-2 low temperature mineral fibre board :
 - .1 meeting ASTM C612,
 - .2 rigid for flat surfaces or,

- .3 scored board for curved surfaces 250 mm (10 in) dia and over,
- .4 jacket of kraft bonded to aluminum foil reinforced with glass fibre yarn,
- .5 thermal performance: 0.033 W/m/C° @ 24 °C (0.23 btu/hr/in/sq ft/F° @ 75 °F),
- .6 density: 48 kg/m3 (3.0 lb/cu ft),
- .7 suitable for service with jacket at: 66 °C (150 °F) and un-jacketed material at: 232 °C (450 °F).
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville 814 Spin-Glas
 - .2 Owens Corning
 - .3 Knauf Fiberglass
- .3 Type E-3 high temperature mineral fibre board:
 - .1 meeting ASTM C612,
 - .2 rigid for flat surfaces,
 - .3 thermal performance: 0.033 W/m/C° @ 24 °C (0.23 btu/hr/in/sq ft/F° @ 75 °F),
 - .4 density: 48 kg/m3 (3.0 lb/cu ft),
 - .5 suitable for service at: 454 °C (850 °F).
 - .1 Standard of Acceptance
 - .1 Johns Manville - 1000 Series Spin-Glas
 - .2 Owens Corning
 - .3 Knauf Fiberglass
- .4 Type E-4 high temperature mineral fibre blanket:
 - .1 meeting ASTM 612,
 - .2 flexible (for irregular curved surfaces),
 - .3 thermal performance: 0.039 W/m/C° @ 24 °C (0.27 btu/hr/in/sq ft/F° @ 75 °F),
 - .4 density: 16 kg/m3 (1.0 lb/cu ft),
 - .5 suitable for service at: 538 °C (1000 °F).
 - .1 Standard of Acceptance
 - .1 Johns Manville - HTB 26 Spin-Glas
 - .2 Owens Corning
 - .3 Knauf Fiberglass
- .5 Type E-5 calcium silicate block:
 - .1 meeting ASTM C553,
 - .2 rigid moulded block, radiused for pipe sizes NPS 8 and smaller, and segmented blocks for NPS 10 and larger
 - .3 thermal performance: 0.058 W/m/C° @ 149 °C (0.40 btu/hr/in/sq ft/F° @ 300 °F),
 - .4 suitable for service at: 649 °C (1200 °F).

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- .5 hydraulic finishing cement
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville Thermo-12/Gold
 - .2 Owens Corning
 - .3 Knauf Fiberglass

 - .6 Type E-6 flexible elastomeric closed cell foam:
 - .1 meeting ASTM C534,
 - .2 sheet self-adhering, roll type,
 - .3 thermal performance: 0.04 W/m/C° @ 24 °C (0.28 btu/hr/in/sq ft/F° @ 75 °F),
 - .4 suitable for service at: 82 °C (180 °F).
 - .1 Standard of Acceptance
 - .1 Armstrong - AP Armaflex Self-Adhering Sheet Insulation
 - .2 Rubatex

 - .7 Type E 7 low temperature phenolic board:
 - .1 meeting ASTM C1126 (Gr.1),
 - .2 rigid for flat surfaces,
 - .3 thermal performance: 0.019 W/m/C°@ 24°C (0.13 btu/hr/in/sq ft/F° @ 75°F),
 - .4 density: 35 kg/m3 (2.2 lb/cuft),
 - .5 suitable for service at: 73°C to +121 °C (100°F to 250°F).
 - .1 Standard of Acceptance
 - .1 Kingspan Koolphen K

 - .8 Type E-8 removable/reuseable high temperature insulation blankets:
 - .1 Custom fabricated, removable insulation covers for hot surfaces,
 - .2 suitable for outdoor use,
 - .3 maximum touch-safe temperature protection : 95 °C (203 °F) to UL2200.
 - .4 insulation: high density, fire resistant mineral or fibreglass insulation suitable for system operating temperature.
 - .5 cover: silicone impregnated fibreglass cover, for temperatures up to 260 °C (500 °F).
 - .6 internal liner: silicone impregnated fibreglass fabric, or stainless steel knitted wire mesh.
 - .7 single piece construction
 - .8 metal identification tag, referenced equipment served.
 - .9 tie-straps with D-rings, or Velcro closures.
 - .1 Standard of Acceptance
 - .1 Firwin Corporation
 - .2 Thermohelp Canada Inc.

2.3 DUCT INSULATION

- .1 Type D-1 mineral fibre blanket :
 - .1 meeting ASTM C1290,
 - .2 flexible blanket,
 - .3 jacket of aluminum foil reinforced with glass fibre yarn bonded to fire resistant kraft,
 - .4 thermal performance: 0.040 W/m/C° @ 24 °C (0.27 btu/hr/in/sq ft/F° @ 75 °F),
 - .5 suitable for service at: 121 °C (250 °F),
 - .6 density: 12 kg/m3 (0.75 lb/cu ft).
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville Microlite Type 75
 - .2 Manson - Alley Wrap
 - .3 Owens Corning
 - .4 Knauf Fiberglass
- .2 Type D-2 mineral fibre board:
 - .1 meeting ASTM C612,
 - .2 rigid board,
 - .3 jacket of aluminum foil reinforced with glass fibre yarn bonded to fire resistant kraft,
 - .4 thermal performance: 0.033 W/m/C° @ 24 °C (0.23 btu/hr/in/sq ft/F° @ 75 °F),
 - .5 density: 48 kg/m3 (3.0 lb/cu ft),
 - .6 suitable for service with jacket at: 66 °C (150 °F) and un-jacketed material at: 232 °C (450 °F).
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville 800 Series Spin-Glas
 - .2 Owens Corning
 - .3 Knauf Fiberglass
- .3 Type D-3 flexible elastomeric closed cell foam:
 - .1 meeting ASTM C534,
 - .2 sheet self-adhering, roll type,
 - .3 Thermal Performance: 0.04 W/m/C° @ 24 °C (0.28 btu/hr/in/sq ft/F° @ 75 °F),
 - .4 Suitable for service at: 82 °C (180 °F).
 - .1 Standard of Acceptance
 - .1 Armstrong - AP Armaflex Self-Adhering Sheet Insulation and
 - .2 Rubatex
- .4 Type D-4 phenolic board:
 - .1 meeting ASTM C1126 (Gr.1),
 - .2 rigid for flat surfaces,

.3 thermal performance: 0.019 W/m/C°@ 24°C (0.13 btu/hr/in/sq ft/F° @ 75°F),

.4 density:35 kg/m3 (2.2 lb/cuft),

.5 suitable for service at 73°C to +121°C (100°F to 250°F).

.1 Standard of Acceptance

.1 Kingspan Koolphen K

2.4 INSTALLATION PRODUCTS

.1 Adhesives

.1 Contact bond cement:

.1 Quick setting for metal surfaces.

.1 Standard of Acceptance

1. Bakor - No. 200-37

.2 Waterproof vapour retarder:

.1 for flexible elastomeric closed cell foam:

.1 Standard of Acceptance

1. Armaflex 520

2. Rubatex R-373

.3 Lap seal adhesive:

.1 for joints and lap sealing of vapour barriers.

.1 Standard of Acceptance

1. Childers CP-80

2. Foster 87-75

.4 Contact adhesive:

.1 for fibrous insulation.

.1 Standard of Acceptance

1. Childers CP-82

2. Foster No. 85-20

.5 Lagging adhesive - fire retardant coating.

.1 for insulation except elastomeric closed cell foam.

.1 Standard of Acceptance

1. Bakor - No. 120-09

2. Childers CP 50A-HV2

3. Foster 30-36 at 1.25 m2/l (15 sq ft/gal)

.2 for use with elastomeric closed cell foam.

.1 Standard of Acceptance

1. Childers CP-56 Adhesive

.2 Vapour barrier tape

.1 Colour matched and foil faced

.2 UL 181A listed.

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- .1 Standard of Acceptance
 - .1 Johns Manville - Zeston Z-Tape
 - .2 MacTac Canada Limited - Vinyl Scrim or Foil Scrim Kraft
 - .3 Compac Corp.
 - .4 Fattal Canvas Inc. - Insultape
 - .3 Insulation cement
 - .1 Hydraulic-setting finishing type.
 - .1 Standard of Acceptance
 - .1 Johns Manville - Zeston Z-10 or Z-20PK Insulation
 - .4 Weld Pins, Studs and Clips
 - .1 Standard of Acceptance
 - .1 Midwest Fasteners
 - .2 Continental Studwelding
 - .5 Staples
 - .1 Monel, flare type, minimum size 12 mm (½ in).
 - .6 Tie Wire
 - .1 1.6 mm (16 ga) stainless steel with twisted ends.
 - .7 Caulking
 - .1 Fast-drying colour matched flexible butyl elastomer based vapour barrier sealant.
 - .1 Standard of Acceptance
 - .1 Tremco
 - 2.5 COATINGS AND MASTICS
 - .1 Indoor applications, breathable coating (Hot work):
 - .1 fire resistive, abrasion resistive.
 - .1 Standard of Acceptance
 - .1 Foster 30-36
 - .2 Bakor 120-09
 - .2 Indoor applications, vapour barrier coating (Cold work):
 - .1 fire resistive, flexible.
 - .1 Standard of Acceptance
 - .1 Foster 30-80 / 30-90
 - .2 Bakor 120-09 with 130-12
 - .3 Outdoor applications, breathable mastic (Hot work):
 - .1 fire resistive, abrasion resistive, flexible, grey in colour.
 - .1 Standard of Acceptance
 - .1 Foster 46-51
 - .2 Bakor 120-10

- .4 Outdoor applications, vapour barrier mastic (Cold work):
 - .1 fire resistive, non-asphalt, white in colour
 - .1 Standard of Acceptance
 - .1 Foster 60-38
 - .2 fire resistive, asphalt based, black in colour:
 - .2 Standard of Acceptance
 - .1 Foster 65-05

2.6 FIELD APPLIED JACKET MATERIALS

- .1 Glass fabric reinforcing material:
 - .1 for use with elastomeric closed cell foam:
 - .1 Standard of Acceptance
 - .1 Leno 10 x 10 weave glass cloth
 - .2 Reinforcing fabric for outdoor mastics:
 - .1 Leno weave, synthetic fibre.
 - .1 Standard of Acceptance
 - .1 Foster Mast-A-Fab
 - .3 PVC (Polyvinyl Chloride) jacket material:
 - .1 20 or 30 mil thickness, with permeability not more than 0.09 perms,
 - .2 fitting covers, one piece, pre moulded,
 - .3 self-sealing longitudinal joints.
 - .1 Standard of Acceptance
 - .1 Johns Manville - Manville Zeston 2000
 - .2 ACWIL Insulations
 - .3 Sure Fit Systems
 - .4 pressure sensitive, colour matching vinyl tape.
 - .4 Canvas jacket material:
 - .1 ULC listed plain weave cotton fabric at 220 g/m2 (6 oz/sq yd), treated with fire retardant lagging adhesive.
 - .1 Standard of Acceptance
 - .1 Fattal's Thermocanvas
 - .2 Alpha Maritex 3451 RW
 - .3 Clairmont Diplag 60
 - .4 Glass-Cell FR
 - .2 self-adhering membrane of rubberized asphalt compound with siliconized release paper,
 - .3 laminated to glass scrim reinforced aluminum foil,
 - .4 self-sealing with penetration of self-tapping screws.
 - .5 water vapour permeance 0.05 perms.

- .1 Standard of Acceptance
 - .1 Bakor - Foilskin
 - .2 Polyguard Products Alumaguard 60
- .5 Metal jacket:
 - .1 straight pipe, duct or plenum:
 - .1 stucco embossed aluminum not less than 0.45 mm (0.016 in) thick sheet or,
 - .2 corrugated stainless steel not less than 0.25 mm (0.010 in) thick sheet.
 - .2 Fittings:
 - .1 Custom made swaged ring or lobster back covers on bends and die shaped fitting covers over fitting, valves, strainers, flanges, and grooved couplings.
 - .3 Bands:
 - .1 12 mm (½ in) wide stainless steel with mechanical fasteners.
 - .1 Standard of Acceptance
 - 1. Alcan Canada Products - Thermaclad Type 1
 - 2. Childers Products Inc. - Fab Straps
- .6 Protective finish for elastomeric cellular foam insulation
 - .1 Indoors:
 - .1 Standard of Acceptance
 - .1 SB Armaflex Finish
 - .2 Outdoors:
 - .1 Standard of Acceptance
 - .1 WB Armaflex Finish

PART 3 - EXECUTION

3.1 INSULATION GENERAL REQUIREMENTS

- .1 Apply insulation after pressure and leakage testing is completed and accepted, and heat tracing is installed.
- .2 Surfaces to be clean and dry before application of insulation.
- .3 Store and use adhesives, mastics, and insulation cements at ambient temperatures and conditions recommended by product manufacturers.
- .4 Do not apply insulation on chrome plated surfaces of piping, valves, fittings, and equipment.
- .5 Cut and bevel insulation around nameplates and pressure vessel stamps.
- .6 Neatly finish insulation at supports, protrusions, and interruptions.

3.2 JACKET COVER GENERAL INSTALLATION REQUIREMENTS

- .1 Make jacket materials detachable at valves, unions, strainers, traps and other equipment requiring access.
- .2 Use fitted removable covers, or insulated removable metal covers on manholes and access openings.

- .3 Cut jacket materials used for covering to allow 50 mm to 100 mm (2 in to 4 in) longitudinal overlap and similar circumferential overlap onto adjacent sheets.
- .1 On vertical pipes arrange circumferential overlap on adjacent sheets outside of sheet below and under sheet above.
- .4 PVC sheeting (indoor use only):
 - .1 Fittings : seal PVC fitting covers at throat and heel seams by solvent bonding and secured over insulation by banding or taping ends to adjacent pipe covering with vapour barrier tape.
 - .2 Hot piping and equipment:
 - .1 secure sheeting with colour matched tape around circumference, at least two places per section of sheet.
 - .2 Overlap adjacent sheets by minimum of 50 mm (2 in) and staple fasten the sheets.
 - .3 Do not seal edges with vapour barrier tape.
 - .3 For cold and dual temperature piping systems;
 - .1 seal edges and circumferential edges of PVC fitting covers with colour matched vapour barrier tape extending over adjacent pipe insulation, and with an overlap on itself of at least 50 mm (2 in) on downward side.
- .5 Mastics, Coatings and fabric:
 - .1 Indoor installation: cover with canvas and multiple coats of coating, in accordance with coating manufacturer's listing.
 - .2 Outdoor installation: cover with multiple coats of mastic with reinforcing fabric, in accordance with manufacturer's listing.
 - .3 Use vapour barrier coatings and mastics for cold and dual temperature piping.
 - .4 Use breather coatings and mastics for hot piping.
 - .5 Apply mastics and coatings when ambient temperature is above 4 °C (40 °F), unless manufacturer's instructions permit colder ambient conditions.
- .6 Metal:
 - .1 Use lock-on systems or secure sheeting with bands 450 mm (18 in) apart.
 - .2 Joint sealing:
 - .1 Hot pipe and equipment: do not seal joints.
 - .2 Cold and dual temperature pipe and equipment: seal joints with caulking.
 - .3 Equipment curved surfaces: custom made swaged ring or lobster back covers.

3.3 HOT PIPING SYSTEMS INSULATION

- .1 Insulate hot piping systems including pipe, valves and fittings, with the following operating temperature conditions:
 - .1 Safety relief valve piping, up to 2800 mm (8 ft) above floor or work surface, or within 1200 mm (4ft) horizontally of a work surface: up to 176 °C (350 °F).
 - .2 Hot water heating: 93 °C (200 °F).
 - .3 Domestic hot water: 40 to 60 °C (105 to 140 °F)
- .2 Select insulation thickness and type based on pipe size and fluid operating temperature.

Hot Piping Systems, Insulation Type and Thickness							
Fluid Design Operating Temp. Range		Nominal Pipe Size (NPS)					
°C	°F	Insulation Type	< 1	1 to 1¼	1½ to <4	4 to <8	8 and over
61 to 93	141 to 200	P-1	38 mm (1½ in)	38 mm (1½ in)	38 mm (1½ in)	38 mm (1½ in)	38 mm (1½ in)
		P-5	20 mm (¾ in)	25 mm (1 in)	25 mm (1 in)	25 mm (1 in)	25 mm (1 in)
40 to 60	105 to 140	P-1 P-4	25 mm (1 in)	25 mm (1 in)	25 mm (1 in)	38 mm (1½ in)	38 mm (1½ in)
		P-5	20 mm (¾ in)	20 mm (¾ in)	20 mm (¾ in)	25 mm (1 in)	25 mm (1 in)

3.4 COLD AND DUAL TEMPERATURE PIPING SYSTEMS INSULATION

- .1 Insulate cold and dual temperature piping systems including pipe, valves and fittings for surface temperatures as listed, with the following operating temperature conditions;
 - .1 Domestic cold water 4.4 °C (40 °F).
 - .2 Domestic hot water 40.5 to 60 °C (105 to 140 °F).
 - .3 Drainage system 5.5 °C (42 °F)
 - .1 all storm water drainage,
 - .2 underside of roof drain bodies,
 - .3 horizontal sanitary piping,
 - .4 sanitary drainage piping in ceiling spaces and where exposed
 - .5 exposed drain traps for handicap lavatory and sink fixtures.
 - .4 Equipment drains on chilled water fancoils and water-cooled DX air conditioning units: 10 °C (50 °F).
 - .5 Refrigeration suction piping, valves, fittings, and accessories 4 °C (40 °F) and below.
- .2 Select insulation thickness and type based on pipe size and fluid operating temperature from the following table:

Cold and Dual Temperature Piping Systems, Insulation Type and Thickness							
Fluid Design Operating Temp. Range		Nominal Pipe Size (NPS)					
°C	°F	Insulation Type	< 1	1 to 1¼	1½ to <4	4 to <8	8 and over
40.5 to 60	105 to 140	P-1 P-4	25 mm (1 in)	25 mm (1 in)	38 mm (1½ in)	38 mm (1½ in)	38 mm (1½ in)
		P-5	20 mm (¾ in)	20 mm (¾ in)	25 mm (1 in)	25 mm (1 in)	25 mm (1 in)
4.4 to 16	40 to 60	P-1	20 mm (¾ in)	25 mm (1 in)	38 mm (1½ in)	38 mm (1½ in)	50 mm (2 in)
		P-4	13 mm (½ in)	20 mm (¾ in)	25 mm (1 in)	25 mm (1 in)	25 mm (1 in)
		P-5	13 mm (½ in)	20 mm (¾ in)	20 mm (¾ in)	20 mm (¾ in)	20 mm (¾ in)

3.5 APPLICATION OF INSULATION TO PIPE AND FITTINGS

- .1 Straight pipe sections:

- .1 Locate insulation joints and cover seams in least visible locations; stagger adjacent longitudinal seams.
 - .2 Secure pipe insulation with bands or vapour barrier tape at centre of each section and at each end and at not more than 900 mm (3 ft) intervals.
 - .3 Elastomeric closed cell insulation self-adhered or provide 100% coverage of contact adhesive.
- .2 Elbows:
 - .1 Use matching preformed fibreglass or phenolic insulation fittings or mitred segments of insulation at pipe elbows and wrap joints with vapour barrier tape.
 - .2 Number of mitred segments to be sufficient to maintain thickness of insulation around throat of elbow.
 - .3 Where glass fibre pipe insulation is used;
 - .1 elbows NPS ½ to NPS 1 ½ , use mitred corners.
 - .2 elbows NPS 2 to NPS 4 may be wrapped with glass fibre blanket to thickness equal to that of adjoining insulation, using 50 mm (2 in) wide strips with a minimum of 25 mm (1 in) overlap on each pass, and provided with 100% coverage of vapour barrier tape, for all locations.
 - .4 Finish elbows with jacket of same material as rest of piping system.
- .3 Flanges:
 - .1 Insulate flanges with same material as pipe.
 - .1 Build up insulation shoulders on each side of flange, minimum 50 mm (2 in) wide, until flush to outside diameter of flange.
 - .2 Add insulation collar around outside of flange same thickness as pipe insulation, with width equal to flange plus insulation shoulders.
 - .2 Finish flange with jacket of same material as rest of piping system.
- .4 Fittings, valves, strainers and joints of grooved piping systems:
 - .1 Where glass fibre pipe insulation is used, wrap with two layers of insulation of thickness equal to that of adjoining insulation and finish with jacket of same material as rest of piping system.
 - .2 Where phenolic or elastomeric insulation is used;
 - .1 Provide insulation, mitred, cut and glued, to cover fittings, valves and strainers from flange to flange or coupling to coupling.
 - .2 At grooved couplings, butt pipe insulation to each side of coupling and provide section of oversized insulation overlapping at least 75 mm (3 in) on either side.
 - .3 Secure insulation by banding and tape ends to adjacent pipe covering with vapour barrier tape.
 - .3 Finish with same material as used for pipe.
- .5 Pipeline accessories - Hot piping:
 - .1 Applicable systems: fluid operating temperatures ≥93 °C (200 °F).
 - .2 Provide removable fitted insulation covers for the following pipeline items located within 2100 mm (7 ft) above a floor or work surface:
 - .1 valves
 - .2 strainers
 - .3 pressure reducing valves

-
- .4 safety valves
 - .5 meters
 - .3 Allow free movement of valve actuator.
 - .6 Pipeline accessories - Hot piping:
 - .1 Applicable systems: fluid operating temperatures $\geq 93^{\circ}\text{C}$ (200°F).
 - .2 Use detachable fabricated box type insulated metal jackets over the following pipeline items:
 - .1 valves
 - .2 strainers
 - .3 pressure reducing valves
 - .4 safety valves
 - .5 meters
 - .3 Allow for free movement of valve actuator.
 - .4 For strainers, provide a two piece detachable end-cap or top-cap as applicable, to permit removal of strainer and for installation of blow-down valve on Y-style strainers.
 - .7 Pipeline accessories - Cold and dual temperature piping:
 - .1 Provide type E6 (elastomeric foam) insulation adhered to pipeline accessories with 100% adhesive coverage.
 - .1 valves
 - .2 strainers
 - .3 air separators
 - .4 meters
 - .2 At locations requiring access, extend insulation to create collar around bolted connection, and install a compression fit piece of insulation to cover equipment.
 - .3 Finish with same material as used for pipe.
 - .8 Hangers and supports:
 - .1 Cold and dual temperature pipe: steel piping all sizes, and other piping of copper, glass, stainless steel or plastic NPS 1½ or larger;
 - .1 provide inserts between insulation protection shields and pipe at each hanger or support,
 - .2 fabrication: Type P-5 (phenolic) or P-3 (cellular glass) insulation,
 - .3 size: 225 mm (9 in) long for lines up to and including NPS 2, and 450 mm (18 in) for lines NPS 2½ and over,
 - .4 cover inserts with vapour barrier wrapping and overlap adjacent insulation approximately 300 mm (12 in) at each end and seal,
 - .5 seal vapour barrier wrapping over insert and adjacent jacket with vapour barrier adhesive then tape with vapour barrier tape at each end of the wrapping and on each side of hanger,
 - .6 install insulation protection shields between hanger or pipe roll support and vapour barrier and any recovering.
 - .2 Hot pipes: steel piping NPS 1½ or larger;
 - .1 provide insulation insert inside protective saddle welded to pipe at each hanger or support,
 - .2 fabrication: same insulation as specified for service,

- .3 size: 225 mm (9 in) long for lines up to and including NPS 2 and 450 mm (18 in) for lines NPS 2 and over,
- .4 cover inserts and protective saddle with "all purpose jacket" material and overlap adjacent insulation approximately 300 mm (12 in) at each end and seal,
- .5 hanger or pipe roll support to be in contact with "all purpose jacket" and any recovering.
- .9 Sleeves through fire and smoke separations:
 - .1 Hot pipes:
 - .1 Interrupt covering and associated adhesives and insulation at fire and smoke separations and provide fire stopping.
 - .2 Cold pipes:
 - .1 pass insulation through opening, and provide additional installation requirements including metal jacket as required to suit the fire-stop product listing.
- .10 Drainage systems - additional requirements:
 - .1 Insulate pipe and fittings with Type E 1 (low temperature mineral fibre blanket), E 6 (flexible elastomeric closed cell foam) or Type P 4 (elastomeric closed cell foam) insulation 25 mm (1 in) thick.
 - .2 Apply insulation on roof drain bodies with 100% coverage of adhesive.
- .11 Cold and dual temperature pipe insulation systems - additional requirements:
 - .1 Insulate around anchor plates with type E-1 (low temperature mineral fibre blanket) or E-6 (flexible elastomeric closed cell foam) insulation and seal with vapour barrier tape.
 - .2 Maintain integrity of vapour barrier through sleeves, around fittings and at hangers and supports.
 - .3 Secure longitudinal laps and butt joints of pipe insulation vapour retardant jacket to be secured with
 - .1 UL listed pressure sensitive tape and vapour barrier mastic or,
 - .2 self-sealing longitudinal laps and butt strips or,
 - .3 75 mm (3 in) wide strips of jacket material adhered in place with vapour barrier adhesive.
 - .4 Where pipe insulation outside diameter exceeds 300 mm (12 in) band insulation with additional 75 mm (3 in) wide circumferential strips of jacket material at 500 mm (24 in) centres, adhered in place with vapour barrier adhesive.

3.6 PROTECTION AND FINISHING OF PIPE INSULATION - INDOORS

- .1 Mechanical damage protection:
 - .1 Protect exposed pipe insulation at floor line with 1.2 mm (18 ga) stainless steel jacket approximately 100 mm (4 in) high, secured to floor slab. Fastenings to be concealed by floor plate.
 - .1 For piping systems using metal finishes, this protection cover replaces a portion of the specified pipe cover.
 - .2 For piping systems using other finishes, this protection cover is in addition to the specified pipe cover.
 - .2 Cover exposed insulated piping inside of building with PVC jacket material.
 - .3 Cover exposed insulated piping on steam systems over 860kPa (125 psig) inside of building with metal sheeting material.

3.7 FIRE RATED PIPE INSULATION

- .1 Provide two (2) hour rating of type P-6 insulation on tube or pipe, where shown.
- .2 Install insulation, including pipe hangers, in accordance with manufacturer's listing.

3.8 HOT EQUIPMENT INSULATION

- .1 Insulate hot equipment where surface temperature of equipment in normal service is greater than 60°C (140°F).
 - .1 Equipment surface operating temperature < 200°C (400°F):
 - .1 Heat exchangers (shell and tube, plate and frame).
 - .2 Domestic water heaters.
 - .3 Domestic hot water storage tanks.
 - .4 Radiant Ceiling Panels (back side, facing into ceiling space)
 - .5 Boilers.
 - .6 Boiler feed pumps.
 - .7 Fuel oil heaters.
 - .8 Induced draft fans.
 - .2 Equipment surface operating temperature > 200°C (400°F):
 - .1 Breechings.
 - .2 Stacks and chimneys
 - .3 Engine exhaust systems
 - .4 Engine SCR emission control systems
 - .3 Equipment insulation is not required on:
 - .1 equipment that is supplied with factory applied and finished insulation and jacketing.
- Insulation type and thickness in accordance with following table:

Hot Equipment, Insulation Type and Thickness			
Equipment Description	Surface Temperature	Insulation Type	Insulation Thickness
Equipment with surface temperature between 60°C (140°F) and 200°C (400°F), not otherwise identified.	less than 200°C (400°F)	E-1 to E-3	40 mm (1½ in)
Heat exchanger: Shell-and-tube Plate and frame	less than 200°C (400°F)	E-2	50 mm (2 in)
		E-2	25 mm (1 in)
Expansion tank	less than 200°C (400°F)	E-2	40 mm (1½ in)
Domestic hot water tank & heaters	less than 200°C (400°F)	E-2	40 mm (1½ in)
Radiant ceiling panels	less than 200°C (400°F)	E-1	50 mm (2 in)
Boilers	less than 200°C (400°F)	E-3 to E-5	50 mm (2 in)
Equipment with surface temperature above 200°C (400°F), not otherwise identified.	greater than 200°C (400°F)	E-4, E-5	50 mm (2 in)
Boiler stacks	greater than 200°C (400°F)	E-5	2 layers each 50 mm (2 in)

Hot Equipment, Insulation Type and Thickness			
Boiler breechings	greater than 200°C (400°F)	E-5	2 layers each 50 mm (2 in)
Diesel exhaust piping, engine exhaust silencer	greater than 200°C (400°F)	E-4, E-5	2 layers each 50 mm (2 in)
SCR system	up to 590°C (1100°F)	E-5	touch safe
Engine exhaust gas heat exchanger	greater than 200°C (400°F)	E-5	2 layers each 50 mm (1-1/2 in)

3.9 APPLICATION OF INSULATION TO HOT EQUIPMENT

- .1 Type E-1 (low temperature mineral fibre blanket) and Type E-4 (high temperature mineral fibre blanket):
 - .1 apply on curved surfaces with radius of curvature less than 250 mm (10 in).
- .2 Type E-2 (low temperature mineral fibre board) and Type E-3 (high temperature mineral fibre board):
 - .1 apply on flat surfaces and curved surfaces with radius of curvature greater than 250 mm (10 in).
- .3 Installation:
 - .1 Place insulation with joints staggered, sealed and tightly butted.
 - .2 Attach to equipment surfaces with weld pins, studs or clips in staggered rows at 300 mm (12 in) on centre in both directions. Apply speed washers when insulation has been placed on metal pins and cut off excess pin length flush with speed washer.
 - .3 At nozzles, manholes, and access doors;
 - .1 terminate insulation with straight cut with space of 25 mm (1 in) at connection;
 - .2 seal cut with insulation cement bevelled away from flanged or union connections; and
 - .3 cover flanged joint, union, manhole and access doors with removable and replaceable aluminum insulated box overlapping adjacent insulation by 50 mm (2 in) and secured with bands.
 - .4 For irregular shaped portions of equipment use preformed insulation fittings, mitred segments of pipe insulation, or flexible blanket insulation with compressed portions built-up to specified thickness.
- .4 Type E-5 (calcium silicate block) insulation:
 - .1 Apply using high temperature adhesive,
 - .2 Place insulation in double layers with joints tightly butted and staggered and fill voids and openings in assembly with insulating cement.
 - .3 Secure insulation with 1.6 mm (16 ga) stainless steel wire or bands 300 mm (12 in) apart. Use welded studs, clips, flanges or angles as anchors for wire and bands.
 - .4 For irregular shaped portions of equipment, pipe couplings and flanged nozzles; use mitred segments of insulation secured with stainless wire or wrap with type E-4 (high temperature mineral fibre blanket) insulation to thickness equal to that of adjoining insulation.

3.10 PROTECTION AND FINISHING HOT EQUIPMENT INSULATION - INDOOR

- .1 Surface temperature < 200 °C (400 °F):

- .1 E-1 and E-2 insulation:
 - .1 finish with PVC jacket.
- .2 E-3 to E-5 insulation:
 - .1 finish with metal jacket.
- .2 Surface temperature > 200 °C (400 °F):
 - .1 E-4 and E-5:
 - .1 finish with metal jacket.

3.11 COLD EQUIPMENT INSULATION

- .1 Insulate cold equipment where surface temperature of equipment in normal service is less than 14 °C (60 °F)
 - .1 Insulated equipment:
 - .1 Cold water booster pumps.
 - .2 Cold water meter assembly.
 - .3 Water softener.
 - .2 Equipment insulation is not required on:
 - .1 equipment that is supplied with factory applied and finished insulation and jacketing.
 - .3 Cold equipment insulation thickness: 25 mm (1 in) except as otherwise noted.

3.12 APPLICATION OF COLD EQUIPMENT INSULATION

- .1 General:
 - .1 Type E 1 (low temperature mineral fibre blanket) or E 6 (flexible elastomeric closed cell foam):
 - .1 apply on curved surfaces with radius of curvature less than 250 mm (10 in) and on irregular curved surfaces.
 - .2 Type E 2 (low temperature mineral fibre board), E 6 (flexible elastomeric closed cell foam) or E 7 (low temperature phenolic board):
 - .1 apply on flat surfaces, and curved surfaces with radius of curvature greater than 250 mm (10 in).
 - .3 Installation:
 - .1 Secure insulation in place with bands 300 mm (12 in) apart with joints staggered and sealed.
 - .2 For irregular shaped portions of equipment, pipe couplings and flanged nozzles use preformed insulation fittings, mitred segments of pipe insulation, type E 6 (flexible elastomeric closed cell foam) or type E 1 (low temperature flexible blanket) insulation secured with stainless wire.
 - .3 After E 1 (low temperature flexible blanket) and E 2, (low temperature mineral fibre board) insulation is applied, seal holes, corners and jambs with 75 mm (3 in) wide foil faced vapour barrier tape.
 - .4 After E 6 (flexible elastomeric closed cell foam) insulation applied seal butt joints, holes and corners with adhesive.
- .2 Cold pumps:
 - .1 Insulate pump casing:

- .1 one layer of 20 mm (¾ in) type E 6 (flexible elastomeric closed cell foam) insulation adhered to clean oil free metal surfaces by compression fit method with full coverage of adhesive.
- .2 Construct removable, replaceable insulated box consisting of:
 - .1 1.6 mm (16 ga) aluminum or stainless steel sheeting,
 - .2 lined with 50 mm (2 in) thick E 6 (flexible elastomeric closed cell foam), or
 - .3 25 mm (1 in) thick E 7 (phenolic board).
 - .4 Maintain access to packing gland for service with box in place.
 - .5 Vapour seal joints between adjacent insulation and metal casing after box is in place.

3.13 FINISHING COLD EQUIPMENT INSULATION - INDOORS

- .1 E 1 (low temperature mineral fibre blanket), E 2 (low temperature mineral fibre board) and E 7 (phenolic board) :
 - .1 finish with PVC jacket.
- .2 E 6 (flexible elastomeric closed cell foam) insulation:
 - .1 apply thin coat of lagging adhesive, and apply glass mesh.
 - .2 When dry apply indoor or outdoor finish at 400 square feet per gallon. Apply second coat of same material, at same rate of application, after four hours.

3.14 AIR HANDLING SYSTEMS INSULATION

- .1 Externally insulate air handling system components:
 - .1 Conditioned air supply unit casings and plenums, and free standing conditioned air supply fans for both recirculating and non-recirculating type systems, with cooling coils.
 - .2 Conditioned air supply ducts including downstream of reheat coils.
 - .3 Heating only supply air ducts and plenums up to the space served but not in the space itself.
 - .4 Unconditioned supply air ducts and plenums that pass through unheated rooms or spaces.
 - .5 Return air ducts and plenums in unheated spaces.
 - .6 Outside air intake ducts and plenums. For non-recirculating type ventilation systems without cooling coils, terminate plenum or casing insulation 300 mm (12 in) downstream of final heating coil.
 - .7 Mixed air plenums and ducts. For recirculating type ventilation systems without cooling coils, terminate outside air intake insulation 300 mm (12 in) downstream of mixing plenum.
 - .8 Sheet metal blank-off plates behind unused sections of air intake louvers.
- .2 Externally insulate ductwork located outdoors:
 - .1 Supply ducts.
 - .2 Conditioned supply ducts.
 - .3 Return ducts.
 - .4 Exhaust ducts on roof.
- .3 External insulation is not required on:

- .1 casings, ducts or plenums which have been lined with acoustic insulation,
- .2 free standing supply fans, supply ducts and plenums for systems without cooling coils except as noted above for ducts in unheated spaces, and fresh air and mixed air plenums and ducts,
- .3 portions of intake ducts or plenums, unit casings and conditioned air plenums which are of double wall insulated construction,
- .4 pre-insulated flexible ducts.
- .5 factory insulated air handling units.
- .4 Application to rectangular duct systems
 - .1 Exposed:
 - .1 25 mm (1 in) thick type D-2 (mineral fibre board) or 20 mm (3/4 in) thick D-4 (phenolic board).
 - .2 Concealed:
 - .1 25 mm (1 in) thick type D-1 (mineral fibre blanket), D-2 (mineral fibre board) or 20 mm (3/4 in) thick D-4 (phenolic board).
 - .3 Outdoor:
 - .1 25 mm (1 in) thick type D-2 (mineral fibre board) or 20 mm (3/4 in) thick D-4 (phenolic board).
- .5 Application to round and oval duct systems
 - .1 Exposed, and concealed:
 - .1 25 mm (1 in) thick type D-1 (mineral fibre blanket) or D-2 (mineral fibre board).
 - .2 Outdoor:
 - .1 two layers of 25 mm (1 in) thick type D-3 (elastomeric), staggered joints.
- .6 Application to plenums and casings
 - .1 Exposed:
 - .1 Apply two, 25 mm (1 in) thick layers of type D-2 (mineral fibre board), D-3 (flexible elastomeric closed cell foam) or one 25 mm (1 in) thick D-4 (phenolic board).
- .7 General installation requirements:
 - .1 Type D-1 (mineral fibre blanket) flexible insulation:
 - .1 wrap tightly onto the duct work with circumferential and longitudinal joints overlapped minimum of 50 mm (2 in).
 - .2 Type D-2 (mineral fibre board) insulation:
 - .1 secure with bands or vapour barrier tape at centre of each section and at each end and at not more than 900 mm (3 ft) intervals.
 - .3 Type D-3 (flexible elastomeric)
 - .1 wrap tightly onto ductwork and secure with 100% adhesive coverage.
 - .4 Type D-4 (phenolic board)
 - .5 Attach insulation to the duct surface with mechanical fasteners and speed clips at 300 mm (12 in) longitudinal centres in both directions, with not less than 2 rows per side and bottom.

- .6 Where ductwork is 600 mm (24 in) or greater in width, or more than 450 mm (18 in) in diameter, secure insulation on underside with mechanical fasteners and speed clips in staggered rows at 300 mm (12 in) on centre in both directions and not less than two rows.
- .7 Cover angles or standing seams on the outside of plenums, casings and ducts which extend beyond face of applied rigid insulation with;
 - .1 same material and thickness as adjacent ductwork
 - .2 Extend this insulation 75 mm (3 in) on each side of the angle and place tight around the projecting leg of the angle.
 - .3 Apply rigid insulation overlapping edge of flexible insulation on angle so that outstanding part of insulated angle projects through work.
- .8 Seal longitudinal laps and butt joints of vapour barrier jacket with 75 mm (3 in) wide strips of jacket material securely adhered in place with vapour barrier adhesive.
- .9 Cut and mitre rigid insulation at elbows and fittings and attach to ductwork with 50% coverage of adhesive, and mechanical fasteners with speed clips.
- .10 Attach speed washers when insulation has been placed on metal pins and cut off excess pin length flush with speed washer. Re-cover washers with vapour barrier tape.
- .11 At junctions between external insulation and acoustic insulation, overlap external insulation 300 mm (12 in) over acoustic lining.

3.15 PROTECTION AND FINISHING INSULATED DUCTWORK, CASINGS, AND PLENUMS - INDOORS

- .1 General:
 - .1 Use standoffs for duct mounted control accessories.
 - .2 Interrupt covering of ducts, including associated adhesives and insulation, where ducts penetrate fire separations, at electric resistance heaters, and at fuel-burning heaters or furnaces.
- .2 Mechanical protection of exposed duct insulation at floor line:
 - .1 Protect duct insulation at floor line with 1.2 mm (18 ga) stainless steel jacket approximately 100 mm (4 in) high, secured to floor sleeve.
 - .2 Protect ductwork, casings, and plenums where any portion is located less than 2.4 m (8 ft) above the finished floor:
 - .1 Fasten 75 mm x 75 mm x 0.4 mm (3 in x 3 in x 26 ga) stucco embossed aluminum angles to bottom corners of horizontal ductwork,
 - .2 provide same to top, bottom and vertical corners of casings and plenums and to corners of vertical ductwork, and
 - .3 cover edges of angles with vapour barrier tape.
- .3 Concealed ductwork:
 - .1 Tape longitudinal laps and butt joints of vapour barrier jacket, and patch speed washers using vapour barrier tape.
- .4 Exposed ductwork, casings, and plenums:
 - .1 Finish with coated canvas.

3.16 PROTECTION AND FINISHING PIPING, EQUIPMENT, DUCTWORK, CASINGS, AND PLENUMS - OUTDOORS

- .1 General:

- .1 Protect insulated piping, equipment, ductwork, casings, and plenums installed outdoors with weather protective jacketing.
- .2 Piping, equipment, and ductwork, surface temperature < 200 °C (400 °F) - Mastic and Metal:
 - .1 Build-up insulation on top of rectangular ducts to create a roof pitch, minimum slope of 1%.
 - .2 Apply outdoor mastic finish with reinforcing membrane, and re-cover with aluminum jacket secured with bands at maximum 450 mm (18 in) centres.
 - .1 use vapour barrier mastic for cold and dual temperature piping, cold equipment, and all ductwork,
 - .2 use breather mastic for hot piping and hot equipment.
 - .3 Arrange metal overlap joints to sheet water, and caulk corners, joints, seams and penetrations of sheeting with clear silicone.
- .3 Piping, equipment, and ductwork, surface temperature < 200 °C (400 °F) - Self Adhesive Membrane:
 - .1 Build-up insulation on top of rectangular ducts to create a roof pitch, minimum slope of 1%.
 - .2 Apply self-adhesive weather barrier membrane sheeting, in accordance with manufacturer's instructions.
 - .3 Provide FSK jacket on un-faced insulation.
 - .4 Attach membrane with mechanical fasteners on underside of ductwork, plenums and casings, and seal washers with 100 x 100 mm (4 x 4 in) patches of membrane material.
 - .5 Attach membranes to sides and top of insulation, an lap as required. Roll-out membrane using a laminate roller.
 - .6 Recover with aluminum jacket secured with bands at maximum 450 mm (18 in) centres.
- .4 Hot equipment, surface temperature > 200 °C (400 °F) - Mastic and Metal:
 - .1 Build-up insulation on top of rectangular ducts to create a roof pitch, minimum slope of 1%.
 - .2 Apply outdoor breather mastic finish with reinforcing membrane, and re-cover with stucco embossed aluminum jacket secured with bands at maximum 450 mm (18 in) centres.
 - .3 Arrange metal overlap joints to sheet water, and caulk corners, joints, seams and penetrations of sheeting with clear silicone.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Test, adjust, and balance (TAB) exhaust fan systems installed.

1.2 QUALIFICATIONS AND PERFORMANCE STANDARDS

- .1 Balancing to be performed under supervision of recognized expert with an established reputation in this field.
 - .1 TAB contractor to be a member of AABC or NEBB
- .2 Perform testing and balancing in accordance with:
 - .1 SMACNA Testing, Adjusting and Balancing guidelines,
 - .2 Associated Air Balancing Council standards for Total System Balance.

1.3 PREPARATORY WORK

- .1 Review design drawings and specifications, shop drawings, interference drawings and other related documentation to become familiar with their intended performance.
- .2 Carry out site visits during later stages of construction to ensure that arrangements for TAB are incorporated.
- .3 Confirm proper placement of thermometer wells, test ports, pressure gauge cocks, balancing valves, balancing dampers and splitter dampers, and access doors.
- .4 Submit TAB schedule, with descriptive data outlining procedures and sample forms showing method of data presentation, three months before start of TAB work on site.
- .5 Provide details of specific procedures to be used for determining test parameters from test measurements and criteria proposed to establish compliance with specification requirements.
- .6 List instruments to be used, method of instrument application (by sketch) and correction factors.
- .7 Calibrate instruments in accordance with recognized standards, and submit calibration curves not more than three months before commencement of TAB.
- .8 TAB measurements to commence when building is "closed in" and work is sufficiently advanced to include;
 - .1 Installation of ceilings, doors and windows.
 - .2 Application of sealing, caulking, and weather stripping.
 - .3 Normal operation of mechanical systems.

1.4 SYSTEMS, EQUIPMENT AND RELATED CONTROLS REQUIRING TAB

- .1 Exhaust Fans

PART 2 - AIR MOVING SYSTEMS

2.1 PARAMETERS

- .1 Listed below is an outline of the information to be established in the TAB process:

- .1 Air flow related;
 - .1 Air velocity
 - .2 Flow cross sectional area.
 - .3 Static pressure.
 - .4 Velocity pressure.
- .2 Temperature related;
 - .1 Wet bulb.
 - .2 Dry bulb.
- .3 Equipment related;
 - .1 rotational speed (rpm)
 - .2 Electrical power,
 - .3 Voltage.
 - .4 Current draw.
- .2 Measurement are required to characterize system performance;
 - .1 at main ducts.
 - .2 at branch ducts.
 - .3 at sub-branch ducts.
 - .4 at each supply, exhaust and return air inlet and outlet.
 - .5 in each thermostatically controlled zone.

2.2 GENERAL CRITERIA

- .1 Balance systems so that fans operate at lowest possible speed and static pressure consistent with delivery of specified air quantity at most remote terminal point.
- .2 Set-up supply fans with sufficient speed to deliver required air quantity when filters are loaded to manufacturers recommended maximum pressure drop. Temporarily block filters to achieve maximum pressure drop at design air flow.
- .3 Air quantities at each exhaust system inlet and supply system outlet are to be measured and throw and pattern is to be adjusted at each supply outlet.

2.3 FAN PERFORMANCE ASSESSMENT

- .1 Measure air quantity by taking anemometer traverses across a coil or at a filter bank or by pitot tube traverse in a straight section of duct at fan suction or discharge.
- .2 Measure static pressure difference between fan inlet and discharge, motor amperage and fan speed in rpm. Determine motor input power from a curve showing power output as a function of motor amperage for the particular motor.
- .3 Plot results of measurements on fan characteristic curve supplied by fan manufacturer and the air volume, static pressure and fan speed lines should form a triangle enclosed by a rectangle with a dimension of not more than 15% of the rated static pressure by a dimension of not more than 10% of the specified air quantity. Input power taken from the fan characteristic should be within 10% of the power determined from the motor amperage readings.
- .4 If required precision is not obtained, readings to be repeated. If subsequent testing shows that the required precision is unobtainable then fan manufacturer is to submit written report explaining actual fan performance and provide new characteristic curve showing actual performance for fan "as installed".

- .5 Measure static pressure loss across cooling coils, heating coils and individual filter banks and tabulate readings with manufacturers published pressure loss figures for the actual measured air volume.

PART 3 - EQUIPMENT TESTING

3.1 PERFORMANCE DATA

- .1 Submit the following data as a minimum. If contractor's standard forms provide for additional data, also submit such additional data.
 - .1 Include nameplate data and as-tested results.
- .2 Motors:
 - .1 manufacturer,
 - .2 model or Serial number,
 - .3 amperage and voltage,
 - .4 horsepower,
 - .5 RPM,
 - .6 corrected full load amperage,
 - .7 measured amperage and voltage,
 - .8 calculated BHP (kW).
- .3 Fans:
 - .1 manufacturer,
 - .2 model or Serial number,
 - .3 flow rate
 - .4 RPM,
 - .5 static pressures (suction and discharge),
 - .6 pulley size, type and manufacturer,
 - .7 belt size and quantity.
- .4 Pumps:
 - .1 manufacturer,
 - .2 model or Serial number,
 - .3 flow rate,
 - .4 developed pump head,
 - .5 RPM.
- .5 Heat Transfer Equipment:

- .1 manufacturer and type,
- .2 inlet and outlet temperatures,
- .3 pressure drop,
- .4 flow rate.

PART 4 - REPORT PRESENTATION AND VERIFICATION

4.1 REQUIRED REPORTS

- .1 Provide the following reports:
 - .1 Air and water balancing report
 - .2 Alternate season test report.

4.2 REPORT FORMAT

- .1 Reports to incorporate approved standard forms, with values expressed in SI and (Imperial) units.
- .2 Include "as-built" system schematics showing flow quantities and measurement points. Use as-built drawings and ventilating line diagrams for references.
- .3 Submit four hard copies of TAB reports, with index tabs, in "D" ring binders, for verification.
- .4 Submit two soft copies of TAB reports in Adobe Acrobat V7 PDF format.

4.3 ACCURACY

- .1 Adjust systems until operating values within plus or minus 5% of design values are achieved.
- .2 Measurements to be accurate to within plus or minus 2% of actual values.

4.4 SPOT CHECKS

- .1 After review of the Draft Report by the Consultant and at the Consultants direction, retest up to 30% of all measurements in locations as directed by the Consultant, at no cost extra to the contract.
- .2 If results indicate unusual testing inaccuracy, omissions, or incomplete balancing/adjustment, in the opinion of the Consultant, re balance entire affected system(s) at no increase in Contract Price.

4.5 BALANCE POSITION MARKING

- .1 Mark the balance position of dampers and valves at the completion of the final testing:
 - .1 Ductwork: indicate with arrow using paint or permanent marker,
 - .2 Exposed ductwork in public areas: self adhesive label, placed adjacent to balancing damper, neatly filled in with % open or degree open value.
 - .3 Valves: self-adhesive label, placed on piping (insulated or not) adjacent to valve, neatly filled in with either % valve open, or number of valve turns to open.
- .2 Additional requirements for Double Regulating Valves:
 - .1 Remove valve handle or other protective device, and set memory stop to limit valve open travel. Replace valve handle or protective cover.

4.6 RECORD KEEPING

- .1 Keep records of trial and final balance and submit preliminary report as each system is completed.
- .2 Make spot checks as requested and repeat balancing of system if actual spot check quantities do not agree with preliminary report figures.

4.7 VERIFICATION

- .1 Reported measurements will be verified.
- .2 Provide instrumentation and manpower to verify results of up to 30% of reported measurements.
- .3 Number and location of verification measurements to be at discretion of Engineer.
- .4 Where discrepancies are encountered repeat TAB, and resubmit reports.

4.8 COMPLETION

- .1 Continue TAB until reports are approved.
- .2 The Substantial Performance of the Mechanical Work will be considered reached when the initial Start Up and Performance Testing report is accepted by the Consultant and in the opinion of the Consultant all systems have been satisfactorily installed, operated tested, balanced, and adjusted to meet the specified and intended performance.
- .3 The substantial performance is not dependent upon alternate season testing.
- .4 The total performance of the Mechanical Subcontract (Contract) will not be considered reached until the alternate season testing and balancing is completed and the final report submitted and accepted by the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide commissioning of mechanical systems provided under Division 20.
- .2 Mechanical system installation, start up, testing, balancing, preparation of O&M manuals and operator training are the responsibility of the Division 20 Contractors, with the coordination of the commissioning process the responsibility of the General Contractor/ Construction Manager.
- .3 All mechanical and BAS systems shall be commissioned.
- .4 Mechanical Contractor shall make allowances for participation in a robust commissioning process and activities where commissioning planning, scripts and execution are to be followed by the mechanical contractor.
- .5 Coordinate commissioning activities with other trades to ensure equipment is powered and ready for manufacturer's start-up, commissioning and training.
- .6 Fuel system final acceptance by Owner shall be predicated on written acceptance by TSSA.
- .7 Coordinate and provide manufacturer's startup of equipment.

1.2 RELATED WORK

- .1 Commission mechanical systems in conjunction with:
 - .1 Section 20 08 05, Testing, Adjusting and Balancing
 - .2 Section 20 08 19, Project Close Out Mechanical

1.3 REFERENCE STANDARDS

- .1 Comply with the latest edition of the following:
 - .1 ASHRAE Guideline 1 1996 The HVAC Commissioning Process, as amended herein.

1.4 COMMISSIONING PROCESS

- .1 The Commissioning process develops, coordinates, and documents the following:
 - .1 Equipment start up
 - .2 Control system calibration
 - .3 Testing and balancing
 - .4 Verification and Performance Testing
 - .5 Operation documentation
 - .6 Operator training
- .2 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

1.5 WORK INCLUDED

- .1 Commissioning work of Division 20 includes, but is not limited to:
 - .1 Testing and startup of equipment.
 - .2 Testing, adjusting and balancing of air systems.
 - .3 Cooperation with the Commissioning Authority in developing and implementation of the commissioning plan.
 - .4 Providing qualified personnel for participation in implementing commissioning test procedures, including seasonal testing required after the initial testing.
 - .5 Providing equipment, materials, and labour as necessary to correct construction and/or equipment deficiencies found during the commissioning process.
 - .6 Providing operation and maintenance manuals, and as built drawings to the Commissioning Authority for verification.
 - .7 Providing training and demonstrations for the systems specified in this Division.
- .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 Generator room ventilation
 - .2 Electric heating systems
 - .3 Air distribution and exhaust systems
 - .4 Building Automation Systems
 - .5 Fuel systems
- .3 Commission 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 Mechanical Contractor or their sub-trades and is included in the value of the Work.
- .4 Commission services to equipment, but not the equipment itself, where the supply of the equipment does not form part of the mechanical Work.
- .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 Authority.

1.6 EXCLUDED WORK

- .1 Unless otherwise specified, equipment which is not supplied by the mechanical 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 Mechanical Contract (NIMC).

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 PDF 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 HVAC Systems
 - .2 Building Automation Systems
- .5 Provide three (3) CD R or DVD R copies of commissioning documentation.

1.10 SUBSTANTIAL PERFORMANCE

- .1 Substantial Performance
- .2 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, including TAB reports,
 - .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 commissioning process.
- .2 Utilities (water, gas, fuel oil, electrical power) are provided by the Owner
- .3 Provide any proprietary test equipment and software required by equipment manufacturer for programming and / or start up, whether specified or not.
- .4 Manufacturer provides test equipment, demonstrate its use, and assists in the commissioning process as needed.
- .5 Turn-over proprietary test equipment to the Owner upon completion of the commissioning process, where such requirement is specified in the relevant equipment specification sections.

PART 2 - ORGANIZATION

2.1 GENERAL

- .1 Complete all phases of work so that the systems can be started, tested, balanced, and owner's acceptance procedures be undertaken in a timely manner such that only one acceptance test is conducted at any one time.
- .2 Participate and assist in the development of the Commissioning Plan and 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 commissioning test results,

- .4 Commissioning Authority:
 - .1 develops commissioning plan and procedures,
 - .2 coordinates Owner's commissioning team members who witnesses tests,
 - .3 selectively witnesses commissioning tests on an audit basis to confirm compliance by the Contractor to the Commissioning Plan,
 - .4 reviews commissioning test results and makes recommendations to the Owner for acceptance.
- .5 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.
- .6 Mechanical trades Contractors:
 - .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 20 scope of Work. 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 components 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.
- .7 Controls Contractor, in addition to the requirements described above:
 - .1 Provide test reports using own documentation formats, for wiring tests, loop testing, loop tuning, and sequence functional tests.
 - .2 Provide details of the control system, schematics, and a narrative description of control sequences of operation.
- .8 Electrical Contractor:
 - .1 provide a foreman electrician familiar with the electrical interlocks, interfaces with emergency power supply, and interfaces with alarm and life safety systems. Provide access to the contract plans, and all as built schematics of sub systems, interfaces and interlocks.
- .9 Equipment suppliers:
 - .1 provide the services of manufacturers' service personnel to provide assistance with pre start and initial startup of the equipment, as required.

PART 3 - EXECUTION

3.1 COMMISSIONING MEETINGS

- .1 Conduct, chair, and record 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 Controls Validation
 - .7 Appendices.
- .3 Document Sign Off:
 - .1 each completed procedure is signed off by the following parties:
 - .1 Contractor, for testing,
 - .2 Commissioning Consultant, for review and witnessing,
 - .3 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 preprinted manufacturer installation and startup checklists are permitted and encouraged; however, the commissioning procedure checklists may contain supplemental items.
- .6 Installation Verification Systems:
 - .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 Controls Validation:
 - .1 Step by step testing methodologies to prove the functional operation of control systems, for normal and abnormal operating conditions, and alarm conditions.
- .9 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: complete the pre-start, start-up and testing, and adjusting and balancing tests. On completion of this phase, complete the related documentation and submit to the Commissioning Authority and Consultant.
- .2 Steps 2 and 3: on completion of Step 1, conduct the Verification and Validation testing of the operating systems. Identify deficiencies and correct. After the deficiencies have been corrected, notify the Commissioning Authority and agree on dates to demonstrate the commissioned systems.
- .3 Step 4: where the Commissioning Authority identifies systems which require witness demonstration, repeat Steps 2 and 3. These demonstrations may be coordinated with training demonstrations of Owner's operations staff.
- .4 On completion of systems which do not require witness demonstration, finalize the report and submit to the Commissioning Authority and the Consultant for review.
- .5 On completion of systems which have been witness demonstrated, the Commissioning Authority is to sign-off the completed document, before they are issued for review.

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 of the Building Automation System.
- .3 Validate the results of the TAB report.
- .4 Roles and Responsibilities:

Organized by:	General Contractor
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Organized by:	General Contractor
Test sheets provided by:	Commissioning Authority
Testing Conducted by:	Div 20 Contractors
Testing recorded by:	Div 20 Contractors
Tests witnessed by:	Commissioning Authority (selected tests) Design Consultant (selected tests)
Reports reviewed by:	General Contractor Commissioning Authority Design Consultant Owner
Reports Accepted by:	Owner

3.5 OPERATING CHECKS

- .1 The Commissioning Authority 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 shut down
 - .2 Normal auto position
 - .3 Normal manual position
 - .4 Unoccupied cycle
 - .5 Emergency power operation, including transition states.
 - .6 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 cycle that applies to the system being tested.
- .5 Check the operating condition of the following elements during all modes of operation of the system:
 - .1 Safety interlocks
 - .2 Alarms
- .6 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.
- .7 Verify the operational control of the systems through the Building Management System as follows:
 - .1 TAB airflow rates and calibrate terminal boxes in all modes of operation
 - .2 Equipment operation in both heating and cooling modes.
- .8 Verify the proper responses of instrumentation and control devices (actuators) as follows:

- .1 For each controller or sensor, record the indicated monitoring and control system reading, and the test instrument reading.
- .2 If the initial test indicates that the test reading is outside of the control range of the installed device, check the calibration of the installed device and adjust as required. Re-test the deficient device and record the results on the checklist data sheets.
- .9 The Commissioning Authority witnesses the field verification of the final TAB report as follows:
 - .1 Select, at random, 10% of the report data for verification.
 - .2 The TAB contractor will be provided advance notice of the date of retesting, but not the equipment to be tested.
 - .3 The TAB contractor uses the same equipment and instruments used for collecting the original data.
- .10 Test failure is defined as:
 - .1 For all readings other than sound, a deviation of more than 10 percent from the TAB report results.
 - .2 For sound pressure readings, a deviation of 2 dB at any bandwidth, not including differences in background noise readings.
 - .3 A failure rate greater than 10% of the selected items (1% of all TAB test results) will result in rejection of the final TAB report.
- .11 Acceptance
 - .1 The final reports will be reviewed by the Commissioning Authority and the Consultant, to determine if verification is complete and the operating systems are functioning in accordance with the contract documents.
 - .2 The Commissioning Authority, 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 heating and cooling performance (capacity), including but not limited to:
 - .1 Capability of the hydronic and domestic water heating systems to deliver the required flow rate, and temperature.
 - .2 Capacity of electric heating systems at design temperatures.
 - .3 Confirm the ability of the HVAC systems to deliver the required cooling/heating services, at the design supply air temperature, required static pressure, and proper outside air ventilation rate.

3.7 PROBLEM RESOLUTION

- .1 In the event that additional work is required to either correct systems, misapplied equipment, and/or deficient performance under varying load conditions, assist the Owner and Commissioning Authority 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 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.
- .2 Noise measurements during generator full load tests

3.10 SYSTEMS OPERATING MANUALS

- .1 Provide Operating and Maintenance Manuals in accordance with the requirements of section 20 01 01.
- .2 The Systems Operating Manuals (SOM) are in addition to the Operating and Maintenance Manuals (OMM) required under Section 20 01 01.
 - .1 Provided by Commissioning Authority and/or Consultant.

3.11 TRAINING

- .1 Equipment Training:
 - .1 Provide equipment training in accordance with Section 20 01 01. The manufacturer's representative training will emphasize operating instructions and preventative maintenance.
- .2 Systems Training:
 - .1 Systems training is not in the scope of Work for Division 20.
 - .2 In addition to the equipment training described above, provide additional training to describe the operational requirements and design intent of each system.
 - .3 Include classroom instruction, delivered by competent instructors. Place emphasis on overall systems diagrams and descriptions, and design criteria and conditions.
 - .4 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.
 - .5 Training topics to include:
 - .1 Types of installed systems
 - .2 Design intent and design criteria
 - .3 Design constraints
 - .4 Different operating modes - occupied, unoccupied, emergency conditions, etc.
 - .5 Seasonal operating modes
 - .6 System operation
 - .7 Automatic controls

- .8 Service, maintenance, diagnostics and repairs
 - .9 Use of reports and logs
 - .10 Troubleshooting
 - .6 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 startup and shut down of each system.
 - .7 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.
 - .8 Structure each training session based on type of maintenance personnel attending the training session, i.e., Plumbers, fitters, general maintenance, controls technicians, etc. Develop the proposed training plan and obtain approval from the Owner before commencing the training.
 - .9 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 handouts for each session.
 - .2 Collect training material and bind into separate binders.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide documentation deliverables at completion of the Work.

1.2 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 Prepare and submit to the Consultant a comprehensive deficiency list of items to be completed or corrected, as part of the application for a review by the Consultant to establish Substantial Performance of the Work, or for each designated portion of the Work in the case of phased Substantial Performance.
 - .1 Failure to include an item on the list does not alter the Contractor's responsibility to complete the Work.
- .4 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.

1.3 TOTAL PERFORMANCE

- .1 Submit the following documentation with the application for Total Performance. Application for Total Performance cannot be submitted any earlier than the date of Alternate Season testing.
 - .1 Where documentation has already been submitted to the Owner, provide a copy of the transmittal.

SUBSTANTIAL 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.

- .2 Contractor has compiled and submitted a detailed deficiency list, identifying work still to be completed, incomplete, or requires correction.
- .3 Equipment start up reports (Interim).
- .4 Building department inspection reports.
- .5 TSSA pressure piping inspection reports
- .6 TSSA fuel system field inspection reports
- .7 ESA field inspection reports.
- .8 Air and Water Balancing reports (Interim).

- .9 Acoustic survey report.
- .10 Vibration survey report (if specified).
- .11 Controls / BAS operation report.
- .12 Equipment, pipeline, and valve identification completed
- .13 Clean-up completed.
- .14 Spare parts and replacement parts turned over to Owner; transmittal attached.
- .15 Warranty certificates
- .16 Operating and Maintenance Manuals, draft, submitted.
- .17 As-built drawings submitted
- .18 Training completed and attendance logs submitted.
- .19 Commissioning reports submitted and reviewed by Consultant

CONSULTANT REVIEW	
Status:	<input type="checkbox"/> Reviewed <input type="checkbox"/> Incomplete or deficient - resubmit
Signed:	
Date:	

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.

- .20 All known deficiencies have been corrected, including latent deficiencies reported by the Owner.
- .21 Air and water balancing - final versions including alternate season testing completed and submitted.
- .22 Final commissioning reports submitted and accepted by Owner.
- .23 Operating and Maintenance manuals - finalized and submitted (if final version was issued at time of Substantial Performance indicated here:
- .24 As-built drawings final version submitted (if final version was issued at time of Substantial Performance indicate here:

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

NOT USED

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide fuel oil systems as shown including but not limited to:
 - .1 Veeder Root console and probes with Bacnet gateway (see specification section 25 51 00)
 - .2 Fuel storage tanks, piping, valves, filters, flex hoses and special fittings
 - .3 Fuel polishing system with Bacnet Gateway
 - .4 Pumps and pump control panels with Bacnet gateway
 - .5 Bacnet interface and monitoring by BAS for above noted systems
 - .6 Fuel piping shall be welded. Weld inspection shall be by of 20% of the welds. Should results not be satisfactory 100% of the welds will be inspected and x-rayed
- .2 Provide fuel pipe flushing and waste disposal as required
- .3 Provide fuel pipe pressure test reports
- .4 Contractor shall coordinate, apply, pay for and obtain all variances and permits from TSSA required for filling and operation of the fuel oil system
- .5 Coordinate welding and inspections of fuel oil piping. Refer to specification section 20 05 24 Pipe Welding.

1.2 SHOP DRAWINGS

- .1 Submit manufacturer's data sheets for storage tanks, valves, special piping, and oil pumps with model numbers, performance and design data, outline dimensions and power requirements.

1.3 APPLICABLE CODES AND STANDARDS

- .1 Legislation:
 - .1 CSA B139 Series 15 Installation Code for Oil-Burning Equipment
 - .2 National Fire Code.
- .2 Installation standards:
 - .1 NFPA 85: Boiler and Combustion Systems Hazards Code,
 - .2 NFPA 30 Flammable and Combustible Liquids Code
 - .3 NFPA 31 Standard for Installation of Oil Burning Equipment
 - .4 NFPA 37 Stationary Combustion Engines and Gas Turbines
- .3 Product standards:
 - .1 CAN/ULC-S602, Aboveground Steel Tanks for Fuel Oil and Lubricating Oil.
 - .2 ULC-S601, Aboveground Horizontal Shop Fabricated Steel Tanks.
 - .3 ANSI/API 650, Welded Steel Tanks for Oil Storage.

- .4 American Petroleum Institute (API).
- .5 API RP 651, Cathodic Protection of Aboveground Petroleum Storage Tanks.
- .6 ULC/ORD-C58, Secondary Containment Liners for Underground and Aboveground Tanks.
- .7 CAN/CSA B139
- .8 ASTM A53 Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless.
- .9 ASME B16.3 Malleable Iron Threaded Fittings
- .10 ASME B16.9 Factory Made Wrought Steel Buttwelding Fittings
- .11 ASME B16.11 Forged Fittings, Socket-Welding and Threaded
- .12 ASME B16.5 Pipe Flanges and Flanged Fittings
- .13 ASME B18.2.1 Square and Hex Bolts and Screws
- .14 ASME B18.2.2 Square and Hex Nuts
- .15 ASTM A106 Standard Specification for Seamless Carbon Steel Pipe for High Temperature Service
- .16 ASTM A307 Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength
- .17 ASTM A563 Standard Specification for Carbon and Alloy Steel Nuts
- .18 ASTM A194 Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both
- .19 ASME B16.21 Non-Metallic Flat Gaskets for Pipe Flanges
- .20 ASME B16.20 Metallic Gaskets for Pipe Flange: Ring-Joint Spiral Wound and Jacketed
- .21 ULC /ORD C107.19 Secondary Containment for Underground Piping for Flammable and Combustible Liquids
- .22 ULC/ORD C107.7 Glass-Fibre Reinforced Plastic Pipe and Fittings
- .23 ULC/ORD C107.4 Ducted Flexible Underground Piping Systems for Flammable and Combustible Liquids.

1.4 DIESEL AND FUEL OIL SYSTEMS

- .1 Piping design code:
 - .1 to ASME B31.1 Power Piping.
- .2 System includes:
 - .1 Controls
- .3 System design criteria:
 - .1 Design pressure aboveground: 1030 kPa (150 psig)
 - .2 Design maximum temperature: 38°C (100°F)

PART 2 - PRODUCTS

2.1 STORAGE TANKS (DAY TANKS)

- .1 Indoor, above-ground installation
- .2 Carbon steel construction
- .3 Capacity: 1100 liters
- .4 Oblong Tank to ULC S602 standard
- .5 Containment: 360 degree double wall
- .6 Vacuum monitored with gauge and switch
- .7 Connections for fill, vent, supply, spares, pressure relief and supply/return piping
- .8 Vent hood termination and prefabricated roof or wall flashing sleeve

2.2 STORGAE TANK (MAIN TANK)

- .1 Indoor, above-ground installation
- .2 Carbon steel construction
- .3 Capacity: 45000 liters
- .4 Horizontal Cylindrical Tank to ULC S601standard
- .5 Containment: 360 degree double wall
- .6 Vacuum monitored with gauge and switch
- .7 Connections for fill, vents, supply, spares, pressure relief and supply/return piping
- .8 Vent hood termination and prefabricated roof or wall flashing sleeve

2.3 TANK PROBES

- .1 Critical High Level Switch set to 95%
- .2 Continuous level with water detection (Main Tank only)
- .3 5-level Float Switch (Day Tank Only) set to
 - .1 90% High-High Level Alarm
 - .2 85% Day Tank Full – Stop Pump
 - .3 70% Day Tank Fill – Start Pump
 - .4 60% Low Level Day Tank / Start Lag Pump / Alarm
 - .5 10% Critical Low Level – shut-down generator

2.4 FLEX HOSES

- .1 Flex hoses to isolate from vibration
- .2 Flex hoses must be ULC listed for intended use

2.5 FUEL FILTERS

- .1 Provide fuel filters with valving option to bypass filters if clogged and valving option to change one filter cartridge while under operation
- .2 Filters shall have 200% capacity of maximum rated fuel flow when generator running under full load
- .3 Water probe and alarm monitored by Veeder Root
- .4 Pressure gauges
- .5 Standard of acceptance:
 - .1 Racor

2.6 ABOVE GROUND - STEEL PIPE FOR OIL SUCTION, DISCHARGE, RETURN AND VENT

- .1 Pipe:
 - .1 NPS 2 and under:
 - .1 ASTM A106 Gr B, schedule 40 Seamless
 - .2 NPS 2-1/2 to 10:
 - .1 ASTM A53 Gr B, schedule 40 Electric Resistance Weld (ERW)
 - .3 NPS 12 and over:
 - .1 ASTM A53 Gr B, 0.375 in wall, ERW.
- .2 Fittings:
 - .1 NPS 2 and under:
 - .1 steel socket welding type to ASME B 16.11, 2070 kPa (300 #) forged, wall thickness to match pipe,
 - .2 1030 kPa (150 #) black malleable iron, bronze face, ground joint unions.
 - .1 Standard of Acceptance
 - 1. Fittings Limited 165
 - .2 NPS 2 and under - high pressure systems:
 - .1 steel socket welding type to ASME B 16.11, 2070 kPa (300 #) forged, wall thickness to match pipe,
 - .2 2070 kPa (300 #) black malleable iron, bronze face, ground joint unions.
 - .1 Standard of Acceptance
 - 1. Fittings Limited 165
 - .3 NPS 2 1/2 and over:
 - .1 welding fittings, wall thickness to match pipe,

- .2 butt weld type to ASME 16.9 or socket weld type to ASME 16.11.,
- .3 long radius elbows,
- .4 tee fittings:
 - .1 prefabricated weld type where branch connections are same size as main,
 - .2 welded tee fittings or welded outlet fittings where branch connections are smaller than main and where main is NPS 2 ½ and over.
- .3 Flanges:
 - .1 NPS ½ and over:
 - .1 forged steel, 1035 kPa (150 #) to ASME B16.5, weld neck with wall thickness to match pipe, or slip on type.
 - .2 gaskets to ASME B16.21, ASME B16.20 or ASME A21.11 of heavy duty graphite impregnated compressed sheet 1.6 mm (1/16 in) thick
 - .1 Standard of Acceptance
 - 1. Chesterton 195
 - .2 NPS ½ and over, high pressure oil lines:
 - .1 Forged steel, 2070 kPa (300#) to ASME B16.5, weld neck with wall thickness to match pipe.
 - .2 Gaskets to ASME B16.5 ring style spiral wound type with carbon steel outer ring and stainless steel inner ring for raised face flanges
 - .1 Standard of Acceptance
 - 1. Flexitallic.
 - .3 Studs, bolts and nuts:
 - .1 "high strength" type to ASME B18.2.1 with ASME 18.2.2 or ASTM A307 with ASTM A563 or ASTM A194.
- .4 Fittings:
 - .1 metal swaged/compression fittings for primary flexible piping,
 - .2 non-metallic VPC adaptors with dual seals, and stainless steel hose clamps for secondary flexible piping,
 - .3 supplied by piping system manufacturer.

2.7 VALVES

- .1 Shut-off or isolation ball valves, Jomar, ULC listed
- .2 Pressure relief valve, Fulflo
- .3 Overfill valve
- .4 Anti-syphon with built-in pressure relief, ULC listed
 - .1 Type:
 - .1 pipe line size, spring loaded, two position angle valve with zinc plated cast iron body, machined seats and Buna-N seals.
 - .2 selected for the hydrostatic head measured from top of tank to generator fuel supply line.
 - .3 fitted with pressure relief trim.

- .1 Standard of Acceptance
 - 1. OPW 199ASV
- .5 Fire Safe Emergency Shut-Off Valves - Aboveground
 - .1 Firesafe ball valve NPS 2 and under, flanged;
 - .1 ends,
 - .2 Spring loaded, held-open actuator, with fusible set to release at 73 C (165 F).
 - .3 ULC listed firesafe valve.
 - .1 Standard of Acceptance
 - 1. Morrison Bros.
- 2.8 FUEL POLISHER
 - .1 Fuel Polisher with control panel for remote monitoring and control; Bacnet MSTP pr Bacnet IP
 - .1 Standard of Acceptance
 - .1 ACM
- 2.9 FUEL TRANSFER PUMPS
 - .1 Positive displacement pumps and control panel
 - .2 Standard of acceptance:
 - .1 Albany Pump
 - .2 Other manufacturer's may be accepted but at the sole discretion of owner
- 2.10 DAY TANK CONTROL PANEL
 - .1 Control panel:
 - .1 microprocessor based programmable relay control, Bacnet MSTP or Bacnet IP
 - .2 LCD display
 - .3 time delay relays (hardware or internal software timer) for day tank level point switches HIGH, LOW, and LOW-LOW set for 5 secs debounce time on level switch power-up,
 - .4 time delay relay (hardware) for day tank high level alarm, set for 5 secs debounce time on level switch power-up,
 - .5 day-tank high level alarm contact wired as permissive interlock for both Auto and Hand operation,
 - .6 numbered terminals for connection of external power and control wiring.
 - .7 factory wired
 - .2 Sequence of operation:
 - .1 When switches are selected for Auto, pumps are started and stopped alternately by level switch in day tank.
 - .2 When switch is in Hand position pump operates.
 - .3 Second low level switch in day tank starts lag pump when switches are in Auto position.

2.11 LEAKAGE DETECTION SYSTEM - TANKS

- .1 Type:
 - .1 monitoring instrument with temperature compensated solid state circuitry,
 - .2 ULC/CSA approved.
- .2 Leak detection sensors:
 - .1 detects presence of liquid in annular space surrounding sensor.
 - .1 Standard of acceptance: Veeder Root
 - .2 Pump drip trays
 - .1 By pump manufacturer, monitored at pump control panel

2.12 LEAK DETECTION SYSTEM – FLOORS

- .1 Veeder Root TLS-350 Plus console
- .2 Provide floor mounted fuel leak detectors in generator and tank rooms
- .3 Type:
 - .1 hydrocarbon detection with oil / water discrimination,
 - .2 ULC/CSA approved.
- .4 Leak detection sensors:
 - .1 Veeder Root

PART 3 - EXECUTION

3.1 PIPING INSTALLATION - ABOVE GROUND

- .1 Above ground piping and piping inside of building:
 - .1 NPS 2 and smaller: socket weld fittings.
 - .2 NPS 2-1/2 and larger: welded, with butt weld fittings.
 - .3 Piping connections to oil pump set, tanks, and other equipment: flanged.
- .2 Slope piping down in direction of tank.
- .3 Locate fittings and joints in accessible chambers.
- .4 Ream steel pipe after cutting to length, clean off scale and dirt inside and outside of pipe.
- .5 Cap ends during construction to prevent entry of foreign matter.
- .6 Use eccentric reducers at pipe size change installed FOT to provide positive drainage.
- .7 Install secondary containment piping over primary flexible piping and into sumps and chambers using entry fittings clamped down on secondary pipe.
- .8 Branch connections, direct welding:

- .1 may be welded directly into steel pipe main provided main is NPS 6 or larger and branch is at least 2 pipe trade sizes smaller than main.
- .2 maximum branch size of NPS 3 on a NPS 6 main.
- .3 Cut openings in main true and beveled.
- .4 Do not project branch pipes inside main pipe.
- .5 Openings to be sized to prevent entry of welding metal and slag into pipes.
- .9 Where saddle type branch welding fittings are used on steel pipe mains hole saw or drill and ream main to maintain full inside diameter of branch line prior to welding.
- .10 Make flanged connections to equipment.
- .11 Apply two coats of bituminous paint to buried steel or steel in contact with concrete.
- .12 Pressure test piping and provide reports

3.2 HANGER INSTALLATION

- .1 Install hangers for steel pipe with spacing and hanger rod diameter in accordance with table 1 or to meet fuel oil piping requirements as per CSA B139-15 whichever is more stringent.

Table 1: Hanger Spacing for Steel Piping

Pipe Size NPS	Rod Diameter	Maximum Spacing
½	10 mm (3/8 in)	1.8 m (6 ft)
¾ to 1¼	10 mm (3/8 in)	2.1 m (7 ft)
1½	10 mm (3/8 in)	2.7 m (9 ft)
2	10 mm (3/8 in)	3.0 m (10 ft)
2½	13 mm (½ in)	3.0 m (10 ft)
3	13 mm (½ in)	3.3 m (12 ft)
4	16 mm (5/8 in)	4.2 m (14 ft)
6	16 mm (¾ in)	5.1 m (17 ft)
8	22 mm (¾ in)	5.7 m (19 ft)
10	22 mm (7/8 in)	6.7 m (22 ft)
12	22 mm (7/8 in)	7.0 m (23 ft)

- .2 Support vertical riser piping:
 - .1 NPS 1 and smaller: every other floor level.
 - .2 NPS 1-1/4 and larger at every floor level.

3.3 LEVEL GAUGE SYSTEM – TANKS

- .1 Provide leak and vapour proof caulking at connections.
- .2 Shield capillary and tubing connections in heavy duty 50 mm polyethylene pipe.
- .3 Calibrate system.

3.4 LEAK DETECTION SYSTEM - TANKS

- .1 Monitor day tank vacuum switch at BAS.

3.5 LEAK DETECTION SYSTEM – FLOORS

- .1 Install leak detection sensors at floor level.
 - .1 terminate at Veeder Root console,

3.6 ALARM MONITORING

- .1 Wire monitoring and alarm outputs from control panels to Building Automation System:
 - .1 Day tank control panels - each tank:
 - .2 Leak alarms
 - .3 Refer to controls drawings

3.7 TESTING

- .1 Conduct air and soap test on secondary containment pipe upon delivery at 35 kPa (5 psi) for 30 minutes.
- .2 Air test primary pipe after assembly at 415 kPa (60 psi).
- .3 Conduct initial pneumatic air test on steel piping at 110% of design pressure. Fill system with No.1 or No.2 fuel oil and conduct service pressure test at design pressure for 2 hours. Test passes if there is no pressure drop over the test duration. Conduct visual check for leaks.
- .4 Coordinate tests with other trades as necessary

3.8 FLUSHING AND CLEANING

- .1 Flush out oil piping after pressure test with No. 2 fuel oil for minimum of 2 hours. Clean strainers.
- .2 Dispose of flushing oil as contaminated waste.

3.9 INSPECTIONS

- .1 Arrange for, apply, pay and obtain TSSA variances as required
- .2 Arrange for, apply, pay and obtain TSSA inspections
- .3 Conduct comprehensive inspection report by qualified personne,
- .4 Provide to Owner a copy of the fuel distributor's inspection report.
- .5 Provide fuel oil delivery inspection reports
- .6 Inspect pipe welding as per specification section 20 05 24 Pipe welding.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide Generator Exhaust systems as shown.
- .2 Conform to UL Listing 103
- .3 Products shall be ULC or cUL listed

1.2 SUBMITTALS

- .1 Shop Drawings: Submit shop drawings of all Generator Exhaust systems used. Include manufacturer's data sheets and installation and support requirements.
- .2 Alternate materials and installation methods are to be submitted for approval minimum of two weeks prior to tender close.

1.3 PERTINENT CODE SECTION(S)

- .1 NFPA 211
- .2 NFPA 37
- .3 CSA B139-15

PART 2 - PRODUCTS

2.1 THE SCHEBLER COMPANY – MODEL P2A

- .1 The factory built modular Generator Exhaust sections shall be tested and listed for use as per UL 103. Section shall bear the cUL listing in Canada. Sections shall be sealed with banded flanges and high temperature joint sealant for temperatures not exceeding 1400 degrees F and 1800 degrees F intermittent operation.
- .2 Inner shell material to be 304 Stainless Steel. Thickness shall be .036" for 6" to 36" diameter systems. All inner shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted.
- .3 Outer shell material shall be aluminized steel with thickness of .034" for 6" to 36" systems. All outer shell seams shall be full penetration welded the entire length of the pipe section. Riveted, tack or spot welded seams are not permitted.
- .4 Outer shell shall be of type 304 stainless steel above the roof line.
- .5 Between the inner and outer shells there shall be a minimum of a 1" air gap and 2" of 1600 degree F rated low conductivity ceramic fibre insulation. The insulation is to be securely attached to the inner shell with steel straps and insulating pins welded to the inner shell. Stainless steel

centering clips shall be welded to the outer shell to maintain the 3" spacing and ensure concentricity of the shells.

- .6 Stacks terminating above a roof must terminate as required by code or NFPA 211 and as outlined in the contract drawings.
- .7 Stacks shall free-stand without the use of guy wires to the following heights: diameters up to and including 11" shall free-stand up to 8ft; diameters 12" and over shall free-stand up to 12ft.
- .8 Utilize a minimum 1/4" thick steel, fully welded, adaptor flange for connection between generator muffler and pre-fabricated Model P2A generator exhaust.
- .9 Product is distributed by DuraSystems Barriers Inc. 199 Courtland Ave. Vaughan, Ontario L4K 4T2 (905)-660-4455, (866)-338-0988. Please contact Gerry Saieva.
- .10 Other manufacturers may be accepted at the sole discretion of the owner.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install Model P2A Generator Exhaust systems in accordance with their listings and the manufacturer's installation instructions.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide motorized dampers as shown.

1.2 RELATED SECTIONS

- .1 Dampers complying with this section:
 - .1 25 35 01: B.A.S. Instrumentation and Actuators
 - .2 Generator room ventilation

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit manufacturer's catalogue literature with:
 - .1 performance charts, pressure drop vs approach velocity for range of blade angles from 0 to 90°
 - .2 torque requirements.
 - .3 construction details.

PART 2 - PRODUCTS

2.1 MULTI-LEAF DAMPERS

- .1 Opposed blade type
 - .1 for other modulating service.
- .2 Performance:
 - .1 leakage in closed position: maximum 2% of rated air flow at 500Pa (2 in wg) differential across assembly,
 - .2 pressure drop in open position: maximum 50 Pa (0.2 in wg) differential at 5 m/s (1000 fpm).
- .3 Construction:
 - .1 blades, insulated: extruded aluminum interlocking double thickness insulated blades,
 - .2 frame, insulated: extruded aluminum, thermally broken,
 - .3 seals: extruded vinyl seals, and spring stainless steel side seals,
 - .4 maximum blade width: 125 mm (5 in),
 - .5 maximum blade length: 1200 mm (4 ft).
 - .6 self-lubricated bronze bearings.
 - .7 blade linkage with steel tie rods, brass pivots and steel brackets.
- .4 Actuator:

- .1 Electric actuators with position feedback
 - .1 Standard of Acceptance
 - .1 Belimo - electric actuators

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Secure dampers within ductwork, air handling units and at air inlets and exhaust outlets, and as shown.
- .2 Caulk around frames and between multiple damper modules with UL listed silicone-free sealant.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide fire dampers as shown.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit manufacturers' product sheets with installation data for:
 - .1 Fire dampers.

1.3 APPLICABLE CODES AND STANDARDS

- .1 General:
 - .1 AMCA 500 Laboratory Methods of Testing Dampers for Ratings.
 - .2 AMCA 503 Fire Ceiling (Radiation), Smoke, and Fire/Smoke Dampers Application Manual.
- .2 Fire dampers:
 - .1 tested in accordance with appropriate provisions of;
 - .1 CAN/ULC - S112 Standard Method of Fire Test of Fire Damper Assemblies
 - .2 ULC CAN4 - S112.2 Standard Method of Fire Test of Ceiling Firestop Flap Assemblies respectively
 - .3 UL-555 Fire Dampers or UL-555C Ceiling Dampers, including tests to demonstrate closure under dynamic conditions.
 - .2 listings:
 - .1 listed by and bearing label of ULC
 - .2 classified by and bearing label of UL, labelled by Warnock Hersey or other approved testing agency.
 - .3 In compliance with requirements of The Ontario Building Code.

PART 2 - PRODUCTS

2.1 FIRE DAMPERS - GENERAL

- .1 Type:
 - .1 "Static": rated only to close with essentially no airflow through damper.
 - .2 "Dynamic": rated to close with air flow through damper.
- .2 Style:
 - .1 Type A: blades and frames in airstream,
 - .2 Type B: blades out of airstream,
 - .3 Type C: blades and frame out of airstream, rectangular, round and flat oval ductwork.
- .3 Ratings, each dynamic damper;

- .1 air velocity, maximum: 10 m/s (2000 fpm)
- .2 differential pressure, maximum: 1000 Pa (4 in wc.)
- .4 Manufacturers:
 - .1 Standard of Acceptance
 - .1 Nailor
 - .2 EH Price (National Controlled Air)
 - .3 Ruskin

2.2 FIRE DAMPERS - CURTAIN TYPE

- .1 Construction:
 - .1 frame: G60 roll formed galvanized steel frame,
 - .2 blades: curtain type, interlocking blades, G60 galvanized steel,
 - .3 sleeve: same material as damper frame, length to suit application with steel enclosure and transition collars, and retaining angles,
 - .4 enclosure: type A and B
 - .5 fusible link: 74°C (165°F) unless otherwise shown.
 - .6 notwithstanding the above, frame, sleeve, and blades to be stainless steel where damper is installed in a duct system which is stainless steel.
- .2 Dynamic dampers:
 - .1 as above, and
 - .2 fitted with stainless steel closure spring,
- .3 Static dampers:
 - .1 as above, and
 - .2 mounting in vertical plane: fitted with stainless steel closure spring.
 - .3 mounting in horizontal plane: fitted with stainless steel closure spring.

2.3 FIRE DAMPERS - AIRFOIL MULTIBLADE TYPE

- .1 Construction:
 - .1 type: dynamic,
 - .2 frame: G60 galvanized steel hat channel,
 - .3 blades: airfoil multiblade type, opposed action, interlocking blades, G60 galvanized steel,
 - .4 linkage: concealed in frame (out of airstream),
 - .5 jackshaft: with internal locking quadrant, for use as a balancing damper,
 - .6 sleeve: same material as damper frame, length to suit application with steel enclosure and transition collars, and retaining angles,

- .7 enclosure: type A and B
- .8 fusible link: high torque spring/fusible link, 74°C (165°F) unless otherwise shown.
- .9 notwithstanding the above, frame, sleeve, and blades to be stainless steel where damper is installed in a duct system which is stainless steel.
- .2 Operator, electric:
 - .1 where required by listing, for multiple damper installations:
 - .2 factory installed electric two position, fail close, operator, 120 VAC motor,
 - .1 electric resettable link: 121°C (250°F), with manual reset button,
 - .2 controlled rate spring closure.

PART 3 - EXECUTION

3.1 FIRE DAMPERS

- .1 Install fire dampers and fire stop flaps throughout supply, return and exhaust air systems.
- .2 Install fire dampers in accordance with manufacturer's instructions, with sleeve, duct connections and angle supports to comply with terms and conditions of listing or classification and maintain integrity of fire wall and/or fire separation.

3.2 FIRE DAMPER SELECTION

- .1 Select damper types as follows:
 - .1 "Dynamic" - all locations,
- .2 Select damper styles as follows:
 - .1 Dynamic damper:
 - .1 requirement in each column must be met.
 - .2 width is duct dimension parallel to blades, height is duct dimension perpendicular to blades.

Duct Velocity	Duct Height	Duct Width	Style
≤ 7.5 m/s	> 300 mm	> 300 mm	A
≤ 7.5 m/s	> 200 mm	> 200 mm	B
≤ 7.5 m/s	> 200 mm	< 200 mm	C
any	< 200 mm	any	C
> 7.5 m/s	any	any	C

Duct Velocity	Duct Height	Duct Width	Style
≤ 1500 fpm	> 12 in	> 12 in	A
≤ 1500 fpm	> 8 in	> 8 in	B
≤ 1500 fpm	> 8 in	< 8 in	C

Duct Velocity	Duct Height	Duct Width	Style
any	< 8 in	any	C
> 1500 fpm	any	any	C

.2 Static dampers:

- .1 requirement in each column must be met.
- .2 width is duct dimension parallel to blades, height is duct dimension perpendicular to blades.

Duct Velocity	Duct Height	Duct Width	Style
≤ 7.5 m/s	> 300 mm	> 300 mm	A
any	any	any	B

Duct Velocity	Duct Height	Duct Width	Style
≤ 7.5 m/s	> 300 mm	> 300 mm	A
≤ 7.5 m/s	> 200 mm	> 200 mm	B

.3 Install individual dampers and/or assemblies of individual dampers within limitations of listing or classification;

- .1 use curtain dampers in single damper installations;
 - .1 for greater clarity, do NOT use curtain dampers in multiple damper assemblies, with or without mullions.
- .2 where duct size exceeds above requirements for curtain dampers, use multiblade fire dampers,
- .3 where listing requires multiple damper assemblies, use multiblade fire dampers,
- .4 where duct size exceeds allowable dimensions for listed or classified multiblade fire damper assemblies, use combination fire and smoke dampers.

.4 Install stainless steel dampers in stainless steel duct systems and/or wherever ductwork is specified to be watertight construction.

.5 Position duct access door at each fire damper, to permit visual inspection and replacement of fusible link.

.6 Install fire stop flaps in accordance with manufacturers' instructions to comply with terms and conditions of listing or classification. Position supplied thermal blankets to cover ceiling diffusers.

3.3 DAMPER ACCESS

- .1 Position duct access door at each fire damper, to permit visual inspection and replacement of fusible link.
- .2 Position duct access door at each combination fire and smoke damper, to permit visual inspection and service of detection/actuation mechanism.
- .3 Provide similar access door upstream or downstream of each smoke damper for visual inspection.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide sound attenuation for generator room ventilation in accordance with ASTM E477, ASTM E90 and ASTM C423, selected to maintain noise levels as per schedule.
- .2 Provide engine exhaust silencers (mufflers).
- .3 Provide silencers in exhaust fan systems.
- .4 Provide shop drawing or product data sheet for each piece of attenuation equipment.
- .5 Provide performance rating data on silencers and acoustic plenums, certified by Professional Engineer and supported by test results in accordance with referenced standards as follows
 - .1 Silencer; Insertion loss, pressure drop.
- .6 Provide noise measurements during generator full load tests

1.2 APPLICABLE CODES AND STANDARDS

- .1 ASTM E477 Standard Test Method for Measuring Acoustical and Airflow Performance of Duct Liner Material and Prefabricated Silencers
- .2 ASTM E90 Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements
- .3 ASTM C423 Standard Test method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
- .4 ASTM C 739 Standard Specification for Cellulosic Fiber Loose-fill Thermal Insulation
- .5 ASTM A653 Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process
- .6 Sheet Metal and Air Conditioning Contractors National Association (SMACNA) material and fabrication specifications.

PART 2 - PRODUCTS

2.1 ACOUSTIC PLENUMS AND PANELS

- .1 Manufacturers:
 - .1 Standard of Acceptance
 - .1 Vibro-Acoustics
 - .2 Vibron
 - .3 Korfund
 - .4 IAC
- .2 Panels:
 - .1 tongue and groove connection type, with individual panels removal for equipment access,

- .2 outer sheet of 1.3 mm (18 ga) thick galvanized steel to ASTM A653, with coating designation Z90,
 - .3 inner sheet of 0.8 mm (22 ga) thick galvanized steel to same specification with 2 mm (3/32 in) diameter perforations on 5 mm (3/16 in) staggered centres,
 - .4 edge frame made up with 1.3 mm (18 ga) galvanized steel channels,
 - .5 horizontal stiffeners of 0.8 mm (22 ga) minimum galvanized steel on 800 mm (32 in) centres.
- .3 Access panels:
- .1 sized for equipment removal,
 - .2 two handles per panel and machine screws around perimeter at 100 mm (4 in) maximum centres,
 - .3 perimeter neoprene sponge gasket.
 - .4 constructed as specified above for standard panel.
- .4 Access doors:
- .1 minimum 510 mm x 1375 mm (20 in x 54 in) opening,
 - .2 constructed as specified for standard panel except with interior sheet unperforated.
 - .3 perimeter neoprene sponge gasket,
 - .4 zinc plated hardware; two butt type nylon bushed hinges and two cam type latches with inside and outside handles,
 - .5 opening against direction of air flow.
- .5 Inspection windows:
- .1 minimum 310 mm x 310 mm (12 in x 12 in) opening,
 - .2 double glazed with 6 mm (¼ in) wire reinforced glass mounted in neoprene 'U' channels.
- .6 Plenum assembly:
- .1 stiffened to limit deflection to 1/200th of span when subjected to pressure differential equal to fan shut off static pressure.
 - .2 fabricated with base sections and flashing of 1.3 mm (18 ga) minimum galvanized steel.
 - .3 externally sealed at panel and flashing joints with 5 mm (3/16 in) diameter bead of elastomeric sealant.
 - .4 sealed between floor channel and floor connection with 3 mm x 13 mm (□ in x ½ in) monolastic tape.
- .7 Openings in panel assembly:
- .1 factory cut and framed where greatest dimension exceeds 310 mm (12 in),
 - .2 located and cut on site where greatest dimension is less than 310 mm (12 in),
 - .3 cut 50 mm (2 in) larger than pipe or conduit and sleeved with 0.8 mm (22 ga) minimum galvanized steel, with

- .4 space between pipe or conduit and sleeve or frame to be filled with acoustic media, covered and sealed.
 - .8 Plenum performance:
 - .1 Assembly RSI to be not less than 1.2 (m².°C)/W at 10°C.
- Certified acoustical transmission loss to ASTM E90 and acoustical absorption to ASTM C423 to be in accordance with following table.

	Octave bands (Hz)					
	125	250	500	1k	2k	4k
Transmission loss, db	21	28	39	50	53	56
Absorption coefficient	0.7	0.9	0.99	0.99	0.9	0.9

2.2 ABSORPTION AND INSULATING MEDIA

- .1 Material:
 - .1 acoustic quality, glass fibre, free of shot and odour.
 - .2 bacteria and fungus resistant.
 - .3 free of corrosion causing or accelerating agents.
 - .4 minimum density of 72 kg/m³ (4.5 lb/ft³) when packed under 10% compression.
 - .5 in accordance with Code fire requirements for duct lining.

2.3 SILENCERS

- .1 Factory manufactured of galvanized or prime painted steel, meeting SMACNA material standards.
- .2 Construction:
 - .1 0.8 mm (22 ga) minimum outer shell with airtight mastic filled seams for rectangular low velocity applications up to 10 m/s (2000 fpm),
 - .2 1.6 mm (16 ga) welded outer shell for rectangular high velocity application over 10 m/s (2000 fpm) and for circular units 600 mm (24 in) diameter and larger,
 - .3 1.2 mm (18 ga) welded outer shell for circular units of less than 600 mm (24 in) diameter,
 - .4 50 mm (2 in) slip connections, and lifting lugs, and
 - .5 acoustic media.
- .3 Fittings:
 - .1 inner casing minimum 0.8 mm (22 ga) perforated metal, enclosing acoustic media, and
 - .2 media erosion protection of mold resistant cloth between media and perforated metal, where airflow gap velocity exceeds 22.5 m/s (4500 fpm).
 - .1 Standard of Acceptance
 - .1 Vibro-Acoustics
 - .2 EH Price

- .3 Vibron
- .4 Korfund
- .5 IAC

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install sound attenuation equipment in accordance with manufacturer's instructions

3.2 MANUFACTURER'S INSPECTION

- .1 On completion of installation and start-up of equipment;
 - .1 make arrangements for manufacturer/supplier of Sound Attenuation equipment to visit site, check performance of noise attenuation 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.

3.3 TESTING

- .1 Engage and pay for an experienced sound and vibration professional to take measurements of sound generated by HVAC systems.
- .2 Co-operate with manufacturer/supplier of Vibration Isolation equipment in this measurement and testing.
- .3 Sound measurements to extend over full audio frequency range and to be taken in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and main electrical rooms.
- .4 Submit outline of tests to be performed, details of instrumentation to be used and floor plans showing test locations prior to commencing work.
- .5 Provide notice one week in advance of commencement of tests.
- .6 Submit complete report of tests addressing noise levels measured in occupied areas and adequacy of Sound Attenuation and Vibration Isolation equipment.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide exhaust fans as shown.

1.2 SHOP DRAWINGS AND PRODUCT DATA SHEETS

- .1 Submit manufacturer's data sheets for:
 - .1 Exhaust fans,
- .2 Provide equipment model numbers, performance and design data, outline dimensions, power requirements, prefabricated curb details, support and connection details and unit weights.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Exhaust fans, to be products from current catalogue of one manufacturer.
 - .1 Standard of Acceptance
 - .1 Penn Ventilator
 - .2 Greenheck
 - .3 Carnes
 - .4 Loren Cook

2.2 EXHAUST FANS

- .1 Construction:
 - .1 centrifugal direct drive,
 - .2 non overloading, statically and dynamically balanced aluminum fan wheels,
 - .3 lubricated ball bearing shaft and motor mounted in compartment isolated from air stream,
 - .4 motor disconnect switch mounted in motor compartment,
 - .5 vibration isolation between static and rotating components,
 - .6 eisenheiss coated wheel,
 - .7 bird screen and gravity backdraft dampers.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install fans,
- .2 Interlock motorized dampers with fan operation, open with fan ON, closed with fan OFF.

3.2 COMMISSIONING

- .1 Check direction of fan rotation and adjust variable pitch drives during balancing.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide heaters as shown.

1.2 SHOP DRAWINGS

- .1 Submit manufacturer's data sheets for unit heaters with:
 - .1 equipment model numbers,
 - .2 performance and design data,
 - .3 outline dimensions,
 - .4 power requirements,
 - .5 support and connection details,
 - .6 equipment weights.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Heating equipment capacities as shown on drawings and specs.

2.2 CABINET UNIT HEATERS

- .1 Casings:
 - .1 surface mounted,
 - .2 1.6 mm (16 ga) steel finished with factory applied baked primer with internal glass fibre insulation,
 - .3 integral air outlet and inlet grilles,
 - .4 removable access panels allowing service of fans, coils, isolating valves and controls,
 - .5 removable 25 mm (1 in) fibrous glass media replaceable filters
- .2 Electric coils:
 - .1 nickel-chrome electric resistance wire embedded in refractory material and enclosed in steel sheathing with low watt density extended fins,
 - .2 arranged for two stage heating with magnetic contactors, high temperature limit switch, and fan override switch built into cabinet,
 - .3 heating elements and fan to be controlled by two stage thermostat and common On/Off control switch.
- .3 Fan:
 - .1 statically and dynamically balanced, double width centrifugal fans with sleeve bearings, direct connected to resiliently mounted three speed single phase motor.

- .2 speed controller and single phase motor starting switch factory wired to motor and mounted inside cabinet behind access door
- .4 Accessories:
 - .1 Starters for remote start capability by BAS where noted (see drawings)
 - .2 Wall mount thermostats where noted (see drawings).
- 2.3 DOOR HEATER
 - .1 Casings:
 - .1 1.2 mm (18 ga) steel, with prime coat finish and angle brackets for connection of hanger rods.
 - .2 four way adjustable air outlet louvres or adjustable multi-vane diffuser on unit discharge.
 - .2 Coils:
 - .1 seamless copper tubing, silver brazed to steel headers with evenly spaced aluminum fins mechanically bonded to tubing,
 - .2 leak tested to 1000 kPa (150 psi) with air under water.
 - .3 Fans:
 - .1 factory balanced belt driven centrifugal type cabinet fans, with motors mounted outside cabinet.
 - .4 Accessories:
 - .1 supplied with line voltage thermostat for remote mounting.

PART 3 - EXECUTION

- 3.1 HEATER SUPPORT
 - .1 Attach heaters to building structure with angles, hanger rods and supplementary suspension steel before installation of piping.
 - .2 Provide spring isolation hangers for door heaters.
- 3.2 CABINETS AND ENCLOSURES
 - .1 Install cabinets tight against furrings, columns, or wall surfaces.
 - .2 Enclosure lengths to be job measured at site where enclosure extends between walls, furrings or similar fixed objects.
 - .3 Provide elements, hangers, hanger brackets and piping connections where enclosures are provided under another Division.
- 3.3 COMPLETION
 - .1 Clean coils and comb fins on finned elements.
 - .2 Re-finish units damaged during installation.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide Building Automation System (BAS) with Direct Digital Control (DDC), and Energy Management for building mechanical and electrical systems.
- .2 Interface with other microprocessor based building subsystems including lighting control systems.
- .3 Include software and hardware, wiring, and computing equipment.
- .4 Expand on existing Honeywell system in the Hospital Building to suit buildout in New Power House.
- .5 Provide interface with EPMS system for all new electrical equipment.

1.2 RELATED SECTIONS

- .1 Building Automation System includes Sections:
 - .1 25 13 01B.A.S. Building Controllers
 - .2 25 14 01B.A.S. Equipment Controllers
 - .3 25 35 01B.A.S. Instrumentation and Actuators
 - .4 25 90 01B.A.S. Sequence of Operations

1.3 EQUIPMENT SUPPLIED FOR INSTALLATION UNDER OTHER SECTIONS

- .1 Supply the following equipment for installation under other Sections of Division 20;
 - .1 Actuators for motorized dampers including associated end switches and relays.

1.4 EQUIPMENT PROVIDED UNDER OTHER SECTIONS

- .1 The following equipment is provided under other Sections of Division 20;
 - .1 unit heater and cabinet unit heater line voltage thermostats
 - .2 manual dampers, fire dampers, gravity dampers, relief dampers

1.5 APPLICABLE STANDARDS

- .1 ANSI/ASHRAE standard 135-2001 BACnet
- .2 ANSI 709.1 Lonworks
- .3 Interfacing Standard:
 - .1 Input/output devices to use ASCII (American Standard for Communication and Information Interchange) code and standard EI (Electronic Industry Association) interfaces.
 - .2 CSA T530: Building Facilities, Design Guidelines for Telecommunications (same as EIA/TIA 569).
 - .3 IEEE 802.3 Ethernet 10Base-T LAN.

1.6 ABBREVIATIONS AND DEFINITIONS

.1 The following definitions, abbreviations, and acronyms apply:

- | | | |
|-----|--------|---|
| .1 | AI | Analog Input: continuously variable value, usually a sensor, referenced to a controller |
| .2 | AO | Analog Output: continuously variable value, usually a control signal to an actuator device, referenced to a controller. |
| .3 | BI | Binary (digital) Input: a two-state (On-Off) value, usually .4 |
| .4 | BO | Binary (digital) Output: a two-state (On-Off) value, usually associated with starting or stopping equipment or generating an alarm, referenced to a controller. |
| .5 | BCU | Building Control Unit |
| .6 | ECU | Equipment Control Unit |
| .7 | FAS | Fire Alarm System |
| .8 | GUI | Graphic User Interface: an LED, LCD or monitor display |
| .9 | I/O | Input/Output |
| .10 | LAN | Local Area Network |
| .11 | NC | Normally Closed: position of device in a de-energized state. |
| .12 | NO | Normally Open: position of device in a de-energized state. |
| .13 | OWS | Operator workstation: a PC based server or computer |
| .14 | Tier 1 | High level network providing communication between BCU's and workstations. |
| .15 | Tier 2 | Lower level network providing communications between ECU's and BCU's |
| .16 | WAN | Wide Area Network |

1.7 MANUFACTURERS AND INSTALLERS

- .1 Provide BAS with DDC and Energy management for mechanical and electrical systems by an organization:
- | | |
|----|--|
| .1 | specializing in design, installation, commissioning and service of open protocol DDC systems, |
| .2 | having completed five (5) projects of similar size and complexity within the preceding five (5) years, |
| .3 | employing certified journeymen experienced in this type of work. |
| .1 | Standard of Acceptance |
| .1 | Honeywell BacNet System |

1.8 CONTINUITY OF STAFF AND SUBCONTRACTORS

- .1 Project Manager is to be nominated at time of shop drawing submission and is to remain involved with project, from shop drawing preparation through to Acceptance, unless request for change is submitted and approved.
- .1 Subcontractors listed in preliminary design submission are to execute work defined as sublet in preliminary design document, unless request for change is submitted and approved.

- .2 Requests for changes in staff, subcontractors, or extent of work subcontracted are to be submitted for approval and such approval is not to be unreasonably withheld.

1.9 IDENTIFICATION OF NON-CONFORMING MATERIALS AND EQUIPMENT.

- .1 Submit documentation at time of bid, identifying nature and extent of non-conformance and variances from specifications or referenced standards.
- .2 Failure to submit this documentation at time of bid will be interpreted as confirmation that materials, workmanship, hardware and software will be in strict accordance with specifications and standards.

1.10 LICENCES AND OWNERSHIP

- .1 Ownership of, and licenses for, hardware and software supplied or used for this project or for ongoing system operation, maintenance and modification to be registered, without restrictions, in Owner's name.
- .2 This is applicable to System Software, Workstation Application Editors, and Controller Software.
- .3 Licensing to permit an unlimited number of users to access system without additional fees.
- .4 As of last day of warranty period, software is to be upgraded to current version or release.
- .5 Project developed software and resulting documentation to be treated as part of system and subject to these same requirements for ownership and licensing. This material includes;
 - .1 Project graphic images
 - .2 CAD generated record drawings
 - .3 Project database
 - .4 Project specific application programming code and documentation.

1.11 SHOP DRAWINGS

- .1 Submit one completely engineered and coordinated shop drawing package. Partial or incomplete submission of data and/or drawings will be returned without review.
- .2 Submit shop drawings for designed elements;
 - .1 list of materials of equipment to be used indicating manufacturer, model number, and other relevant technical data.
 - .2 BAS riser diagram showing system controllers, operator workstations, network repeaters, and network wiring.
 - .3 single-line schematics and system flow diagrams showing location of control devices.
 - .4 points list for each system controller, including: Point Type, System Name, Object Name, Expanded ID, Display Units, Controller Type, Address, Cable Destination, Panel, Reference Drawing, and Cable Number.
 - .5 points to be named by function, and list to include software points such as programmable set-points, range limits, time delays, and so forth.
 - .6 detailed analysis of each Sequence of Operation from design documents, ready for development of actual programming code.
 - .7 Sequence of Operations to cover normal operation and operation under various alarm conditions applicable to that system.
- .3 Submit shop drawings schedules for;

- .1 control damper; spreadsheet type, to include separate line for each damper and columns for damper attributes.
- .2 control valve; spreadsheet type, to include separate line for each valve and separate columns for valve attributes.
- .4 Submit catalogue cut-sheets for;
 - .1 manufacturer's description and technical data, such as performance curves, product specification sheets, and installation/maintenance instructions for equipment and hardware items as follows;
 - .2 Controllers (BCU's and ECU'S)
 - .3 Transducers/Transmitters and Sensors with
 - .1 accuracy data, range and scale information,
 - .2 one sheet for each device marked with applicable options. (Where several devices of same type are to be used, submit one sheet for each device, individually marked.)
 - .4 Actuators
 - .5 Relays/Switches
 - .6 Panels
 - .7 Power Supplies
 - .8 Batteries
 - .9 Operator Interface
 - .10 Wiring and wiring accessories
- .5 hardware data sheets for Operator Interfaces, local panels, and portable operator terminals.
 - .1 Submit supporting documentation:
 - .2 examples of graphics for Operator Interface to include;
 - .3 BAS network schematics
 - .4 typical terminal unit floor plan graphic that shows conditions on occupied floor
 - .5 typical equipment room floor plan graphic
 - .6 typical graphics for each system and terminal unit at least one sample graphic for each type of equipment and system
 - .7 one sample graphic for Data Hall Cooling and Ventilation System
 - .8 one sample graphic for Electrical Room (Spline) Cooling System
 - .9 one sample graphic for hot water system
 - .10 description of techniques used for animation of information displayed on graphics.
- .6 Software manuals for applications programs for Operator Interface, portable operator terminals, and programming devices.
- .7 Protocol Implementation Conformance (PIC) statement for BACnet devices.

- .8 Evidence that LonWork devices are LonMark approved and bear LonMark Logo.
- .9 Where interfaces occur with control or wiring diagrams of other sections, obtain reproducible copies of these diagrams and revise to show terminal numbers at interface and include diagrams as part of interconnection schematic shop drawings.

1.12 PROJECT SCHEDULES

- .1 At time of shop drawing submission provide Gantt type Schedule of Work with;
 - .1 project broken down into discrete work items
 - .2 start date of each work item
 - .3 duration of each work item
 - .4 relationships between work items and showing constraints on work flow.
 - .5 planned delivery dates for ordered material and equipment with expected lead times.
 - .6 procedures.
- .2 During design, installation and start-up of installation provide monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated Schedule of Work with each report.

1.13 WARRANTY

- .1 At completion of Work, submit written guarantee undertaking to remedy defects in work for period of two (2) years from date of acceptance, which includes:
 - .1 rectification of control system failures attributable to defects in workmanship, materials, hardware, and software,
 - .2 Service Technician to arrive on site within 24 hours of warranty service request, to install and de-bug software patches, to replace defective parts, materials or equipment, and to provide incidental supplies, and labour for remedial work,
 - .3 Technician to remain in attendance until system is returned to operating condition.
- .2 Submit similar guarantee for any part of work accepted by Owner, before completion of whole work.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:
 - .1 Temperature - 0° to 32.2°C (32° to 90°F)
 - .2 Relative Humidity 10% to 90% non condensing
 - .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.
- .2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 EQUIPMENT STANDARD

- .1 Products and software: manufacturer/developer/supplier's catalogued current stock.

- .2 This installation is not to be used as test site for newly developed product or software, without explicit written approval.
- .3 Equipment and systems installed under this Contract to meet;
 - .1 performance specifications when subjected to VHF, UHF, FM, AM or background RFI as generated by commercial or private, portable or fixed transmitters that meet regulatory codes.
 - .2 Federal Communication Commission (FCC) Rules and Regulations, Part 15, Subpart J for computing devices.

2.3 GENERAL BAS ARCHITECTURE

- .1 Control system:
 - .1 high-speed, peer-to-peer network of microprocessor based Direct Digital Control (DDC) controllers with web-based operator interface,
 - .2 each mechanical system, building floor plan, and control device to be displayed through point-and-click graphics,
 - .3 Web server with network interface card to gather data from this system and generate web pages that can be accessed through conventional web browser on any PC connected to network,
 - .4 Operators to access this system through web browser, and browser interface to perform normal operator functions.
- .2 Open protocol:
 - .1 Provide an integrated, open protocol building automation system, either/ or in combination:
 - .1 BACnet to ANSI/ASHRAE Standard 135-2001,
 - .2 Lonworks (ANSI 709.1)
- .3 OEM Controller integration:
 - .1 provide hardware and software to allow bi-directional data communications between BAS and 3rd party manufacturers' control panels for;
 - .1 Fuel Management System – Veeder Root
 - .2 Generator Control Panel
 - .3 Honeywell BAS in main Hospital Building,
 - .2 integrate real-time data from these systems.
- .4 BAS network architecture - Dedicated LAN for BAS:
 - .1 BAS communication architecture to consist of at least two tiers with each tier using local area networks.
 - .2 Tier 1: Building Controller network;
 - .1 Ethernet communications (ISO 8802-3/IEEE 802-3), using high speed local area network communications. TCP/IP to be used as communication protocol on first tier network.
 - .3 Tier 2: Equipment Controller network;
 - .1 open, peer-to-peer control networks to interconnect BAS controllers (BCU's and/or ECU's) on ring or star topology bus.
 - .2 Peer-to-peer configuration means units exist and speak equally on same bus.

- .3 Controllers in peer-to-peer configuration can share data without assistance from Operator Interface.
- .5 Bas network architecture - common structured LAN for IT and BAS.
 - .1 Tier 1 : Building Control Network;
 - .1 Structured Tier 1 network
 - .2 Tier 2 : Equipment Controller Network;
 - .1 open, peer-to-peer control networks to interconnect BAS controllers (BCU's and/or ECU's) on ring or star topology bus.
 - .2 Peer-to-peer configuration means units exist and speak equally on same bus.
 - .3 Controllers in peer-to-peer configuration can share data without assistance from Operator Interface.
- .6 BAS network architecture: no network
 - .1 No networking of controllers required.
 - .2 For greater clarity, all equipment controllers are stand-alone devices.

2.4 GENERAL FUNCTIONAL REQUIREMENTS

- .1 Control mechanical and electrical equipment as specified in Control Sequences, shown on Control Schematics, detailed in Points Lists, and described in Equipment Schedules.
- .2 System architecture to be modular, permitting stepped expansion of application software, system peripherals, and field hardware.
- .3 Each controller ;
 - .1 operates with local closed loop programming, independent from server, if peer-to-peer communication is interrupted;
 - .2 performs resident control routines;
 - .1 receiving information from field mounted sensors and switches and
 - .2 transmitting instructions to actuators to perform control sequences.
 - .3 manages local hardware and software alarms;
 - .1 to collect historical data,
 - .2 to facilitate operator input and output and
 - .3 to communicate with Central BAS web server and operator interface.
- .4 Central BAS Web server ;
 - .1 performs global application programs and data consolidation;
 - .1 communicating with controllers,
 - .2 obtaining data from field devices for central monitoring of building systems, and
 - .3 transmitting instructions to controllers.
 - .2 has software routines for;
 - .1 BAS Server operation,
 - .2 database creation and data storage,
 - .3 web based Graphical User Interface (GUI) with graphics generation and display,
 - .4 report formulation, printing, and presentation,

- .5 alarm detection and reporting and
- .6 event initiated programming.

2.5 PERFORMANCE

.1 General:

- .1 information transmission and display times are based upon network, rather than modem, connections.
- .2 test systems using manufacturer's recommended hardware and software for operator interface.

.2 Performance criteria:

- .1 Graphic Display;
 - .1 display graphic with 20 dynamic points with current data within 10 seconds.
- .2 Graphic Refresh;
 - .1 update graphic with 20 dynamic points with current data within 10 seconds and
 - .2 automatically refresh every 15 seconds.
- .3 Configuration and Tuning Screens;
 - .1 special screens used for configuring, calibrating, or tuning points, PID loops, and similar control logic to refresh every 5 seconds.
- .4 Object Command response;
 - .1 time between command of binary object at Operator Interface (OI) and reaction by device to be less than 5 seconds.
 - .2 time between command of analog object at Operator Interface (OI) and start of adjustment to be less than 5 seconds.
- .5 Alarm Response Time;
 - .1 time between when an object goes into alarm and when it is annunciated at Operator Interface (OI) to be less than 15 seconds.
- .6 Program Execution Frequency;
 - .1 execution repeat frequency to be selected in manner consistent with mechanical process under control.
 - .2 custom and standard applications to be capable of executing as often as once every 5 seconds.
 - .3 programmable controllers to be able to perform PID control loop routines at selectable frequency, adjustable at Operator Interface (OI) down to once every second.
 - .4 workstations connected to network to receive alarms with not more than 5 seconds spread between first and last annunciation .
- .7 Reporting Accuracy;
 - .1 system to report values with an end to end accuracy equal to or better than those listed below.
 - .2 control loops to maintain measured variable at set point value within tolerances equal to or better than those listed below.

2.6 CAPACITY FOR FUTURE EXPANSION

.1 Tier 1 network;

- .1 network backbone to have capacity for 50 routers or building controller/routers.
- .2 each router or building controller/router on network backbone to have routing capacity for 50 controllers.
- .2 System to have an overall capacity for 12,500 input/output objects from any mix of controllers, custom application controllers and application specific controllers.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Inspect site and thoroughly examine documents to establish locations for control devices and equipment and report discrepancies, conflicts, or omissions for resolution before starting rough-in work.
- .2 Be responsible for correction of defects caused through neglect of inspections and examinations or failure to report and resolve discrepancies.

3.2 PROTECTION

- .1 Protect work and material against damage during construction and be responsible for work and equipment until inspected, tested, and accepted.
- .2 Protect material not immediately installed and close open ends with temporary covers or plugs during storage and construction to prevent entry of foreign objects.
- .3 Protect electronic equipment from elements during construction.

3.3 COORDINATION

- .1 Coordinate and schedule control work with other work in same area to ensure orderly progress.
- .2 Testing and balancing:
 - .1 Supply set of tools for Testing and Balancing Technicians to interface to control system, train these technicians in use of tools and provide qualified Control Technician to assist with testing and balancing first 10 terminal units.
 - .2 Tools to be turned over to Owners on completion of testing and balancing.
- .3 Controls work by others:
 - .1 Integrate and coordinate this control work with controls and control devices provided or installed by others.
 - .2 Each supplier of control product to configure, program, start up, and test that product to satisfy requirements of Sequence of Operation regardless of where within contract documents product is specified or described.
 - .3 Resolve compatibility issues between control products provided under this section and those provided under other sections or divisions of this specification.

3.4 GENERAL WORKMANSHIP

- .1 Installation to be performed by skilled and certified technicians.
- .2 Install equipment, piping, and wiring or raceways horizontally, vertically, and parallel to building lines.
- .3 Provide sufficient slack and flexibility in connections to allow for vibration isolation between conduit, raceways, piping and equipment.
- .4 Verify wiring integrity to ensure continuity and freedom from shorts and ground faults.

- .5 Install instrumentation and devices in locations providing adequate ambient conditions.
- .6 Protect components placed in areas of potentially high humidity.

3.5 CLEANING

- .1 Clean up debris, remove packaging material, collect waste and place in designated location, on a daily basis.
- .2 Keep work areas free from dust, dirt, and debris.
- .3 On completion of work, check finish of equipment provided under this section for damage and repair damaged factory-finished paint, replace deformed cabinets and enclosures with new material, and repaint to match original.

3.6 FIELD QUALITY CONTROL

- .1 Ensure work, materials, and equipment comply with this specification and approved shop drawings.
- .2 Monitor field installation for code compliance and workmanship quality.
- .3 Arrange and pay for inspections by local or provincial authorities having jurisdiction.

3.7 WIRING

- .1 Electrical materials, equipment and installation procedures under to conform to Ontario Electrical Safety Code as amended to date and standards established in Division 26.
- .2 Conduit:
 - .1 thin wall (EMT) conduit up to and including 32mm (1 1/4 in) size for exposed wiring up to 3 m (10 ft) above floor level,
 - .2 rigid galvanized steel conduit in locations accessible to public, subject to mechanical injury, or outdoors; and for conduit 40mm (1 1/2 in) size and larger,
 - .3 watertight compression fittings in exterior locations.
- .3 Run conduit and raceways parallel to building lines and be secured to building structure.
- .4 Wiring not to be installed in conduit to be installed parallel to building lines and be secured to building structure with clips at minimum 3m (6 ft) centres. Where possible, wiring to run above corridors and in service spaces.
- .5 Wiring in return air ceiling spaces to be plenum rated.
- .6 Where conduit leaves heated areas and enters unheated areas, seal conduit.
- .7 Provide interposing and motor control relays at local item of equipment or at associated MCC as applicable.
- .8 Provide 120 VAC wiring as needed to support operation of system networking hardware, field panels, and controllers. Refer to Section 20 05 13 for description of division of work and responsibility.
- .9 Provide control transformers for system components requiring power supply that do not have integral control transformers.
- .10 Where point schematics and specifications indicate auxiliary contact provision, provide instrumentation, wiring, conduit, power supplies and services as to integrate these points into BAS.
- .11 Mount transformers in enclosures.

3.8 IDENTIFICATION OF EQUIPMENT

- .1 Identify discrete items of equipment with plastic nameplates, identifying equipment and function.
- .2 Identification plates are in addition to manufacturers plates.
- .3 Manufacturers' nameplates and UL or CSA labels to be visible and legible after equipment is installed.
- .4 Identification plates:
 - .1 provided for equipment identified with number designations in schedules and equipment shop drawings.
 - .2 marked with equipment type, number and service following wording and numbering used in contract documents and shop drawings
 - .3 laminated plastic
 - .4 white face and black centre
 - .5 minimum size 75 mm x 40 mm x 3 mm (3 in x 1½ in x 0.118 in),
 - .6 engraved with 6.5 mm (1/4 in) high lettering.
 - .7 securely attached to equipment.
- .5 Label wiring and cabling, including that within factory-fabricated panels, with control system address or termination number at each end within 50 mm (2 in) of termination
- .6 Label pneumatic tubing at each end within 50 mm (2 in) of termination with descriptive identifier.
- .7 Permanently label or code each point of field terminal strips to show instrument or item served.
- .8 Label each control component with permanent label. Label plug-in components so that label remains stationary during component replacement.
- .9 Label room sensors related to terminal boxes or valves with nameplates. Place labels on back of sensors.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide Equipment Controllers ("ECU") for Building Automation System.

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:
 - .1 Temperature - 0° to 32.2°C (32° to 90°F)
 - .2 Relative Humidity 10% to 90% non-condensing
 - .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal,
 - .4 Operating voltage: operate at 90% to 110% of nominal voltage rating and to perform an orderly shutdown below 80% nominal voltage,
 - .5 Operation to be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 1 m (3 ft).
- .2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 EQUIPMENT CONTROLLERS - GENERAL

- .1 ECU's separated into two types: Programmable, and Configurable.
- .2 General:
 - .1 stand alone, multi tasking, multi user, real time digital processors with hardware, software, and communications interfaces, power supplies, and input/output modular devices.
 - .2 removable (hot swappable) without disconnection of terminals and wiring,
 - .3 have access to data within network to accomplish global control strategies.
 - .4 support firmware upgrades without need to replace hardware and to have spare capacity for I/O.
 - .5 continuously perform self diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.
 - .6 monitor status of overrides and inform operator if automatic control has been inhibited, and allow operator to manually override automatic or centrally executed inhibit command.
- .3 Input/Output points:
 - .1 hardwired inputs and outputs to tie into system through various Equipment Control Units (ECU's).
 - .2 protected such that shorting of point to itself, shorting of point to another point, or shorting of point to ground will not damage controller.

- .3 protected such that voltage spikes of up to 24 V, of any duration, and any polarity will not damage controller.
- .4 Analog input: compatible with, and field configurable to commonly available sensing devices using low voltage signals (0-10 VDC), current signals (4-20 ma), or resistance signals from thermistors or RTD.
- .5 Analog output: in form of modulating electronic signal, either voltage mode (0-10VDC) or current mode (4-20mA).
- .6 Digital inputs: allow monitoring of on/off signals from remote devices. Digital inputs to provide wetting current of at least 12 ma and to be compatible with commonly available control devices.
- .7 Digital outputs: provide on/off operation, or pulsed low voltage signal for pulse width modulation control. Digital outputs to be relays, 24 Volts AC or DC maximum, having 3 Amp maximum current. Each relay to be configured as normally open or normally closed, and either dry contact or bussed. Triac outputs are not acceptable.
- .8 Universal inputs: Thermistor Precon Type II, dry contacts, or 0-5VDC with 0-10K Ohm input impedance.
- .4 Spare I/O capacity, each ECU:
 - .1 minimum of 15% spare I/O point capacity for each point type found at each location.
 - .2 15% of each type if input points are not universal,
 - .3 15% of each type if outputs are not universal,
 - .4 Minimum of one spare is for each type of point used.
 - .5 Future use of spare capacity to involve provision of field device, field wiring, point database definition, and custom software. These spare points to be configurable without additional controller boards or point modules. Wiring connections to be made to field removable, through modular terminal strips or termination cards connected by ribbon cable.
- .5 Time Clock:
 - .1 Controllers that perform scheduling operations to have on board real time clock.
 - .2 In network application, time clock synced to associated BCU.
- .6 Communications:
 - .1 communication port (RS-232 DB-9, RJ-11 or RJ-45) for connection to laptop computer or operator interface device to allow memory downloads and other commissioning and troubleshooting operations.
 - .2 communication services over BAS networks to support operator interface performance, and value passing as follows;
 - .1 connection of an operator interface device to any one controller on network to allow operator to interface with other controllers as if that interface were directly connected to those other controllers.
 - .2 data, status information, control algorithms, inputs, outputs, etc., from any controller on network is to be available for viewing and editing through operator interface device that is connected to any controller on network.
 - .3 links to execute control strategies to be programmed and tested so that an operator with appropriate password privileges is able to edit these links either by typing in standard object addresses, or by using simple point and click commands.
 - .4 daily routine automatically synchronize time clocks in controllers. An operator initiated change to master time clock setting to be automatically broadcast to other controllers on network.

- .5 minimum baud rate for peer to peer communication between controllers in system LAN to be at 10 Mbps and communication with low level controllers, to be at 76 Kbps.
- .7 Power interruption:
 - .1 continue to provide control functions in event of network communication failures.
 - .2 incorporate sufficient non volatile memory to store critical configuration data in event of loss of normal power, and sufficient battery backup to support real time clock and volatile memory for minimum of 72 hours.
- .8 Memory:
 - .1 sufficient memory to support its own operating system, including data sharing.
- .9 GUI:
 - .1 face mounted LED type annunciation to display operational mode, and power and communication status.
- .10 Tier 2 LAN:
 - .1 ECU's reside on either ARCNET or MS/TP physical data link layer protocol to provide BACnet internetworking, or reside on LonTalk FTT 10 network and provide data using LonMark standard network variable types and configuration properties.
- .11 BACNet devices, Tier 2 Network;
 - .1 Conformance Class 3,
 - .2 support the BACnet functional groups for
 - .1 Change-of-Value (COV) Event Initiation,
 - .2 Change-of-Value (COV) Event Response,
 - .3 Event Initiation,
 - .4 Event Response,
 - .3 support the BACnet standard application services of;
 - .1 Read Property,
 - .2 Write Property.
 - .4 support the standard BACnet object types of;
 - .1 Device,
 - .2 Analog Input,
 - .3 Analog Output,
 - .4 Analog Value,
 - .5 Binary Input,
 - .6 Binary Output and Binary Value,
 - .7 Loop,
 - .8 Multi-State Input,
 - .9 Multi-State Output,
 - .10 Notification Class at a minimum.

- .5 The described functionality provides reading and writing of all analog or digital inputs and outputs between BACnet devices on the network and provides for change-of-value initiation and reporting.

.12 LonMark/LonWorks devices, Tier 2 Network:

- .1 LonMark or LonWorks devices must be networked from LonTalk to an Ethernet Datalink and IP data structure.
- .2 Binding of LON devices including Domain, Subnet, Node ID, and SNVT's (Standard Network Variables Types) structure and Standard Objects and Functionality Profiles.
- .3 Configuration of network variables for IP tunneling to be responsibility of LON device supplier.
- .4 Supplier of LON devices to arrange and pay for inclusion of Echelon's proprietary LNS Services and LON Manager in software packages.

2.3 EQUIPMENT CONTROL UNIT (ECU) - PROGRAMMABLE

.1 General:

- .1 capable of stand alone, microprocessor based operation.
- .2 fully programmable controller for larger equipment and small systems such as hydronic air handling system, simple chiller or boiler plants, cooling towers and pumps.
- .3 support firmware upgrades without need to replace hardware and to have minimum of 15 percent spare capacity of I/O functions.
 - .1 type of spares to be in same proportion as implemented functions on controller, but in no case there to be less than one point of each implemented I/O type.
- .4 continuously perform self diagnostics, communication diagnosis, and provide both local and remote annunciation of any detected component failures, low battery condition; and upon failure to assume predetermined failure mode.

2.4 EQUIPMENT CONTROL UNITS (ECU) - CONFIGURABLE

.1 General:

- .1 capable of stand alone, microprocessor based operation.
- .2 purpose-built for specific application to which they are applied, including;
 - .1 terminal unit (VAV, CAV, FPVAV) box,
 - .2 unit heaters,
 - .3 fan coils,
 - .4 rooftop unit
 - .5 heat pumps
 - .6 local reheat zones
 - .7 perimeter heating control
 - .8 free standing fans
- .3 Optically isolated from other controllers on communication loop.
- .4 Memory : maintain all BIOS and programming information in the event of a power loss for at least 90 days.

.2 Air terminal units (VAV, CAV and FPVAV boxes):

- .1 integral damper electronic actuator on terminal unit controllers.

- .2 auxiliary universal I/O points for control of reheat coil hot water control valve or SCR electric reheat coil, and a second zone (perimeter) heating control valve or SCR electric baseboard heater.
 - .1 0-10 VDC, or 4-20 mA outputs
- .3 factory calibrated velocity pressure sensor,
- .4 calibration data stored in EEPROM memory for at least 15 velocity/pressure points within terminal unit range,
- .5 terminal units ECU delivered to terminal unit manufacturer's factory for installation.
- .3 Local zone control:
 - .1 wired to wall mounted temperature sensor with jack style communications wiring.

2.5 EQUIPMENT CONTROLLER SOFTWARE

- .1 General:
 - .1 applications software for building systems operation and monitoring and energy management to reside and operate in system controllers (ECU's),
 - .2 using and editing of applications to be available to an operator with appropriate authorization, through operator workstation/browser interface or at other engineering workstations,
 - .3 software to support concurrent operation of multiple standard and non-standard protocols including but not limited to:
 - .1 BACnet
 - .2 LonTalk
 - .3 MODBUS
 - .4 OPC
 - .5 SNMP
 - .4 Memory resident and available to the programs a full library of DDC algorithms, intrinsic control operators, arithmetic, logic, and relational operators for implementation of control sequences.
 - .5 Proportional Control, Proportional plus Integral (PI), Proportional plus Integral plus Derivative (PID), and Adaptive Control (self learning).
 - .6 Adaptive Control algorithm used on control loops, as indicated in the I/O summary, where the controlled medium flow rate is variable (such as VAV units and variable flow pumping loops).
 - .7 Adaptive control algorithm monitor the loop response characteristics in accordance with the time constant changes imposed by variable flow rates. The algorithm operates in a continuous self learning manner and retains in memory a stored record of the system dynamics so that on system shutdown and restart, the learning process starts from where it left off and not from ground zero.
 - .8 Standard PID algorithms are not acceptable substitutes for variable flow applications since they will provide satisfactory control at only one flow rate and will require continued manual fine tuning.
 - .9 Make available DDC setpoints, gains and time constants associated with DDC programs to the operator for display and modification via the central operator interface and portable operators terminal.
 - .10 Adjustable execution interval of each DDC loop from two to 120 seconds in one second increments.

- .11 Assignment of initialization values to all outputs to assure that controlled devices assume a fail safe position on initial system start up.
- .2 Configurable ECU programming:
 - .1 Series of user selectable and configurable pre programmed control functions.
 - .2 Control parameters field adjustable during balancing to compensate for variations in terminal unit installation, type and size.
- .3 Software application programs:
 - .1 Scheduling
 - .1 capable of scheduling each object or group of objects.
 - .2 separate schedules for each day of week with up to five start/stop pairs. (10 events)
 - .3 exception schedules defined up to year in advance and once events on exception schedule day have been executed, definition of the exception schedule day will be discarded and replaced by standard schedule for that day of week.
 - .4 up to 24 holiday schedules may be placed on scheduling calendar and will be repeated each year.
 - .5 ability to override programmed start/stop based on outside temperature reaching or exceeding an adjustable value, operator initiated, individual for each system
 - .2 Optimal Start/Stop
 - .1 Delay startup of each HVAC system to latest possible time which will allow building space to reach target conditions occupancy time
 - .2 Also advance shutdown of each system to earliest possible time.
 - .3 Include modeling techniques using building mass temperature and outdoor air temperature to predict building warm up and cool down times under different outdoor and indoor conditions.
 - .4 Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.
 - .3 Temperature based load control
 - .1 Provide temperature setback or set up according to programmed occupancy schedules with capability to assign separate schedules to each control zone.
 - .2 Control of setback or set up achieved through setpoint adjustment, cycling of systems or cooling plant temperature conditions occupancy time
 - .3 Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.
 - .4 Supply air reset
 - .1 Monitor heating and cooling loads in building spaces and adjust HVAC discharge sensors to most energy efficient levels which will still satisfy measured load. zone.
 - .2 Generate reports to show current value of variables, inputs and outputs involved and estimates of energy savings.
 - .5 Enthalpy Economizer:
 - .1 Program to control outside and return and exhaust air dampers during the cooling season based on inside and outside enthalpy comparisons.
 - .2 modulate dampers to mix outside and return air for free cooling whenever outside temperature is less than the supply air temperature setpoint
 - .3 Use either return or outdoor air to effect smallest enthalpy change across the cooling coil whenever outside temperature is above the supply air setpoint.
 - .6 Grouping of objects

- .1 able to group together objects associated with equipment based on function and location so that group may be used for scheduling, logging, assigning global commands and other applications.
- .2 at a minimum, assemble the following groups;
 - .1 each air handling unit and objects from all terminal units controllers associated with the specific air handling unit
- .3 assemble other groups as directed by the Consultant, Commissioning Agent and Client
- .7 Alarms
 - .1 each binary input and binary value object capable of generating an alarm based on an operator specified state and to have capability to enable or disable this alarm.
 - .2 each analog object capable of generating an alarm based on an operator specified high and low alarm limit and to have capability to enable or disable this alarm.
 - .3 delivered with alarms enabled as listed in Sequences of Operation.
- .8 Electrical demand management
 - .1 capable of managing electrical demand by monitoring power consumption from signals received from pulse generator provided by others mounted at building power meter or from watt transducer or current transformers attached to building electrical feeder lines.
 - .2 If power consumption exceeds operator definable levels, system to be capable of automatically adjusting set-points, de energizing low priority equipment, and taking other pre programmed actions as described in Sequences of Operation to reduce demand.
 - .3 If demand drops below operator defined levels, action will be taken to restore loads in predetermined order.
- .9 Maintenance Management.
 - .1 able to monitor equipment status and generate maintenance alarms based upon user designated run time, starts, or performance limits.
 - .2 configured to deliver maintenance alarms based upon Sequences of Operation.
- .10 Sequencing.
 - .1 able to sequence chillers, boilers, and pumps with lead, lag, standby, priority assignment based upon run time,
 - .2 configured as specified in Sequences of Operation.
- .11 PID Control.
 - .1 PID (proportional integral derivative) algorithm with direct or reverse action, controlled variable, set point, and PID gains user selectable.
 - .2 this algorithm to calculate time varying analog value that is used to position an output object or stage series of output objects.
 - .3 integral windup protection as a fundamental part of PID algorithm.
- .12 Staggered Start.
 - .1 able to prevent controlled equipment from restarting simultaneously on power restoration after power outage.
 - .2 user selectable sequence to establish order in which equipment (or groups of equipment) is started, and time delay between starts.
- .13 Energy Calculations.
 - .1 calculation routines to establish and accumulate instantaneous power demand in kW, flow rates in L/s temperature differences in C? and convert information to energy usage data.

- .2 two algorithms;
 - .1 first one calculates sliding window average with operator specified window intervals.
 - .2 second one calculates fixed window average with digital input signal to define start of window period and synchronize fixed window average calculation with start time used by utility.
- .14 Anti Short Cycling.
 - .1 routines to protect binary output objects from short cycling with operator selected on time and off time minimums.
- .15 On/Off Control with Differential.
 - .1 direct acting or reverse acting algorithm that cycles binary output object based on operator selected controlled variable, set point and differential.
- .16 Run Time Totalization.
 - .1 calculation routine that totalizes run times for any binary input or object with operator selected high runtime alarms.
 - .2 delivered with run time totalization and alarms configured as specified in Sequences of Operation.

PART 3 - EXECUTION

3.1 GENERAL

- .1 Provide ECU's for control and instrumentation strategies as detailed in sequence of operation, and as shown.
- .2 Provide custom programming to meet the control strategies as called for in the sequence of operation sections.
- .3 Install equipment in accordance with manufacturer's recommendations.
- .4 Mount units on modular channel frames (Unistrut or equivalent) adjacent to equipment being controlled.
 - .1 for free-standing frames, provide cross bracing and spread footing to withstand a horizontal seismic force equal to 150% of weight of ECU and support frame.
 - .2 ECU's may be mounted directly to fixed building elements, including columns and walls.
 - .3 Do not mount or attach ECU or mounting frames to any equipment subject to vibration.
- .5 Install piping securely anchored to structure or equipment.
- .6 Make power connections to controller units and sensors.

3.2 TIER 2 LAN DEVICE DENSITY

- .1 Total number of devices on each Tier 2 LAN not to exceed 80% of maximum device limitations (with the use of repeater devices).

3.3 ECU DATABASE

- .1 Configure each ECU and provide database to include:
 - .1 room temperature setpoint,
 - .2 maximum room temperature setpoint: occupant selectable,

- .3 minimum room temperature setpoint: occupant selectable,
- .4 cooling setpoint,
- .5 heating setpoint,
- .6 internal cooling Signal: used to reset supply air temperature if more cooling is required,
- .7 internal Heating Signal: used to reset supply air temperature is less cooling is required

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 Provide Instrumentation, dampers, control valves, and Actuators for Building Automation System.
- .2 Provide actuators for operating dampers provided as part of factory built air handling units.

1.2 RELATED SECTIONS

- .1 Operating dampers provided as part of factory built air handling equipment;

PART 2 - PRODUCTS

2.1 GENERAL

- .1 Provide equipment which functions and meets detailed performance criteria when operating in following minimum ambient condition ranges:
 - .1 Temperature - 0° to 32.2°C (32° to 90°F)
 - .2 Relative Humidity 10% to 90% non-condensing
 - .3 Electrical power service of single phase, 120 VAC +/- 10%, 60 Hz nominal.
- .2 Components installed within motor control devices to be designed to operate with transient electrical fields occurring within these devices.

2.2 POWER SUPPLIES AND LINE FILTERING

- .1 Power Supplies:
 - .1 control transformers to be UL listed,
 - .2 line voltage units to be CSA listed,
 - .3 provide over-current protection in primary and secondary circuits,
 - .4 limit connected loads to 80% of rated capacity.
- .2 DC power supplies:
 - .1 output to match equipment current and voltage requirements,
 - .2 units to be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation to be 1.0% line and load combined, with 100-microsecond response time for 50% load changes,
 - .3 units to have built-in over-voltage and over-current protection and to be able to withstand 150% current overload for at least three seconds without trip-out or failure,
 - .4 units to operate between 0°C and 50°C (32°F and 120°F). EM/RF to meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
- .3 Power Line Filtering:

- .1 provide internal or external transient voltage and surge suppression for workstations and control modules,
- .2 surge protection:
 - .1 dielectric strength of 1000 V minimum,
 - .2 response time of 10 nanoseconds or less,
 - .3 transverse mode noise attenuation of 65 dB or greater,
 - .4 common mode noise attenuation of 150 dB or greater at 40-100 Hz.

2.3 MOTORIZED CONTROL DAMPERS

- .1 Construction:
 - .1 in accordance with section 23 33 13 Dampers Balancing and 23 33 15 Dampers - Fire and Smoke

2.4 TEMPERATURE SENSORS/TRANSMITTERS

- .1 Sensor alternative technologies:
 - .1 Resistance temperature device (RTD) of precision thin film platinum element type;
 - .1 linear characteristics over sensor range,
 - .2 1000 ohm, ± 20 ohms (2%) reference resistance at 0°C (32°F),
 - .3 0/.0385ohms/ohm/°C (0.0212 ohms/ohm/°F) temperature coefficient of resistance and
 - .4 $\pm 0.36^\circ\text{C}$ at 21°C ($\pm 0.65^\circ\text{F}$ at 70°F) accuracy to Din IEC 751
 - .2 Resistance temperature device (RTD) of precision thin film nickel element type, with
 - .1 linear characteristics over sensor range,
 - .2 1000 ohm, ± 20 ohms (2%) reference resistance at 21°C (70°F),
 - .3 5.4 ohm/°C (3.0 ohm/°F) temperature coefficient of resistance and
 - .4 $\pm 0.18^\circ\text{C}$ at 21°C ($\pm 0.34^\circ\text{F}$ at 70°F) accuracy
 - .3 Thermistor with
 - .1 non-linear negative temperature coefficient of resistance,
 - .2 10,000 ohms reference resistance at 25°C (77°F),
 - .3 curve matched to $\pm 0.2^\circ\text{C}$ ($\pm 0.36^\circ\text{F}$) temperature accuracy over 0°C to 70°C (32°F to 158°F), and
 - .4 long term stability of 0.025°C (0.045°F) drift per year
- .2 Each sensor:
 - .1 2 integral anchored lead wires
 - .2 waterproof sensor to sheath seal
 - .3 strain minimizing construction
 - .4 standard conduit box termination with cover
 - .5 pig-tail wire leads with wire nuts or screwed terminal connector block
 - .6 factory calibrated and capable of end to end (sensing element to BAS) accuracy of $\pm 0.25^\circ\text{C}$ ($\pm 0.5^\circ\text{F}$) over full range of measured variable.

- .7 transducing circuit to convert output to signal compatible with equipment controller
- .8 concealed USB or serial communications port for portable PC or hand held commissioning equipment.
- .3 Averaging element type temperature sensors:
 - .1 average style element for ducts of greater cross section than 0.4 m² (4 sq ft).
 - .2 sensor operating temperature range from -40°C to 121°C (-40°F to 250°F)
 - .3 copper sheathed construction
 - .4 non-condensing 5 to 95% RH
 - .5 minimum immersion length of 4000 mm (13 feet)
 - .6 probe field formable to minimum radius of 100mm (4 in) at any point along probe length, other than with 200 mm (8 in) of connector box, without degradation of specified performance
 - .7 provided as multiple sensors where single averaging element cannot be located to provide proper duct or plenum temperature sampling.
- .4 Duct mount probe type temperature sensors:
 - .1 provided for ducts of cross section less than 0.4 m² (4 sq ft)
 - .2 sensor operating temperature range from -40°C to 121°C (-40°F to 250°F)
 - .3 copper or brass or stainless steel sheathed construction
 - .4 non-condensing 5 to 95% RH
 - .5 metal mounting plate
 - .6 length such that sensing element is no less than 1/2 of duct width or diameter from duct wall greater
 - .7 provided as multiple sensors where single element cannot be located to provide proper duct or plenum temperature sampling.
- .5 Outside air temperature sensors:
 - .1 insertion type for through-the-wall installation with stainless steel sheath
 - .2 sensor operating temperature range from -25°C to 60°C (-13°F to 140°F)
 - .3 waterproof seal at wall
 - .4 non-condensing 5 to 95% RH
 - .5 total active probe length of 100 to 150 mm (4 in to 6 in)
 - .6 with non-corroding outdoor shield to minimize solar heating effect and
 - .7 inert section passing through wall to allow precise measurement of outdoor temperature.
- .6 Space temperature sensors, Type 1:
 - .1 for measurement of space temperatures throughout facility

- .2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F)
- .3 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors.
- .4 guard secured to mounting plate by screws.
- .7 Adjustable space temperature sensors with display, Type 2:
 - .1 for measurement and adjustment of space temperatures in rooms at designated location as shown on plans or described in Sequences of Operation.
 - .2 digital key pad or slider control for temperature adjustment, 20°C to 25°C (68°F to 78°F
 - .3 On/Off button to allow occupant override feature.
 - .4 three digit LED digital temperature display with 0.2° display resolution
 - .5 5 to 95% RH non condensing
 - .6 set point operating temperature range from 4°C to 60°C (40°F to 140°F)
 - .7 minimum/maximum limit set point values adjustable from BAS operator interface and controller
 - .8 surface mounted plastic mono-chromatic guard with surface mounting plate and wall anchors.
 - .9 guard secured to mounting plate by screws.
- .8 Space temperature sensors - Secure Areas:
 - .1 for measurement of space temperatures at locations subject to vandalism as shown on plans or described in Sequences of Operation.
 - .2 sensor operating temperature range from 4°C to 60°C (40°F to 140°F)
 - .3 stainless steel flat plate surface type with sensor epoxy-bonded to back of cover plate.
 - .4 tamperproof / secure concealed fasteners.

2.5 HUMIDITY SENSORS - ELECTRONIC

- .1 Each humidity sensor:
 - .1 suitable for operating ranges of 10 to 100% R.H.
 - .2 sensor operating temperature range from -40°C to 121°C (-40°F to 250°F)
 - .3 solid state sensing element,
 - .4 accuracy of $\pm 3\%$ over range of 5 to 95% R.H.
 - .5 independent, non-interactive span and zero adjustments
 - .6 0-100% linear proportional output signal indicating relative humidity, 4-20 mA, 0-5 Vdc or 0-10 Vdc
 - .7 strain minimizing construction
 - .8 dust proof enclosure
 - .9 screwed terminal connector block.

- .2 Duct mount probe type humidity sensors:
 - .1 metal mounting plate
 - .2 constructed with 304 stainless steel element enclosure
 - .3 length such that sensing element is not less than 1/2 of duct width or diameter from duct wall.
- .3 Outside air type humidity sensors:
 - .1 weatherproof enclosure with cover
 - .2 waterproof seal.
- .4 Space humidity sensors:
 - .1 surface mounted plastic guard with surface mounting plate and wall anchors
 - .2 guard secured to mounting plate by screws
 - .3 analogue LCD humidity display.

2.6 ELECTRICAL DEVICES

- .1 Current sensing relays:
 - .1 metering transformer ranged to match load being metered,
 - .2 plug in base and shorting shunt to protect current transformer when relay is removed from socket,
 - .3 current transformer for single or three phase metering connected into single relay,
 - .4 adjustable latch level, adjustable delay on latch and minimum differential of 10% of latch setting between latch level and release level,
 - .5 discrimination between phases in three phase applications to allow worst case selection,
 - .6 mounted in motor starter enclosure and fed from starter control transformer,
 - .7 relay contacts capable of handling 10 amps at 240 volts.
- .2 Current transducer:
 - .1 output signal proportional to measured line current,
 - .2 output signal in one of following ranges; 4-20 mA, 0-5 Vdc or 0-10 Vdc
- .3 Control Relays:
 - .1 plug-in type, UL listed, with dust cover and LED "energized" indicator.
 - .2 contact rating, configuration, and coil voltage suitable for application.
 - .3 NEMA 1 enclosure for relays not installed in local control panels.
- .4 Time Delay Relays:
 - .1 solid-state plug-in type, UL listed, with adjustable time delay adjustable $\pm 100\%$ from set point shown.

- .2 contact rating, configuration, and coil voltage suitable for application.
- .3 NEMA 1 enclosure for relays not installed in local control panels.
- .5 Override Timers:
 - .1 spring-wound line voltage, UL Listed, with contact rating and configuration by application unless implemented in control software.
 - .2 0-6 hour calibrated dial.
 - .3 flush mounted on local control panel face.
- .6 AC Current Transmitters:
 - .1 self-powered, combination split-core current transformer type with built-in rectifier and high-gain servo amplifier with 4-20 mA two-wire output.
 - .2 full-scale unit ranges of 10 A, 20 A, 50 A, 100 A, 150 A, and 200 A, with internal zero and span adjustment.
 - .3 $\pm 1\%$ full-scale accuracy at 500 ohm maximum burden.
 - .4 UL/CSA listed and meet or exceed ANSI/ISSA 50.1 requirements.
- .7 AC Current Transformers:
 - .1 UL/CSA listed
 - .2 completely encased (except for terminals) in approved plastic material.
 - .3 selected for appropriate current ratios with $\pm 1\%$ accuracy at full-scale output.
 - .4 fixed-core transformers for new wiring installation
- .8 AC Voltage Transmitters:
 - .1 self-powered single-loop (two-wire) type, 4-20 mA output with zero and span adjustment.
 - .2 adjustable full-scale unit ranges; 100-130 Vac, 200-250 Vac, 250-330 Vac, and 400-600 Vac.
 - .3 $\pm 1\%$ full-scale accuracy at 500 ohm maximum burden.
 - .4 UL/CSA listed, 600 Vac rated and conforming to ANSI/ISSA 50.1.
- .9 AC Voltage Transformers:
 - .1 UL/CSA listed, 600 Vac rated with built-in fuse protection.
 - .2 suitable for ambient temperatures of 4°C-55°C (40°F-130°F) and
 - .3 $\pm 0.5\%$ accuracy at 24 Vac and 5 Va load.
 - .4 windings (except for terminals) enclosed with metal or plastic.
- .10 Power Monitors:
 - .1 three-phase type with three-phase disconnect and shorting switch assembly,
 - .2 UL listed voltage transformers, and

- .3 UL listed split-core current transformers.
- .4 selectable output either rate pulse for kWh reading or 4-20 mA for kW reading.
- .5 maximum error of $\pm 2\%$ at 1.0 power factor or $\pm 2.5\%$ at 0.5 power factor.
- .11 Current Switches:
 - .1 self-powered, solid-state type with adjustable trip current
 - .2 integral current transformers and relays to indicate motor status
 - .3 SPDT output relay suitable for use as digital input
 - .4 field adjustable output relay trip setting, over 0-100% of range. Deadband adjustment to maximum of 10% of range
 - .5 integral zero-leakage LED's indicating sensor power and switch status
 - .6 long term setting drift of current transformer and relay combination not more than 5% full range over 6 months
 - .7 over current and over voltage protection for current transformer and relay
 - .8 operating temperature range; -10°C to 50°C (14°F to 122°F)
 - .9 operating humidity range; 5% to 90% RH non condensing
- .12 Electronic signal isolation transducers:
 - .1 provided whenever;
 - .1 an analog output signal from BAS is connected to an external control system as an input (such as chiller control panel) or
 - .2 BAS is to receive an analog input signal from an external remote system.
 - .2 designed for ground plane isolation between systems.
- 2.7 LOCAL EQUIPMENT PANELS
 - .1 General:
 - .1 NEMA 2 sheet metal cubicles with vertically hinged lockable doors,
 - .2 sensors, transducers, BAS controllers, and relays mounted on backing board and/or DIN rails within inner section,
 - .3 enclosures sized to house controllers and associated transformers, control relays, wiring, conduits and other auxiliary equipment.
 - .4 engraved lamaroid labels with white lettering indicating function of each sensor, transducer, controller, gauge and instrument.
 - .5 wiring terminations labelled
 - .6 EMT conduit openings and adapters in sufficient quantities and sizes to accommodate wiring terminating within enclosure
 - .7 wiring within enclosure installed in neat and protected manner, enclosed in wireways or plastic conduit.

- .8 inside each panel, one set of as built, plasticized control Shop Drawings for equipment served by that panel permanently affixed to cabinet frame.

2.8 WIRING AND RACEWAYS

- .1 Wiring, conduit, and raceways to Section 20 05 13.
- .2 Wire used for power and control:
 - .1 insulated copper conductors,
 - .2 UL listed for minimum 90°C (200°F) service.
 - .3 Power wiring minimum 12 gauge.
 - .4 Control wiring for digital functions: 18 AWG minimum with 300 Volt insulation.
 - .5 Control wiring for analog functions: 18 AWG minimum with 300 Volt insulation, twisted and shielded, 2 or 3 wire to match analog function hardware.
 - .6 Transformer current wiring: 16 AWG minimum.
 - .7 Sensor wiring: 22 AWG minimum twisted and shielded, 2 or 3 wire to match analog function hardware. Provide additional conductors as to support supplemental features of sensor (i.e. set-point adjustment, override, etc.)

PART 3 - EXECUTION

3.1 INSTALLATION OF SENSORS

- .1 General:
 - .1 Mount sensor assemblies and elements;
 - .1 in clean areas wherever possible,
 - .2 accessible to allow for replacement and servicing without interfering with access for adjacent equipment and personnel traffic in surrounding space,
 - .3 provide access doors where assemblies and elements are concealed.
 - .2 Install transmitters, transducers, controllers, solenoid air valves and relays in NEMA2 enclosures;
 - .1 install wiring and tubing within enclosures in trays or individually clipped to back of panel with identification tags and terminal numbers visible.
 - .3 Rigidly support field mounted transmitters, transducers, and sensors on pipe stands or channel brackets.
 - .4 Orient sensing elements to correctly sense measured variable and to be isolated from vibrations and environmental conditions that could affect measurement or calibration.
 - .5 Identify each cable and wire at every termination point.
 - .6 Air seal wires attached to sensors at entry into junction box.
- .2 Temperature sensors:
 - .1 Install room temperature sensors on concealed junction boxes supported by wall framing.

- .2 Use averaging sensors in mixing plenums and hot and cold decks. Install averaging sensors in serpentine manner vertically across duct. Support each bend with capillary clip.
 - .3 Install mixing plenum low-limit sensors in serpentine manner horizontally across duct. Support each bend with capillary clip. Provide sensor element length to coil area ratio of 3 m per 1 m² (1 ft per 1 sq ft).
 - .4 Install pipe-mounted liquid temperature sensors in wells with heat-conducting material. Where thermowell installation necessitates shutting down of pumps or draining of pumps, coordinate with Consultant and Owner.
 - .5 Cut and recover piping insulation to one foot either way for installation of strap-on temperature sensors. Provide removable insulation box over sensor and patch insulation to match existing.
 - .6 Install outdoor air temperature sensors on north facing wall with sun shield.
 - .7 Mount space temperature and humidity sensors 1200mm (4 ft) above finished floor.
 - .3 Safety controls:
 - .1 Smoke detectors, freezestats, high-pressure cut-offs, and other safety switches and controls to be hard-wired to de-energize equipment as described in Sequence of Operation.
 - .1 unless otherwise shown.
 - .2 Safety switches and controls to require Operator intervention to activate local manual reset.
 - .3 Provide contacts that allow BAS software to monitor safety control status.
- 3.2 ACTUATORS
- .1 General:
 - .1 Mount actuators and adapters according to manufacturer's recommendations.
 - .2 Electric and Electronic Damper Actuators:
 - .1 Mount damper actuators directly on damper shaft or jackshaft
 - .2 Mount valve actuator directly on shaft or with linkages according to manufacturer's recommendations.
 - .3 For low-leakage dampers with seals, mount actuator with minimum 5 degree travel available for damper seal tightening.
 - .4 To compress seals when spring-return actuators are used on normally closed dampers, power actuator to approximately 5 degree open position, manually close damper, then tighten linkage.
 - .5 Provide mounting hardware and linkages for actuator installation.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 This section covers the work for the supply, installation, programming, testing and commissioning of components for a fuel monitoring system.
- .2 The fuel monitoring system will interface with the BAS system. The BAS will monitor Veeder Root alarms via a Chipkin BacNet interface module.

1.2 PRODUCT DATA

- .1 Veeder Root TLS-350 Plus
- .2 Note that the overfill alarm components shall be ULC listed. If not ULC listed provide a stand-alone overfill alarm that meets ULC requirements.
- .3 Submit product data for fuel monitoring system as an electronic copy to engineer with contractor stamp.

1.3 WARRANTY

- .1 Product warranty shall be manufacturer's current standard warranty.

PART 2 - PRODUCTS

2.1 MAGNETOSTRICTIVE PROBE

- .1 Magnetostrictive probe, Veeder-Root Model 847390-105, suitable for a 1256mm (or final selected tank dimension) diameter tank, for continuous monitoring of fuel level.
- .2 Probe complete with installation kit and accessories, including: floats(s), spacer rings, connector assembly, cord grip fittings, Veeder Root 4" Diesel Float Kit Model 849600-101.

2.2 LEAK (LIQUID) SENSOR

- .1 Leak sensors and mounting kits.
- .2 Leak sensor (discriminating type) for installation on floor in generator room, Veeder-Root Model 794380-322.
- .3 Leak sensor for installation in underground fuel storage tank piping sumps, Veeder-Root Model 794380-208 or 209.
- .4 Universal mounting kit including brackets, bolts and clamp.

2.3 INTERSTITIAL SENSOR

- .1 Monitor vacuum switch on tank or provide hydrostatic sensor (see below)
- .2 Single-float hydrostatic sensor for install in the reservoir of aboveground double wall fuel storage to detect fluid change in the reservoir and interstice, Veeder-Root Model 794380-302.
- .3 Plastic riser cap kit including riser cap, cord grip nut, cord grip bushing and vent cap.

2.4 OVERFILL ALARM AND ACKNOWLEDGEMENT DEVICE

- .1 Overfill alarm shall be ULC listed
- .2 Enclosure: painted steel, NEMA 4 with ½" conduit connectors.
- .3 Supply voltage: 120V AC, 60 Hz.
- .4 Actuation from system console (Veeder Root TLS-350).
- .5 Audible alarm: adjustable "Time On" from 0 to 60 seconds.
- .6 Visual alarm: 25 W lamp rating, red polycarbonate lens, 75 flashes per minute.
- .7 Acknowledgement lamp: 120 V, amber lens.
- .8 Veeder Root products 790091-001 (overfill alarm) and 790095-001 (acknowledge switch).

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

- .1 Install fuel monitoring system components (console, probe, sensors, and alarms) at the locations indicated on drawings.
- .2 Follow manufacturer's Installation Manual for each of the system components and use the accessory kits supplied.
- .3 Install and connect probe/sensor wiring. Do not splice wiring between probe/sensor and system console.
- .4 Install and connect wiring between the standby generator control panel and monitoring system console
- .5 Calibrate sensors and program system console to provide the functionality intended (fuel inventory monitoring, leak detection, and other selectable alarms). Connect outgoing alarm wiring as indicated. Retain services of a fuel management system specialist for commissioning of system.
- .6 Test system operations to verify the functionality intended – simulate all monitored conditions to test.

END OF SECTION

CAS-2700-02
Veeder TLS 300, 350, 450
Modbus (RTU and TCP) and BACnet and HTML
Gateway

Description

The Veeder Serial Driver allows the Gateway to poll Veeder TLS Panel's for status, real time and configuration data. Thus the driver can be used to read Tank Inventory, System Status, Tank Alarms, Sensor Alarms and more .

The Veeder Gateway serves data from a TLS panel as Modbus, BACnet or Web data. The gateway supports all these options simultaneously. Use the data you want and ignore the other.

The Gateway connects to the TLS Panel, reads data and stores it internally. When a remote system requests data, this data is served in a form that is appropriate to the protocol. In the event that the connection to the TLS Panel is lost, or data cannot be read, the gateway can signal this to the remote data client.

The gateway requires minimal configuration and can be considered a plug and play component of a system, in that it is ready to operate out of the box with the default configuration.

The driver is a serial driver using a RS232 serial port to connect between the Gateway and the TLS Panel. The Panel must have a suitable RS232 card installed.

Specs.

- **UL and ULc approved**
- 10/100BaseT with RJ-45 connector
- 1x RS232 Port
- 1x RS485 Port (Different Models have additional ports)
- 2MBytes flash memory, 8MBytes of SDRAM
- Power: 5-24VDC
- Operating Temperature: 0 to 70 C
- Dimensions: 4.2" x 3.25" x 1"
- LEDs: Link, Speed/Data, Power

Max Nodes Supported

Gateway Mode	Nodes	Comments
Client	1	<i>Only 1 TLS Panel per connection</i>
Server	0	<i>Not supported or documented.</i>

Connection Information - Port 1: Veeder Port

Connection type:	EIA232
Baud Rates:	Driver Supports : 1200, 2400, 4800, 9600 ; 19200Baud
Data Bits:	Driver Supports : 7, 8
Stop Bits:	Driver Supports : 1,2
Parity:	Driver Supports : Odd, Even, None
Hardware interface:	N/A
Multidrop Capability	No

Connection Information - Port 2: Modbus RTU Server Port

Connection type:	RS485 (Jumper change to RS232)
Baud Rates:	9600 ; 19200 Baud
Data Bits:	8
Stop Bits:	1
Parity:	None
Hardware interface:	N/A
Multidrop Capability	Yes

Devices tested

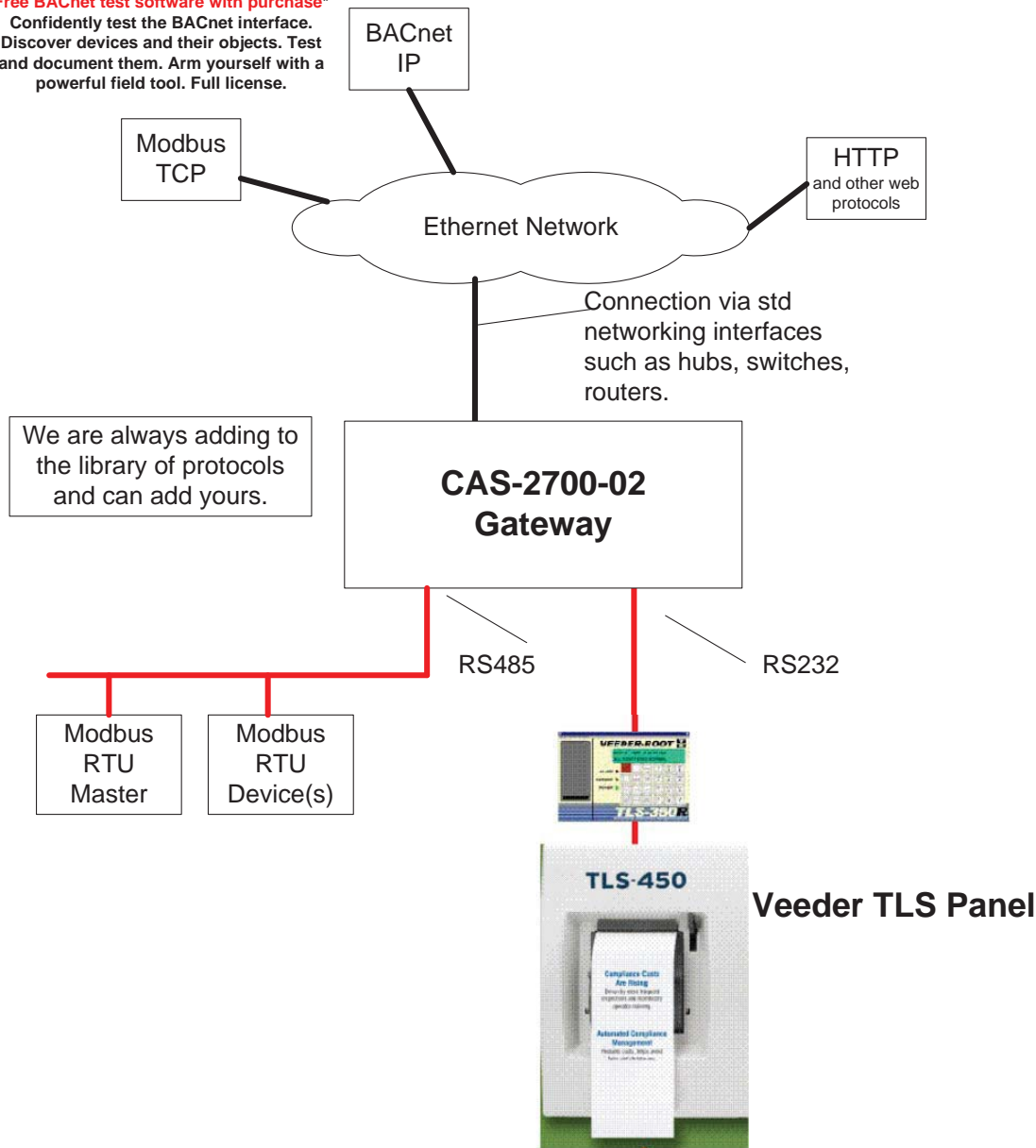
Device	Tested (FACTORY, SITE)
Veeder TLS 300	Tested
Veeder TLS 350	Tested
Veeder TLS 350 Plus	Tested
Veeder TLS 450	Tested

Connection configurations

Monitor and Control **Veeder TLS 300/350/450** Panels using BACnet, Modbus or Web

Free BACnet test software with purchase*

Confidently test the BACnet interface. Discover devices and their objects. Test and document them. Arm yourself with a powerful field tool. Full license.



Driver Operation

The driver can be configured to execute any of the commands in the 'supported function' list. The data sent is stored internally in the Gateway and is made available to other protocols (Modbus RTU, Modbus TCP, BACnet IP and HTML) .

The frequency with each data point is read is configurable. The driver retries on errors or timeouts. If the data cannot be read then after some configurable time it is marked as out of service.

The driver reports operating stats and issues on a web page, maintains a log that can be uploaded by HTTP or ftp.

Configuration

Via Web Page. Configure IP settings, Node ID's, Baud Rate and other parameters.

Users are able to select

Up to 10 Tanks – specify the number and name of each

Up to 10 Sensors – specify the number and name of each

Up to 1 Vacuum Sensor – specify the number and name of each

The names are used to form the names of the BACnet objects and populate the web page showing current values.

Use can specify

ModbusTCP: Node_ID

ModbusRTU: Node_ID, baud, parity, data length, stop bits

BACnet: Device instance number, device name.

Communications functions

Supported functions.

Not all Veeder communication functions are supported. The following functions are supported by the Web based configuration. Additional functions are supported but must be configured manually.

COMMAND		
101	System Status Report	
201	In-Tank Inventory Report	
202	In-Tank Delivery Report	
203	In-Tank Leak Detect Report	

B38	Vacuum Sensor Report	

The driver will not send the next command until a response has been received from the previous or until a timeout has expired.

Support

This driver was developed by Chipkin Automation Systems (CAS). CAS are proud to provide support for the driver. For support please call CAS at (866) 383-1657.

Revision History

Date	Resp	For mat	Driver Ver.	Doc. Rev.	Comment
26 Aug 2010	PMC		0.00	0	Created
21 Sep 2010	PMC		0.00	1	Updated. Replaced supported function list.
14 Dec 2010	PMC		1.00	2	Updated, Added ModbusRTU, Block Diagram. Port Settings.

PART 1 - GENERAL

1.1 DEFINITIONS

- .1 System Start: actions required at system start-up under schedule control or on re-start after power failure.
- .2 Normal Operation: normal control sequence after initial start-up requirements are satisfied.
- .3 Demand Limiting: special operation parameters during normal utility power outages (emergency generator operation)
- .4 System Stop: shut-down of system under schedule control and fail-safe position of system in event of loss of normal power.
- .5 Schedule: scheduled operation of system
- .6 Alarm: minimum alarm points required.
- .7 Emergency Power: control system elements to be fed from emergency power, refer to electrical drawings.

PART 2 - PRODUCTS

- 2.1 REFER TO SECTIONS OF DIVISION 25 05 01 BUILDING AUTOMATION SYSTEM GENERAL

PART 3 - EXECUTION

3.1 SEQUENCE OF OPERATION AND CONTROL DRAWINGS

- .1 Refer to control strategies outlined on mechanical drawings for sequence of operation.
- .2 Review sequence of operation described for each system and allow for additional input and output points to achieve method of control described. Review documents to determine quantity of each piece of equipment or system.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 The work described in this specification covers the supply and installation of electrical equipment and materials, testing and commissioning of the systems installed, and other services as described in the various sections of the electrical specifications and as shown on the drawings.
- .2 The scope of the electrical work includes, without being limited to the following:
 - .1 Construction of new underground concrete encased duct banks
 - .2 Supply and installation of three indoor Diesel generators, complete with their ancillary systems
 - .3 Supply and installation of medium voltage generator paralleling switchgear
 - .4 Supply and installation of medium voltage transfer and distribution switchgear
 - .5 Supply and installation of equipment, devices and materials for general power distribution within the Powerhouse building
 - .6 Supply and installation of lighting system and controls
 - .7 Supply and installation of security equipment, devices and wiring
 - .8 Supply and installation of fire alarm system and devices in designated areas and connection to existing building fire alarm system.
 - .9 Supply and installation of cables, wiring and raceways to equipment installed by the Electrical trade, and power wiring to equipment installed by the Mechanical trade
 - .10 Supply and installation of wiring devices (receptacles, telephone and data outlets)
 - .11 Testing and commissioning of all equipment and systems supplied and installed
 - .12 All other work required to deliver a complete and functional system, whether or not detailed on the drawings or described in the specifications. This includes:
 - .1 Removal of existing medium voltage cables
 - .2 Provision of temporary power during transition from the old to the new system
 - .3 Coordination with other trades as required for proper integration into the overall
 - .4 Restoration of existing services, structures and finishes affected by the electrical work of this contract
 - .13 Training of Owner's designated staff in the operation and care of the equipment and systems installed

1.2 DEFINITIONS

- .1 Wherever the words "equal", "approved", or "approved equal" are used, they shall be understood to mean, "equal", "approved", or "approved equal".

- .2 "Concealed" is defined as "out of sight" in "normal" viewing conditions, and includes buried in concrete, above acoustic tile or gypsum board ceilings, within masonry or gypsum board constructed walls, within cable trays or below raised access floors.
- .3 Whenever the words "install", "provide", or "supply and install", are used, they shall be understood to mean "provide and install, inclusive of all labour, materials, installation, testing, and connections" for the item to which they refer.

1.3 CODES AND STANDARDS

- .1 All work shall meet or exceed the latest applicable Codes and Standards. Do complete installation in accordance with the CSA 22.1 (the Code) and the Ontario Electrical Safety Bulletins.
- .2 CAN3-C235, Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .3 Abbreviations for electrical terms: to CSA Z85.
- .4 Unless noted otherwise, reference to a code or standard shall mean the most recent version of that code or standard.

1.4 PERMITS, FEES AND INSPECTION

- .1 The Contractor shall be responsible for paying the fees associated with obtaining the Permit for the electrical work.
- .2 The Consultant will make drawings available to the Contractor at no cost for the purpose of obtaining the Permit.

1.5 DRAWINGS AND SPECIFICATIONS

- .1 Drawings and Specifications are intended to cover the scope of work described herein. It is not the intent to show or describe every detail, and it shall be agreed that the Contractor will provide all work and material required to satisfy the intent of the Drawings and Specifications.
- .2 Drawings and Specifications are not guaranteed to be free of discrepancies and the Owner and/or Consultant will not be responsible for the absence of any detail the Contractor may require, or for any special work, equipment, material or labour which may be found necessary as the work progresses.
- .3 It shall be specifically understood that the omission of any Drawing or Schedule, or reference thereto, or any item from any Drawing or Schedule, or from the Specification, which is required to make the work complete and operational, shall not relieve the Contractor from the obligation of providing the required items and associated labour.
- .4 Any discrepancies shall be submitted to the Consultant for his instructions.

1.6 VOLTAGE RATINGS

- .1 Operating voltages to: CAN3-C235.
- .2 Motors, electric heating, lighting, control and distribution devices and equipment shall operate satisfactorily at 60 Hz within normal operating limits established by above standard.

Equipment shall operate in extreme operating conditions established in above standard, without damage.

1.7 CONSULTANT'S INSTRUCTIONS

- .1 During construction, the Consultant will issue such instructions in writing as may be necessary for verification and correction of the work. These instructions shall be binding as part of the Contract Documents.

1.8 ADDITIONAL WORK AND CHANGES

- .1 No additional money over and above the Contract Price will be paid for extra work unless a written order, signed by the Owner's representatives for such work is given.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- .1 Equipment and material shall be new and suitable for the use intended.
- .2 Equipment and material shall be certified by CSA or such other agency as may be recognized by the Safety Authority. Where there is no alternative to supplying equipment which is not thus certified, obtain special approval from Electrical Safety Authority, and notify the Consultant of any extra costs.
- .3 Factory assemble control panels and component assemblies.
- .4 Where materials, equipment, apparatus, or other products are specified by a manufacturer's brand name, type or catalogue number, such designation is to establish the standards of desired quality, style or dimensions, and shall be the basis of the Bid. Furnish materials so specified under this Contract unless changed by mutual agreement.
- .5 Where the use of equivalent, alternate or substitute equipment alters the design or space requirements indicated on the plans, the Contractor for this contract shall include all items of cost for the revised design and construction, including the cost of all the other trades involved.
- .6 Acceptance of the proposed equivalents, alternates or substitutions shall be subject to the review by the Consultant, and if requested, the Contractor shall submit for inspection, samples of both the specified and the proposed alternate items.
- .7 In all cases where the use of equivalents, alternates or substitutions is permitted, the Contractor shall bear any extra costs of evaluating the quality of proposed materials and equipment by the Consultant.

2.2 EQUIVALENTS AND ALTERNATES

- .1 Should the Contractor propose to furnish material and equipment other than those specified, he shall apply in writing to the Consultant for approval of equivalents at least five working days prior to the closing of Tenders, submitting with his request for approvals, complete descriptive and technical data on the item or items he proposes to furnish. Approval for

- changes in the base bid specifications will be considered only upon the individual requests of the Contractor. No blanket approval for equipment will be given to suppliers, distributors or contractors.
- .2 Unless requests for changes in base bid specifications are received and approved prior to the opening of the bids, as defined above, the Contractor will be held to furnish all specified items under his base bid. After the contract is awarded, changes in specifications will be made only as defined in this Section.
 - .3 For the equipment to be supplied by the Contractor, alternates may be offered in lieu of items named in the specifications. Alternate proposals must be accompanied by full descriptive and technical data on the article proposed, together with a statement of the amount of addition or deduction from the base bid if the alternate is accepted. Prior review by the Consultant is not required on items submitted as alternate bids, but the decision on acceptance of the alternate(s) will rest with the Consultant.
 - .4 Replace unspecified materials and/or rejected equivalents and alternates built into the work with specified or accepted materials, at no additional cost to the Consultant.
 - .5 In case of differences in price, the Owner shall receive all benefit of the difference in cost involved in any substitution, and the Contract shall be altered by change order to credit the Owner with any savings so obtained.
 - .6 Materials and equipment substituted or offered as alternatives shall have spare parts and servicing available and shall fit into the space allocation shown on the drawings.
 - .7 If any material or equipment being considered for substitution involves additional design, architectural or engineering fees or other costs in checking whether or not the substitute material or equipment is suitable for the project, such fees or costs shall be paid for by the Contractor.

2.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with relevant Section.
- .2 After execution of the Contract, within ten (10) working days, provide a schedule for shop drawing submission and a schedule for the delivery of equipment to the site. At this stage, identify any equipment whose delivery time could negatively impact the project completion date. Failure to do so will require the Contractor to provide temporary equipment until the specified equipment is available. .
- .3 Specifications and Drawings are intended to cover all electrical systems. It is not the intent to describe or show every detail, and it shall be agreed that the Manufacturer will provide all work and material required to provide equipment according to the requirements and intent of the Drawings and Specifications.
- .4 Submitted Shop Drawings must indicate details of construction, dimensions, scale, capacities, weights and electrical performance characteristics of equipment or materials, as well as project name and specification reference Section number.
- .5 Shop drawings shall be provided in digital format (pdf), with sufficient space on the front page for all Consultant's and/or Contractor's "review" stamps.

- .6 Where applicable, include wiring, single line and schematic design drawings, and diagrams showing interconnections with the work of other suppliers.
- .7 Work affected by submittals shall not proceed until review is complete.
- .8 Review submittals prior to submission to Consultant. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and co-ordinated with requirements of the work and Contract Documents.
- .9 Changes made to Shop Drawings by the Consultant will not affect the Contract Price.
 - .1 Shop drawings will be reviewed by the Consultant and returned to the Manufacturer marked "REVIEWED", "REVIEWED AS NOTED" or "RETURNED FOR CORRECTION". Shop drawings noted "RETURNED FOR CORRECTION" shall be corrected and re-submitted.
 - .2 No equipment shall be delivered to the job site unless the Manufacturer has received a "REVIEWED" or "REVIEWED AS NOTED" copy of the pertinent shop drawing.
 - .3 The Manufacturer's Schedule shall allow 5 business days for review or return for correction of shop drawings submitted to Consultant with the time period starting at the time of receipt of the Drawings by the Consultant.

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Lay out of the work of this contract. Take special precautions and note drawing scales. Generally floor plans are drawn at metric scale. Make field verifications of dimensions on plans since actual locations, distances, and level will be governed by actual field conditions.
- .2 Wherever differences occur between plans and riser diagrams or schematics, and between specifications and drawings, most stringent conditions shall govern. Bring discrepancies between plans, or between plans and actual field conditions, or between plans and specifications promptly to the attention of the Consultant for clarification.
- .3 As the work progress and before installing apparatus, equipment, fixtures and devices which may interfere with the interior treatment and use of the building, obtain approval from the Consultant with detailed drawings or sketches for the exact location of all electrical raceways, panels, trays/ladders, equipment, fixtures and wiring devices. Failure to do so will make the Contractor responsible for rectification at no cost.
- .4 Confer with other trades engaged on the work and arrange the work so that it will be carried out in the best interest of all concerned. Before commencing to work, check and verify with the Consultant all elevations, levels, dimensions etc. to ensure proper and correct installation of the work.
- .5 Protect finished and unfinished work and equipment and work of other trades from damage due to the carrying out of the work of this trade.
- .6 In addition to the work specifically mentioned in the specifications and shown on the drawings, provide all other items that are required by the authorities having jurisdiction over the work.

- .7 Contain all work being performed within the physical area of work which is underway during any particular period of time. Keep the amount of disruption in the existing facility to a minimum.
- .8 Should the work within a particular area cause any electrical apparatus in another area to cease to function properly, identify and remedy the problem with the apparatus which has ceased to function properly.

3.2 SCHEDULING OF WORK

- .1 For all work to be performed under this contract, adhere to construction schedule detailed in other parts of the contract.
- .2 Ensure that all equipment and material is ordered in time to meet the schedule. Provide a schedule of deliveries to the Consultant/Owner. Furnish promptly information required for the construction schedule.
- .3 Proceed with the work as quickly as practical so that construction may be completed in as short a time as possible and in accordance with the building schedule.
- .4 Co-ordinate all required shutdowns of the existing facilities with the operating staff to maintain any disruption to a minimum. Provide ample notice to Owner before shutting down any existing facility.

3.3 INSTALLATION OF RACEWAYS

- .1 Install all conduits, cable trays, etc., to conserve headroom and interfere as little as possible with the free use of the space through which they pass.
- .2 Install conduits, wireways, etc., particularly those which may interfere with the inside treatment of the building, or conflicting with other trades, only after the locations have been fully coordinated with other trades.
- .3 Take special care in the installation of conduits, wireways etc., which must be concealed to see that they come within the finished lines of floors, walls, and ceilings. Where such bus ducts, conduits, wireways, etc., have been installed in a manner causing interference, remove and reinstall in suitable locations without extra cost.
- .4 Do not remove or damage any structural fireproofing. Leave space to permit the fireproofing to be inspected and/or repaired.

3.4 MOUNTING HEIGHTS

- .1 Mounting height of equipment is from finished floor to centreline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.
- .3 Install electrical equipment at following heights unless indicated otherwise.
 - .1 Local switches: 1200 mm.

- .2 Wall receptacles: General: 300 mm; in utility rooms: 1200 mm.
- .3 Panelboards: as required by Code or as indicated.
- .4 Wall mounted telephone outlets: 1500 mm.
- .5 Fire alarm horns/strobes: 2100 mm.

3.5 CUTTING AND PATCHING

- .1 Employ the trade responsible for a particular item of work to do all cutting, patching and repairing of surfaces affected by that work.
- .2 Supporting members of any floor, wall or the building structure shall be cut only in such a location and manner as directed by the Consultant/Owner.
- .3 All holes and surfaces shall be repaired with the type of material removed by the tradesmen expert in the type of repair required.
- .4 Provide fire barriers around all components in holes which penetrate fire separations. The fire barrier medium provided shall make the fire separation equal to or better than the one which was cut away. All materials shall be CSA approved and UL listed.
- .5 All floor sawcutting and drilling required for electrical services shall be performed within hours approved by the Owner. Prior written notice of 48 hours must be given to the Consultant.

3.6 CONCRETE WORK

- .1 The Electrical Contractor shall co-ordinate and supervise the work by General Contractor for the provision of the concrete pads for the selected electrical equipment, as shown on the drawings.

3.7 FIRE STOPPING

- .1 Where cables, conduits or cable trays pass through floor and fire rated walls pack space between wiring and sleeve and seal with caulking compound conforming to CGSB 19-GP-9Ma AMDT - Oct-80.
- .2 For conduit, cable tray, and cable penetrations of the fire rated walls, provide an ULC-classified and F.M. approved fire seal system to maintain the integrity of the fire separation.
- .3 Fill void around bus duct, conduit, tray or cable opening with silica fibre panels and seal both sides with fire retardant elastomeric coating, in accordance with manufacturer's instructions.

3.8 PAINTING AND FINISHING

- .1 All hangers, channels, conduits, etc. shall be delivered to the site galvanized after fabrication and all metal cut and finishes damaged on the job shall be painted to match.
- .2 All equipment and materials, panels, luminaires, etc., shall be stored in a dry, clean location, covered if necessary to preserve factory finish.
- .3 Where equipment and material is designated unfinished, all exposed metal work, with the exception of chromed locks and hardware, shall be left with a suitable prime coat finish.

- .4 Painting of equipment and material requiring a finished coat or touch up after installation shall be carried out wherever required. This does not apply to the making good of damaged factory finishes which shall be done by the Electrical Contractor.

3.9 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with laminated plastic nameplates.
- .2 Nameplate colours shall be as follow:
 - .1 equipment on utility power: black
 - .2 equipment on standby power: orange
 - .3 fire alarm system: red
 - .4 security equipment: green
- .3 Nameplate text shall be in one of three sizes, as follow:
 - .1 25 mm: Generator Switchboard and Transfer and Distribution Switchboard switchboards and
 - .2 12 mm: main distribution branch devices (breakers and switches) ;
 - .3 6 mm: distribution transformers, panelboards, miscellaneous disconnects, starters, junction boxes, etc.
- .4 Nameplates shall be secured with screws or rivets.
- .5 Wording on nameplates to be approved by Owner and/or Consultant prior to manufacture.
- .6 Allow for average of twenty-five (25) letters per nameplate.
- .7 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage rating, power flow directions.
- .8 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .9 Terminal cabinets and pull boxes: indicate system, voltage and power flow direction.
- .10 Transformers: indicate capacity, primary and secondary voltages, power flow direction on primary cable entry and secondary entry, and name assigned by Owner/Consultant.
- .11 Light Switches: indicate panel name and circuit number on adhesive label.
- .12 Receptacles: indicate panel name and circuit number on adhesive label.
- .13 Fire Alarm System: indicate device number on adhesive label

3.10 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.

- .3 Colour code: in accordance with the Canadian Electrical Code.
- .4 Use colour coded wires in communication cables, matched throughout system.

3.11 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters or exits wall, ceiling, or floor, and at 10m intervals.
- .3 Label all conduits using "P-Touch" or Paint at every entry or exit of wall, ceiling and at 10m intervals.

Colours: 25mm wide prime colour and 15mm wide auxiliary colour.

Prime colours shall be:

31 V to 250 V	blue
251 V to 750 V	yellow
Fire alarm system	red
Security system	green

Auxiliary colours shall be:

Normal power	none
Emergency power	orange
Telephone	none
Other communications	blue

3.12 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring are to be suitable for copper conductors, according to the material of the wiring being terminated.
- .2 Electrical Contractor shall provide cable lugs, terminals, screws, etc. required for wiring terminations.

3.13 MANUFACTURER'S AND APPROVAL LABELS

- .1 Provide visible and legible labels after equipment is installed.

3.14 WARNING SIGNS

- .1 Provide warning signs to meet requirements of Electrical Inspection Authority and any Authority having jurisdiction.

3.15 TESTING AND COMMISSIONING

- .1 Provide testing and commissioning of all equipment/systems supplied and installed.
- .2 Generally, commissioning shall comprise four stages:
 - .1 Pre-functional tests (PFT)

- .2 Functional tests (FT)
- .3 Independent system tests (IST)
- .4 Integrated Operational Systems Test (ISOT)
- .3 Pre-functional tests shall include initial visual checks of equipment after arrival on site and following mechanical and electrical installation.
- .4 Functional tests shall include individual startup and standalone testing of equipment. Refer to the individual equipment specification for specific testing requirements.
- .5 Independent system testing shall include operation of several pieces of equipment as part of one system to validate its standalone performance.
- .6 Integrated systems operational tests shall include operation of the entire system as one integrated assembly, under all possible scenarios, to ensure adequate system response, and to validate performance.
- .7 Arrange and pay for services of manufacturers' factory service technicians to supervise start-up of installation, check, adjust, balance and calibrate components, wherever required.
- .8 Resolve all commissioning issues discovered at each stage before proceeding to the next level of commissioning.

3.16 OPERATOR TRAINING

- .1 Instruct Owner and operating personnel in the operation, care and maintenance of equipment.
- .2 Prepare training material with a level of detail adequate for each type of equipment/system installed. Provide an outline of the training material to the Owner prior to delivering the training.
- .3 Conduct "classroom" training followed by "hands-on" training. Demonstrate the operation of each equipment / system and its features. Enlist the assistance of manufacturers' representatives where appropriate.
- .4 Provide these services for such period, and for as many visits, as necessary to ensure that operating personnel are conversant with all aspects of equipment operation and care. Obtain written acceptance of operating personnel's understanding of the systems.

3.17 CLEANING

- .1 During the performance of the work and on completion, remove from the site and premises all debris, rubbish and waste materials caused by the performance of the work for this contract. Remove all tools and surplus materials after acceptance of the work to the Owner and/or Consultant's satisfaction.
- .2 Vacuum all equipment thoroughly at the time of final acceptance of the work. Clean plastic components and exposed components of lighting fixtures in accordance with the manufacturer's recommendation.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 This section describes the requirements for a Short-circuit/Coordination Study and Arc Flash Hazard Analysis to cover the new electrical system installed under this contract.
- .2 The above studies shall be prepared by the medium voltage switchgear manufacturer on behalf of the Electrical Contractor.
- .3 The studies shall be completed before the commissioning of the new electrical power distribution system.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA Z462 – Workplace Electrical Safety
- .2 Institute of Electrical and Electronics Engineers, Inc. (IEEE):
 - .1 IEEE 141 - Recommended Practice for Electric Power Distribution and Coordination of Industrial and Commercial Power Systems
 - .2 IEEE 242 - Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems
 - .3 IEEE 399 - Recommended Practice for Industrial and Commercial Power System Analysis
 - .4 IEEE 1015 - Recommended Practice for Applying Low-Voltage Circuit Breakers Used in Industrial and Commercial Power Systems
 - .5 IEEE 1584 - Guide for Performing Arc-Flash Hazard Calculations
- .3 American National Standards Institute (ANSI):
 - .1 ANSI C 37.41 - Standard Design Tests for High Voltage Fuses, Distribution Enclosed Single-Pole Air Switches, Fuse Disconnecting Switches and Accessories
 - .2 ANSI C37.5 - Methods for Determining the RMS Value of a Sinusoidal Current Wave and Normal-Frequency Recovery Voltage, and for Simplified Calculation of Fault Currents
- .4 The National Fire Protection Association (NFPA)
 - .1 NFPA 70 - National Electrical Code, latest edition
 - .2 NFPA 70E - Standard for Electrical Safety in the Workplace

1.3 SUBMITTALS

- .1 The short-circuit and protective device coordination studies shall be submitted to the Consultant prior to testing and commissioning the new power distribution equipment.

- .2 The results of the short-circuit, protective device coordination and arc flash hazard analysis studies shall be summarized in a final report. Submit three (3) hard copies and three (3) CD's of the report, complete with section containing the computer printout of the short-circuit input and output data.
- .3 The report shall include the following sections:
 - .1 Executive Summary including source of information and assumptions made
 - .2 Descriptions, purpose, basis and scope of the study
 - .3 One-line diagram showing protective device ampere ratings and associated designations, cable size & lengths, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/panelboard designations
 - .4 Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings
 - .5 Protective device time versus current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings
 - .6 Fault study input data, and current calculations including a definition of terms and guide for interpretation of the computer printout
 - .7 Incident energy and flash protection boundary calculations
 - .8 Comments and recommendations for system improvements, where needed.

1.4 QUALIFICATIONS

- .1 The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a Professional Electrical Engineer licensed in Ontario and skilled in performing and interpreting power system studies.

PART 2 - PRODUCTS

2.1 SCOPE OF STUDY

- .1 The coordination study shall include all electrical protective devices beginning with (and inclusive of) the utility company's feeder protective device, down to and including all branch circuit breakers and motor starters in the new Powerhouse.
- .2 The study shall also include transformers and protective devices associated with emergency generators, associated paralleling equipment and distribution switchgear.
- .3 The study shall generally be limited to the new system installed; however, where the new system interfaces with the existing system (e.g. existing switchboard fed by the new system), the study shall also investigate coordination with existing devices and recommend settings as necessary to ensure it.

2.2 DATA COLLECTION

- .1 Contractor shall furnish all field data as required by the power system studies. The Engineer performing the short-circuit, protective device coordination and arc flash hazard analysis studies shall furnish the Contractor with a listing of required data. The Contractor shall expedite collection of the data to eliminate unnecessary delays and assure completion of the studies as required for final approval of the study prior to the commissioning of the system.
- .2 Source combination shall include present and future utility supply, motors, and generators.
- .3 Load data utilized shall include existing and proposed loads obtained from Contract Documents provided by Owner or Contractor.
- .4 Include fault contribution of existing motors in the study, with motors < 50 hp grouped together. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.3 SHORT-CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- .1 Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standards 141, latest edition.
- .2 Transformer design impedances and standard X/R ratios shall be used when test values are not available.
- .3 Provide the following:
 - .1 Calculation methods and assumptions
 - .2 Selected base per unit quantities
 - .3 One-line diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted
 - .4 Source impedance data, including electric utility system and motor fault contribution characteristics
 - .5 Typical calculations
 - .6 Tabulations of calculated quantities
 - .7 Results, conclusions, and recommendations
- .4 Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:
 - .1 Utility (Whitby Hydro) supply point
 - .2 Generator Paralleling Switchgear
 - .3 Transfer and Distribution Switchgear
 - .4 Power Distribution Panel
 - .5 Other significant locations throughout the system

- .5 Protective Device Evaluation:
 - .1 Evaluate equipment and protective devices and compare to short circuit ratings
 - .2 Adequacy of switchgear and panelboard bus bracing to withstand short-circuit stresses
 - .3 Adequacy of transformer windings to withstand short-circuit stresses
 - .4 Cable sizes for ability to withstand short-circuit heating
 - .5 Notify Consultant in writing, of existing, circuit protective devices improperly rated for the calculated available fault current

2.4 PROTECTIVE DEVICE COORDINATION STUDY

- .1 Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper.
- .2 Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- .3 Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed.
- .4 Identify device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- .5 Plot the following characteristics on the curve sheets, where applicable:
 - .1 Electric utility's protective device
 - .2 Medium voltage equipment relays
 - .3 Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands
 - .4 Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters
 - .5 Conductor damage curves
 - .6 Ground fault protective devices, as applicable
 - .7 Pertinent generator short-circuit decrement curve and generator damage point
 - .8 Other system load protective devices for the largest branch circuit
- .6 Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

2.5 ARC FLASH HAZARD ANALYSIS

- .1 The arc flash hazard analysis shall be performed according to the equations presented in NFPA70E-2004, Annex D of CSA Z462 and IEEE 1584
- .2 The short circuit calculations and the clearing times of the phase overcurrent devices shall be retrieved from the short-circuit and coordination study model. .
- .3 The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, panelboards, busway and splitters) where work could be performed on energized parts.
- .4 The Arc-Flash Hazard Analysis shall include all 13.8 kV locations and significant locations in the 240 V system fed from the station transformer.
- .5 Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- .6 Arc flash computation shall include both line and load side of breakers.

2.6 REPORT SECTIONS

- .1 Input Data:
 - .1 Utility three-phase and line-to-ground available contribution with associated X/R ratios
 - .2 Cable type, construction, size, # per phase, length, impedance and conduit type
- .2 Short-Circuit Data:
 - .1 Source fault impedance and generator contributions
 - .2 X to R ratios
 - .3 Asymmetry factors
 - .4 Motor contributions
 - .5 Short circuit kVA
 - .6 Symmetrical and asymmetrical fault currents
- .3 Recommended Protective Device Settings:
 - .1 Phase and Ground Relays:
 - .1 Current transformer ratio.
 - .2 Current setting.
 - .3 Time setting.
 - .4 Instantaneous setting.
 - .5 Specialty non-overcurrent device settings.
 - .6 Recommendations on improved relaying systems, if applicable.

- .2 Circuit Breakers:
 - .1 Adjustable pickups and time delays (long time, short time, ground).
 - .2 Adjustable time-current characteristic.
 - .3 Adjustable instantaneous pickup.
 - .4 Recommendations on improved trip systems, if applicable.
- .4 Incident energy and flash protection boundary calculations.
 - .1 Arcing fault magnitude
 - .2 Device clearing time
 - .3 Duration of arc
 - .4 Arc flash boundary
 - .5 Working distance
 - .6 Incident energy
 - .7 Hazard Risk Category
 - .8 Recommendations for arc flash energy reduction.

PART 3 - EXECUTION

3.1 FIELD ADJUSTMENT

- .1 Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments shall be completed by the party retained to commission the medium voltage switchgear (could also be the engineering services division of the equipment manufacturer).
- .2 Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
- .3 Notify Consultant in writing of any required major equipment modifications.
- .4 Following completion of all studies, acceptance testing and startup by the field engineering service division of the equipment manufacturer, a 2-year warranty shall be provided on all components manufactured by the engineering service parent manufacturing company.

3.2 ARC FLASH WARNING LABELS

- .1 The vendor shall provide a 3.5 in. x 5 in. thermal transfer type label of high adhesion polyester for each work location analyzed.
- .2 The label shall have an orange header with the wording, "WARNING, ARC FLASH HAZARD", and shall include the following information:
 - .1 Location designation
 - .2 Nominal voltage
 - .3 Flash protection boundary

- .4 Hazard risk category
 - .5 Incident energy
 - .6 Working distance
 - .7 Engineering report number, revision number and issue date
- .3 Labels shall be machine printed, with no field markings
- .4 Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings.
- .5 For each switchgear, one flash label shall be provided
- .6 For medium voltage switches one arc flash label shall be provided
- .7 Labels shall be field installed by the engineering service division of the equipment manufacturer under the Startup and Acceptance Testing contract portion.

3.3 ARC FLASH TRAINING

- .1 The equipment vendor shall train personnel of the potential arc flash hazards associated with working on energized equipment (minimum of 4 hours). Maintenance procedures in accordance with the requirements of CSA Z462, Workplace Electrical Safety, shall be provided in the equipment manuals. The training shall be certified for continuing education units (CEUs) by the International Association for Continuing Education Training (IACET).

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCE STANDARDS

- .1 Canadian Standards Association (CSA International): CSA-C22.2 No. 131.
- .2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA): ICEA S-93-639/NEMA WC74, 5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .3 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .4 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
- .5 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .6 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control. Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence and cleaning procedures.

1.3 DELIVERY, STORAGE AND HANDLING

- .7 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .8 Waste Management and Disposal: Separate waste materials for recycling in accordance with Section 01 74 21 - Construction/Demolition Waste Management and Disposal.

PART 2 - PRODUCTS

3.1 CONCENTRIC NEUTRAL POWER CABLES

- .1 Concentric neutral power cable: to ICEA S-93-639/NEMA WC74.
- .2 Single copper conductor, size as indicated.
- .3 Semi-conducting shield.
- .4 Class 2.
- .5 Insulation: cross-linked thermosetting polyethylene material rated 90 degrees C and 15 kV for 100% voltage level.
- .6 Semi-conducting insulation shielding layer.
- .7 Copper neutral wires applied helically over insulation shield equivalent to 100% full capacity.

- .8 Separator tape over neutral wires.
- .9 Extruded PVC jacket rated minus 40 degrees C

3.2 CABLE TERMINATION KIT

- .1 IEEE Standard 48 Approved for Class 1, cold shrink terminations.
- .2 Molded silicone rubber insulation, 4-skirt, 1-piece construction
- .3 Voltage rating: 15kV; BIL: 95 kV
- .4 Diameter suitable to accommodate conductor of size show on the drawings.
- .5 Product: 3M or equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install power cable in ducts and manholes as indicated and in accordance with manufacturer's instructions.
- .2 Provide supports and accessories for installation of high voltage power cable.
- .3 Install stress cones, terminations and splices in accordance with manufacturer's instructions
- .4 Install grounding in accordance with local inspection authority having jurisdiction.
- .5 Provide cable identification tags and identify each phase conductor of power cable.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use of qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.
- .3 Engage an independent testing agent to test high voltage power cable. Submit test result and inspection certificate.

END OF SECTION

GENERAL

1.1 REFERENCES

- .1 CSA C22.2 No.0.3, Test Methods for Electrical Wires and Cables.
- .2 CSA C22.2 No. 35, Extra-Low-Voltage Control Circuit Cables, Low-Energy Control Cable, and Extra-Low-Voltage Control Cable.
- .3 CSA C22.2 No. 38, Thermoset-Insulated Wires and Cables (Tri-National Standard, with UL-44 and ANCE NMX-J-451).
- .4 CSA C22.2 No. 208, Fire Alarm and Signal Cable.

PART 2 - PRODUCTS

2.1 BUILDING WIRES

- .1 Cable: to CSA C22.2 No. 38.
- .2 Conductors: stranded for #8 AWG and larger. Minimum size: #12 AWG.
- .3 Copper conductors: size as indicated, with 600V insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 CONTROL CABLES

- .1 Type LVT: soft annealed copper conductors, number and size as indicated, with thermoplastic insulation, and outer covering of thermoplastic jacket.
- .2 Low energy 300V control cable: solid annealed copper conductors sized as indicated, with insulation type T90 Nylon.

2.3 FIRE ALARM CABLES

- .1 Cable: to CSA C22.2 No. 208, type FAS 105, rated 300 V.
- .2 Conductor: solid bare copper.
- .3 Insulation: 105oC flame retardant polyvinyl chloride.

PART 3 - EXECUTION

3.1 INSTALLATION OF BUILDING WIRES

- .1 Install wiring in raceways, in trays, exposed, or buried, in accordance with the relevant Sections of this Division.
- .2 Connect cables as indicated.

3.2 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in raceways, as indicated, and connect.
- .2 Ground control cable shield.

3.3 INSTALLATION OF FIRE ALARM CABLES

- .1 Install cables in EMT conduit and connect.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests using qualified personnel and the necessary instruments and equipment.
- .2 Identify each phase conductor of each feeder.
- .3 Check each feeder for continuity, short circuits and grounds.
- .4 Pre-acceptance tests
 - .1 After installing cable but before splicing and terminating, perform insulation resistance test with megger on each phase conductor. Ensure insulation resistance to ground of circuits is not less than 50 megohms.
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .5 Acceptance Tests
 - .1 Ensure that terminations and accessory equipment are disconnected.
 - .2 Ground all shields, ground wires, metallic armour and conductors not under test.
 - .3 High Potential (Hipot) Testing: Conduct hipot testing at 100% of original factory test voltage in accordance with the more stringent of manufacturer's or ICEA recommendations.
 - .4 Leakage Current Testing:
 - .1 Raise voltage in steps from zero to maximum values as specified by ICEA or manufacturer for type of cable being tested.
 - .2 Hold maximum voltage for time period specified by ICEA or manufacturer.
 - .3 Record leakage current at each step.
 - .5 Provide Consultant with list of test results showing location at which each test was made, circuit tested and result of each test.
 - .6 Remove and replace entire length of cable if cable fails to meet any of test criteria.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 This section covers the requirements for system and equipment grounding.

1.2 REFERENCES

- .1 CSA C22.3 No.2, General Grounding Requirements and Grounding Requirements for Electrical Supply Stations.
- .2 ANSI/IEEE 837, Qualifying Permanent Connections Used in Substation Grounding.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Conductors: stranded, insulated, soft annealed copper wire, size No 250 MCM AWG and 1/0 AWG for ground bus, metal structures, transformers, switchgear, motors, ground connections.
- .2 Ground bus: copper, size 6 mm x 50 mm complete with insulated supports.
- .3 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings,
 - .2 Protective type clamps,
 - .3 Bolted type conductor connectors,
 - .4 Thermit welded type conductor connectors,
 - .5 Bonding jumpers, straps,
 - .6 Pressure wire connectors.

2.2 NEUTRAL GROUNDING RESISTORS

- .1 UL listed, NEMA 1 enclosure
- .2 C/w/15 KV Neutral CT, 50:5 ratio
- .3 13800/8000 VAC; 200 Amp; 40.0 Ω @25° C; 10 Seconds
- .4 Maximum Duty, 760°C temperature rise; stainless steel
- .5 Edgewound element

PART 3 - EXECUTION

3.1 INSTALLATION - GENERAL

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories in accordance with CSA C22.3 No.2.

- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect grounding conductors from mechanical injury.
- .4 Make connections to structural steel work using copper welding by thermit process.
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 Perform earth loop test and resistance tests using method appropriate to site conditions and to approval of Consultant and Electrical Safety Authority.
- .3 Perform test before energizing electrical system.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 This section describes miscellaneous equipment and materials to be used in the electrical installation.
- .2 The drawings do not necessarily show junction and pull boxes.

PART 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 to match required size and number of incoming and outgoing conductors as indicated.
- .3 At least three spare terminals on each set of lugs.

2.2 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes.
- .3 Where wiring from 2 or more sources are contained in or running through pull or junction box, the box shall be labelled with appropriate warning as well as voltage and sources.

PART 3 - EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.
- .2 Extend full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION AND PULL BOX INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Install pull boxes so as not to exceed 30 m of conduit run, or two 90° bends, between pull boxes.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No.18, Outlet Boxes, Conduit Boxes, and Fittings.
 - .2 CSA C22.2 No.56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No.83, Electrical Metallic Tubing
 - .4 CSA C22.2 No. 211.1, Rigid types EB1 and DB2/ES2 PVC Conduit.

1.2 RELATED WORK

- .1 Comply with the relevant Sections of this and other Divisions of this Specification.

1.3 APPLICATION

- .1 Rigid PVC conduit shall be used outdoors, direct buried or in concrete encased duct banks, and indoors for ground wires (except in air plenums).
- .2 EMT conduits may be used in all indoor locations, except as excluded herein and provided that it is not susceptible to mechanical injury.
- .3 Flexible metallic conduit shall be used for the last 1.0 m in connections to vibrating equipment including, but not limited to motors and transformers.
- .4 Flexible metallic conduit may be used for horizontal wiring runs in hollow partitions, and for connections to luminaires in suspended ceilings, as permitted by Code.
- .5 Liquid-tight flexible metallic conduit shall be used outdoor for final connection to equipment. .
- .6 Notwithstanding anything in this Article, a specific direction on the Drawings to use a particular type of conduit shall override this Article.

PART 2 - PRODUCTS

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No.83, with couplings.
- .2 Flexible metal conduit: to CSA C22.2 No.56, steel and liquid-tight flexible steel.

2.2 CONDUIT FASTENINGS

- .1 One-hole steel straps to secure surface conduits 50 mm and smaller. Two-hole steel straps for conduits larger than 50 mm. "Caddy" clips shall not be used.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits at 1.2 m oc.

- .4 Threaded rods, 5 mm diameter, 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° bends are required for 25 mm and larger conduits.
- .3 Compression watertight connectors and couplings for EMT exposed to moisture.
- .4 Set-screw fittings for EMT conduit where acceptable.

2.4 FISH CORD

- .1 Install Polypropylene wire in each conduit.

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .3 Mechanically bend steel conduit over 20 mm diameter.
- .4 Install fish cord in empty conduits.
- .5 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .6 Dry conduits out before installing wire.
- .7 Remove burrs at conduit ends prior to installing wire.

3.2 SURFACE CONDUITS

- .1 Run conduits parallel or perpendicular to building lines.
- .2 Group conduits wherever possible on channels.
- .3 Do not pass conduits through structural members.
- .4 Do not locate conduits less than 75 mm parallel to hot water lines with minimum of 25 mm at crossovers.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

1. CSA International: CSA C22.2 No.193, High-Voltage Full-Load Interrupter Switches.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

1. Submit in accordance with Section 01 33 00 - Submittal Procedures.
2. Product Data: Submit manufacturer's instructions, printed product literature and data sheets for interrupter switches and include product characteristics, performance criteria, physical size, finish and limitations.

1.3 CLOSEOUT SUBMITTALS

1. Submit in accordance with Section 01 78 00 - Closeout Submittals.
2. Operation and Maintenance Data: submit operation and maintenance data for interrupter switches for incorporation into manual.

1.4 DELIVERY, STORAGE AND HANDLING

1. Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
2. Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
3. Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect interrupter switches from nicks, scratches, and blemishes.
 - .3 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 LOAD INTERRUPTER SWITCH

1. Load Interrupter Switch: to CSA C22.2 No.193.
2. 3 pole, quick-make, quick-break assembly, stored energy operating mechanism [manual] operated, assembled on welded steel base.
3. Continuous full load rating: 600 A, interrupting rating: 25 kA, symmetrical at 15 kV.
4. Voltage rating: 15 kV.
5. 95 kV BIL.

6. Interphase barriers.
7. Non-removable operating handle c/w provision for [pad locking] [key interlock].
8. Power fuses: 100E maximum.
9. Enclosure: CSA Enclosure 1.
10. Include viewing windows that permits full view of the position of all three switch blades.
11. Interlocks with features as follow:
 - .1 Fuse is only accessible after switch is opened.
 - .2 Switch can be closed only after fuse access door is closed.

2.2 FABRICATION

1. Factory assemble and adjust 3 pole gang operated switch, operating assembly, interphase barriers and interlocks.

PART 3 - EXECUTION

1.1 EXAMINATION

1. Verification of Conditions: verify that conditions of concrete bases previously installed under other Sections are acceptable for interrupter switches installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect bases in presence of Consultant.
 - .2 Inform Owner and Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Owner or Consultant.

1.2 INSTALLATION

1. Install load interrupter switches.
2. Check switch contact resistance with low resistance meter.
3. Megger switch across each pole, from pole to pole, and from pole to ground.

1.3 CLEANING

1. Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
2. Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This specification covers the requirements for the 15 kV generator paralleling switchgear lineup labeled SG-G1 on the Single Line Diagram and layouts.
- .2 In connection with this equipment, the following services are required:
 - .1 Manufacturing in accordance with this specification
 - .2 Factory acceptance testing, in conjunction with the generators
 - .3 Delivery to the site, unloading and storage
 - .4 Installation (physical and electrical)
 - .5 Testing and commissioning (site acceptance testing)
 - .6 Training of Owner's operation personnel, and
 - .7 Documentation
- .3 This equipment design and construction must be coordinated with that of the Generators (Section 26 32 13) and transfer and distribution switchgear (Section 26 13 18.2), to ensure the performance of the integrated system of generators, paralleling and transfer/distribution switchgear is as specified, and that a reliable and cost-effective solution is provided.
- .4 The paralleling switchgear SG-G1 shall be the product of the same manufacturer supplying the transfer and distribution switchgear SG-E1 for reasons of component commonality, coordination of features and performance, and single source of responsibility.
- .5 The Generators and Transfer and Distribution Switchgear SG-E1 are shown on the Single Line Diagram and layout drawings.

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.14, Industrial Control Equipment.
 - .2 CSA C22.2 No. 58, High-Voltage Isolating Switches.
 - .3 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 1. Bill of Material
 2. Product Data: include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
 3. All shop drawings and manufacturer's descriptive literature shall clearly reflect the requirements of this specific Project.
- .3 Include information not limited to the following:
 1. Complete outline dimensions of the switchgear lineup, including control section (if standalone). Provide overall plans and elevations, foundation plans and operating weight, locations of all accessories and equipment. Detailed interface arrangement of the components shall be shown.
 2. Details of bus connections between switchgear sections.
 3. Mimic bus on front of the lineup, warning signs, and nameplates.
 4. Single line and three-line diagrams of the complete assemblies.
 5. Catalogue sheets showing physical and electrical characteristics of all equipment and devices. Include: circuit breakers, load interrupter switches (if used), digital power monitors, generator controls, master controller and peripherals, relays, pilot devices, operator interface etc.
 6. Elementary wiring diagrams of all power and control devices, alarm, monitoring and instrumentation circuits.
 7. Time current curves of fuses and protection relays.
 8. Power draw of all breakers and control components.
 9. Wiring diagrams shall indicate and differentiate between factory wiring and field installed wiring. At each wiring terminal, identify source and load served.
 10. A line numbering method shall be incorporated and all associated components shall be referenced by line number to enable rapid location in the circuits of related elements, e.g. relay coils, contacts, etc.
 11. Coordinate with the manufacturers of the generators and with the wiring of transfer/distribution switchgear in order to prepare point-to-point wiring diagrams in AutoCAD of the integrated system.
 12. The wiring diagrams must show connections between components installed in the paralleling switchgear, and between
 1. Paralleling switchgear and generators
 2. Paralleling switchgear and generator control panels
 3. Paralleling switchgear and Transfer and Distribution switchgear (SG-E1)

4. Paralleling switchgear and Building Automation System
5. Paralleling switchgear and all associated field devices

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for switchgear assembly for incorporation into manual. Include the following:
 1. Shop drawings, including any field modifications or changes to reflect actual, "as installed" conditions.
 2. Technical data (Manufacturer/OEM) in searchable .pdf format:
 1. illustrated parts lists with catalogue numbers
 2. schematic diagram of electrical controls
 3. fault locating guide
 4. precise details for adjustment and setting of time delay relays or sensing controls, which require on site adjustment.
 3. Operation instructions for each individual component
 4. Recommended maintenance and repair/troubleshooting instructions and schedules
 5. Certified factory and field test reports
 6. Warranty
 7. Addresses and phone numbers of suppliers and/or their authorized representatives.

1.5 SOURCE QUALITY CONTROL (FACTORY ACCEPTANCE TESTING - FAT)

- .1 Owner and Consultant will conduct inspection of the paralleling switchgear and witness its testing prior to shipping.
- .2 Ship paralleling switchgear to the generator manufacturer's plant for testing together as an integrated system.
- .3 The inspection of the switchgear and testing in the presence of Owner and Consultant is intended only for demonstration and confirmation of performance. The generator and switchgear manufacturers shall conduct their production tests in coordination and validate the full operation of the equipment prior to the witnessed test.
- .4 Notify Owner and Consultant in writing minimum 15 days before the date of the factory testing.
- .5 Submit manufacturer's type test certificates indicating cubicles of the paralleling switchgear, together with their components, were tested as an integrated assembly.

- .6 Submit test procedures for Consultant's review, at least 10 days prior to testing
- .7 The Contractor shall retain the equipment manufacturer or an independent party to complete the power study before the FAT, so that recommended settings for the relays can be implemented and tested prior to the equipment being shipped to the site.
- .8 At the time of factory testing the control logic programming, if used in the paralleling solution, shall be completed, debugged, and ready for demonstration. Failure to comply with this requirement may result in repeated testing, at Contractor's expense.
- .9 Have the equipment set up in conditions similar to those of the final installation, including control wiring between power and control sections. All sources of power and external devices and instruments shall be available to simulate the real-life operation scenarios and monitor equipment response.
- .10 Demonstrate automatic and manual operation of the equipment. Simulate generator start, synchronization, assumption of load, modification of bus configuration (i.e. automatic closing and opening of ties), generator shutdown, and system alarms.
- .11 Demonstrate operation of switches, breakers, pilot devices, alarms, and communications interface.
- .12 Document the outcome of the inspection and testing in a final FAT Report – to be submitted to, and approved by, the Owner and the Consultant.

1.6 FACTORY INTEGRATED SYSTEM TEST

1. Owner and Consultant will witness testing of the paralleling switchgear with the generators as an integrated system prior to shipping
2. Upon completing individual equipment factory acceptance tests (FAT) Switchgear SG-G1 along with the Paralleling Controls Cabinet shall be delivered to the facility of the generator manufacturer for Integrated System Testing (IST).
3. Provide suitable test area. Assemble and setup each unit for the tests to be witnessed.
4. The IST shall include but not be limited to the following tests:
 1. Generator automatic start upon utility power failure.
 2. Generator synchronization (tie open) and paralleling to common bus (tie closed)
 3. With switchgear lineup carrying load, demonstrate load distribution between the three generators. This test shall be performed for all possible combinations of running generators:
 1. DG-1 and DG-2 in parallel
 2. DG-2 and DG-3 in parallel
 3. DG-3 and DG-1 in parallel
 4. DG-1, DG-2 and DG-3 in parallel.
 4. Simulate various modes of failure and confirm presence of alarms at the HMI,

including shutdowns

5. Demonstrate navigation through the various screens of the HMI.
6. With the system set to Manual mode demonstrate control of the generators operator interface, including:
 1. Generator start
 2. Generator synchronization and paralleling
 3. Generator stop
 4. Emergency remote stop
5. Perform additional tests or demonstrations as requested by members of the witnessing party.
6. Demonstrate generator plant automatic shut down upon expiration of cool down time.
7. Record the operations performed on the test forms for incorporation into the Factory Acceptance Test Report.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle paralleling switchgear in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Ship and store switchgear assembly in upright position.
 - .2 Keep doors locked and protect instruments from damage and dust.
 - .3 Ship channel base sills, anchoring devices in advance of switchgear.
 - .4 Store switchgear indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .5 Store and protect switchgear assembly from nicks, scratches, and blemishes.
 - .6 Replace defective or damaged materials with new.

1.8 COORDINATION

- .1 Co-ordinate time-current characteristics of protective relays and fuses (if used) and with the completion of the Power Study by the switchgear manufacturer or an independent party.

1.9 EXTRA MATERIALS

- .1 Submit maintenance materials in accordance with 01 78 00 - Closeout Submittals.
- .2 Include:

- .1 1 set of power fuses of each type (if installed).
- .2 6 of each type of indicator light bulbs installed.
- .3 Touch-up paint of same colour as switchgear enclosure.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Switchgear assembly: to EEMAC G8-3.2, G8-3.3 or both, as applicable.
- .2 Steel for cubicles: to CSA G40.21.
- .3 Load Interrupter Switches (if used): to CSA C22.2 No.193.
- .4 Isolating Switches (if used): CSA C22.2 No.58
- .5 Insulators: to EEMAC G1-1
- .6 Enclosure finish: to ANSI C57.12.

2.2 SWITCHGEAR DESCRIPTION

- .1 Equipment shall be completely factory-built, assembled, wired, and tested. All equipment and components shall be of new construction.
- .2 Paralleling switchgear: indoor, 13.8 kV, 600 A, 3 phase, 3 wire, short circuit capacity 31.5 kA, BIL 95 kV.
- .3 Configured as a single lineup consisting of power and control sections/compartments with the following functionality:
 - .1 Power sections, containing breakers (or breakers and load break switches – if solution also employs switches) for three bus segments, to
 - .1 Receive power from the respective generator, via the associated generator breaker
 - .2 Distribute power to the existing and future building loads, via breakers or load break switches, and
 - .3 Distribute power to the load bank bus via breaker or load break switches, and
 - .4 Segregate the bus into two or three sections
 - .2 Generator controls, to
 - .1 manage generator functions including start, synchronization, load sharing, protection, alarms and shutdown
 - .2 monitor power flow of each generator

Controls can be housed in a separate compartment of each generator breaker section, can be distributed throughout the lineup, accommodated in a dedicated section at one end of the lineup, or be a standalone section located away from the paralleling switchgear lineup. Controls can also be integrated with those of the transfer/distribution switchgear if the manufacturer can offer this option – subject to the functional requirements and space constraints.

- .3 Master control compartment (or section) to
 - .1 Manage the system operation, including opening and closing of tie breakers
 - .2 Provide operator interface (HMI, control and pilot devices)
 - .3 Provide communication interface to building automation system

2.3 ENCLOSURE

- .1 Assembly of metal clad or combination of metal clad and metal enclosed sections (if switches are also employed), free standing, floor mounted, dead front, CSA Enclosure 1, constructed from rolled flat steel sheets. Size: maximum 31 ft – 6 in (9600mm) wide by 90 inches (2286 mm) deep.

NOTE: These dimensions are critical and must not be exceeded regardless of the power devices employed.

- .2 Switchgear sections shall be arranged with due consideration to accessibility. Access shall be provided from both front and back. If draw-out device (breakers) are used, their placement shall be such that adequate access and working clearances are maintained. Carefully review the space layout, including the position of columns to ensure the proposed layout complies with the accessibility and clearance requirements.
- .3 Cubicle exterior and interior: gray.
- .4 Ventilating louvres: insect and vermin-proof with easily replaceable fiberglass filters.
- .5 Use non-corrosive bolts and hardware.
- .6 Steel channel sills for base mounting in single length common to multi-cubicle lineup.
- .7 Full height outer doors, gasketed, hinged on same side, with provision for multiple padlocking. All rear doors shall be padlockable. Three point latch, stops, to open at least 135 degrees with viewing windows of transparent shatterproof material for inspection of disconnecting switch position.
- .8 Gaskets on removable covers.
- .9 Inner door (where required): hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts, to open at least 90 degrees.
- .10 Storage container on inside surface of door capable of accommodating 3 spare fuse refills (if used). Include spare fuses.

- .11 Metal pocket with weatherproof envelope and 1 set of drawings and diagram prints on inside surface of door.
- .12 Space heaters: 120 V, 250 W, 60 Hz, single phase, low watt density complete with thermostat and breaker in each cubicle.
- .13 Circuit breaker compartments shall be designed to house 15.0 kV removable-element circuit breakers. Stationary primary disconnect contacts shall be silver-plated copper. Grounded metal safety shutters shall isolate all primary connections in compartment when breaker is withdrawn from connected position.
- .14 Access control: Equip doors providing access to interrupter switches with fuses (if installed) with key to guard against:
 - .1 Opening door if interrupter switch on source side of fuse is closed.
 - .2 Closing interrupter switch if door is open.

2.4 BUS BARS

- .1 Three phase, insulated, continuous current rating 600 A extending full width of multi-cubicle power lineup and suitably supported on insulators.
- .2 Main connections between bus bars and major switching components of continuous current rating to match major switching components.
- .3 High conductivity tin plated copper for bus bars and main connections.
- .4 Brace bus bar system including ground bus to withstand stresses resulting from short circuit currents specified.
- .5 Tin surfaced joints, secured with non-corrosive bolts and Belleville washers, tightened with torque wrench in accordance with manufacturer's recommendations.
- .6 Identify phases of bus bars by suitable marking.
- .7 Bus bar connectors when switchgear shipped in more than one section.

2.5 GROUNDING

- .1 Copper ground bus not smaller than 50 x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.
- .2 Lugs at each end for size 2/0AWG grounding cable.
- .3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

2.6 WIRING/TERMINATIONS

- 1. Power feeders to and from the switchgear lineup are high voltage cables, as shown on the drawings. Adequate space shall be provided in each section for installation,

termination and connection of the incoming/outgoing cables.

2. Cables enter the switchgear through the top, as shown on the drawings.
3. Front accessible, isolated vertical wireways for routing of factory and field control wiring through each section/compartment of the switchgear
4. Control wiring:
 1. SIS type, minimum 12 gauge for control circuits and 10 gauge for current transformer and shunt trip circuits.
 2. ring type terminations suitable for 10 gauge wiring
 3. current transformer secondary wiring connected to shorting terminal blocks
5. Control wiring across shipping splits terminated at identically marked terminal blocks in each section; wire jumpers terminated with ring connectors at each terminal block
6. Control wiring leaving the switchgear routed through terminal blocks with numbered strips and provision for #10 AWG field connections and marked as to its origin and destination by means of wire markers/sleeves at each end.
7. Control wiring terminated with compression, ring-type connectors. Rail-mounted fuse blocks, disconnect switches and terminal blocks of finger safe design.
8. Identification of source and load served at each wiring terminal, by means of sleeves heat stamped with the wire origin and destination information.

2.7 LOAD INTERRUPTER SWITCHES (if used)

- .1 Load Interrupter Switch: to CSA C22.2 No.193.
- .2 3 pole, quick-make, quick-break assembly, stored energy operating mechanism, manual operated, assembled on welded steel base.
- .3 Continuous full load rating: 600 A, interrupting rating: 600 A, peak withstand and duty-cycle fault closing of 65,000 A.
- .4 Voltage rating: 15 kV.
- .5 95 kV BIL.
- .6 Interphase barriers.
- .7 Non-removable operating handle c/w provision for pad locking.
- .8 Power fuses: as shown.
- .9 Include viewing windows to allow full view of the position of all three switch blades.
- .10 Interlocks with features as follow:

- .1 Fuse is only accessible after switch is opened.
- .2 Switch can be closed only after fuse access door is closed.

2.8 CIRCUIT BREAKERS

- .1 Circuit breakers shall be draw-out type, rated 1200 A, with symmetrical interrupting rating of 31.5 kA at 13.8 kV. Circuit breakers of equal rating shall be interchangeable.
- .2 Breaker operation shall be by electrically charged, mechanically and electrically trip-free, stored-energy spring. A handle shall be provided to manually charge the spring.
- .3 Breakers shall be equipped with secondary disconnecting contacts, which shall automatically engage in the connected position.
- .4 Each breaker compartment shall have a breaker rack-out device. In the disconnected position, breaker shall be easily removable from compartment, with door closed. Breaker position shall be indicated visibly.
- .5 Rack-out device shall have provisions to padlock in connected or disconnected position. When locked in disconnected position, breaker shall be removable from compartment using portable lifting device. Padlock shall not interfere with breaker operation
- .6 Interlocks shall prevent moving breaker to or from operating position unless main contacts are open. Operating springs shall be discharged automatically when breaker is moved from the connected or disconnected position.
- .7 Automatic shutters shall cover primary disconnect stabs when breaker is withdrawn to test/disconnect position. Linkages connected to racking mechanism shall positively drive shutters. A stationary barrier shall be located in front of the shutters for additional safety
- .8 Breaker control voltage shall be 48 V DC from an external source (station battery).
- .9 If installed in the lower compartment breaker shall be capable of being removed without the use of a breaker dolly once it is moved to the disconnected position
- .10 Each circuit breaker shall be provided with an auxiliary switch containing six "a" (normally open) and six "b" (normally closed) contacts. All spare contacts shall be wired to terminal blocks.
- .11 Each circuit breaker shall be provided with a position switch indicating whether the circuit breaker is in the "Connected" or Disconnected" position. Each switch shall have a three "a" (normally open) and three "b" (normally closed) contacts. All spare contacts shall be wired to terminal blocks.
- .12 For each breaker provide a hand-resettable lockout relay (device 86) to disable closing of the corresponding circuit breaker until the relay has been reset.
- .13 Each breaker compartment shall have the following devices mounted on the compartment door:

- .1 two-position Auto/Manual selector switch wired in breaker control circuit. Selecting "Auto" shall permit automatic operation as dictated by the paralleling controls; selecting "Manual" shall permit operation using the local breaker control switch. Selector switch contacts shall be wired to inputs on the appropriate protective relay to monitor the switch position
- .2 three indicating lights, pushbutton type (push-to-test): red for CLOSED, green for OPEN, and one white for the lockout relay.

2.9 PROTECTION RELAYS

- .1 The generator protection relay shall be per the generator manufacturer's recommendation for the application.
- .2 The feeder protection relays shall be selected by the switchgear manufacturer.

2.10 INSTRUMENT TRANSFORMERS

- .1 Current transformer accuracy shall be ANSI standard. Transformer mechanical ratings shall equal the momentary rating of the circuit breakers. Bar type current transformers, when mounted in switchgear assemblies, shall be rated for the full voltage of the switchgear.
- .2 Short circuit style terminal blocks shall be installed in current transformer secondary wiring between the current transformer and all connected devices.
- .3 Voltage transformers shall be draw-out type, with current-limiting fuses and with BIL rating equal to that of the switchgear.

2.11 ARC FLASH MITIGATION

- .1 Provide capability to lower the incident energy level that an operator could be exposed to during maintenance activities on energized switchgear, using active arc flash mitigation technology
- .2 The arc flash energy shall be limited to a maximum of 8 cal./cm sq. at 18" from the gear, and arc extinction time shall be less than 4 ms after fault detection such as ABB UFES solution (Ultra-Fast Earthing switch).
- .3 The solution employed for arc flash reduction depends on the technologies of various manufacturers, with performance equal to ABB UFES solution. Regardless of manufacturer and technology, arc energy reduction shall be achieved without sacrificing coordination.

2.12 PERFORMANCE REQUIREMENTS

- .1 **Generator plant must provide 2500 kW of effective capacity at 13.8 kV within 10 seconds of utility power loss, in accordance with CSA Standard Z32 – Electrical Safety and Essential Electrical Systems in Health Care Facilities.**

- .2 **This performance shall be achieved regardless of the method employed for the synchronization/paralleling of generators, i.e. through conventional controls or using dead bus (“start-up”) synchronization.**
- .3 **In either case, the 10 second time limit (from power loss to assumption of load) shall also include the time required by the transfer system to operate. The performance of this control system must be coordinated with that of the transfer system (switchgear SG-E1) to ensure the overall objective of 10 seconds of less (from loss to restoration of power) is met.**

2.13 SEQUENCE OF OPERATION – CONVENTIONAL SYNCHRONIZATION

- .1 When utility power is present (default state), the breaker states are as follows:
 - .1 Generator breakers G1-B1, G1-B2, G1-B3: CLOSED
 - .2 Tie breakers G1-T1, G1-T2: OPEN
- .2 Upon loss of utility power in either incoming feeder Transfer and Distribution Switchgear SG-E1 sends start signal to all generators.
- .3 All generators start and build up the voltage and frequency
- .4 When nominal voltage and frequency are attained, breakers E1-B1 and E1-B3 in Switchgear SG-E1, close. The total building load is separately supplied by generators DG-1 and DG-3 – in up to 10 seconds; generator DG-2 is the redundant machine
- .5 Control system synchronizes the three generators while DG-1 and DG-3 are carrying load (no time restriction)
- .6 When the three generators are in sync, tie breakers G1-T1 and G1-T2 close. The bus is common and the total building load is shared between three machines in parallel.
- .7 If any of the generators fails to start, to synchronize, or its breaker does not close within a pre-programmed time interval, the controls shall lock out the generator and its breaker; an alarm shall be generated, and a request for operator intervention shall be issued. The total building load continues to be supplied by the two generators remaining connected to the common bus.
- .8 If any of the tie breakers does not close, the controls shall lock out the breaker, an alarm shall be generated and a request for operator intervention shall be issued. The tie switch in switchgear SG-E1 downstream (or tie breakers further downstream, in the building) must be closed manually.
- .9 While the system runs in normal conditions (i.e. generators are connected to their own bus, and the three buses are connected together), the master controller shall monitor the load and manage the generator system’s capacity (i.e. disconnect and stop one or more generators) as follows:
 - Load below capacity of one generator – stop two generators
 - Load below the aggregate capacity of two generators – stop one generator

- .10 Upon restoration of utility power to switchgear SG-E1, and after utility power has stabilized (pre-programmed time delay on retransfer), transfer controller sends signal to master controller of switchgear SG-G1 to enter cooldown and shutdown mode.

2.14 SEQUENCE OF OPERATION – DEAD FIELD (START-UP) SYNCHRONIZATION

- .1 When utility power is present (default state), the breaker states are as follows:
 - .1 Generator breakers G1-B1, G1-B2, G1-B3: CLOSED
 - .2 Tie breakers G1-T1, G1-T2: CLOSED
- .2 Upon loss of utility power in either incoming feeder Transfer and Distribution Switchgear SG-E1 sends start signal to all generators.
- .3 All generators start – without excitation (i.e. dead field) and build up speed, up to nominal rpm.
- .4 When the last engine reaches nominal speed, the control system switches on the excitation simultaneously on all generators (field flashing). Bus voltage shall build up to nominal in less than 7-8 seconds.
- .5 Upon attainment of nominal bus voltage, the control system signals switchgear SG-E1 downstream to close emergency side breakers E1-B1 and E1-B3. The total building load is shared between three machines in parallel.
- .6 Should dead field synchronization fail, the control system shall revert to standard synchronization by opening the generator breakers and re-closing them when generator and bus frequency match. The tie breakers G1-T1 and G1-T2 shall remain closed.
- .7 If one off-line generator must be connected to the live bus, the control system shall revert to standard synchronization by voltage and frequency matching.
- .8 Generator plant capacity management (i.e. taking one or two generators off line) and cooldown and shutdown sequences shall be achieved in the same manner as with conventional synchronization.

2.15 CONTROLS AND OPERATOR INTERFACE

- .1 Generator controls can also be integrated with the transfer controls for switchgear lineup SG-E1 if the functional and reliability requirements outlined herein are met and if the solution offer space or cost savings versus separate controls for each lineup.
- .2 Controls shall be designed to operate the system in automatic, dead field synchronization mode, in less than 10 seconds as default.
- .3 System shall also have the capability to manually synchronize the generators in standard mode, by matching generator voltage and frequency to those of the bus. All hardware, including instrumentation and operator control devices must be provided for this functionality.

- .4 Synchronization controls shall utilize true hot standby (primary and secondary) master PLC controllers.
- .5 The controls for monitoring, protection, synchronization and paralleling of each generator shall be installed in the top compartment of the switchgear section also containing the generator breaker, if possible. The compartment shall be completely equipped, wired and programmed at the factory, and shall contain, without being limited to, the following components:
 - .1 Digital synchronizer and load controller (DSLCL)
 - .2 Generator management relay
 - .3 Redundant remote I/Os connected to both the primary and secondary master controllers in an Ethernet ring topology.
 - .4 Sync check relays
 - .5 Lockout relay
 - .6 Bus differential relay
 - .7 Ethernet switches
 - .8 Miscellaneous control components and wiring associated with the above functions including control relays, terminal blocks, fuses, circuit breakers, etc.
 - .9 Door-mounted pilot devices, instruments, and controls shall include:
 - .1 Indicating lights for
 - 1. Generator Running
 - 2. Generator Alarm
 - 3. Generator Shutdown
 - 4. Generator Breaker Open/Closed
 - .2 Instruments:
 - 1. Ammeter
 - 2. Voltmeter
 - 3. Synchroscope
 - .3 Switches and Potentiometers:
 - .1 Ammeter switch
 - .2 Voltmeter switch
 - .3 Voltage adjustment potentiometer
 - .4 Speed adjustment potentiometer
 - .5 Lockout switch
 - .6 Emergency stop pushbutton
 - .4 Power Monitor
 - .5 Generator Management Relay coordinated with the relays provided for the transfer and distribution switchgear SG-E1 to offer the required protection and control features for a cost-effective system protection and control solution.
- .6 The arrangement of the components described above may be different between manufacturers, however, the general intent is to have the generator controls installed

only in this section; additional controls associated with the generator may also be distributed throughout the lineup or installed in the master control section of the lineup.

- .7 Wiring for external control and monitoring points shall terminate at dedicated terminal blocks within the control compartment/section.
- .8 Operator interface (HMI) shall be industrial-type, minimum 15" diagonal, touch screen graphic display, mounted on the door of the master control section of the lineup, providing the following:
 1. Menu driven display screens for monitoring of status, alarms, and field functions and settings, complete with navigation keys.
 2. Generator detail screens providing information on status, operating parameters of engine and alternator, etc. – may differ between manufacturers
 3. Single line diagram screen showing the symbols of generators, feeders, generator and tie breakers, and bus, all complete with labels. The following colours shall represent the status of the various components:
Feeders and Bus: Energized – Red; De-energized – Green
Breakers: Closed – Red; Open – Green; Withdrawn – Grey (or blank/no symbol)
 4. Diagnostic screens, including Synchronization History and Alarm Log (loss of source, breaker trip, cause of trip), with date and time stamp.
 5. Password protection
 6. Soft buttons that become visible and operable in Manual Mode.
 7. Instructions screen, displaying a step-by-step operation instructions narrative
 8. Settings screen for the various timers, cooldown time and others, if applicable – adjustable
- .9 A System Control Switch shall be provided on the door of the master control section to allow selection of the operating mode between Automatic and Manual. Changing the switch to the Manual position shall generate an alarm. A transparent plastic cover shall be provided over the switch.
- .10 Control system to provide Modbus TCP/IP connection for BAS integration.

2.16 EQUIPMENT IDENTIFICATION

- .1 Provide mimic bus on the front (and back, where applicable) of the switchgear showing device symbols and power flow.
- .2 Identify sections and compartments with the device name, per the Single Line Diagram. Provide nameplates for all door mounted pilot and control devices. All names shall be legible from a standing position. Materials and colours shall be the manufacturer's standard.

2.17 MANUFACTURERS

1. Acceptable switchgear manufacturers (subject to compliance with this specification):
 1. ABB
 2. Commercial Switchgear Limited (CSL)
 3. KRKA Power
 4. IEM
 5. Eaton
 6. S&C Electric
 7. Schneider Electric
 8. Siemens
2. Acceptable power circuit breaker manufacturers
 1. ABB
 2. Eaton
 3. Schneider Electric
 4. Siemens
3. Acceptable protection relay manufacturers
 1. ABB
 2. Basler Electric
 3. Eaton
 4. GE Multilin
 5. Schweitzer (SEL)
4. Acceptable controls manufacturers:
 1. ABB
 2. ASCO
 3. ComAp
 4. CAT
 5. Eaton

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for switchgear assembly installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

- .1 Set and secure switchgear assembly in place on channel base, rigid, plumb and square.
- .2 Install field power and control wiring and make connections in accordance with manufacturer's recommendations.
- .3 Connect ground bus to building system ground.
- .4 Render entire assembly rodent and insect proof by means of plates, screens or grouting.
- .5 Ensure fixed housing into which circuit breaker moving carriage enters, is plumb.
- .6 Check factory made connections for mechanical security and electrical continuity.
- .7 Check relay settings and fuse sizes against shop drawings and per the recommendations of the Power Study.

3.3 FIELD QUALITY CONTROL (SITE ACCEPTANCE TESTING)

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Coordinate the test of the paralleling switchgear with the generator site acceptance testing so that they can be tested together. Provide load bank of 2000 kW capacity, and load bank cables for this purpose.
- .3 Test the installed and connected paralleling switchgear together with the generators and the transfer and distribution switchgear as an integrated system to validate performance.
- .4 Operate load interrupter switches (if installed) and circuit breaker closing and tripping mechanisms, to verify correct functioning.
- .5 Check insulation of switchgear assembly with DC Hi-Pot tester in accordance with manufacturer's approved methods. If values are not satisfactory, clean, dry and heat switchgear and repeat tests until readings acceptable to Owner and Consultant.
- .6 Check phase rotation of each feeder.
- .7 Check fuses for correct type and rating.
- .8 Check for grounding continuity.
- .9 Test paralleling switchgear with generators running and load bank connected. Check meter readings to ensure proper functioning of instruments and satisfactory load sharing between generators.
- .10 Test operation of switchgear in all modes (Auto, Manual, dead field and conventional synchronization) and configurations (common bus, segmented bus) to verify correctness of installation and wiring and to demonstrate performance to Owner and Consultant.

.11 Have factory representative commission final installation and certify proper installation and operation before placing in service.

.12 Prepare Test Report and submit to Owner and Consultant for review.

3.4 PROTECTION

.1 Protect installed products and components from damage during construction.

.2 Repair damage to adjacent materials caused by primary switchgear assembly installation.

3.5 TRAINING

.1 Upon completion of testing and commissioning, and prior to acceptance, provide training of Owner's personnel in the care and operation of equipment.

.2 Prepare training material and distribute to Owner prior to conduction the training session.

.3 Training shall be delivered in a format that includes a "classroom" session followed by a hands-on session.

.4 Present equipment features and components, and demonstrate operation modes.

.5 Emphasize safety aspects of equipment operation.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This specification covers the requirements for the 15 kV transfer and distribution switchgear lineup labeled SG-E1 on the Single Line Diagram and layouts.
- .2 Also included in this package is the supply and installation of a 48 V station battery and DC distribution panel. Charger for the station battery is covered under Section 26 33 43,.
- .3 In connection with this equipment, the following services are required:
 - .1 Design, manufacturing, programming and setup in accordance with this specification
 - .2 Factory acceptance testing
 - .3 Delivery to the site, unloading and storage
 - .4 Installation (physical and electrical)
 - .5 Testing and commissioning (site acceptance testing)
 - .6 Training of Owner's operation personnel, and
 - .7 Documentation
- .4 This equipment design and construction must be coordinated with that of generator paralleling switchgear (Section 26 13 18.1), to ensure the performance of the integrated system of generators, paralleling and transfer/distribution switchgear is as specified, and that a reliable and cost-effective solution is provided.
- .5 The transfer and distribution switchgear SG-E1 shall be the product of the same manufacturer supplying the generator paralleling switchgear SG-G1 for reasons of component commonality, coordination of features and performance, and single source of responsibility.
- .6 The Generators and Paralleling Switchgear SG-G1 are shown on the Single Line Diagram and layout drawings

1.2 REFERENCE STANDARDS

- .1 CSA International
 - .1 CSA C22.2 No.14, Industrial Control Equipment.
 - .2 CSA C22.2 No. 58, High-Voltage Isolating Switches.
 - .3 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
- .2 National Electrical Manufacturers Association (NEMA)

1.3 ACTION AND INFORMATION SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - 1. Bill of Material
 - 2. Product Data: include dimensions and manufacturer's technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 3. All shop drawings and manufacturer's descriptive literature shall clearly reflect the requirements of this specific Project.
- .3 Include information not limited to the following:
 - 1. Complete outline dimensions of the switchgear lineup, including control section (if standalone). Provide overall plans and elevations, foundation plans and operating weight, locations of all accessories and equipment. Detailed interface arrangement of the components shall be shown.
 - 2. Details of bus connections between switchgear sections.
 - 3. Mimic bus on front of the lineup, warning signs, and nameplates.
 - 4. Single line and three-line diagrams of the complete assemblies.
 - 5. Catalogue sheets showing physical and electrical characteristics of all equipment and devices. Include: station battery, circuit breakers, load interrupter switches, digital power monitors, programmable logic controller and peripherals, pilot devices, operator interfaces, relays etc.
 - 6. Elementary wiring diagrams of all power and control devices, alarm, monitoring and instrumentation circuits.
 - 7. Wiring diagrams shall indicate and differentiate between factory wiring and field installed wiring. At each wiring terminal, identify source and load served.
 - 8. A line numbering method shall be incorporated and all associated components shall be referenced by line number to enable rapid location in the circuits of related elements, e.g. relay coils, contacts, etc.
 - 9. Time current curves of fuses and protection relays.
 - 10. Power draw of all breakers and control components.
 - 11. Calculation of station battery capacity.
 - 12. Coordinate with the wiring of the generator paralleling switchgear in order to prepare point-to-point wiring diagrams in AutoCAD of the integrated system.
 - 13. The wiring diagrams must show connections between components installed in the paralleling switchgear, and between
 - 1. Paralleling switchgear and Transfer and Distribution switchgear
 - 2. Paralleling switchgear and Building Automation System

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for switchgear assembly for incorporation into manual. Include the following:
 1. Shop drawings, including any field modifications or changes to reflect actual, "as installed" conditions.
 2. Technical data (Manufacturer/OEM) in searchable .pdf format:
 1. illustrated parts lists with catalogue numbers
 2. schematic diagram of electrical controls
 3. fault locating guide
 4. precise details for adjustment and setting of time delay relays or sensing controls, which require on site adjustment.
 3. Complete point-to-point wiring diagrams in AutoCAD showing connections between internal components as well as between internal components and the paralleling switchgear and/or generators.
 4. Operation instructions for each individual component
 5. Recommended maintenance and repair/troubleshooting instructions and schedules
 6. Certified factory and field test reports
 7. Warranty
 8. Addresses and phone numbers of suppliers and/or their authorized representatives.

1.5 SOURCE QUALITY CONTROL (FACTORY ACCEPTANCE TESTING - FAT)

- .1 Owner and Consultant will conduct inspection of the transfer/distribution switchgear at the manufacturer's plant and witness its testing prior to shipping.
- .2 The inspection of the switchgear and testing in the presence of Owner and Consultant is intended only for demonstration and confirmation of performance. The switchgear manufacturers shall conduct its production tests and validate the full operation of the equipment prior to the witnessed test.
- .3 Notify Owner and Consultant in writing minimum 15 days before the date of the factory testing.
- .4 Submit manufacturer's type test certificate indicating cubicles of the transfer/distribution switchgear, together with their components were tested as an integrated assembly.
- .5 Submit test procedures, at least 10 days prior to testing

- .6 The Contractor shall retain the equipment manufacturer or an independent party to complete the power study before the FAT, so that recommended settings for the relays can be implemented and tested prior to the equipment being shipped to the site.
- .7 At the time of factory testing the control logic programming shall be completed, debugged, and ready for demonstration. Failure to comply with this requirement may result in repeated testing, at Contractor's expense.
- .8 Have the equipment set up in conditions similar to those of the final installation, including control wiring between power and control sections. All sources of power and measuring / monitoring / recording devices and instruments shall be available to simulate the real-life operation scenarios and monitor equipment response.
- .9 Demonstrate automatic and manual operation of the equipment. Simulate utility power failure, forward transfer to the generator source, and utility power restoration followed by reverse transfer from generator to utility power.
- .10 Demonstrate operation of switches, breakers, pilot devices, alarms, and communications interface.
- .11 Document the outcome of the inspection and testing in a final FAT Report – to be submitted to, and approved by, the Owner and the Consultant.

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle transfer/distribution switchgear in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions
- .2 Delivery and Acceptance Requirements: deliver switchgear to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Ship and store switchgear assembly in upright position.
 - .2 Keep doors locked and protect instruments from damage and dust.
 - .3 Ship channel base sills, anchoring devices in advance of switchgear.
 - .4 Store switchgear indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .5 Store and protect switchgear assembly from nicks, scratches, and blemishes.
 - .6 Replace defective or damaged materials with new.

1.7 COORDINATION

- .1 Co-ordinate time-current characteristics of protective relays and fuses (if used) fuses and with the completion of the Power Study by the switchgear manufacturer or an independent party.

1.8 EXTRA MATERIALS

- .1 Submit maintenance materials in accordance with 01 78 00 - Closeout Submittals.
- .2 Include:
 - .1 1 set of power fuses of each type (if installed).
 - .2 6 of each type of indicator light bulbs installed.
 - .3 Touch-up Paint of same colour as switchgear enclosure.

PART 2 - PRODUCTS

2.1 MATERIALS

- .1 Switchgear assembly: to EEMAC G8-3.2, G8-3.3 or both, as applicable.
- .2 Steel for cubicles: to CSA G40.21.
- .3 Load Interrupter Switches (if used): to CSA C22.2 No.193.
- .4 Isolating Switches (if used): CSA C22.2 No.58
- .5 Insulators: to EEMAC G1-1
- .6 Enclosure finish: to ANSI C57.12.

2.2 SWITCHGEAR DESCRIPTION

- .1 Equipment shall be completely factory-built, assembled, wired, and tested. All equipment and components shall be of new construction.
- .2 Transfer and distribution switchgear: indoor, 13.8 kV, 600 A, 3 phase, 3 wire, short circuit capacity 31.5 kA, BIL 95 kV.
- .3 Configured as a single lineup consisting of a control section and two power sections with two buses separated by a tie switch, and performing the following functions:
 - .1 Receive two incoming underground utility power feeders, one for each section, via draw-out circuit breakers
 - .2 Receive two overhead emergency power feeders (from generator plant/paralleling switchgear), one for each section, via draw-out circuit breakers
 - .3 Supply two outgoing underground distribution feeders, one from each section, via draw-out circuit breakers or fused load break switches
 - .4 Supply an integral station transformer for local power (within the Powerhouse), via draw-out circuit breakers or a fused load break switch
 - .5 Execute transfers between the utility and generator supply sources in open-transition transfer mode, and

- .6 Provide operator interface for control and monitoring of system status, and instruments for displaying power flow in the utility feeders
- .7 Controls can also be integrated with those of the paralleling switchgear if the manufacturer can offer this option – subject to the functional requirements and space constraints

2.3 ENCLOSURE

- .1 Assembly of metal clad or combination of metal clad and metal enclosed sections (if switches are also employed), free standing, floor mounted, dead front, CSA Enclosure 1, constructed from rolled flat steel sheets. Size: maximum 24 ft (7300 mm) wide by 90 inches (2286 mm) deep.

NOTE: These dimensions are critical and must not be exceeded regardless of the power devices employed.

- .2 Switchgear sections shall be arranged with due consideration to accessibility. Access shall be provided from both front and back. If draw-out device (breakers) are used, their placement shall be such that adequate access and working clearances are maintained. Carefully review the space layout, including the position of columns to ensure the proposed layout complies with the accessibility and clearance requirements.
- .3 Cubicle exterior and interior: gray.
- .4 Ventilating louvres: insect and vermin-proof with easily replaceable fiberglass filters.
- .5 Use non-corrosive bolts and hardware.
- .6 Steel channel sills for base mounting in single length common to multi-cubicle lineup.
- .7 Full height outer doors, gasketed, hinged on same side, with provision for multiple padlocking. All rear doors shall be padlockable. Three point latch, stops, to open at least 135 degrees with viewing windows of transparent shatterproof material for inspection of disconnecting switch position.
- .8 Gaskets on removable covers.
- .9 Inner door (where required): hinged and bolted mesh steel screens to prevent inadvertent contact with exposed live parts, to open at least 90 degrees.
- .10 Storage container on inside surface of door capable of accommodating 3 spare fuse refills (if used) .Include spare fuses.
- .11 Metal pocket with weatherproof envelope and 1 set of drawings and diagram prints on inside surface of door.
- .12 Space heaters: 120 V, 250 W, 60 Hz, single phase, low watt density complete with thermostat and breaker in each cubicle.
- .13 Circuit breaker compartments shall be designed to house 15.0 kV removable-element circuit breakers. Stationary primary disconnect contacts shall be silver-plated copper.

Grounded metal safety shutters shall isolate all primary connections in compartment when breaker is withdrawn from connected position.

- .14 Access control: Equip doors providing access to interrupter switches with fuses (if used) with key to guard against:
 - .1 Opening door if interrupter switch on source side of fuse is closed.
 - .2 Closing interrupter switch if door is open.

2.4 BUS BARS

- .1 Three phase, insulated and full capacity neutral bus bars, continuous current rating 600 A extending full width of multi-cubicle power lineup and suitably supported on insulators.
- .2 Main connections between bus bars and major switching components of continuous current rating to match major switching components.
- .3 High conductivity tin plated copper for bus bars and main connections.
- .4 Brace bus bar system including ground bus to withstand stresses resulting from short circuit currents specified.
- .5 Tin surfaced joints, secured with non-corrosive bolts and Belleville washers, tightened with torque wrench in accordance with manufacturer's recommendations.
- .6 Identify phases of bus bars by suitable marking.
- .7 Bus bar connectors when switchgear shipped in more than one section.
- .8 Include full capacity neutral.

2.5 GROUNDING

- .1 Copper ground bus not smaller than 50 x 6 mm extending full width of multi-cubicle switchboard and situated at bottom.
- .2 Lugs at each end for size 2/0AWG grounding cable.
- .3 Bond non-current carrying parts, including switchgear framework, enclosure and bases to ground bus.

2.6 WIRING/TERMINATIONS

- 1. Power feeders to and from the switchgear lineup are high voltage cables, as shown on the drawings. Adequate space shall be provided in each section for installation, termination and connection of the incoming/outgoing cables. Cables enter the switchgear through the bottom and the top, as shown on the drawings.
- 2. Front accessible, isolated vertical wireways for routing of factory and field control wiring through each section/compartment of the switchgear

3. Control wiring:
 1. SIS type, minimum 12 gauge for control circuits and 10 gauge for current transformer and shunt trip circuits.
 2. ring type terminations suitable for 10 gauge wiring
 3. current transformer secondary wiring connected to shorting terminal blocks
4. Control wiring across shipping splits terminated at identically marked terminal blocks in each section; wire jumpers terminated with ring connectors at each terminal block
5. Control wiring leaving the switchgear routed through terminal blocks with numbered strips and provision for #10 AWG field connections and marked as to its origin and destination by means of wire markers/sleeves at each end.
6. Control wiring terminated with compression, ring-type connectors. Rail-mounted fuse blocks, disconnect switches and terminal blocks of finger safe design.
7. Identification of source and load served at each wiring terminal, by means of sleeves heat stamped with the wire origin and destination information.

2.7 LOAD INTERRUPTER SWITCHES (if used)

- .1 Load Interrupter Switch: to CSA C22.2 No.193.
- .2 3 pole, quick-make, quick-break assembly, stored energy operating mechanism, manual operated, assembled on welded steel base.
- .3 Continuous full load rating: 600 A, interrupting rating: 600 A, peak withstand and duty-cycle fault closing of 65,000 A.
- .4 Voltage rating: 15 kV.
- .5 95 kV BIL.
- .6 Interphase barriers.
- .7 Non-removable operating handle c/w provision for pad locking.
- .8 Power fuses: as shown.
- .9 Include viewing windows to allow full view of the position of all three switch blades.
- .10 Interlocks with features as follow:
 - .1 Fuse is only accessible after switch is opened.
 - .2 Switch can be closed only after fuse access door is closed

2.8 CIRCUIT BREAKERS

- .1 Circuit breakers shall be draw-out type, rated 1200 A, with symmetrical interrupting rating of 31.5 kA at 13.8 kV. Circuit breakers of equal rating shall be interchangeable.

- .2 Breaker operation shall be by electrically charged, mechanically and electrically trip-free, stored-energy spring. A handle shall be provided to manually charge the spring.
- .3 Breakers shall be equipped with secondary disconnecting contacts, which shall automatically engage in the connected position.
- .4 Each breaker compartment shall have a breaker rack-out device. In the disconnected position, breaker shall be easily removable from compartment, with door closed. Breaker position shall be indicated visibly.
- .5 Rack-out device shall have provisions to padlock in connected or disconnected position. When locked in disconnected position, breaker shall be removable from compartment using portable lifting device. Padlock shall not interfere with breaker operation
- .6 Interlocks shall prevent moving breaker to or from operating position unless main contacts are open. Operating springs shall be discharged automatically when breaker is moved from the connected or disconnected position.
- .7 Automatic shutters shall cover primary disconnect stabs when breaker is withdrawn to test/disconnect position. Linkages connected to racking mechanism shall positively drive shutters. A stationary barrier shall be located in front of the shutters for additional safety
- .8 Breaker control voltage shall be 120 V AC from an external source (station transformer).
- .9 If installed in the lower compartment breaker shall be capable of being removed without the use of a breaker dolly once it is moved to the disconnected position
- .10 Each circuit breaker shall be provided with an auxiliary switch containing six "a" (normally open) and six "b" (normally closed) contacts. All spare contacts shall be wired to terminal blocks.
- .11 Each circuit breaker shall be provided with a position switch indicating whether the circuit breaker is in the "Connected" or Disconnected" position. Each switch shall have a three "a" (normally open) and three "b" (normally closed) contacts. All spare contacts shall be wired to terminal blocks.
- .12 For each breaker provide a hand-resettable lockout relay (device 86) to disable closing of the corresponding circuit breaker until the relay has been reset.
- .13 Each breaker compartment shall have the following devices mounted on the compartment door:
 - .1 two-position Auto/Manual selector switch wired in breaker control circuit. Selecting "Auto" shall permit automatic operation as dictated by the paralleling controls; selecting "Manual" shall permit operation using the local breaker control switch. Selector switch contacts shall be wired to inputs on the appropriate protective relay to monitor the switch position
 - .2 three indicating lights, pushbutton type (push-to-test): red for CLOSED, green for OPEN, and one white for the lockout relay.

2.9 PROTECTION RELAYS

- .1 Each feeder breaker (total of 4) shall have a relay providing feeder protection, control, monitoring and metering functions in one digital relay package for application on feeders and suitable for incorporation into an integrated switchgear monitoring and transfer control system.
- .2 The feeder protection relays shall be selected by the switchgear manufacturer and shall incorporate the following:
 - .1 Protection functions
 - .2 Control functions:
 - .3 Monitoring and metering functions:
 - .4 Communications
 - .5 HMI shall have used programmable LEDs and pushbuttons for status and manual control and navigation.

2.10 INSTRUMENT TRANSFORMERS

- .1 Current transformer accuracy shall be ANSI standard. Transformer mechanical ratings shall equal the momentary rating of the circuit breakers. Bar type current transformers, when mounted in switchgear assemblies, shall be rated for the full voltage of the switchgear.
- .2 Short circuit style terminal blocks shall be installed in current transformer secondary wiring between the current transformer and all connected devices.
- .3 Voltage transformers shall be draw-out type, with current-limiting fuses and with BIL rating equal to that of the switchgear.

2.11 ARC FLASH MITIGATION

- .1 Provide capability to lower the incident energy level that an operator could be exposed to during maintenance activities on energized switchgear, using active arc flash mitigation technology
- .2 The arc flash energy shall be limited to a maximum of 8 cal./cm sq. at 18" from the gear, and arc extinction time shall be less than 4 ms after fault detection such as ABB UFES solution (Ultra-Fast Earthing switch).
- .3 The solution employed for arc flash reduction depends on the technologies of various manufacturers, with performance equal to ABB UFES solution. Regardless of manufacturer and technology, arc energy reduction shall be achieved without sacrificing coordination.

2.12 OWNER METERING

- .1 Provide, in each breaker section, the following:
 - .1 Voltage selector switch

- .2 Ammeter selector switch
- .3 Analog voltage and current meter, switchboard type, with range appropriate for the maximum ratings of the circuit.

2.13 STATION TRANSFORMER

- .1 Rating: 75 kVA, 1 phase, 60 Hz.
- .2 Impedance: standard.
- .3 Insulation class: 220⁰ C
- .4 Primary winding: 13.8 kV, delta, BIL 95 kV
- .5 Secondary winding: 120/240 V, three wire with neutral brought out and effectively grounded
- .6 No load and full load losses to not exceed those indicated in CAN/CSA-C802.2.

2.14 TRANSFER CONTROLS

- .1 Each pair of utility – generator breakers shall be configured to operate as a transfer with the utility as the preferred source and the generator as the alternate source.
- .2 Default state of switching devices is as follows:
 - .1 Utility source breakers: Normally closed
 - .2 Generator source breakers: Normally open
 - .3 Tie breaker (switch, if used): Normally open
- .3 Interlocking shall be provided between the utility, generator breakers and tie breaker (switch) to prevent paralleling of sources, as follows:
 - .1 Utility breakers across the tie
 - .2 Generator breakers across the tie
 - .3 Utility breakers and generators breakers on the same section of bus
 - .4 Utility breakers and generator breakers across the tie.
- .4 System default operation mode shall be Auto. In this mode the system reacts to the loss of the power source currently supplying the load by effecting transfers to the alternate source.
- .5 Transfer controls shall monitor the status of all tie breakers and tie load break switches downstream of transfer switchgear (i.e. in the building). Should any of the downstream tie breakers or tie load break switches be closed, transfer from utility supply to generator supply shall only be executed after at least two generators are operational and synchronized, and the corresponding generator breakers and the tie breaker(s) in Switchgear SG-G1 are closed.
- .6 Manual operation capability shall be provided for both operation and testing purposes. Closing of breakers and tie switch shall only be possible for safe configuration, as

- allowed by the interlocks for operation purposes. For testing purposes (i.e. when breakers are withdrawn) closing of breakers shall not be restricted by the interlocks.
- .7 Transfers between the two sources shall be open transition type, both on loss and restoration of the preferred source (forward and reverse).
 - .8 Transfer controls shall be implemented using programmable logic residing in two independent PLCs (or purpose-built controllers), one for each of the two bus sections. The PLCs / controllers and their I/O modules shall be configured for operation in hot standby mode, so that each can assume the functionality of the other in case of failure.
 - .9 Time delays shall be programmable for the forward and reverse transfers, with the forward transfer being the shortest non-zero time from the moment the alternate source becomes available (i.e. voltage and frequency within parameters). Reverse transfer time delay shall be adjustable up to 60 minutes to allow for stabilization of the returning source (preferred source – utility)
 - .10 Controls shall be housed in separate section, matching the height of the power lineup. The section shall accommodate sensing relays, power supplies, processing units, I/O modules, terminal blocks, miscellaneous control and pilot devices, wiring, and an operator interface. Controls can also be integrated with those of the paralleling switchgear if the manufacturer can offer this option – subject to the functional requirements and space constraints
 - .11 Indicating lights shall be installed on the door of the control section to show the following conditions:
 - .1 Status of each source (total of 4): Red – available
 - .2 Source connected (total of 4): Green: connected
 - .3 System not fully in Auto (if any of the individual breaker selector switches is in Manual)
 - .4 Control power failure
 - .5 Any other trouble or alarm, per manufacturer's standard or recommendation
 - .12 Audible alarm shall be provided to operate in conjunction with all monitored alarm conditions. Alarm acknowledgement via pushbutton shall also be provided for silencing the alarm.
 - .13 Operator interface (HMI) shall be a touch screen configured to display the following information:
 - .1 System single line diagram, with devices colour-coded to indicate their status (Red – Closed; Green – Open; Grey – Withdrawn/Disconnected)
 - .2 Navigation screens for settings, selection of operating modes, administrative functions
 - .3 Alarm log for recording event history, with date and time stamp
 - .14 Power supply for controls shall also be redundant, with the primary source being the available AC source (utility or generator) and the backup source being the station battery. Provide converters and transfer circuits / best source selectors as required to ensure the continuity of control power under all operation scenarios.

2.15 EQUIPMENT IDENTIFICATION

- .1 Provide mimic bus on the front (and back, where applicable) of the switchgear showing device symbols and power flow.
- .2 Identify sections and compartments with the device name, per the Single Line Diagram. Provide nameplates for all door mounted pilot and control devices. All names shall be legible from a standing position. Materials and colours shall be the manufacturer's standard.

2.16 WARNING SIGNS

- .1 Include warning signs in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.17 MANUFACTURERS

1. Acceptable switchgear manufacturers (subject to compliance with this specification):
 1. ABB
 2. Commercial Switchgear Limited (CSL)
 3. KRKA Power
 4. IEM
 5. Eaton
 6. S&C Electric
 7. Schneider Electric
 8. Siemens
2. Acceptable power circuit breaker manufacturers
 1. ABB
 2. Eaton
 3. Schneider Electric
 4. Siemens
3. Acceptable protection relay manufacturers
 1. ABB
 2. Basler Electric
 3. Eaton
 4. GE Multilin
 5. Schweitzer (SEL)
4. Acceptable controls manufacturers:
 1. ABB
 2. ASCO

3. ComAp
4. CAT
5. Eaton

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections are acceptable for switchgear assembly installation in accordance with manufacturer's written instructions.

3.2 INSTALLATION

- .1 Set and secure switchgear assembly in place on channel base, rigid, plumb and square.
- .2 Make field connections in accordance with manufacturer's recommendations.
- .3 Connect ground bus to building system ground.
- .4 Render entire assembly rodent and insect proof by means of plates, screens or grouting.
- .5 Ensure fixed housing into which circuit breaker moving carriage enters, is plumb.
- .6 Check factory made connections for mechanical security and electrical continuity.
- .7 Check relay settings and fuse sizes against shop drawings.

3.3 FIELD QUALITY CONTROL (SITE ACCEPTANCE TESTING)

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Operate load interrupter switches (if installed) and circuit breaker closing and tripping mechanisms, to verify correct functioning.
- .3 Check insulation of switchgear assembly with DC Hi-Pot tester in accordance with manufacturer's approved methods. If values are not satisfactory, clean, dry and heat switchgear and repeat tests until readings acceptable to Owner and Consultant.
- .4 Check phase rotation of each feeder.
- .5 Check fuses for correct type and rating (if used).
- .6 Ensure relay settings are as per the recommendations of the Power Study.
- .7 Check for grounding and neutral continuity between station ground and system neutral. Place primary switchgear in service and check meter readings to ensure proper functioning of instruments and satisfactory phase balance of loads.

- .8 Have factory representative commission final installation and certify proper installation and operation.
- .9 Test operation of switchgear in all modes and configurations to verify correctness of installation and wiring and demonstrate performance to Owner and Consultant.

3.4 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by primary switchgear assembly installation.

3.5 TRAINING

- .1 Upon completion of testing and commissioning, and prior to acceptance, provide training of Owner's personnel in the care and operation of equipment.
- .2 Prepare training material and distribute to Owner prior to conduction the training session.
- .3 Training shall be delivered in a format that includes a "classroom" session followed by a hands-on session.
- .4 Present equipment features and components, and demonstrate operation modes.
- .5 Emphasize safety aspects of equipment operation.

END OF SECTION

PART 1 - GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data in accordance with Section 26 05 00.

PART 2 - PRODUCTS

2.1 SWITCHES

- .1 Line Switches:
 - .1 20 A, 120 V, single pole; three-way switches where shown on drawings.
 - .2 Manually-operated general purpose ac switches with following features:
 - .3 Terminal holes approved for No. 10 AWG wire; silver alloy contacts.
 - .4 Urea or melamine molding for parts subject to carbon tracking.
 - .5 Toggle operated, fully rated, and up to 80% of rated capacity of motor loads.
 - .6 Switches of one manufacturer throughout project.
 - .7 Acceptable materials: Hubbell, Leviton or equivalent.

2.2 RECEPTACLES

- .1 Duplex receptacles, CSA type 5-15 R, 125 V, 15 A, U ground, with following features:
 - .1 Ivory urea molded housing.
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and rivetted grounding contacts
 - .6 Receptacles of one manufacturer throughout project
 - .7 Acceptable materials: Hubbell, Leviton or equivalent.

2.3 COVER PLATES

- .1 Cover plates for wiring devices.
- .2 Cover plates from one manufacturer throughout project.
- .3 Sheet steel utility box cover for wiring devices installed in surface-mounted utility boxes.
- .4 Sheet metal cover plates for wiring devices mounted in surface-mounted FS or FD type conduit boxes.

PART 3 - EXECUTION

3.1 INSTALLATION

.1 Switches:

- .1 Install single throw switches with handle in "UP" position when switch closed.
- .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .3 Mount switches at 1400 mm height above the floor.

.2 Receptacles:

- .1 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
- .2 Mount receptacles at 1200 mm in utility rooms

.3 Cover plates:

- .1 Install suitable common cover plates where wiring devices are grouped.
- .2 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

PART 1 - GENERAL

1.1 PRODUCT DATA

- .1 Submit shop product data (shop drawings) showing electrical detail of each disconnect switch, quantity, rating and enclosure dimensions.
- .2 Submit fuse performance data characteristics for each fuse type and size above 100 A.

1.2 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 26 05 00.
- .2 Six spare fuses of each type and size installed up to 600 A.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 Fused, horsepower rated disconnect switch in CSA Enclosure 1, size as indicated.
- .2 Mechanically interlocked door to prevent opening when handle in ON position, with provision for padlocking in off switch position by three locks.
- .3 Quick-make, quick-break action.
- .4 ON-OFF switch position indication on switch enclosure cover.
- .5 Fuse holders: suitable without adaptors, for type and size of fuse indicated.

2.2 FUSES

- .1 HRCI-J fuses (formerly Class J): time delay, capable of carrying 500% of its rated current for 10 s minimum.

2.3 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Electrical General Requirements.
- .2 For each disconnect switch provide nameplate indicating load controlled.

2.4 MANUFACTURERS

- .1 Eaton Electric (Cutler-Hammer)
- .2 Schneider Electric
- .3 Siemens

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses.
- .2 Ensure correct fuses fitted to assigned electrical circuit.

END OF SECTION

PART 1 – GENERAL

1.1 SCOPE OF WORK

1. This specification covers the supply, installation, testing and commissioning of three (3) Diesel generators for a health care application. The generators are indoor type, labelled DG-1, DG-2 and DG-3, as noted in the attached Single Line Diagram and layout drawings.
2. In connection with this equipment the scope of work shall also include the cost of the following services:
 1. Factory Acceptance Testing (FAT) of the generators prior to shipping to the installation site. The testing will be witnessed by the Owner and/or Owner's representative (Consultant).
 2. Shipping of the generators to the installation site, unloading and moving into the building.
 3. Installation, Site Acceptance Testing (SAT) and commissioning.
 4. Preparation and submission of documentation
 5. Site support by the manufacturer, including as many visits as required by the Contractor during installation, SAT and commissioning, to ensure soundness of the installation and adequate performance during testing and commissioning.
 6. Training of Hospital's site operating personnel upon acceptance of the work

1.2 REFERENCE STANDARDS

1. Canadian Standards Association: C282-05, CSA Z299, CSA 22.2 – 94, CSA B-139
2. Technical Standards and Safety Association (TSSA)
3. Underwriters' Laboratories of Canada, Inc. (ULC)
4. American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME)
 - B16.5 - . Steel Pipe Flanges and Flanged Fittings
 - C50,- Rotating Machines
5. American Society of Heating, Refrigerating and Air-Conditioning Engineers (ASHRAE): ASHRAE Handbook, HVAC Applications Volume, Chapter 47, "Sound and Vibration Control)
6. American Society for Testing and Materials (ASTM):
 - D975 - Standard Specification for Diesel Fuel Oils
 - D2622 - Standard Test Method for Sulphur in Petroleum Products
7. ISO 8528 - Reciprocating internal combustion engine-driven alternating current generating sets

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8. ISO 3046 – Reciprocating Internal Combustion Engines
 9. National Electrical Manufacturers Association (NEMA)
 - MG1 Motors and Generators
 - MG2 Safety Standard for Construction and Guide for Selection, Installation and Use of Electric Motors and Generators
 10. National Fire Protection Association (NFPA)
 - 37 Stationary Combustion Engines and Gas Turbines
 - 70 National Electrical Code
 - 101 Standard for Safety to Life from Fire in Buildings and Structures
 - 110 Emergency and Standby Power Systems
 11. Underwriters Laboratories, Inc. (UL)
 - 142 Above-ground Tanks for Flammable and Combustible Liquids
 - 489 Low Voltage Circuit Breakers
 - 1066 Power Circuit Breakers
 - 2200 Stationary Engine Generator Assemblies (600V generators or less)
 12. Occupational Health and Safety Administration (OHSA): 29 CFR 1910, Occupational Safety and Health Standards

1.3 WARRANTY

1. Warranty Period: two (2) years, commencing upon acceptance of the equipment by the Hospital.
2. Warranty shall account for continuous operation of the system for an extended outage duration.
3. Warranty shall include two (2) preventative maintenance (PM) visits per year; each visit shall include up to four (4) hours of site support following the completion of the PM tasks.
Provide separate cost of yearly PM service following the expiration of warranty.
4. Manufacturer shall agree to repair or replace all generator components that fail in materials or workmanship within the specified warranty period. Warranty shall include all labour, material, and related expenses to restore equipment and / or components from failures.
5. Correction of defects in materials and workmanship shall be completed within ten (10) days from receiving written notification of equipment failure to meet the guaranteed performance. In the meantime, the Hospital reserves the right to use the equipment as required for operation until service is performed.
6. The warranty specified in this Article shall not deprive the Hospital of rights under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the manufacturer under the requirements of the Contract Documents.

1.4 SUBMITTALS

1. Provide the following product information:
 1. Capacity calculations to verify that the power ratings of submitted engine-generator set are adequate for the specified load profile.
 2. General arrangement drawings showing the overall dimensions, clearances, and operating weights.
 3. Product Data:
 1. Continuous full load output of set at 0.8 PF lagging
 2. Engine: make and model, DIN rating, performance curve
 3. Engine heaters: make and electrical characteristics
 4. Cooling air requirements (cfm) and radiator sizing calculations
 5. Governor: make and type
 6. Exhaust muffler (silencer): make, type and acoustic performance curve
 7. Flow diagrams for Diesel fuel, cooling air and lubricating oil
 8. Fuel consumption data at 50%, 75% and 100% load
 9. Acoustical performance of the open engine
 10. Emissions content of the engine.
 11. Alternator: make, model, reactance data and Thermal Damage Curve
 12. Voltage Regulator: make, model and type
 13. Battery: make, type, capacity and other relevant characteristics
 14. Battery Charger: make, model and relevant characteristics
 15. Control Panel: make and type of meters and controls
 16. Circuit breakers, relays
 17. Communications interface type and capabilities
2. Submit shop drawings, including:
 1. Bill of Material
 2. Dimensioned outlines of generator sets showing plan, side, front, rear and side views, and anchoring provisions
 3. AC single line and three-line schematic diagrams with all components cross referenced.
 4. Equipment interconnection drawings showing terminal points and external device function.
 5. Schedule of breakers, with all relevant ratings
 6. Calculation of battery size and battery charger, in accordance with ANSI/IEEE-1115.

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7. Quality control procedures, including:
 1. Factory witness test and field-test procedures
 2. Sample factory witness test report
 3. A summary of the customer training to be furnished. Training shall be conducted by a factory service technician at the Project Site.
 8. Certifications: submit paragraph-by-paragraph specification compliance statement, describing the differences between the specified and proposed equipment. Submit proof of compliance with indicated qualification requirements.
 3. Provide Operation and Maintenance Manual in printed and soft format. Include the following:
 1. Shop drawings, including any field modifications or changes to reflect actual, "as installed" conditions.
 2. Technical data:
 1. Illustrated parts lists with catalogue numbers
 2. Schematic diagram of electrical controls
 3. Flow diagrams for: fuel system, lubricating oil, cooling system
 4. Fault locating guide
 5. Precise details for adjustment and setting of time delay relays or sensing controls, which require on site adjustment.
 3. Complete point-to-point wiring diagrams in AutoCAD showing connections between components installed inside the generator control panel, and between the generator(s) and external equipment/switchgear or other equipment (e.g. fuel tanks, ventilation controls, monitoring system etc.)
 4. Operation instructions for each individual component
 5. Recommended maintenance and repair/troubleshooting instructions and schedules
 6. Recommended spare parts list, showing all consumables anticipated to be required during routine maintenance and testing
 7. Certified factory and field test reports
 8. Warranty
 9. Addresses and phone numbers of suppliers and/or their authorized representatives.
 4. The soft format documents shall be AutoCAD and PDF files.
 5. PDF files shall be created in Adobe Acrobat and shall be formatted with bookmarks and table of contents.
 6. Printed (hard copy) documents shall be assembled in a manual complete with a CD/DVD or flash drive, inserted in a plastic sleeve attached to the manual binder.

1.5 SOURCE QUALITY CONTROL

1. Provide Factory Acceptance Testing (FAT) of the equipment at the manufacturer's facility in presence of Hospital and/or Hospital's representatives.
2. The Bid Price shall include travel expenses (transportation, accommodation and meals) for up to two participants for the duration of the factory tests.
3. Provide notice of factory test date at least fifteen (15) days prior to the test date.
4. Prior to the FAT, provide manufacturer's pre-acceptance test reports indicating that the assembled equipment is ready for factory acceptance tests. Provide such reports five (5) days in advance of the FAT.
5. The Vendor's local Service Supervisor for the contract shall attend the factory acceptance test. This individual shall have a technical background and shall be the primary contact for all future system startup and maintenance.
6. Provide suitable test area with adjustable loading facilities. Assemble and setup each unit for tests to be witnessed. Prior to commencing the tests, ensure that
 1. the engine has run sufficiently prior to load test
 2. the system has been de-bugged
 3. monitors/recorders are connected, and
 4. all test forms are filled with the information pertaining to the system tested.
7. Visual inspection: a complete mechanical and electrical examination will be conducted to determine compliance with specification and drawings with respect to materials, workmanship, dimensions, and marking.
8. Non-operational tests and checks: perform following checks before starting the unit:
 1. Shaft alignment, end float, angular and parallel
 2. Cold resistance of generator windings
 3. Electrical wiring and equipment grounds
 4. All lubricating points
 5. Personnel safety guards
 6. Air filters
 7. Lubricating oil type and level
 8. Type of fuel
 9. Vibration isolator adjustment
 10. Temperature and pressure sensors
 11. Engine exhausts system
 12. Tools
 13. Spares.

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9. Provide fuel for factory tests.
 10. Operational test and check: on completion of the above. Provide multi-channel recorder and record the following:
 1. Time for unit to cold-start and reach stable voltage and frequency
 2. Time from initiation of start to full load application, with voltage and frequency settled
 3. Voltage and frequency transient and steady state limits for full load to no load, 3/4 load to no load, 1/2 load to no load, 1/4 load to no load and vice versa. Measure machine vibration levels under the same load conditions.
 4. Record battery voltage drop during cranking.
 11. Protection and control demonstration. Following completion of the previous step, demonstrate the following:
 1. In manual and automatic mode:
 - a. Over-temperature protection
 - b. Low oil pressure protection
 - c. Over-speed protection
 2. In automatic mode only:
 - a. Cranking cut-out
 - b. Over-crank protection (3 attempts)
 - c. Under and over frequency
 - d. Under and over voltage
 3. All control functions.
 12. Load tests: load test the unit for 8 h at full rated load in ambient room temperature of minimum 25°C. Record the following data at the start of load test and every 15 minutes thereafter:
 1. Frequency
 2. Voltage
 3. Current
 4. Kilowatts
 5. Generator frame temperature
 6. Engine temperature
 7. Oil temperature and pressure
 8. Manifold pressure
 9. Ambient room temperature
 10. Generator cooling air outlet temperature.

13. Miscellaneous: provide accurate means for determining fuel and lubricating oil consumption.
14. Provide strip chart recorder (or digital data logger) for monitoring frequency, voltage and load. The recorder shall have been calibrated by the recorder manufacturer (or designated representative) within three months of the factory testing.
15. Voltage and frequency regulation tests: on completion of load tests record resistance of the hot generator windings. Subject the unit to voltage and frequency regulation tests while the unit is hot. Perform tests and record voltage and frequency applying load starting at no load, to 25%, 50%, 75% and 100% load, and vice versa.
16. Control panel functions and performance: check sequence of operation under service conditions.
17. Hi-pot tests: perform over potential tests on primary and secondary wiring in accordance with appropriate EEMAC Standard.
18. Additional tests: perform any tests consistent with the contract, which the Hospital representative may require to satisfy themselves of the performance of the units.

1.6 FACTORY INTEGRATED SYSTEM TEST (IST)

1. Upon completing individual equipment factory acceptance tests (FAT) the generators shall be tested together with the paralleling switchgear, as an integrated system.
2. The following components shall be connected in one system for Integrated System Test :
 1. Generators DG-1, DG-2 and DG-3
 2. Paralleling Switchgear SG-G1
 3. System Controller / Operator Interfaces (HMI)
3. Arrange with manufacturer of Paraleling Switchgear to deliver the equipment to the generator manufacturer's facility for testing of synchronization and paralleling.
4. Assemble and set up the switchgear for the tests to be witnessed.
5. The test shall include but not be limited to the following tests:
 1. Generators DG-1, DG-2, DG-3 automatic start and paralleling to common bus upon utility power failure – in 8 seconds or less.
 2. Demonstrate load distribution between generators (only two generators carry load during normal operation). This test shall be performed for all possible combinations of running generators:
 1. DG-1 and DG-2
 2. DG-2 and DG-3, and
 3. DG-3 and DG-1

1.7 MAINTENANCE MATERIALS

3. Provide a complete set of specialized tools required for the proper care, adjustment and maintenance of equipment supplied.
4. Include in Bid the following replacement parts:
 1. air filters, 2 each for each generator
 2. oil filters, 2 each for each generator
 3. fuel filters, 2 each for each generator
 4. spare pilot lamps, 2 each for each generator
 5. spare fuses for control panel, 2 of each size, one set for each generator
 6. spare jacket water heater element
 7. antifreeze inhibitor; inhibitor test kit
 8. oil sampling kit
5. Provide a list of recommended spare parts complete with unit cost and lead time, indicating what parts are to be kept on site for repair and/or replacement during the first 600 hours of operation.

1.8 SHIPPING

1. Ship all equipment and material by direct dedicated carrier, without en-route transfers.
2. Adequately package/crate, brace and secure equipment to prevent physical and environmental damage during transit and handling. Provide shipping damage indicators to allow easy identification of spots damaged during transportation.
3. All material not mounted or installed on the major equipment during shipping shall be properly crated and shipped with the associated equipment.
4. Coordinate shipping of all equipment and material with the Hospital to ensure receiving arrangements are in place.
5. Arrange shipping components to permit transportation and moving through building at destination without need to remove or modify building elements.
6. The equipment shall be equipped for handling by crane, forklift, pallet jack and rollers.
7. All equipment arriving at site must match the equipment that was factory tested. If the serial number of any equipment shipped differs from the equipment that was witness tested, it will be rejected and sent back to the manufacturer at no cost to the Hospital. The manufacturer shall be responsible for all costs resulting from this, including new manufacturing, testing, shipping, etc.
8. At time of receipt of equipment the supplier's technical representative shall be present to inspect the equipment prior to unloading and report any damage to the Hospital. The technical representative shall also witness the unloading and advise on the appropriate method for handling the equipment in order to avoid damage during the unloading, moving and pre-assembly. In the event the equipment has been found to be damaged

before unloading, it shall be returned immediately to the factory for repairs and/or replacement.

9. In the event of damage occurring at any time during unloading and until the equipment is accepted by the Hospital, the Contractor shall be responsible for repairs and/or replacement to the satisfaction of the Hospital.

1.9 SITE ACCEPTANCE TESTING

1. Provide the first fuel fill of the main storage tank before commencing the site tests.
2. Perform visual checks on generator sets and ancillary equipment prior to starting and testing.
 1. Ensure that all shipping members have been removed.
 2. Check for damage, including dents, scratches, frame misalignment and damage to panel devices.
 3. Ensure that assembly is free of foreign materials, tools, loose materials and dirt.
 4. Check electrical connections and grounding.
2. Functional Tests:
 1. Attach a phase rotation meter to generator output and observe proper phase sequences.
 2. Check for proper phasing and identification.
 3. Check components for proper alignment and operation.
 4. Check and test selector switches and pushbuttons and meters for proper operation.
 5. Check and test indicating lights and alarms for proper operation and colour.
3. Perform manufacturer's on-site field test procedures:
 1. Demonstrate that all functions and interlocks have been implemented.
 2. Test each installed engine-generator set for an 8-hour period using a resistive load bank. Supply load bank and load bank cables to facilitate governor adjustments, generator synchronization, engine generator start-up under loaded conditions, and to conduct the load tests described above. Instrument readings on engine generator sets and generator paralleling switchgear shall be recorded every 15 minutes.
 3. Field tests shall include, but not be limited to, automatic engine starting and control, standby system transfers, metering, annunciators and control panel operations.
 4. Perform installation acceptance tests required by NFPA 110, including cold start and load acceptance tests.
 5. Test 100 percent single-step load application and acceptance within 5 seconds. Additional step loading test shall also be performed at 25 percent, 50 percent, and 75 percent.
 6. After completing all adjustments and field tests in accordance with the approved field test procedures, conduct an acceptance and integration test for each piece of equipment, and an additional final system integration test, to demonstrate compliance with the requirements of this Specification.

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7. If any of the site acceptance tests are not successful, make any necessary corrections and re-test the corrected equipment at no cost to the Hospital.
 4. Replace engine oil and filters before turning generators over to the Hospital.
 5. Top up fuel tank at the completion of site tests.
- 1.10 TRAINING
1. Demonstrate generator operation to the satisfaction of Hospital and/or Hospital's Representative prior to acceptance.
 2. Provide two (2) training sessions (both in 'classroom' setting and hands-on) of minimum four (4) hours each, at the installation site.
 3. Prepare training outline and materials to be used during the presentations. Issue training materials in advance of the sessions for review by the team for adequacy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

1. The listing of the specific manufacturers below does not imply acceptance of products that do not meet the specified ratings, features or functions required for this project. Manufacturers listed below are not exempted from meeting these specifications in their entirety
2. The complete system(s) shall be engineered, fabricated, tested, delivered, and warranted by a single source. The approved vendors (no equal, unless approved by Hospital) are:
 1. Caterpillar, c/o Toromont
 2. Cummins, c/o Cummins Power Systems.
 3. Generac, c/o Total Power Limited
 4. MTU, c/o Wajax Power Systems
3. Unique, non-standard capacity ratings will not be accepted. Only certified performance data, published and listed as the manufacturer's standard offering will be considered.
4. The generator set manufacturer shall also provide the generator paralleling switchgear, complete with all relevant documentation required for installation, start-up, testing and monitoring. Refer to separate paralleling switchgear specification Section 26 23 01 for specific requirements.

2.2 VENDOR QUALIFICATIONS

1. Vendor shall be an authorized factory distributor of the equipment manufacturer.
2. Vendor shall maintain complete parts and service availability with factory-certified technicians available 24 hours per day, 7 days a week with a four (4) hour response time.

2.3 CONDITIONS AND RATINGS

1. Diesel generator sets required to maintain the specified power output continuously (i.e. for an unlimited number of hours), in a healthcare application.
2. Diesel generator sets capable of accepting full rated load within 10 seconds of receiving a start signal.
3. Sizing of generators based on the published maximum allowable power (kW) loading over a 24-hour period. Sizing based on nameplate rating, or Standby, Momentary, Intermittent, or special ratings not acceptable.

Note: *The maximum allowable percent loading over a 24-hour period is defined per ISO 8528 or as stated by manufacturer's published literature. Maximum allowable ("usable") loading shall be based on a constant load profile – no stipulations based on varying loading will be accepted.*

4. Each generator rated to deliver minimum 1250 kW at the output of the alternator, 0.8 power factor.
5. System Configuration: 13.8 kV, three phase, three wire, high resistance grounding (generators only). Installation in the following environmental conditions:
 1. Altitude: 650 ft (200 m) above sea level:
 2. Ambient temperature: 40° C.
 3. Relative humidity: 85 %.
6. Installation type: Indoor, on a skid

2.4 SEISMIC REQUIREMENTS

1. Generator set designed and constructed to meet the seismic design criteria per the 2012 Ontario Building Code (O.Reg. 332/12, as amended), Division B, Article 4.1.8.18.

2.5 SYSTEM DESCRIPTION

1. Refer to the Single Line Diagram drawing attached to this Specification.
2. Designed and configured for automatic, unattended operation, in conjunction with external paralleling switchgear. Coordination with the supplier / manufacturer of the paralleling switchgear is required for this purpose.
3. Modes of operation:
 1. The system is configured for N+1 redundancy; each generator is connected to its own bus
 2. Generators can be synchronized and paralleled to a common bus (individual buses connected via a tie breaker)
 3. In normal operation conditions, only two generators carry the full load.
 4. Transfers between the utility and generator sources - open transition type, performed via pairs of breakers in separate switchgear.

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4. Each generator set includes:
 1. Diesel engine, complete with governor, cooling, lubrication, fuel, and exhaust system
 2. Engine starting systems
 3. Alternator
 4. Engine and alternator control panel
 5. Remote annunciator - one for each generator, suitable for wall mounting. Supplier to coordinate with manufacturer of paralleling switchgear to ensure no gap or duplication in the remote annunciation capabilities.

2.6 DIESEL ENGINE

1. Diesel engine: to ISO 3046-1, standard product of current manufacture, with performance per the requirements of subsection 2.3.
2. Four-stroke, four-cycle design, turbo-charged and intercooled, synchronous speed 1800 rpm.
3. Capacity: Power output sufficient to deliver the specified electrical output of alternator at rated speed and continuous operation, after de-rating and adjustment for system losses in auxiliary equipment necessary for engine operation, calculated under the site conditions outlined in Section 2.3.
4. Engine capable of producing the specified performance criteria indicated when operating on No. 2 diesel fuel meeting ASTM D 975 and D2622.
5. Combustion system designed to limit emissions for minimum EPA Tier 2 certification.
6. Turbochargers: driven by the exhaust gases, directly connected to an impeller supplying air to the engine intake manifold.
7. Capability to operate lightly loaded without adverse effects.
8. Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.

2.7 STARTING SYSTEM

1. 24 V DC starting system for each generator, each consisting of batteries, battery stands and cables, starter motors, and battery chargers.
2. Starting engine at minimum ambient temperature of 0° C should not affect/degrade life of cranking motor. If this requirement cannot be met, an additional starting motor shall be provided.
3. Starting batteries (two sets for each generator) shall be lead acid, heavy-duty for engine starting applications, capable of 180 seconds of cycle cranking at 0°, including four (4) crank cycles of 45 seconds each. Terminals and all exposed electrical connections shall be protected from accidental short circuit. Provide best battery selector for each generator.

4. Battery sizing shall consider specific application conditions, including engine oil viscosity, ambient starting temperature, control voltage, overcharging and vibration. Submit sizing calculations in accordance to ANSI/IEEE 1115.
5. Battery warranty shall be the responsibility of the engine generator manufacturer.
6. Cranking motor: positively engaged to flywheel ring. Cranking limiter to provide 3 cranking periods of 10-second duration, each separated by 10-second rest.
7. Battery stand: seismic rated battery racks fabricated from angle irons, with tie-down straps, and coated with acid resistant paint, for installation separate from generator frame.
8. Battery Cables: DLO type (locomotive style), multi strand copper conductor with the required cables clamps and lugs.
9. Battery charger (two for each generator):
 1. UL listed/CSA certified
 2. wall-mount type in NEMA 1 enclosure
 3. compatible with batteries provided
 4. solid state (silicon diode full-wave rectifier), with overload protection and voltage surge suppressors
 5. 120 or 208 V AC input, single phase, 24 V output, capacity to recharge its set of batteries within six (6) hours, but not less than 10 A DC output current.
 6. automatic two-stage operation, from trickle charge at standby to boost charge after use, with DC regulation of 1% for $\pm 10\%$ input variation. Automatic boost for 6 h every 30 days
 7. selector switch for manual mode – float or boost/high-rate charge
 8. local DC ammeter and voltmeter, AC and DC circuit breakers
 9. alarm relays with Form C contacts for remote annunciation of faults (at generator annunciator panel); including:
 1. Loss of AC power
 2. Low battery voltage
 3. Ground fault
 4. Trouble signal
 5. LED lights on front panel for low DC volts, rectifier failure, loss of AC power, and high DC volts.

2.8 GOVERNOR

1. Governor and accessories to be selected by engine manufacturer to meet stated performance criteria and to maintain emissions performance.
2. Electronic type, with electric actuator, in compliance with ISO 3046/4.

3. Speed droop, direct acting type, externally adjustable from isochronous to 5%, with ramping function to control engine speed and limit exhaust smoke on unit start. Speed shall be sensed by a magnetic pickup off the engine flywheel ring gear.
4. Speed, stability and gain adjustments to be possible without the use of special devices/tools, including computer/software.
5. Performance:
 1. Minimum range of speed changer (percent of rated speed): -15% to + 5%.
 2. Frequency regulation (percent of steady-state cycles): $\pm 0.25\%$.
 3. Transient response to "sudden addition or removal of 25% percent load"
 1. speed deviation: $\pm 3.0\%$
 2. time to return to steady-state frequency: 3 seconds.

2.9 COOLING SYSTEM

1. System: designed to maintain manufacturer's recommended engine temperature at full load operation in 40°C ambient, measured at the generator air inlet (not at the fan discharge). Pre-alarm temperature set at 50°C (122 F)
2. Heat transfer medium: 50/50 propylene glycol/water mixture. Units shall be delivered with an initial supply of propylene glycol in the amount of 50 percent of the total cooling capacity of the system.
3. Extended life propylene glycol shall be used, to provide a five-year service interval.
4. V-design engines shall be provided with:
 1. piping header to wye the two engine water outlets into a single flanged outlet.
 2. coolant outlet connection.
 3. flanged engine coolant return connection.
5. Rotating parts and parts subject to heating at temperatures over 70°C shall be guarded against accidental contact per OSHA requirements.
6. Water (coolant) Pump: Self-lubricated, engine-driven, gear type
7. Heavy-duty industrial radiator, having the following characteristics:
 1. vertical type with horizontal air discharge, mounted on generator set base
 2. provided with a duct adapter flange for connecting to the discharge duct through the building wall, through a discharge (acoustic) silencer;
 3. bolted steel frame, duct flange, plenum chamber, lifting lugs, core guard, OSHA fan guard and fan drive supported by channels integral to frame.
 4. split, vertical core with continuous aluminium plate fins, solder bonded to flat brass tubes and separate jacket water and intercooler water sections.
 5. oversize top tank for water inspection, single-pass model, for low-pressure drop
 6. sight glass, vent and drain connections, and 15 psi filler cap.

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7. low-level coolant alarm switch, with spare contacts for remote alarm indication
 8. Radiator fan:
 1. forced draft, fixed center, airfoil type with adjustable steel blades, engine-driven by minimum two belts.
 2. capable of operating against a maximum external air pressure drop through the radiator of 0.5" water column
 7. Provide hoses and readily accessible drain valves to allow convenient and full draining of coolant fluid. Hoses shall be stainless steel, with appropriate hydraulic-style, screw-on fittings (SAE100R5) or fittings approved for use with stainless steel hose.
 8. Install jacket water heaters, circulating type, properly sized to maintain jacket water temperature and provide reliable engine starting in the specified ambient conditions.
 9. One heater shall be installed on each side of the 'V' engine.
 10. Heaters shall be
 1. thermostatically controlled and supplied by separate power circuits (120 V or 240/208V), to allow the engine to start and assume full load in max. 10 seconds.
 2. isolated using stainless steel, full port ball valves.
 3. electrically protected with suitable devices mounted in control cubicle.

2.10 LUBRICATION SYSTEM

1. Full-pressure type, complete with duplex filters and oil cooler.
2. Oil pump: engine-driven gear type, complete with strainer and pressure regulator, to supply filtered lubricating oil under pressure to main bearings, crank pin bearings, piston pins, timing gears, camshaft bearings, valve rocker mechanism, governor and turbochargers.
3. Filters: full flow, engine mounted, spin-on canister elements, full flow type, removable without disconnecting piping, and installed in accessible location; filter assembly to include a spring-loaded automatic by-pass valve.
4. Lube Oil Cooler: engine mounted, full flow, equipped with bypass valve and having sufficient capacity to maintain oil temperature within engine manufacturer's tolerances while operating at rated load under conditions specified.
5. Oil sump with oil drain pipe, gate valve and pipe cap, located to permit complete drainage in a convenient manner.
6. Crankcase vent breather filter with fumes recovery system to filter out the oil mist from the blow-by, unless a closed crankcase design is provided.
7. Thermostatically controlled lube oil heaters supplied separately from the jacket water heaters
8. Metallic hoses of steel reinforced rubber type with crimped or swaged end fittings.

2.11 FUEL SYSTEM

1. Fuel: Type A fuel oil to CAN/CGSB-3.6.
2. Fuel system: solid injection, positive displacement, with
 1. Fuel transfer pump: self-lubricated, positive displacement, gear-driven, with hand primer
 2. Fuel filters: 30-micron filter, redundant, triplex hot swap assembly with water separator, installed upstream of fuel pump and injectors. Fuel filters to allow individual filter replacement while engine running at rated speed under full load – generator manufacturer to confirm fuel flow requirements in GPH with only two bowls in service. Engine mounted fuel filter to be manufacturer's standard to maintain equipment warranty and maximize uptime.
 3. Air intake filters: dry type, replaceable, with alarm for low flow indication
 4. Filter elements directly replaceable with elements of Canadian manufacture.
3. Return fuel oil cooler / heat exchanger: mechanical, mounted on engine side of radiator – radiator airflow cools the fuel circulating through cooler; capacity to reject 100% of the heat absorbed by the excess fuel being returned to the oil tank at full load and 40° C ambient. Flexible fuel oil-connectors(s) shall be braided stainless steel type – UL approved. Provide a valve bypass around the cooler.
4. Fuel oil shall be piped from the fuel oil filters to the intake of the engine fuel oil pump and then to the engine.
5. Excess fuel oil shall be piped through the fuel oil cooler and returned to the fuel oil tank.
6. Fuel Injectors: unit fuel injector mounted in each cylinder head, complete with external feeder lines. Injection timing and duration electronically controlled with injection pressure accomplished by a piston pump driven by the engine camshaft.
7. Fuel rack solenoid energized when engine running.
8. Flexible fuel connectors: non-metallic fuel hoses with braided steel reinforcement and crimped or swaged end fittings, ULC approved.

2.12 EXHAUST AND EMISSIONS CONTROL SYSTEM

1. Generator designed to limit emissions to level acceptable for minimum Tier 2 certification.
2. Combustion Exhaust Silencer to mitigate noise:
 1. Hospital grade acoustical performance
 1. Noise level shall not exceed 68 dBA at 10 ft from discharge point (installed outdoors)
 2. Exhaust silencer shall be selected by the generator set Vendor to limit back pressure on the engine to values acceptable to engine manufacturer
 3. Silencer to include a condensate drain outlet, with plug.

2. Silencer inlet and outlet of size determined by the manufacturer to satisfy the specified sound performance criteria – provide calculations.
 3. Coupling between the silencer inlet outlet and engine exhaust outlet shall be through a standard class 125# ANSI flange.
 4. Silencer shall be tested by the manufacturer at a minimum pressure of 3 lb/sqin for a minimum duration of 4 hours, with no leaks. Provide certified test report for review by Consultant. .
3. Engine exhaust manifold outlets to be coupled to the exhaust silencer by means of adequately sized flexible stainless steel connectors with flanged couplings.
 4. Piping, insulation and supports for the exhaust system components of the indoor generators will be supplied and installed by others.

2.13 ALTERNATOR

1. Synchronous type to ANSI/NEMA MG1.
2. Rating: 3 phase, 13.8 kV, 4 wire, 1250 kW, 60 Hz, at 0.8 PF
3. High resistance grounded
4. Output at 40° C ambient: 100% full load continuous operation.
5. Mechanical features:
 1. Drip proof construction, air cooled by a direct drive centrifugal blower fan directly connected to the engine with flexible drive disc and equipped with anti-condensation heater
 2. Ventilation: self-ventilated, with one-piece internal fan for high-volume, low-noise air delivery.
 3. Rotor: one-piece, dynamically balanced, permanently aligned to engine by flexible disc coupling.
 4. Bearings: pre-lubricated, shielded, insulated cartridge type with provisions for adding and changing grease through grease pipes extended to the generator exterior. Minimum L-10 bearing life shall be 40,000 hours.
6. Electrical characteristics:
 1. Revolving field, brushless, four poles.
 2. Stator: copper winding, form wound, insulated, and vacuum pressure-impregnated and baked; 2/3 Pitch to eliminate the third harmonic and to have maximum calculated sub-transient reactance (X_d'') of 13.5% to minimize voltage distortion caused by non-linear load currents.
 3. Main Rotor: four-pole, amortisseur windings with field pole coil supports forming a single-piece rotor core.
 4. Rotating Permanent Magnet Generator (PMG) Exciter: brushless construction with full-wave, three-phase rotating rectifier assembly with hermetically sealed, metallic-type silicon diodes. Mounted outboard of the generator bearing to allow removal of any part of the exciter without disassembly of the generator; checking the rotating

diodes shall be possible without breaking any solder connection. Multi-plate selenium surge protector connected across the rotating diode network to protect it against transient conditions. PMG excitation current derived excitation from pilot exciter mounted on the rotor shaft.

- 5 Insulation System and Temperature Rise: NEMA Class "H" materials, synthetic and non-hygroscopic. Stator winding impregnated and baked, with a final coating of epoxy for extra moisture and abrasion resistance. Rotor winding insulation of thermosetting epoxy impregnation, plus a final coating epoxy for moisture and abrasion resistance. Temperature rise of both rotor and stator (as measured by the resistance method), not to exceed 80° C for continuous rated over a 40° C ambient temperature in accordance with NEMA MG1-22.40 for a Class "H" insulation system.
 - 6 Temperature Detection: minimum two resistance temperature detectors (100 Ohm platinum RTDs) per phase embedded in each stator winding; each bearing provided with RTDs. All temperature detection devices to be wired to compatible transducers in the Control Panel for alarms.
 - 7 Internally mounted anti-condensation strip heater(s), minimum 300 Watts at 120 VAC, with thermostatic control to maintain alternator space at approximately 10 degrees F above ambient.
 - 8 Alternator: capable of sustaining 300% rated current for period not less than 10 seconds, to permit selective tripping of downstream protective devices on short circuit.
7. Alternator Terminal Box:
1. NEMA 1 construction with hinged cover secured with bolts, suitably sized for load feeder connection, and to allow connection through the top, bottom or either side of the box.
 2. Size to accommodate terminations of cables of sizes and number commensurate with generator capacity. Terminal box to accommodate a ground bus for connection of the neutral points of the generator windings and the differential current transformers.
 3. Current sensors for use with external protection relay (if employed in the protection solution), wired to terminal block on the alternator connection box
 4. Potential transformers for voltmeter, frequency and run-time meters.
 5. Barrier to separate terminals for the instrument transformers from the main power lugs.
8. Voltage Regulator:
1. Solid-state (SCR) type, microprocessor-controlled digital voltage regulator with phase-controlled sensing circuit and accessories, including software interface for settings and communications
 2. Mounted on generator set, complete with current and potential transformers for 3-phase sensing
 3. Control and Protection Features and Capabilities:
 1. Communication interface module
 2. Stability network
 3. Accessory input

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4. Manual excitation control
 5. Remote voltage adjusting capability
 6. Stability (minimum 20 selectable stability ranges)
 7. Voltage matching
 8. Paralleling capability
 9. Soft start
 10. Thermal protection
 11. VAR/power factor regulation
 12. Over-excitation / Under-excitation
 13. Overvoltage
 14. Over-frequency / Under-frequency
4. Performance:
1. Voltage Regulation: $\pm 0.25\%$ of mean voltage between no-load steady state and full load steady state
 2. Regulator stability (drift): less than 0.5% of maximum voltage, at any constant load from no-load to full load, over 72 F (23° C) ambient temperature change.
 3. Transient Response: in accordance with ISO 8528-1 to meet G3 Class performance as measured on an Astro-Med recorder.
 4. Harmonic Distortion: maximum 5% total RMS measured line to line at full-rated load
 5. Balanced Telephone Interference Factor (TIF): maximum 50
9. Transformers for cross-current compensation to be provided to paralleling switchgear manufacturer for installation in control panel.
10. Termination block in the Engine Control panel for connection of the raise-lower external inputs from the generator switchgear, if provided.
11. Auxiliaries: Supplied by generator switchgear manufacturer, if provided
1. Current transformers for protective relays, differential relay (Device 87G), cross-current compensation and accessories for the engine.
 2. Mounted and terminated in generator junction box for interfacing with generator switchgear. CTs terminated on shorting terminal blocks by ring type insulated gripping terminals.

2.14 ENGINE AND ALTERNATOR CONTROL PANEL

1. Set mounted control panel to provide local operating, monitoring, control, paralleling and protection functions for the generator set.
2. Digital type (micro-processor based), totally enclosed, in hinged enclosure, prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

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3. 24 V control power from the battery system
 4. Control circuits using heavy-duty electromagnetic relays and time delay relays suitable for industrial applications.
 5. Real time digital communications to all engine and regulator controls via SAE J1939.
 6. Features and functions as follows:
 1. Paralleling and load sharing
 2. Alternator integral protection against electrical faults (overcurrent, overload, ground fault)
 3. Local-Remote-Lockout control switch.

Local - engine can be operated from the Run-Stop switch.

Remote - generator can be run from a remote closed contact in the generator switchgear so that the engine runs as long as the remote contact remains closed.

Lockout - engine is locked out and cannot start or run either locally or from a remote signal
 4. Reset Switch – for fault clearing, to allow restarting the generator after it has shut down due to a fault condition. Reset switch to also extinguish alarm lights. Engine cannot start or run if any of the shutdown signals are present and until the reset switch is operated.
 5. Emergency Stop with extended guard by local button to stop engine and provision for remote emergency stop.
 6. Push-to-test button for all indicating lights
 7. Horn to sound if an alarm is activated. Horn silence push-button to also be provided.
 8. Power monitoring by analogue or digital Instruments to manufacturer's standard, minimum 2% accuracy, for voltage, current, frequency, kW, kVAR, engine RPM, complete with phase selector switches, if applicable.
 7. Engine Status Monitoring, by means of analogue gauges or digital display, per manufacturer's standard equipment, for the following parameters:
 1. Engine oil pressure
 2. Engine coolant temperature
 3. Coolant level
 4. Hours of operation
 5. Battery voltage (DC volts)
 8. Indicator lights for alarm with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 1. Low fuel level
 2. Low and high battery voltage
 3. Ventilation failure
 4. Low coolant temperature

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5. Low coolant level
 6. Control switch not in automatic position
 7. Overcurrent
 8. Overload (kW)
 9. Lamp test button
9. Solid state controller for automatic shutdown and alarms with 1 set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
1. Engine over-crank
 2. Engine over-speed
 3. Engine under-speed
 4. Engine high temperature
 5. Engine low lube oil pressure
 6. Short circuit
 7. AC over-voltage
 8. AC under-voltage
 9. Excitation fault
10. Communication ports: MODBUS and LAN (Ethernet). Coordinate with the paralleling switchgear and main switchgear suppliers to ensure compatibility of communications protocol across all switchgear line-ups.
11. Multiple sets of dry contacts for interfacing with external systems, including:
1. Main switchgear, for generator Start-Stop signals
 2. Ventilation System
 3. Fire alarm System
 4. Building Automation System, for generator status
12. Automatic voltage regulation (AVR) system, matched to and prototype tested with the governing system provided. AVR shall be microprocessor based, with fully programmable operating and protection characteristics, and the following characteristics:
1. Capability to provide generator paralleling with reactive droop compensation and reactive differential compensation
 2. Output voltage regulation of +/- 0.25% for any constant load between no load and full load
 3. VAR/pf control feature
 4. Adjustable dual slope characteristic to optimize voltage and frequency response for site conditions.
 5. Torque-matching characteristic to reduce output voltage in proportion to frequency below a threshold of 58-59 Hz.

6. Control shall also include a voltage adjusting rheostat, locking-screwdriver type, to adjust voltage up to $\pm 5\%$ from rated value, mounted on inside of control panel.
13. Tested and certified to the following environmental conditions:
 1. -40°C to $+70^{\circ}\text{C}$, 0-95% humidity non-condensing, 30°C to 60°C
 2. 5% salt spray, 48 hours, $+38^{\circ}\text{C}$, 36.8 V system voltage
 3. Sinusoidal vibration 4.3Gs RMS, 24-1000Hz
 4. Electromagnetic Capability: 89/336/EEC, 91/368/EEC, 93/44/EEC, 93/68/EEC, BS EN 50081-2, 50082-2)
 5. Shock: withstand: 15Gs

2.15 BASE

1. Engine-generator set and auxiliaries to be mounted on a structural steel base (skid).
2. Base to have the necessary cross-members, braces, lifting lugs, and side-mounting; designed with rigidity sufficient to resist all starting and operating forces.
3. Provide hoisting diagram, showing lift points, weights and centre of gravity.
4. Base to have two (2) NEMA standard 2-hole copper-faced or stainless steel ground pads on opposite corners of the base
5. Seismic-restrained vibration isolators with the following characteristics:
 1. 1 ½ inch minimum static (not 'rated') deflection, and 1 inch clearance between the structural base and the support structure when operating.
 2. Vibration isolators selected for lowest disturbing frequency and uniform static deflections according to distribution of weight and seismic design criteria per the 2012 Ontario Building Code (O.Reg. 332/12, as amended), Division B, Article 4.1.8.18
6. Supply for each generator an oil drip pan made of 16 gauge galvanized steel sheet. The pan shall be leak-proof, and shall be sized to collect any leaks from the radiator end to the engine flywheel end. The pan shall be easily accessible from the alternator end of the generator

PART 3 - PRODUCTS

3.1 INSTALLATION

1. Locate generators where shown on drawings and bolt to floor.
2. Fit and adjust isolators in accordance with the manufacturer's installation and adjustment instruction bulletin contained in the unit manual. If isolator housing feet are equipped with 6 mm rubber sound pads there is no requirement for bolting housings to the foundation.
3. Install battery and battery chargers in the Generator Room, in close proximity to the generators they serve.

4. Install power and control wiring between generators and external equipment (loadbreak switches, paralleling switchgear and distribution and transfer switchgear)
5. Follow manufacturer's recommendation with respect to all work.
6. Engine-generator shaft alignment is adjusted at the factory. Check the alignment on site to ensure that no change has occurred due to shipment and handling

3.2 SITE ACCEPTANCE TESTING

1. Perform visual checks on generator set prior to starting and testing.
 1. Ensure that all shipping members have been removed.
 2. Check for damage, including dents, scratches, frame misalignment and damage to panels.
 3. Ensure that assembly is free of foreign materials, tools, loose materials and dirt.
 4. Check electrical connections and grounding.
2. Arrange to fill up main fuel storage tank. Owner will pay the cost of the first fill.
3. Functional Tests:
 1. Attach a phase rotation meter to generator output and observe proper phase sequences.
 2. Check for proper phasing and identification.
 3. Check components for proper alignment and operation.
 4. Check and test selector switches, pushbuttons and meters for proper operation.
 5. Check and test indicating lights and alarms for proper operation and colour.
4. Perform manufacturer's on-site field test procedures:
 1. Demonstrate to the Owner and Consultant that all functions have been implemented.
 2. Test installed engine-generator sets for an 8-hour period using resistive load banks. Provide load banks and cables to conduct the load tests. Instrument readings on engine generator set and generator paralleling switchgear shall be recorded every 15 minutes.
 3. Field tests shall include, but not be limited to, automatic engine starting and control, standby system transfers, metering, annunciators and control panel operations.
 4. Perform installation acceptance tests required by NFPA 110, including cold start and load acceptance tests.
 5. Test 100 percent single-step load application and acceptance within 10 seconds. Additional step loading test shall also be performed at 25 percent, 50 percent, and 75 percent.
 6. After completing all adjustments and field tests in accordance with the approved field test procedures, conduct an acceptance and integration test for the generators – paralleling switchgear and transfer switchgear, and an additional final system integration test for the benefit of the Owner and Consultant, to demonstrate compliance with the requirements of this Specification.

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7. If any of the field acceptance tests are not successful, the Contractor, in collaboration with equipment manufacturers shall make any necessary corrections and re-test the corrected equipment at no cost to the Owner.
 8. Top up fuel tank at the completion of tests, before turning the generator over to the Owner.

3.3 TRAINING

1. Provide training session (in 'classroom' setting and hands-on), minimum four (4) hours, at the installation site.
2. Prepare training outline and materials to be used during the presentations.
3. Allow the Owner to videotape the training classes for training future employees.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 CSA International: CAN/CSA C22.2 No.107.2, Battery Chargers.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for battery chargers and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Charger data: type and capacity, battery charging sequence, current-time data for Silicon Controlled Rectifier (SCR) protective devices, estimated noise level, metering, alarms, controls and efficiency.
- .3 Shop Drawings: Include outline schematic diagrams with dimensions showing arrangement of enclosure, components, meters and controls.

1.3 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for [battery chargers] for incorporation into manual.
- .3 Operation and maintenance instructions covering design elements, construction features, component functions and maintenance requirements to permit effective operation, maintenance and repair.
- .4 Copy of approved shop drawings.
- .5 Technical description of components.
- .6 Parts lists with catalogue numbers and names and addresses of suppliers.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements] [with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements: Store [battery chargers indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area. Protect from nicks, scratches, and blemishes. SPEC NOTE: Co-ordinate the following paragraph with Section 01 35 21 - LEED Requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- .1 Automatically maintain battery in fully charged state while mains power available. Maintain DC float voltage within plus or minus 1% of setting.
- .2 Float charging rate such that after battery has provided full power output for specified duration, charger returns battery to 95% of fully charged state in 8 hours.
- .3 Manually initiated equalize charging feature with automatic timer adjustable from 0 to 24 hours, to return unit to float charge.
- .4 Manual adjustment of float charge voltage with range plus or minus 5%.
- .5 Manual adjustment of equalizing charge voltage.
- .6 Automatic current limiting adjustable between 80 and 120% of normal rating.
- .7 Audible noise level not to exceed 65 dBA at 1.5 m.

2.2 CHARGER CHARACTERISTICS

- .1 Battery charger: to CAN/CSA C22.2 No.107.2.
- .2 Input: 240 Vac, single phase, 3 wire, grounded neutral, 60Hz.
- .3 Output: 30 A, DC at 48 V, DC, ripple voltage less than 2 %.

2.3 ACCESSORIES

- .1 DC voltmeter: switchboard type, accuracy plus or minus 2 % of full scale, to measure rectifier output voltage.
- .2 DC ammeter: switchboard type, accuracy plus or minus 2 % of full scale, to measure rectifier output current.
- .3 Relay and alarm for ac power failure with time delay to prevent alarm during short power outages.
- .4 Low DC voltage alarm to indicate over discharge or hours emergency time available].
- .5 High DC voltage alarm and high DC voltage automatic shutdown.
- .6 Ground detector relay and alarm.
- .7 Equalizing timer: automatic reset type for unattended stations, 28 day period.
- .8 Filter to reduce ripple voltage in rectifier output

- .9 LEDs mounted on front to indicate: failure AC power, low DC voltage, high DC voltage, no rectifier output.
- .10 Alarms: audible alarm when any LED indicates trouble. Silence pushbutton not to extinguish trouble light.
- .11 Common LED test switch and one common Form C alarm contact.
- .12 Temperature compensation system for voltage output, including remote, battery mounted, temperature sensor.

2.4 ENCLOSURE

- .1 Dead front sheet steel, 2.5 mm thick minimum CSA Enclosure Type 1.
- .2 Access from front.
- .3 Convection ventilated.
- .4 Meters, indicating lamps and controls group mounted on front panel.
- .5 Allow for handling by forklift or sling.
- .6 Apply finish in accordance with Section 26 05 00 - Common Work Results for Electrical.

2.5 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Use size 4 nameplates for major components such as input breakers, output breaker.
- .3 Use size 3 nameplates for mode lights alarms, meters.

PART 3 EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify that conditions of substrate previously installed under other Sections or Contracts are acceptable for battery charger installation in accordance with manufacturer's written instructions.
 - .1 Inform Owner and Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Owner or Consultant.

3.2 INSTALLATION

- .1 Locate and install battery charger as indicated.
- .2 Connect input terminals to AC mains.

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- .3 Connect output terminals to battery.

3.3 TESTS

- .1 Energize battery charger and operate until battery shows full charge.
- .2 Discharge battery to full discharge condition.
- .3 Recharge battery, recording DC voltage and current once per hour for 8 hours. Test battery to ensure it has reached at least 95% full charge.
- .4 Continue charging to ensure charger changes from bulk rate to float charge rate.
- .5 Demonstrate that automatic timer controls charging and correctly transfers from equalize to float charge after selected period.
- .6 Simulate faults to demonstrate that alarm lights and audible alarms are performing as designed.
- .7 At end of tests, with battery in fully charged condition, operate charger on "float" for minimum period of 24 hours to ensure stable condition is reached and held.

3.4 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.5 PROTECTION

- .1 Protect installed products and components from damage during construction.
- .2 Repair damage to adjacent materials caused by battery installation.

END OF SECTION

PART 1 - GENERAL

1.1 REFERENCES

- .1 Institute of Electrical and Electronics Engineers, Inc. (IEEE): IEEE 837, Standard for Qualifying Permanent Connections Used in Substation Grounding.
- .2 CSA International: CAN/CSA-B72, Installation Code for Lightning Protection Systems.

1.2 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Shop Drawings:
 - .1 Submit drawings stamped and signed by professional engineer registered or licensed in Province of Ontario.
 - .2 Indicate materials and methods of attachment of conductors to air terminals and electrodes.

1.3 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with Section 01 61 00 - Common Product Requirements and with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Replace defective or damaged materials with new.

PART 2 - PRODUCTS

2.1 DESCRIPTION

- .1 System to consist of metallic air terminals, lightning conductors connecting air terminals to ground and interconnected ground electrodes, and/or ground cables.

2.2 MATERIALS

- .1 Lightning Rods: aluminum, solid rod.
- .2 Conductor: aluminum, weave type, 1/0 gauge.
- .3 Fastenings and attachment straps: aluminum.
- .4 Ground electrodes: 3.0 m x 19 mm diameter copper coated steel.
- .5 Use aluminum conductors, terminals, connectors and fastenings
- .6 Connections: formed by thermit process

2.3 REGULATORY REQUIREMENTS

- .1 System subject to: approval by authority having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of roof substrates previously installed under other Sections or Contracts are acceptable for lightning protection installation in accordance with manufacturer's written instructions.
 - .1 Inform Owner and Consultant of unacceptable conditions immediately upon discovery.
 - .2 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Owner and/or Consultant.

3.2 INSTALLATION

- .1 Install lightning protection to CAN/CSA-B72.
- .2 Bond discharge conductors to non-current-carrying electrical parts.
- .3 Submit certificate of installation to Owner and Consultant.

3.3 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 – Cleaning. Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.

3.4 PROTECTION

- .3 Protect installed products and components from damage during construction.
- .4 Repair damage to adjacent materials caused by lightning protection installation.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

- .1 This section describes the requirements for the new lighting system to be installed.

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings for lighting equipment. Include, for each type of fixture, the following information:
 - .1 method of mounting
 - .2 type of ballast/driver/controls
 - .3 type of lamp, complete with watts, lumens, CRI, and colour temperature
 - .4 any other relevant features

1.3 SPARE LAMPS

- .1 Provide spare lamps in a number of 10% of the total of lamps installed in each type of fixture.

PART 2 - PRODUCTS

2.1 INDOOR FIXTURES (TYPES A, B)

- .1 LED striplight luminaires: linear, 1.2 m long, 36W, 120 V ac, 5000 lumens at 4000k, 80+ CRI, suitable for mounted suspended on on wall, as shown on the drawings.
- .2 Acceptable product: Lithonia or equal

2.2 OUTDOOR FIXTURES (TYPE G)

- .1 Wall mounted LED luminaire, 68W, 120 V ac, approx 6400 lumens at 4000k, suitable for operation at -40°C
- .2 Acceptable product: Hubbell Perimalighter or equal

2.3 EXIT SIGNS

- .1 Die-cast aluminum construction of modular design
- .2 Surface mounting, suspended or on walls, with LED strip module that can be rotated in the unit for either wall or ceiling mount
- .3 Clear acrylic panel with pictogram legend; standard with double-face panels for use in single-face and double-face applications
- .4 White LED light source with universal AC input: two-wire 120 to 347VAC Housing: cold rolled steel minimum 1.0 mm thick.

2.4 EMERGENCY BATTERY UNITS

- .1 Electrical Characteristics: 120 V, ac supply, 24 V dc output, 60 min operating time
- .2 Battery: sealed, maintenance free.
- .3 Charger: solid state, multi-rate, voltage/current regulated, inverse temperature compensated, short circuit protected with regulated output of plus or minus 0.01 V for plus or minus 10% input variations.
- .4 Solid state transfer circuit.
- .5 Low voltage disconnect: solid state, modular, operates at 80% battery output voltage.
- .6 Signal lights: solid state, for 'AC Power ON' and 'High Charge'.
- .7 Heads: integral on unit, 345° horizontal and 180° vertical adjustment. Lamp type: LED, 4 W.
- .8 Cabinet: suitable for direct or shelf mounting to wall and c/w knockouts for conduit, white finish. Removable or hinged front panel for easy access to batteries.
- .9 Auxiliary devices:
 - .1 Test switch.
 - .2 Time delay relay.
 - .3 Battery disconnect device.
 - .4 Cord and single twist-lock plug connection for ac.
- .10 Acceptable product: Emergi-Lite/Lumacell, 24ESL350/2M

2.5 EMERGENCY REMOTE HEADS

- .1 Heads: clusters of two (2) LED type, 4 W each, arranged as shown on the drawings, and suitable for mounting on wall or suspended from lighting support channel., .
- .2 Acceptable product: Emergi-Lite/Lumacell EF9 series

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Locate and install luminaires as indicated.
- .2 Align luminaires mounted individually parallel or perpendicular to building grid lines.

3.2 CIRCUITTING AND CONTROL

- .1 Connect emergency lighting fixtures (battery packs) to twist-lock receptacles mounted high-up on the wall, at fixture level.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE

1. This section covers the supply and installation of an electronic safety and security (ESS) system for access control and surveillance in the new Powerhouse, including but not limited to:
 1. Physical access control
 2. Intrusion detection
 3. Video surveillance
 4. Delayed egress
 5. Fire alarm interface
 6. Equipment cabinetry
 7. Cabling infrastructure
2. Provide a fully functional and operating ESS system configured as illustrated on the drawings and programmed, documented and tested as specified herein.
3. Specific responsibilities for various components of the Security work:
 1. Supply and installation of specified devices (maglocks, door contacts, card reader, request-to-exit devices, DGPs/controllers, power supply, IP cameras) – by Security Integrator acceptable to Owner, and its cost shall be included in total cost of Security system
 2. Wiring and conduit (supply and installation) to maglocks, door contacts, request-to-exit devices, card reader, DGPs/controllers, power supplies, IP cameras – by Electrical contractor
 3. Configuration (programming), testing and commissioning of the system components – by Security Integrator; this Contractor shall carry the Integrator for this work, and its cost shall be included in total cost of Security system.

1.2 APPLICABLE PUBLICATIONS

1. Canadian Standards Association (CSA International)
2. .2 CSA C22.1, Canadian Electrical Code, Part 1 Safety Standard for Electrical Installations.
3. Underwriters' Laboratories

ULC-S317 Installation and Classification of Closed Circuit Video Equipment (CCVC) Systems for Institutional and Commercial Security Systems.
5. ANSI/TIA/EIA-568-B.1 and its addendum
6. ANSI/TIA/EIA-568-B.3 and its addendum
7. ANSI/EIA-310 and its addendum

8. BICSI Telecommunications Distribution Methods Manual – Most current Edition
9. BICSI Network Design Reference Manual – Most current Edition
10. Institute of Electrical and Electronic Engineers (IEEE).
11. Applicable local Building Codes and Fire Codes
12. Manufacturer's specifications, latest issue.

1.3 SUBMITTALS

1. Submit documentation in electronic format. Include Information confirming compliance with contract requirements, including manufacturer's name, model or catalog numbers, catalog information, technical data sheets, shop drawings, pictures, nameplate data and test reports, as applicable.
2. Provide Operation and Maintenance Manual containing the following:
 1. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the equipment.
 2. A control sequence describing start-up, operation, and shutdown.
 3. Description of the function of each principal item of equipment.
 4. Installation and maintenance instructions.
 5. Safety precautions.
 6. Diagrams and illustrations.
 7. Testing methods.
 8. Performance data.
 9. Pictorial "exploded" parts list with part numbers. Emphasis shall be placed on the use of special tools and instruments. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization.
3. Drawings:
 1. Floor Plan – produced from the Architectural backgrounds issued in the Construction Documents. The contractor shall show security devices on the plans, complete with the following information
 1. Security devices by symbol
 2. The associated device point number
 3. Wire and cable types and counts
 4. Conduit sizing and routing
 5. Conduit riser systems
 6. Device and area detail call outs
 2. Architectural details for each device mounting type (door details), and camera mounting,
 3. Riser Diagrams indicating riser architecture and distribution.

4. Block Diagrams for the local system architecture and interconnections Block diagram shall identify subsystems (e.g., electronic access control, intrusion detection, closed circuit television, etc.) and data transmission and media conversion methodologies.
5. Interconnection Diagrams for each sensor and device component, termination locations, and standard wire details. Diagram shall also identify interfaces to other systems such as the fire alarm systems, and interconnection with the Bank's main security system.

1.4 WARRANTY

1. All equipment and devices supplied and installed under this section shall carry a warranty of minimum two years.
2. Warranty shall cover parts, labour and expenses.

1.5 QUALITY ASSURANCE

1. The security sub-contractor (Integrator) shall be acceptable to the Owner.
2. The security sub-contractor shall use a cable installer with Registered Communication Distribution Designer (RCDD) certification by Building Industry Consulting Service International (BICSI). The installer shall provide consistent oversight of the project cabling throughout system design, layout, installation, termination and testing.
3. Work requiring network connectivity and configuration shall be coordinated with Ontario Shores IT Services group.

PART 2 - PRODUCTS

3.1 MANUFACTURERS / PRODUCTS

1. The various components of the access control system are referenced on the drawings.
2. All equipment and materials used shall be standard components that are regularly manufactured and used in the manufacturer's system.
3. All systems and components shall have been thoroughly tested and proven in actual use.
4. All systems and components shall be provided with the availability of a toll-free (U.S. and Canada), 24-hour technical assistance from the manufacturer. The service shall allow for immediate technical assistance for either the dealer/installer or the end user at no charge for as long as the product is installed.
5. All systems and components shall be provided with a one-day repair turnaround and 24-hour parts replacement. The repair and parts express shipment shall be guaranteed by the manufacturer on both warranty and non- warranty items.

3.2 ACCESS CONTROLLER

1. Modular controller (Data Gathering Panel) for access control for up to 8 doors, with onboard Ethernet, embedded intrusion zone functionality, peer-to-peer communication, and local/global anti-passback control.

2. Supplied from integral 120 VAC input, 12VDC, 5A power supply and rechargeable NiMH batteries for memory backup and real-time clock for 24 hours, with a 24 hour recharge time.
3. Housed in wall-mounted, lockable cabinet with tamper switch on door
4. Product equal to: iStar Pro by Tyco Security/Software House.

3.3 ACCESS CONTROL REMOTE DEVICES

1. Proximity Card Reader

1. Card reader shall be compatible with HID type, 125 kHz cards. Only the manufacturer's identification shall be on the device, with no other labels or integrator markings
2. The reader shall have a 457mm (18") pigtail.
3. The reader shall be programmed to show the device state and LED control patterns as per the table below:

Reader State	LED Control Pattern
Normal	Solid Red
Access Granted	Solid Green
Door Forced/Door Held	Alt Flash Red/Green
Card Rejected/Unknown Card	Alt Flash Red/Green

2. Request to Exit Pushbutton: Universal pushbutton, STI Part No. UB-1.
3. Door Contacts:
 - .1 Door contacts shall be a maximum one inch (1") in diameter, and shall be recessed mounted within door and frame
 - .2 Tamper switch for defeat resistance, Form C, 25 mA at 24 VDC rated contact
 - .3 Product: Honeywell 968XTP or approved equal.
4. Electromagnetic Lock:
 - .1 Single door model with 1000 lbs hold force
 - .2 Aluminum housing with 628 satin finish
 - .3 Automatic voltage sensing (12 VDC or 24 VDC), with polarity protection
 - .4 Magnetic Bond Sensor (MBS) to monitor the strength of the bond between the lock and armature, wired to the data gathering panel (iStar) so you know the door is secure
 - .5 Product: Schlage M450 or approved equal
5. Power Supply for electromagnetic lock: access power distribution module with power supply/charger, 120 VAC input, 12/24 VDC, 6A output (5 circuits, individually protected/fused), in BC300 enclosure – one per floor. Altronix Model AL600ULM.

3.4 ACCESS CONTROL CABLING

1. Access control cables (i.e. between the remote devices and data gathering panels) shall be stranded and shielded copper conductor, minimum #22 AWG, twisted pairs, and stamped with CMR/FT4 rating.

3.5 CCTV EQUIPMENT

- .1 System Manufacturer: Aimetis
- .2 Software: Symphony ver. 6.12

3.6 CCTV (IP) CAMERAS

1. General
 1. New video surveillance system cameras shall be connected to the Ontario Shores Campus Area Network (CAN). For any new work requiring expansion of the existing system configuration, it will be the responsibility of the Contractor to minimize the bandwidth requirements. Additionally, the Contractor performing the work is required to provide Ontario Shores with the overall estimated bandwidth requirements.
 2. Video streams from cameras are to be digitally encoded using the H.264 compression format.
 3. Each camera's bit rate, frame rate and resolution shall be set independently from other cameras in the system, and altering these settings shall not affect the recording and display settings of other cameras.
 4. Cameras installed with light fixtures, direct sunlight coming through windows or similar bright objects within the field of view shall be readjusted to compensate for blooming or any loss of overall picture quality.
 5. Should part numbers contained in this document not be current, the Contractor shall source the up to date replacement part numbers with the manufacturer and ensure all cameras procured are compatible with the existing revision of Aimetis Symphony software currently operating.
2. Indoor Fixed Camera minimum requirements:
 1. Vandal resistant
 2. Impact resistant
 3. Anti- grip housing with no sharp protrusions or ligature points
 4. IP rating: IP66
 5. Low light and infrared able to see in total darkness.
 6. Compatible with Aimetis Symphony ver. 6.12
 7. Active tampering alarm
 8. Resolution: 1.3 Megapixel or greater
 9. Lens: 3.3–12 mm, Auto-iris, Vari-focal,

10. Frame Rate: 30 FPS
 11. Multi Streaming
 12. Wide Dynamic Range
 13. Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 2, max. 4.8 W
 14. Connectors: RJ45 10BASE-T/100BASE-TX PoE,
3. Outdoor Fixed Cameras shall be:
1. Vandal resistant
 2. Impact resistant
 3. Anti- grip housing with no sharp protrusions or ligature points
 4. IP rating: IP66
 5. Low light, day/night and infrared able to see in total darkness.
 6. Compatible with Aimetis Symphony ver. 6.12
 7. Active tampering alarm
 8. Resolution: 1.3 Megapixel or greater
 9. Lens: 3.3–12 mm, Auto-iris, Vari-focal,
 10. Frame Rate: 30 FPS
 11. Multi Streaming
 12. Wide Dynamic Range
 13. Power over Ethernet IEEE 802.3af/802.3at Type 1 Class 2, max. 4.8 W, typical 3.5 W
 14. Connectors: RJ45 10BASE-T/100BASE-TX PoE

3.7 GROUNDING AND BONDING FOR ESS SYSTEM

1. General:
 - .1 Grounding conductors and busbars shall be made of copper.
 - .2 Lugs, HTAPs, grounding strips, and busbars shall be UL listed and shall be made of premium quality tin-plated electrolytic copper
 - .3 Antioxidant shall be used for making bonding connections.
2. Lugs: irreversible, two-hole compression type, meeting NEBS Level 3 as tested by Telcordia. Lugs with inspection windows shall be used in all non-corrosive environments so that connections may be inspected for full conductor insertion
3. All grounding and bonding products specified in this section shall be manufactured by Panduit, and shall meet all applicable codes and standards. Equivalent products may be considered where the ESS Contractor requests approval in writing.

PART 3 - EXECUTION

3.1 INSTALLATION – GENERAL

1. Install active components (controller, power supplies) on wall in the Electrical Room, as shown on the drawings. Mount on plywood backboards of suitable size to accommodate the components, with adequate space around to allow for installation of additional similar component in the future.
2. Install card reader on standard recessed outlet boxes recessed in the wall.
3. Install electromagnetic lock in conjunction with the associated door hardware.
4. Install indoor cameras on pendant brackets and outdoor cameras on corner brackets – at the location shown on the drawings.

3.2 ENCLOSURES, MOUNTS AND SUPPORTS

1. Cameras shall be installed in low profile lockable enclosures capable of being pendant or pole mounted, on a wall, in a corner,
2. All connections shall be contained within secure enclosures. If external to equipment and enclosures, cabling shall be run in rigid or flexible conduit.
3. Final mounting locations of enclosures shall be co-coordinated onsite with the Ontario Shores prior to installation.

3.3 PATHWAYS FOR ESS SYSTEM CABLING

1. The ESS system sub-contractor shall be responsible for measuring and confirming cable pathways prior to installation, to ensure no cabling will exceed the specified distance limitations.
2. Where the distance limitations are exceeded, the Contractor shall inform Consultant prior to installation of cabling. No compensation for removal of cabling will be accepted if this requirement is not adhered to.
3. Prepare all conduits and pathways by deburring prior to installation of cabling.
4. For fire stopping requirements refer to the applicable section of the Architectural specifications.

3.4 CABLE INSTALLATION

1. Install cable in EMT conduit min 3/4" size , and follow proper installation practices for all indoor cable distribution
2. Access control cabling shall be terminated as per manufacturer's recommendations, with only enough cable jacket removed to perform termination.
3. Comply with manufacturer's recommended bundling practices for installation. Ensure that excess pressure is not placed on the cable at any point that may result in the compression or deformation of the cable jacket and internal pair/conductor geometry.

4. Cables shall not be scrapped, dented or otherwise damaged before, during or after installation. All damaged cabling shall be replaced at no extra cost to BMO.
5. Ensure that all cables are installed in a continuous run (without splices) between terminal blocks or panels.

3.5 IDENTIFICATION OF ESS SYSTEM COMPONENTS

1. Confirm labeling convention with Owner prior to preparation and installation of any labeling.
2. Each piece of active equipment (controllers, field devices, switches etc.) shall be labeled with one label on the front and one label on the back (where applicable).
3. Install permanently identification labels on all active equipment. Labels shall be adhesive-style lamicoid with white printing of minimum ½" high font on a black background, and sized to suit the designated label location.
4. Install permanent identification labels on all cables. Labels shall be self-laminating vinyl with black lettering on a white printing area and sized to allow label to wrap around the cable a minimum 1.5 times. Labels shall be minimum ¾" wide, sized to suit the labeling requirement while maintaining a minimum 10pt. font size where possible. Cable labels shall be installed on clean and dry cable and mounted within 100 mm (4") of each end of each cable.
5. All labels shall be laser printed. Handwritten labels will not be accepted.

3.6 POWER SUPPLY AND INTERFACE WIRING

1. Provide backup power to power supplies for controllers.
2. Provide a GFI circuit to the electromagnetic lock power supply.
3. Install interface wiring between corresponding module of building fire alarm system and power supply of electromagnetic locks, to disable lock operation upon a 1st stage fire alarm.
4. Supply and install cables for connection of controller and IP cameras to network switches and network video controllers to complete the connection of the Powerhouse to Owner's existing security network switches and network video recorders.

3.7 TESTING AND COMMISSIONING

1. Test access control and surveillance system at the completion of installation to demonstrate their functionality in all possible operating scenarios.

END OF SECTION

PART 1 - GENERAL

1.1 SCOPE OF WORK

- .1 This Section covers the supply, installation and commissioning of an addressable fire alarm system including detection devices and notification appliances.
- .2 The scope of work also includes:
 - .1 assistance by a qualified service provider in the installation and final testing of system
 - .2 verification of installation
 - .3 preparation of system documentation operator training.

1.2 REFERENCE STANDARDS

- .1 Underwriter's Laboratories of Canada (ULC)
 - .1 CAN/ULC-S524, Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S525, Audible Signal Devices for Fire Alarm Systems, Including Accessories.
 - .3 CAN/ULC-S526, Visual Signal Devices for Fire Alarm Systems Including Accessories.
 - .4 CAN/ULC-S527, Control Units for Fire Alarm Systems.
 - .5 CAN/ULC-S528, Manual Stations for Fire Alarm Systems, Including Accessories.
 - .6 CAN/ULC-S529, Smoke Detectors for Fire Protective Systems.
 - .7 CAN/ULC-S530, Heat Actuated Fire Detectors for Fire Alarm Systems.
 - .8 CAN/ULC-S536, Inspection and Testing of Fire Alarm Systems.
 - .9 CAN/ULC-S537, Verification of Fire Alarm Systems.
- .2 National Fire Protection Agency: NFPA 72, National Fire Alarm and Signaling Code.
- .3 Canadian Electrical Code (CEC)

1.3 REQUIREMENTS OF REGULATORY AGENCIES

- .1 System shall comply with applicable provisions of the Ontario Building Code (OBC), and meet requirements of local authority having jurisdiction.

1.4 SHOP DRAWINGS

- .1 Following contract award submit product data (shop drawings), including:
 - .1 Detailed assembly and internal wiring diagrams of control unit, including battery calculation.
 - .2 Overall system riser identifying control equipment, initiating circuits, signalling circuits; also identified shall be terminations, terminal numbers, conductors and raceways.
 - .3 Details of initiating, signalling and ancillary devices.

- .4 Step-by-step operating sequence, cross referenced to logic flow diagram.

1.5 CERTIFICATES AND REPORTS

- .1 Provide manufacturer's certificate stating that the system has been installed in accordance to manufacturer's recommendations.
- .2 Provide Test Report indicating that the system has been tested as to its full functionality in all modes of operation.
- .3 Provide Verification Report.

1.6 SPARE PARTS

- .1 Provide spare parts as per system manufacturer's recommendations.
- .2 Include, as a minimum, glass rods for manual pull box stations, if applicable, and fuses and lamps for the control panel, if applicable.

1.7 QUALITY ASSURANCE

- .1 Qualifications: Installer shall be a company specializing in fire alarm system installations with minimum 10 years of documented experience, approved by the manufacturer.
- .2 Provide services of manufacturer's representative or service technician experienced in installation and operation of type of system being provided, to supervise installation, adjustment, preliminary testing, and final testing of system.

PART 2 - PRODUCTS

2.1 SYSTEM DESCRIPTION

- .1 The new fire alarm control panel of the Powerhouse shall be capable of report to the existing main building fire alarm system (Notifier) as a separate zone.
- .2 All new fire alarm devices shall be compatible with a Notifier control panel.
- .3 Installation shall include:
 - .1 Central Control Unit in separate enclosure with power supply, standby batteries, central processor with microprocessor and logic interface, main system memory, input-output interfaces for alarm receiving, annunciation/display, and program control/signaling.
 - .2 Power supplies.
 - .3 Initiating/input circuits.
 - .4 Output circuits.
 - .5 Auxiliary circuits.
 - .6 Local annunciator panels.
 - .7 Automatic initiating devices: smoke (laser and ionization type), heat and flame detectors.

- .8 Audible and visual notification appliances.
- .9 End –of-line resistors.
- .10 Wiring.
- .11 Interconnection with the new pre-action sprinkler system.
- .12 Interconnection with existing fire alarm system.
- .13 Signal to individual fire damper to close the damper upon activation of fire detection devices in the room where the damper is located.

2.2 EQUIPMENT AND DEVICES

- .1 Equipment and devices: ULC listed and labelled, and supplied by single manufacturer.
 - .1 Power supply: to CAN/ULC-S524.
 - .2 Audible signal devices: to CAN/ULC-S525.
 - .3 Visual signal devices: to CAN/ULC-S526.
 - .4 Control unit: to CAN/ULC-S527.
 - .5 Manual pull station: to CAN/ULC-S528.
 - .6 Smoke detectors: to CAN/ULC-S529.
 - .7 Thermal detectors: to CAN/ULC-S530.

2.3 SYSTEM OPERATION

- .1 Actuation of any alarm initiating device to:
 - .1 Cause electronic latch to lock-in alarm state at Central Control Unit.
 - .2 Indicate zone of alarm at Central Control Unit and Main Building remote annunciator.
 - .3 Cause audible signaling devices to sound continuously throughout Powerhouse and at central control unit.
 - .4 Transmit signal to fire alarm system in main building.
 - .5 Cause fire dampers, where present at location of alarm initiating device to close.
 - .6 Cause air conditioning and ventilation fans to shut down to provide required control of smoke movement.
- .2 Acknowledging alarm: indicated at Central Control Unit.
- .3 Possible to silence signals by “Alarm Silence” switch at control unit, after 60 s period of operation.
- .4 Subsequent alarm, received after previous alarm has been silenced, to re-activate signals.
- .5 Resetting alarm device not to return system indications/functions back to normal unit control unit has been reset.
- .6 Trouble on system to:
 - .1 Indicate circuit in trouble at Central Control Unit.

- .2 Activate "System Trouble" indication, buzzer and common trouble sequence. Acknowledging trouble condition to silence audible indication; whereas visual indication to remain until trouble is cleared and system is back to normal.
- .7 Trouble on system: suppressed during course of alarm.
- .8 Trouble condition on any circuit in system not to initiate alarm conditions.
- .9 Generator Status: Indicate "Generator Running" and "Generator Trouble" statuses of each generator at Central Control Unit, and local and remote annunciators.

2.4 CONTROL PANEL

- .1 Central control unit (CCU).
 - .1 Suitable for DCLB communication style: to CAN/ULC-S524.
 - .2 Features specified are minimum requirements for microprocessor-based system with digital data control and digital multiplexing techniques for data transmission.
 - .3 Minimum capacity of 150 addressable monitoring and control/signal points.
 - .4 System to provide for priority reporting levels, with fire alarm points assigned highest priority, supervisory and monitoring lower priority, and third priority for troubles. Possible to assign control priorities to control points in system to guarantee operation or allow emergency override as required.
 - .5 Integral power supply, battery charger and standby batteries.
 - .6 Basic life safety software: retained in non volatile Erasable Programmable Read-Only-Memory (EPROM). Extra memory chips: easily field-installed. Random-Access-Memory (RAM) chips in panel to facilitate password-protected field editing of simple software functions (e.g. zone labels, priorities) [and changing of system operation software].
 - .7 Circuitry to continuously monitor communications and data processing cycles of microprocessor. Upon failure, audible and visual trouble indication to activate.
 - .8 Support one (1) RS-232-C I/O port. CCU output: parallel ASCII with adjustable baud rates to allow interface of any commercially available printer, terminal or PC.
 - .9 Equipped with software routines to provide Event-Initiated-Programs (EIP); change in status of one or more monitor points, may be programmed to operate any or all of system's control points.
 - .10 Software and hardware to maintain time of day, day of week, day of month, month and year.

2.5 POWER SUPPLIES

- .1 120 V, 60 Hz as primary source of power for system.
- .2 Voltage regulated, current limited distributed system power.
- .3 Primary power failure or power loss (less than 102 V) will activate common trouble sequence.

- .4 Interface with battery charger and battery to provide uninterruptible transfer of power to standby source during primary power failure or loss.
- .5 During normal operating conditions, fault in battery charging circuit, short or open in battery leads to activate common trouble sequence and standby power trouble indicator.
- .6 Standby batteries: sealed, maintenance free, with sufficient capacity to power the fire alarm system for not less than 24 consecutive hours plus 2 hours of alarm upon a normal AC power failure.
- .7 Continuous supervision of wiring for external initiating and alarm circuits to be maintained during power failure.

2.6 INITIATING/INPUT CIRCUITS

- .1 Receiving circuits for alarm initiating devices such as manual pull stations, smoke detectors, heat detectors and flame detectors, wired in DCLB configuration to Central Control Unit.
- .2 Alarm receiving circuits (active and spare): compatible with smoke detectors and open contact devices.
- .3 Actuation of alarm initiating device: cause system to operate as specified in "System Operation".

2.7 ALARM OUTPUT CIRCUITS:

- .1 Alarm output circuit: connected to signals, wired in Class B configuration to Central Control Unit.
 - .1 Signal circuits' operation to follow system programming; capable of sounding horns continuously at 20 spm. Each signal circuit: rated at 2 A, 24 VDC; fuse protected from overloading/overcurrent.
 - .2 Manual alarm silence, automatic alarm silence and alarm silence inhibit to be provided by system's common control.

2.8 AUXILIARY CIRCUITS

- .1 Auxiliary contacts for control functions.
- .2 Alarm on system to cause operation of programmed auxiliary output circuits.
- .3 Upon resetting system, auxiliary contacts to return to normal or to operate as pre-programmed.
- .4 Auxiliary circuits: rated at 2 A, 24 VDC or 120 VAC, fuse protected.

2.9 WIRING

- .1 Twisted copper conductors: rated 300 V.
- .2 To initiating circuits: 18 AWG minimum, and in accordance with manufacturer's requirements.

.3 To signal circuits: 16 AWG minimum, and in accordance with manufacturer's requirements.

.4 To control circuits: 14 AWG minimum, and in accordance with manufacturer's requirements.

2.10 MANUAL ALARM STATIONS:

.1 Manual alarm stations: pull lever, glass rod, wall mounted surface type, non-coded single pole normally open contact for single stage, English signage.

.2 Addressable manual pull station:

.1 Pull lever, break glass rod, surface wall mounted type, single action, single stage, electronics to communicate station's status to addressable module/transponder over 2 wires and to supply power to station. Station address to be set on station in field.

2.11 THERMAL (HEAT) DETECTORS

.1 Plug-in, addressable, fixed temperature type.

.2 Fixed temperature, rated 88°C, to be installed in generator rooms:

.1 Surface mounted on outlet box.

.2 External indication of operation on fixed temperature actuation.

.3 Addressable thermal fire detectors:

.1 Electronics to communicate detector's status to addressable module/transponder.

.2 Detector address to be set on detector in field.

2.12 SMOKE DETECTORS

.1 Laser Smoke Detectors: plug-in, addressable, 2-wire, with the following features:

.1 Detection technology using laser diode and lens and mirror optics.

.2 Intelligent sensing algorithm (in panel) to differentiate between dust and smoke particles.

.3 Visible indication by dual bi-colour LEDs which blink green in normal and illuminate steady red in alarm mode.

.4 Operation as part of a group of detectors, comparing readings of adjacent detectors to provide faster detection of fire.

.5 Electronics to communicate detector's status to addressable module/transponder.

.6 Detector address to be set on detector in field.

2.13 NOTIFICATION APPLIANCES

.1 Horn/Strobes:

.1 Appliance suitable for indoor installation and universal mounting position

.2 24 V dc power supply, low current design

- .3 Audible part with minimum of two (2) field selectable settings for dBA levels (90 and 95 dBA) and choice of continuous or temporal (Code 3) signal
- .4 Strobe part producing a flash rate of one (1) flash per second over the regulated voltage range and incorporating Xenon flashtube enclosed in a Lexan lens.

2.14 END-OF-LINE DEVICES

- .1 End-of-line devices to control supervisory current in alarm circuits and signaling circuits, sized to ensure correct supervisory current for each circuit.
- .2 Open, short or ground fault in any circuit will alter supervisory current in that circuit, producing audible and visible alarm at Central Control Unit.

2.15 ANCILLARY DEVICES

- .1 Remote relay unit to initiate fan shutdown and fire damper closing

PART 3 - EXECUTION

3.1 INSTALLATION

- .1 Install system in accordance with CAN/ULC-S524.
- .2 Install new fire alarm control panel at location shown on the drawing. Connect to AC power supply, standby power.
- .3 Install new Laser VIEW smoke detectors on ceiling and connect to alarm circuit wiring.
- .4 Install heat and flame detectors in the Generator Room and connect to alarm circuit wiring..
- .5 Install notification appliances at the locations shown. Do not exceed 80% of listed rating in amperes of notification appliance circuit. Provide additional circuits above those shown if required to meet this requirement.
- .6 Install end-of-line devices at end of alarm and signaling circuits.
- .7 Install remote annunciator panels and connect to annunciator circuit wiring.
- .8 Install remote relay units to control fan shut down and fire damper closing.
- .9 For surface mounting devices provide appliance manufacturer's approved back box. Back box finish to match device finish.
- .10 Connect "Generator Running" and "Generator Trouble" alarms of each generator to control panel.
- .11 Connect pre-action sprinkler system to control panel.
- .12 Provide necessary raceways, cable and wiring to make interconnections to devices and control panel as required for a complete and functional installation.

- .13 Install wiring in EMT conduit. Do not splice wiring inside conduit; use junction boxes for this purpose.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Electrical General Requirements and CAN/ULC-S537.
- .2 Test each device and alarm circuit to ensure manual stations, heat, smoke and flame detectors transmit alarm to control panel and actuate general alarm
- .3 Check annunciator panel to ensure zones are shown correctly.
- .4 Simulate grounds and breaks on alarm and signalling circuits to ensure proper operation of systems. Specifically:
 - .1 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals on each side of single open-circuit fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
 - .2 Test each conductor on all DCLA addressable links for capability of providing 3 or more subsequent alarm signals during ground-fault condition imposed near midmost point of each link. Operate Acknowledge/Silence switch after reception of each of the 3 signals. Correct imposed fault after completion of each series of tests.
- .5 Provide final PROM program re-burn for system incorporating program changes made during construction.
- .6 Retain services of an independent third party to perform verification of the system installed and operation integrated with the building's main fire alarm system.
- .7 Obtain verification Report and submit to Consultant for review.

3.3 DOCUMENTATION AND TRAINING

- .1 Submit data for incorporation into the Operation and Maintenance Manual, including:
 - .1 Functional description and sequence of operation of completed installation
 - .2 Detailed operating instructions, including required operator responses.
 - .3 Complete system input/output program information, with site specific data.
 - .4 Detailed maintenance instructions for control equipment and each device type, including maintenance schedule in accordance with CAN/ULC-S536-97.
 - .5 Troubleshooting guide for the installed devices.
 - .6 Manufacturer's data sheets and installation manuals / instructions for equipment installed.
 - .7 A copy of the as-built floor plans indicating all devices shall be submitted with each manual. The system address of each addressable device shall be clearly indicated beside each device on the drawings.

- .8 Final set of reviewed Record Drawings.
- .9 A list of recommended spare parts.
- .10 Copy of verification certificate, verification report and warranty certificates for the complete fire alarm system.
- .11 Name, address and telephone number of service representative of manufacturer to be contacted during warranty period.
- .12 Name, address and telephone number of representative responsible for the future software changes.
- .2 Submit the manuals in protective vinyl hard cover 3-ring type binders.
- .3 Data sheets shall be original manufacturer's literature or shall be clearly legible if reproductions. If data sheets show more than one product, the proposed product shall be clearly identified by arrows or other suitable means.
- .4 Provide training of Owner's personnel in the operation of system. Prepare training material and conduct site demonstration of system components and operation.

END OF SECTION