



District of Port Hardy



**Tender Documents for: Watermain
Replacement, Fort Rupert
Reservoir and Water Treatment
Reservoir Site Development –
Contract 1**

TENDER #:1220-20-518-2017

October 2017

Project Tender Document

1220-20-518-2017
(Tender #)

Watermain Replacement, Fort Rupert Reservoir and Water Treatment Reservoir Site
Development – Contract 1
(TITLE OF CONTRACT)

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The complete Project Construction Documents consist of the following parts:

1. Standard Documents (supplied):

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2. Non-Standard Documents (Supplied):

3. Standard Documents (**not supplied - See MMCD - Volume II Platinum Edition 2009**):

Instructions to Tenderers - Part II
General Conditions
Specification
Standard Detail Drawings

Owner: **District of Port Hardy**

(NAME OF OWNER)

Contract: **Watermain Replacement, Fort Rupert Reservoir and Water Treatment
Reservoir Site Development – Contract 1**

(TITLE OF CONTRACT)

Reference No. **1220-20-518-2017**

(OWNER'S TENDER REFERENCE NO.)

**The Owner invites tenders
for:**

Approximately 3.3km of new watermain, 300mm and 350mm C900 PVC, to be installed offset from the existing AC watermain in the Fort Rupert area. As shown in Drawings, Fort Rupert Road, Beaver Harbor Road, and Byng Road. Work to include, water service connections, new hydrant assemblies, air reliefs, line valves, trench dams and restraints as required as well as asphalt and concrete reinstatement for roadways/sidewalks. Tie in locations will require removing and disposal of existing AC main segments.

Development of both reservoir sites: disassemble the WTP reservoir, perform Geotechnical investigation, install underground piping per design. Develop Ft Rupert site (access road, controls building, underground piping, fencing, grading)

(BRIEF DESCRIPTION OF THE WORK)

**Contract Documents are
available for:**

Download from the District of Port Hardy's website: www.porthardy.ca

(LIST ADDRESSES FOR DOCUMENT PICKUP)

On payment of a non-refundable amount of \$100 including GST payable to:
District of Port Hardy

(NAME THAT CHEQUE SHOULD BE PAYABLE TO)

**The Contract Documents
are available for viewing at:**

District of Port Hardy's website: www.porthardy.ca

(ADDRESS WHERE CONTRACT DOCUMENTS CAN BE VIEWED)

**Tenders are scheduled to
close:**

Tender Closing Time: 2 : 30 , PM local time

Tender Closing Date: November 6 , 20 17

**Submit Tender to
either Address:**

District of Port Hardy	Stantec Consulting Ltd.
7360 Columbia - Box 68	400-655 Tye Rd
Port Hardy, BC V0N 2P0	Victoria, BC V9A 6X5
Attn: Abbas Farahbakhsh	Attn: Jon Bell

(ADDRESS WHERE TENDERS MUST BE SUBMITTED)

**NAME OF OWNER'S
REPRESENTATIVE**

Abbas Farahbakhsh
250-949-7779

(PHONE)

1.0 Introduction.....IT 3

2.0 Tender DocumentsIT 3

3.0 Submission of TendersIT 4

4.0 Additional Instructions to Tenderers.....IT 5

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(FOR USE WHEN UNIT PRICES FORM THE BASIS OF PAYMENT TO BE USED ONLY WITH THE GENERAL CONDITIONS AND OTHER STANDARD DOCUMENTS OF THE UNIT PRICE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS.)

(TO BE READ WITH "INSTRUCTIONS TO TENDERERS - PART II"
CONTAINED IN THE EDITION OF THE PUBLICATION
"MASTER MUNICIPAL CONSTRUCTION DOCUMENTS" SPECIFIED IN ARTICLE 2.2 BELOW)

Owner: **District of Port Hardy**
(NAME OF OWNER)

Contract: **Watermain Replacement, Fort Rupert Reservoir and Water Treatment
Reservoir Site Development – Contract 1**
(TITLE OF CONTRACT)

Reference No. **1220-20-518-2017**
(OWNER'S TENDER REFERENCE NO.)

1.0 Introduction

1.1 These Instructions apply to and govern the preparation of tenders for this *Contract*. The *Contract* is generally for the following work:

Watermain Construction:

Approximately 3.3km of new watermain, 300mm & 350 mm C900 PVC, to be installed offset approximately 1.5m from the existing AC watermain in the Fort Rupert area. As shown in Drawings Fort Rupert Road, Beaver harbor Road, and Byng Road. Work to include, water service connections, new hydrant assemblies, air reliefs, line valves, trench dams and restraints as Required, asphalt and concrete reinstatements. Tie in locations will require removing and disposal of existing AC main segments.

Fort Rupert Reservoir Site Development:

Clearing and grubbing site, construction of a gravel access road, underground piping (C900 PVC to 1m outside the controls building and flow meter vault, and SS 304L after to stub at underside of reservoir foundation) and controls building (housing the PRV, bypass line, strainer, altitude valve, electrical/SCADA, chlorine injection/analyzer equipment). Additional site grading, electrical power, backup power generator, dechlorination manholes, security gates & fencing, flow meter and drainage piping/ditching will be required onsite.

Water Treatment Reservoir Site Development:

The existing reservoir is to be disassembled and removed from site.

A detailed geotechnical investigation will be required to assess the

Soil bearing capacities and requirements for reservoir design

(disassembly of tank and geotechnical investigation to take place

immediately upon award of contract). Site is to be graded.

Underground stainless steel piping to connect into existing system

and stub to underside of reservoir slab. After reservoir construction

Contractor to install level sensor equipment into tank.

(BRIEF DESCRIPTION OF THE WORK)

1.2 Direct all inquiries regarding the *Contract*, to:

Jon Bell, P.Eng. – Stantec Consulting Ltd.

(NAME AND POSITION OF INDIVIDUAL WHO WILL ANSWER INQUIRIES)

Address: #400-655 Tye Road

Victoria, BC V9A 6X5

jon.bell@stantec.com

Phone: 250 388 - 9161

Fax: 250 382 - 0514

2.0 Tender Documents

2.1 The tender documents which a tenderer should review to prepare a tender consist of all of the *Contract Documents* listed in Schedule 1 entitled "Schedule of Contract Documents". Schedule 1 is attached to the Form of Agreement which is included as part of the tender package. The *Contract Documents* include the drawings listed in Schedule 2 to the Form of Agreement, entitled "List of *Contract Drawings*".

- 2.2 A portion of the *Contract Documents* are included by reference. Copies of these documents have not been included with the tender package. These documents are the Instructions to Tenderers - Part II, General Conditions, Specifications and Standard Detail Drawings. These documents are contained in the publication entitled "Master Municipal Construction Documents - General Conditions, Specifications and Standard Detail Drawings". Refer to Schedule 1 to the Form of Agreement or, if not specified in Schedule 1, then the applicable edition shall be the most recent edition as of the date of the *Tender Closing Date*. All sections of this publication are by reference included in the *Contract Documents*.
- 2.3 Any additional information made available to tenderers prior to the *Tender Closing Time* by the *Owner* or representative of the *Owner*, such as geotechnical reports or as-built plans, which is not expressly included in Schedule 1 or Schedule 2 to the Form of Agreement, is not included in the *Contract Documents*. Such additional information is made available only for the assistance of tenderers who must make their own judgment about its reliability, accuracy, completeness and relevance to the *Contract*, and neither the *Owner* nor any representative of the *Owner* gives any guarantee or representation that the additional information is reliable, accurate, complete or relevant.

3.0 Submission of Tenders

- 3.1 Tenders must be submitted in a sealed envelope, **marked on the outside with the *Contract Title and Reference No.***, and must be received by the office of:

Mr. Abbas Farahbakhsh, Director of Operations; or,
Jon Bell, Stantec Consulting Ltd.

(TITLE OF POSITION)

on or before:

Tender Closing Time: 2 : 30 , PM local time
Tender Closing Date: November 6, 2017 , 20 17

at

Address:	District of Port Hardy	Stantec Consulting Ltd.
	7360 Columbia - Box 68	400-655 Tye Road
	Port Hardy, BC V0N 2P0	Victoria, BC V9A 6X5
Fax:	250-949-7779	250-389-2375

- 3.2 Late tenders will not be accepted or considered, and will be returned unopened.

4.0 **Additional
Instructions to
Tenderers**

- 4.1 Tenderers are reminded that completion of all required information on the Form of Tender, including the Appendices, is mandatory. Tenders lacking all required information will be rejected as incomplete.
- 4.2 The Tender must be accompanied by a Bid Security in the form of a Bid Bond. Tenders submitted without a Bid Bond will not be considered. Other forms of bid security noted in the Instructions to Tenderers, Part II Section 5.2.2 are not acceptable.
- 4.3 The District of Port Hardy reserves the right to reject any and all tenders and the lowest tender will not necessarily be accepted.
- 4.4 The District and Stantec will not accept tenders or revisions/ amendments to tenders that are received by facsimile machine or email.
- 4.5 Except as expressly and specifically permitted in these instructions to Tenderers, no Tenderers, shall have any claim for any compensation of any kind whatsoever, as a result of participating in the Tender and by submitting a bid each Tenderer, shall be deemed to have agreed that it has no claim.
- 4.6 The Tenderer must include Appendix 6 – Schedule of Force Account Rates.

FOR USE WHEN UNIT PRICES FORM THE BASIS OF PAYMENT - TO BE USED ONLY WITH THE GENERAL CONDITIONS AND OTHER STANDARD DOCUMENTS OF THE UNIT PRICE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS.

Owner: District of Port Hardy
(NAME OF OWNER)

Contract: Watermain Replacement, Fort Rupert Reservoir and Water Treatment Reservoir Site Development – Contract 1
(TITLE OF CONTRACT)

Reference No. 1220-20-518-2017
(OWNER'S TENDER REFERENCE NO.)

To Owner:

**WE, THE
UNDERSIGNED:**

1.1 have received and carefully reviewed all the *Contract Documents*, including the Instructions to Tenderers, the specified edition of the “Master Municipal Construction Documents - General Conditions, Specifications and Standard Detail Drawings” and the following Addenda:

(ADDENDA, IF ANY)

**ACCORDINGLY, WE
HEREBY OFFER**

1.2 have full knowledge of the *Place of the Work*, and the *Work* required; and

1.3 have complied with the Instructions to Tenderers; and

2.1 to perform and complete all of the *Work* and to provide all the labour, equipment and material all as set out in the *Contract Documents*, in strict compliance with the *Contract Documents*; and

2.2 to achieve: Substantial Performance of the *Work* on or before **154 Calendar days after Contract signing**, and Total Performance of the *Work* on or before **168 Calendar days after Contract signing**; and

2.3 to do the *Work* for the price, which is the sum of the products of the actual quantities incorporated into the *Work* and the appropriate unit prices set out in Appendix 1, the “*Schedule of Quantities and Prices*”, plus any lump sums or specific prices and adjustment amounts as provided by the *Contract Documents*. For the purposes of tender comparison, our offer is

to complete the *Work* for the "*Tender Price*" as set out on Appendix 1 of this Form of Tender. Our *Tender Price* is based on the estimated quantities listed in the *Schedule of Quantities and Prices*, and excludes *GST*.

- WE CONFIRM:** 3.1 that we understand and agree that the quantities as listed in the *Schedule of Quantities and Prices* are estimated, and that the actual quantities will vary.
- WE CONFIRM:** 4.1 that the following appendices are attached to and form a part of this tender:
- 4.1.1 the appendices as required by paragraph 5.3 of the Instructions to Tenderers – Part II; and
 - 4.1.2 the *Bid Security* as required by paragraph 5.2 of the Instructions to Tenderers – Part II.
- WE AGREE:** 5.1 that this tender will be irrevocable and open for acceptance by the *Owner* for a period of **60 calendar days** from the day following the *Tender Closing Date and Time*, even if the tender of another tenderer is accepted by the *Owner*. If within this period, the *Owner* delivers a written notice ("*Notice of Award*") by which the *Owner* accepts our tender we will:
- 5.1.1 within 15 *Days* of receipt of the written *Notice of Award* deliver to the *Owner*:
 - .1 a Performance Bond and a Labour and Material Payment Bond, each in the amount of 50% of the Contract Price, covering the performance of the *Work* including the Contractor's obligations during the Maintenance Period, issued by a surety licensed to carry on the business of suretyship in the province of British Columbia, and in a form acceptable to the *Owner*;
 - .2 a Baseline Construction Schedule, as provided by GC 4.6.1;
 - .3 a "clearance letter" indicating that the tenderer is in Worksafe BC compliance; and
 - .4 a copy of the insurance policies as specified in GC 24 indicating that all such insurance coverage is in place and;
 - 5.1.2 within 2 *Days* of receipt of written "*Notice to Proceed*", or such longer time as may be otherwise specified in the *Notice to Proceed*, commence the *Work*; and
 - 5.1.3 sign the Contract Documents as required by GC 2.1.2.

WE AGREE:

- 6.1 that, if we receive written *Notice of Award* of this *Contract* and, contrary to paragraph 5 of this Form of Tender, we:
 - 6.1.1 fail or refuse to deliver the documents as specified by paragraph 5.1.1 of this Form of Tender; or
 - 6.1.2 fail or refuse to commence the *Work* as required by the *Notice to Proceed*,
then such failure or refusal will be deemed to be a refusal by us to enter into the *Contract* and the *Owner* may, on written notice to us, award the *Contract* to another party. We further agree that, as full compensation on account of damages suffered by the *Owner* because of such failure or refusal, the *Bid Security* shall be forfeited to the *Owner*, in an amount equal to the lesser of:
 - .1 the face value of the *Bid Security*; and
 - .2 the amount by which our *Tender Price* is less than the amount for which the *Owner* contracts with another party to perform the *Work*.

OUR ADDRESS IS AS FOLLOWS:

1

Phone: _____

Fax: _____

Attention: _____

This Tender is executed this _____ day of _____, 20 _____.

Contractor:

(FULL LEGAL NAME OF CORPORATION, PARTNERSHIP OR INDIVIDUAL)

(AUTHORIZED SIGNATORY)

(AUTHORIZED SIGNATORY)

Watermain Replacement, Fort Rupert Reservoir and Water Treatment Reservoir Site Development - Contract 1

SCHEDULE OF QUANTITIES AND PRICES
(see paragraph 5.3.1 of the Instructions to Tenderers - Part II)
(All Prices and Quotations shall include all taxes, but shall not include GST. GST shall be shown separately)

Master Municipal Specifications		GENERAL REQUIREMENTS		
DESCRIPTION				
Clearing and Grubbing		Incidental to Contract		
Master Municipal Specifications		SITE WORK		
DESCRIPTION	Units	Qty.	Rate (\$)	Amount (\$)
CONTRACT SPECIFIC INSTRUCTIONS				
Mobilization & Demobilization		L.S.	1	
TRAFFIC CONTROL				
Traffic Control		L.S.	1	
ENVIRONMENTAL PROTECTION				
Environmental Management Plan, Erosion and Sediment Control		L.S.	1	
CONCRETE WALKS, CURBS, AND GUTTERS				
Extruded concrete median curb (MMCD SD # C6)		m	110	
CAST IN PLACE CONCRETE				
Concrete for Culvert Crossing at Station 50 + 602 minimum 28 day strength required; 25 Mpa		L.S.	1	
WATERWORKS				
Payment for watermain includes: Excavation, disposal of surplus excavated materials, bedding, compaction, supply and installation of all pipe, bolts, gaskets, restraints, couplers, tie-rods, imported backfill, pressure and leak testing, flushing and disinfection, and all required water sampling and testing (by a qualified independent consultant).		NOTE		
350mm PVC C900 Class 235		m	420	
combined trench of 300mm & 350mm C900 PVC Class 235		m	605	
300mm PVC C900 Class 235		m	2,330	
250mm PVC C900 Class 235		m	25	
150mm PVC C900 Class 235		m	65	
350mm 45° DI Bend c/w Thrust block		Ea.	6	
300mm 11.25° DI Bend c/w Thrust block		Ea.	2	
300mm 22.5° DI Bend c/w Thrust block		Ea.	3	
300mm 45° DI Bend c/w Thrust block		Ea.	11	
250mm 45° DI Bend c/w Thrust block		Ea.	4	
150m 45° DI Bend c/w Thrust block		Ea.	16	
350 x 300 x 300 DI Tee c/w Thrust block		Ea.	1	
300 x 300 x 300 DI Tee c/w Thrust block		Ea.	1	
300 x 300 x 250 DI Tee c/w Thrust block		Ea.	1	
300 x 300 x 150 DI Tee c/w Thrust block		Ea.	4	
300mm Cross c/w Thrust block		Ea.	1	
350mm DI Gate Valve		Ea.	4	
300mm DI Gate Valve		Ea.	27	
250mm DI Gate Valve		Ea.	1	
150mm DI Gate Valve		Ea.	4	
Tie-in to existing main: west of Fort Rupert Road		L.S.	1	
Tie-in to existing main: Byng Road at Peel St branch *two connection points, 250mm Byng & 150mm Peel		L.S.	1	
Tie-in to existing main: Byng Road at Beaver Harbour Road		L.S.	1	
Tie-in to existing main: Byng Road at Avalon School		L.S.	1	
Tie-in to existing main: Beaver Harbour Road at Fort Rupert School		L.S.	1	
Tie-in to existing 150mm line: Beaver Harbour Park		L.S.	1	
Tie-in to exist. 150mm line: 5250 Beaver Harbour RD Mobile Park		L.S.	1	
Tie-in to exist. 250mm line: Wagalus School		L.S.	1	
Tie-in to exist. 150mm line: Weynton St		L.S.	1	
Tie-in to exist. 150mm line: Fire Dept. Fire Hydrant - 1935 Beaver Harbour Rd		L.S.	1	
Reducer 250 x 300mm DI		Ea.	3	
Reducer 150 x 300mm DI		Ea.	5	
Fire Hydrant Assemblies c/w Thrust blocks & Restraints. Incl mainline Tee. Fire Hydrant Assemblies w/ korflow culvert 600mm c/w Thrust blocks & Restraints		Ea.	21	
to include complete hydrant assembly with mainline tee, all joint restraints, thrust blocks, valves, as well as culvert and headwall installation. Denso-tape all joints including the mainline tee.		Ea.	7	
Water Service Connections 50mm dia. Includes import backfill, service saddles, connection (drawing W2b) to end at curb located into new meter box (H20 rated per standard drawing W2c), and permanent asphalt & concrete reinstatement.		Ea.	6	
Water Service Connections 25mm dia. Includes import backfill, service saddles, connection (drawing W2b) to end at curb located into new meter box (H20 rated per standard drawing W2c), and permanent asphalt & concrete reinstatement.		Ea.	6	
Water Service Connections 19mm dia. Includes import backfill, service saddles, connection (drawing W2b) to end at curb located into new meter box (H20 rated per standard drawing W2c), and permanent asphalt & concrete reinstatement.		Ea.	28	
Trench Dams		Ea.	5	
50mm Saddle and Corp. Stop at 50+290		Ea.	1	
25mm Air Release Valve and Chamber		Ea.	2	
AC PIPE DISPOSAL				
Removal and Disposal of AC Pipe		m	55	
PAINTED PAVEMENT MARKINGS				
permanent pavement markings (to MoTI standards and permit requirements)		L.S.	1	
PIPE CULVERTS				
600 mm Korflow culvert including access road and motared rock headwalls to Reservoir site		Ea.	1	
				Subtotal

PROVISIONAL ITEMS TO CONTRACT			
HOT-MIX ASPHALT CONCRETE PAVING (PROVISIONAL)			
Permanent pavement restoration - non MoTI roadways (all other works) one lift of Upper Course #2 , placed in 40mm lift to extents shown on drawings.	m ²	5005	
Permanent pavement restoration - non MoTI roadways (all other works) One lift of Lower Course #2 , placed in 40mm lift to max saw cut width shown in drawing details.	m ²	2400	
Permanent pavement restoration Fort Rupert Road and Byng Road east of intersection and extending 20m East down Byng Road (to meet MoTI standards and permit requirements) - Upper Lift to extents shown in drawings	m ²	1010	
Permanent pavement restoration Fort Rupert Road and Byng Road east of intersection and extending 20m East down Byng Road (to meet MoTI standards and permit requirements) - Lower lift to saw cut line shown in drawing details.	m ²	430	
Provisional Unit Rate Items			
Bulk Rock Excavation	m ³	50	
Saw cutting	m	300	
Trench Rock Excavation	m ³	50	
Common Excavation	m ³	100	
Unsuitable foundation Replacement	m ³	100	
Dechlorination Manhole	L.S.	2	
			Subtotal

CONTRACT 1 - FORT RUPERT RESERVOIR SITE				
Description	Units	Qty	Rate (\$)	Amount (\$)
General				
Commissioning, Start-up and Training	L.S.	1		
Sitework				
site preparation	m ²	1200		
PVC Storm Drains, Injection Manhole	L.S.	1		
Site valves, fittings, appurtenances, trenching, backfill	L.S.	1		
Meter Chamber Structure Including Lid	L.S.	1		
All other work	L.S.	1		
Concrete				
Control room floor including foundation walls and footings	L.S.	1		
Generator pad, foundation walls, thrust blocks, pipe saddles and reinforcement	L.S.	1		
All other work	L.S.	1		
Masonry				
Control Room Walls and Reinforcement	L.S.	1		
All other work	L.S.	1		
Metals				
Stainless Steel Piping Within Reservoir Footprint	L.S.	1		
Stainless Steel Piping Outside Reservoir Footprint	L.S.	1		
Wood				
Roof structure and roofing	L.S.	1		
All other work	L.S.	1		
Thermal and Moisture Protection				
	L.S.	1		
Door				
	L.S.	1		
Finishes				
	L.S.	1		
Process Mechanical Inside Building				
Stainless steel piping, fittings and welding	L.S.	1		
PRV, Altitude Valve, valves, strainer, couplings, restraints, joints and appurtenances (excluding mag flow meters)	L.S.	1		
Building Mechanical				
Fans, Heaters, Louvers, and Controls	L.S.	1		
Floor drains and Piping	L.S.	1		
Electrical and Controls				
Buried conduits incl. trench, bed, compact,	L.S.	1		
Wire and above ground conduit	L.S.	1		
Main Breaker	L.S.	1		
Mag flow Meter, Pressure Transducer, Chlorine Analyzer, Chlorine Injection	L.S.	1		
Control System	L.S.	1		
Utility coord and install	L.S.	1		
Ground loop and grounding rods	L.S.	1		
Generator and ATS	L.S.	1		
Divisional Subtotal				
CONTRACT 1 - WATER TREATMENT PLANT				
Water Treatment Plant Improvements				
Relocations - Building and Phone (Electrical & Civil)	L.S.	1		
Decommissioning and Removals - Tank & Foundation	L.S.	1		
Stainless Steel Piping Within 1.0m of Reservoir Footprint	L.S.	1		
Exterior Pipeworks and Valving	L.S.	1		
Site Preparation	L.S.	1		
Reinstatement and Level Sensing Installations	L.S.	1		
Divisional Subtotal				
Contract Subtotal				
CONTINGENCY (15%)				
TOTAL CONTRACT 1 (Excluding Applicable Tax)				
Subtotal				
BC HYDRO BUDGETARY COST OVERHEAD				
TELUS BUDGETARY COST OVERHEAD				
TOTAL CONSTRUCTION BUDGET (Excluding Applicable Tax)				

**Watermain Replacement, Fort Rupert Reservoir and Water
Treatment Reservoir Site Development – Contract 1**

(TITLE OF CONTRACT)

See paragraph 5.3.3 of the Instructions to Tenderers – Part II.

Name: _____

Experience: _____

Dates: _____

Project Name: _____

Responsibility: _____

References: _____

Dates: _____

Project Name: _____

Responsibility: _____

References: _____

Dates: _____

Project Name: _____

Responsibility: _____

References: _____

Dates: _____

Project Name: _____

Responsibility: _____

References: _____

Tenderer's Initials _____

Watermain Replacement, Fort Rupert Reservoir and Water Treatment Reservoir Site Development – Contract 1

(TITLE OF CONTRACT)

See paragraph 5.3.4 of the Instructions to Tenderers – Part II.

PROJECT	OWNER / CONTACT NAME PHONE and FAX	WORK DESCRIPTION	VALUE (\$)
	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		
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	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		
	Owner / Contract _____ Phone () _____ Fax () _____		

Tenderer's Initials _____

**Watermain Replacement, Fort Rupert Reservoir and Water
Treatment Reservoir Site Development – Contract 1**

(TITLE OF CONTRACT)

See paragraph 4.6 of the Instructions to Tenderers – Part I.

LABOUR	HOURLY RATE	OVERTIME RATE
Superintendent		
Foreman		
Pipe Layer		
Equipment Operator		
Skilled Labourer		
Unskilled Labourer		
Truck Driver		
Concrete Finisher		
Carpenter / Form Maker		
Electrician		
Flag Person		
Welder		

Tenderer's Initials

(FOR USE WHEN UNIT PRICES FORM THE BASIS OF PAYMENT TO BE USED ONLY WITH THE GENERAL CONDITIONS AND OTHER STANDARD DOCUMENTS OF THE UNIT PRICE MASTER MUNICIPAL CONSTRUCTION DOCUMENTS.)

BETWEEN *OWNER* AND *CONTRACTOR*

This agreement made in duplicate this

_____ day of _____, 20_____.

Watermain Replacement, Fort Rupert Reservoir and Water Treatment

Contract: **Reservoir Site Development – Contract 1**

(TITLE OF CONTRACT)

Reference No. **1220-20-518-2017**

(OWNER'S TENDER REFERENCE NO.)

BETWEEN:

The District of Port Hardy

(NAME OF OWNER)

(the "Owner")

AND:

(NAME AND OFFICE ADDRESS OF CONTRACTOR)

(the "Contractor")

The Owner and the Contractor agree as follows:

- | | | |
|--|-----|---|
| Article 1 The Work Start / Completion Dates | 1.1 | The <i>Contractor</i> will perform all <i>Work</i> and provide all labour, equipment and material and do all things strictly as required by the <i>Contract Documents</i> . |
| | 1.2 | The <i>Contractor</i> will commence the <i>Work</i> in accordance with the <i>Notice to Proceed</i> . The <i>Contractor</i> will proceed with the <i>Work</i> diligently, will perform the <i>Work</i> generally in accordance with the construction schedules as required by the <i>Contract Documents</i> and will achieve: <i>Substantial Performance</i> of the <i>Work</i> on or before <u>154 Calendar days after signing Contract</u> , and Total Performance of the <i>Work</i> on or before <u>168 Calendar days after signing Contract</u> subject to the provisions of the <i>Contract Documents</i> for adjustments to the <i>Contract Time</i> |

Article 2 Contract Documents

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

Article 3 Contract Price

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

Article 4 Payment

- 4.1 Subject to applicable legislation and the provisions of the *Contract Documents*, the *Owner* shall make payments to the *Contractor*.
- 4.2 If the *Owner* fails to make payments to the *Contractor* as they become due in accordance with the terms of the *Contract Documents* then interest calculated at 2% per annum over the prime commercial lending rate of the Royal Bank of Canada on such unpaid amounts shall also become due and payable until payment. Such interest shall be calculated and added to any unpaid amounts monthly.

Article 5 Rights and Remedies

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

Article 6 Notices

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

The *Owner*:

District of Port Hardy

7360 Columbia - Box 68

Port Hardy, BC V0N 2P0

Fax: 250 949 7433

Attention: Abbas Farahbakhsh, Director of Operations

The *Contractor*:

Fax: _____
Attention: _____

The *Contract Administrator*:

Stantec Consulting Ltd

#400-655 Tyee Road

Victoria, BC V9A 6X5

Fax: 250 382 0514

Attention: Jon Bell, P.Eng.

- 6.2 A communication or notice that is addressed as above shall be considered to have been received
 - 6.2.1 immediately upon delivery, if delivered by hand; or
 - 6.2.2 immediately upon transmission if sent by fax and received in

hard copy; or

6.2.3 after **5 Days** from date of posting if sent by registered mail.

6.3 The *Owner* or the *Contractor* may, at any time, change its address for notice by giving written notice to the other at the address then applicable. Similarly, if the *Contract Administrator* changes its address for notice then the *Owner* will give or cause to be given written notice to the *Contractor*.

6.4 The sender of a notice by fax assumes all risk that the fax is received in hard copy.

Article 7 General

7.1 This *Contract* shall be construed according to the laws of British Columbia.

7.2 The *Contractor* shall not, without the express written consent of the *Owner*, assign this *Contract*, or any portion of this *Contract*.

7.3 The headings included in the *Contract Documents* are for convenience only and do not form part of this *Contract* and will not be used to interpret, define or limit the scope or intent of this *Contract* or any of the provisions of the *Contract Documents*.

7.4 A word in the *Contract Documents* in the singular includes the plural and, in each case, vice versa.

7.5 This agreement shall ensure to the benefit of and be binding upon the parties and their successors, executors, administrators and assigns.

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

Contractor:

(FULL LEGAL NAME OF CORPORATION, PARTNERSHIP OR INDIVIDUAL)

(AUTHORIZED SIGNATORY)

(AUTHORIZED SIGNATORY)

Owner:

District of Port Hardy

(FULL LEGAL NAME OF CORPORATION, PARTNERSHIP OR INDIVIDUAL)

(AUTHORIZED SIGNATORY)

(AUTHORIZED SIGNATORY)

(INCLUDE IN LIST ALL DOCUMENTS INCLUDING, IF ANY, SUPPLEMENTARY GENERAL CONDITIONS, SUPPLEMENTARY SPECIFICATIONS, SUPPLEMENTARY STANDARD DETAIL DRAWINGS.)

Schedule 1 Schedule of Contract Drawings

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

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

- Agreement, including all Schedules;
- Supplementary General Conditions;
- General Conditions*;
- Supplementary Specifications;
- Specifications*;
- Supplementary Standard Detail Drawings;
- Standard Detail Drawings*;
- Executed Form of Tender, including all Appendices;
- *Contract Drawings* listed in Schedule 2 to the Agreement, – "List of *Contract Drawings*";
- Instructions to Tenderers - Part I;
- Instructions to Tenderers - Part II*;
- The following Addenda:

(ADDENDA, IF ANY)

(COMPLETE LISTING OF ALL DRAWINGS, PLANS AND SKETCHES WHICH ARE TO FORM A PART OF THE CONTRACT, OTHER THAN STANDARD DETAIL DRAWINGS AND SUPPLEMENTARY STANDARD DETAIL DRAWINGS.)

Schedule 2 List of Contract Drawings

TITLE	DRAWING NO.	DATE	REVISION NO.	REVISION DATE
Watermain Construction				
Cover Sheet	C000	Oct 10, 2017		
General Notes/Legend	C001	Oct 10, 2017		
Watermain Plan/Profiles	C101 – C110	Oct 10, 2017		
Details	C201, C203	Oct 10, 2017		
Reservoir site				
Cover Sheet	C000	Oct 10, 2017		
General Notes/Legend	C001	Oct 10, 2017		
Fort Rupert Reservoir Site	C301 – C305	Oct 10, 2017		
WTP Reservoir Site	C401, C402	Oct 10, 2017		
Reservoir Civil Details	C501	Oct 10, 2017		
Fort Rupert Structural Notes	S001	Oct 10, 2017		
Fort Rupert Structural Drawings	S101 – S301	Oct 10, 2017		
Fort Rupert Mechanical HVAC Plan	M101	Oct 10, 2017		
Electrical Legend and Notes	E001	Oct 10, 2017		
Electrical Site Plan and Layouts	E101 – E202	Oct 10, 2017		
Instrumentation drawings	EI101 – EI205	Oct 10, 2017		

These Supplementary General Conditions must be read in conjunction with the Master Municipal General Conditions contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions

SG 3.4 Inspection and Site Inspector

SG 3.4.9 (Add Clause 3.4.9 as follows)

The *Contract Administrator*, the *Owner*, and the *Contractor* shall take part in a pre-construction site inspection prior to the *Work* commencing. This shall include a photographic and video survey. The date and time for this meeting shall be set by the *Contract Administrator*.

SG 4.2 Safety

SG 4.2.2 (Add Clause 4.2.2 as follows)

The *Contractor* shall have daily safety meetings, prepare daily hazard assessments and work plans. These may be reviewed by the *Contract Administrator* from time to time.

SG 4.6 Construction Schedule

SG 4.6.2 (Delete Clause 4.6.2 and replace as follows)

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

SG 4.13 Rejected Work

SG 4.13.4 (Add Clause 4.13.4 as follows)

Any non-conformance to the specification is to be reported by the *Contractor* to the *Contract Administrator* immediately with a proposed corrective action and schedule.

Any changes in the *Work* with respect to grade, location or alignment shall be approved in advance by the *Contract Administrator*. Failure to notify the *Contract Administrator* of changes in writing may result in rejection of the *Work*.

SG 4.14 Final Cleanup

SG 4.14.3 (Add Clause 4.14.3 as follows)

The *Contract Administrator* is to make a field judgment if street sweeping is required. The *Contractor* shall directly contract a street sweeping company for site street sweeping. If the District of Port Hardy sends a street sweeper to clean up the area around the work site because of excess dirt and material the *Contractor* will be billed directly for this work.

SG 4.16 Notice of Disruption

SG 4.16.2 (Add Clause 4.16.2 as follows)

The *Contractor* shall designate a public relations program contact who shall be responsible for implementing all measures of the public relation program, and who shall be the contact for any public concerns or questions.”

Written Notice to be delivered to each home or business describing work, schedule and how it affects them. Provide a phone number and the name of the person to be contacted in case of any complaints related to the *Contractor's* work, or to discuss the project or their problems. Notice to be delivered a minimum of one week prior to the anticipated construction start date.

Notification template will be supplied to the *Contractor* to use for Public Notifications. Contractor will be required to fill in any additional information required on the template (i.e. dates of service disconnection and connection etc.) and deliver these notices as per the contract requirements. Verification of notice delivery will be required. The *Contract Administrator* will review the notices from Contractor and will keep the District informed with respect to Public Notifications.

SG 4.16.3 (Add Clause 4.16.3 as follows)

The *Contractor* shall provide public notification as follows:

- .1 48 hours' notice is required for temporary utility shut downs;
- .2 5 days' notice is required for utility long term shut downs that require temporary water service connections.
- .3 5 days' notice for any road closures directly affecting the public (ex. closing the alley behind their house or the road in front of their house.)

SG 9.4 Quantity Variations

SG 9.4 ***(Delete and Replace Clause 9.4 as follows)***

All contract unit rates are final and will be held firm regardless of the quantities supplied or additions/deletions of contract items.

SG 13.9 Liquidated Damages for Late Completion

SG 13.9.1 ***(Delete Clause 13.9.1 and replace as follows)***

If the *Contractor* fails to meet the Milestone Date for *Substantial Performance* as set out in the Form of Tender, paragraph 2.2 as may be adjusted pursuant to the provisions of the *Contract Documents*, then the *Owner* may deduct from any monies owing to the *Contractor* for the *Work*. Liquidated damages will be assessed at this time.

SG 20.1 Laws

SG 20.1.2 ***(Add Clause 20.1.2 as follows)***

Written permission from the *Contract Administrator* will be required for any works to be performed on a Sunday. In case the *Contractor* decides to work on a day which is a Statutory Holiday, he shall provide the *Contract Administrator* in writing at least four (4) business days in advance of such holiday, stating those places where said work is to be conducted. In case the *Contractor* fails to give such notice in advance of any Statutory Holiday, no work within the terms of the *Contract* shall be done on such holiday.

SG 20.2 Permits

SG 20.2.3 ***(Add Clause 20.2.3 as follows)***

In accordance with the *Contract Documents*, the *Contractor* is responsible to consult with and/or obtain any approvals required from all outside agencies including but not limited to BC Hydro, Telus, Fortis BC, etc. in the area of the place of *Work*.

The *Contractor* is responsible to verify the depth of all outside agency utilities by hand digging or by Hydro-Vac in the presence of the Utility Inspector in areas where utility crossings or conflicts are indicated by the agency utilities, *Contract Administrator*, or *Contract Drawings*.

SG 21.0 Workers Compensation Regulations

SG 21.1 ***(Delete Clauses 21.1.1 to 21.1.2 and replace as follows)***

SG 21.1.1 The Contractor will comply with the Worker's Compensation Act and in particular will obtain and maintain during the term of the Contract the necessary coverage for the Proponent's employees and sub consultants. Prior to receiving any payment, the Consultant may be required to submit a Worksafe BC Clearance Letter indicating that all Worksafe BC assessments have been paid.

SG 21.2 ***(Delete Clause 21.2.1 and replace as follows)***

SGC 21.2.1 The proponent will be assigned Prime Contractor status and will be subject to Worksafe BC Prime Contractor requirements.

SG 24.0 Insurance

SG 24.1 ***(Delete Clauses 24.1.1 to 24.1.6 and replace as follows)***

SG 24.1.1 The Contractor will, without limiting its obligations or liabilities and at its own expense, provide and maintain throughout the Contract term, Comprehensive, General Liability Insurance in the amount not less than \$3,000,000.00 inclusive per occurrence insuring against bodily injury, personal injury and property damage and including liability assumed under Contract in the forms and amounts acceptable to the District of Port Hardy. All required insurance shall be endorsed to provide the District of Port Hardy with 30 days advance written notice of cancellation or material change. The Policy shall provide an endorsement including the District of Port Hardy, and Stantec Consulting Ltd. as an additional insured.

SG 24.1.2 The Contractor will at the Contractor's expense, carry with an insurance company or companies and under policies of insurance acceptable to and approved by the Owner Automotive Liability Insurance (Owned and Non-Owned Units) Limits: Bodily Injury and Property Damage – inclusive each accident \$3,000,000.

The Contractor shall, at the Contractors expense, throughout the term of the Contract, maintain such insurance as required under the Insurance (Motor Vehicle) Act of British Columbia.

SG 24.1.3 The Contractor will provide the District of Port Hardy with evidence of the required insurance, in the form of a completed Certificate of Insurance, immediately following execution and delivery of a Contract.

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RESERVOIR DRAWINGS LIST

Sheet Number Sheet Title

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C305	FORT RUPERT RESERVOIR PROCESS PIPING LAYOUT, SECTIONS AND TANK DETAILS
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S001	FORT RUPERT RESERVOIR GENERAL STRUCTURAL NOTES
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E001	FORT RUPERT RESERVOIR AND REPLACEMENT WATER TREATMENT RESERVOIR ELECTRICAL LEGEND, SYMBOLS, ABBREVIATIONS AND NOTES
E101	REPLACEMENT WATER TREATMENT RESERVOIR ELECTRICAL SITE PLAN
E201	FORT RUPERT RESERVOIR ELECTRICAL SITE PLAN AND BUILDING LAYOUTS
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EI101	FORT RUPERT RESERVOIR PROCESS LEGEND, SYMBOLS AND ABBREVIATION
EI201	FORT RUPERT RESERVOIR PROCESS FLOW DIAGRAM
EI202	FORT RUPERT RESERVOIR INSTRUMENTATION CONTROL PANEL LAYOUT
EI203	FORT RUPERT RESERVOIR INSTRUMENTATION CONTROL PANEL POWER DIAGRAM
EI204	FORT RUPERT RESERVOIR INSTRUMENTATION CONTROL SCHEMATIC DIAGRAM
EI205	FORT RUPERT RESERVOIR INSTRUMENTATION CONTROL SCHEMATIC DIAGRAM

DIVISION 01

GENERAL REQUIREMENTS

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern.

1.0 GENERAL

.1 The following subject matter is generally used to formulate this Section:

- .1 Work Covered by Contract Documents
- .2 Contract Method
- .3 Work Sequence
- .4 Contractor Use of Premises
- .5 Occupancy Requirements

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- .1 All work called for in these Contract Documents, shown on the drawings or which is necessary for the completion of the Work called for in these Contract Documents and which is not specifically listed as a separate item in the Form of Tender is deemed to be incidental to the performance of the Work and to the general purpose of the Contract: no separate payment will be made on account of any such Work, but the cost of any such incidental Work shall be included in the Contract Price.
- .2 All work shall be performed in accordance with the Master Municipal Construction Documents Association Platinum Edition Vol II, Ministry of Transportation Permit, which will be provided during tender, and these Contract Documents.
- .3 The Work includes but is not limited to the following:
 - .1 The supply and installation of approximately 3.3 km of new C900 PVC DR18 (Pressure Class 235) Pipe (300mm and 350mm) complete with restraints, supply and installation of appropriate piping for reconnections, appurtenances, associated restoration, and new fire hydrants. Which includes:
 - .1 Combined 300 and 350mm supply and distribution mains up Fort Rupert Road to new Reservoir Site control building.
 - .2 350mm main from Fort Rupert Road east down Byng Road to the Peel Street branch main.

- .3 300mm main from Avalon School on Byng road to Fort Rupert School on Beaver Harbour Road
- .4 Various tie-in and service connections to the existing water system
- .2 Permanent Pavement and Concrete Restorations. (Provisional)
 - .1 this item (or portions of) are dependent on fair and reasonable pricing, otherwise may be taken over by the District.
- .3 Development of Fort Rupert Reservoir site. Work to include, but is not limited to: new access road, site grading, security fencing & gates, reservoir controls building & appurtenances (chlorine injection, PRV, altitude valve, SCADA, etc.), underground piping and vaults, dechlorination manhole, site power (overhead electrical and back-up generator), Stainless piping to topside of foundation slab.
- .4 Development of Water Treatment Reservoir site. Work to include, but is not limited to: demolition, and removal of existing reservoir, and subsequent site preparation including: removal of existing foundation, removal of underground piping, installation of replacement valves, and piping (Stainless to 1m outside foundation footprint, PVC elsewhere), detailed geotechnical Engineering certification report to determine replacement reservoir design requirements, and foundation subgrade preparation.

1.2 CONTRACT METHOD

- .1 Construct the Work under a Unit Price Contract. The Unit Price for each item in the Form of Tender shall include the costs of materials, transportation, taxes, labour, installation, supervision, coordination of Work, all incidental work for which separate payment is not specified elsewhere, and the contractor's overhead and profit.

1.3 WORK SEQUENCE

- .1 Construct work in stages to accommodate Owners construction milestones as indicated below:
 - .1 Construction Start: Immediately upon signing of contract.
 - .2 Disassemble and remove Water Treatment Reservoir tank and foundation and complete/submit the geotechnical engineering certification report to be used for tank design: Submission of finalized report to be no more than 4 weeks after signing of contract.
 - .1 Contract 2 depends on the submission of the geotechnical report. Contractor must meet Schedule Milestones as shown in the Form of Tender – Appendix 2.

- .3 Develop and Construct the Fort Rupert and Water Treatment Reservoir sites to proceeding with watermain.
 - .1 Contract 2 depends on a timely construction and completion of the reservoir sites. Contractor must meet Schedule Milestones as shown in the Form of Tender – Appendix 2.
- .4 Watermain works on Fort Rupert Road and Byng for Reservoir servicing.
- .5 Watermain works on Beaver Harbour Road and Byng.
- .6 Substantial Performance: 154 calendar days After Signing of Contract.
- .7 Total Performance: 168 calendar days after signing of contract.

1.4 CONTRACTOR USE OF PREMISES

- .1 The Contractor has restricted use of the site until Substantial Performance. Work in the areas is restricted to the dates outlined in 1.3 above.
- .2 Coordinate use of premises under direction of the Contract Administrator, District of Port Hardy and the Ministry of Transportation.
- .3 Assume full responsibility for protection and safe keeping of products and materials under this contract.
- .4 Obtain and pay for use of additional storage for operations under this contract.

1.5 OCCUPANCY REQUIREMENTS

- .1 Owner will require access to the site to accommodate ongoing operation and maintenance to the existing water system.
- .2 Cooperate with Owner in scheduling operations to minimize conflict.
- .3 Schedule and complete designated portions of work prior to substantial performance of the entire work.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern.

1.0 GENERAL

1.1 COMMON MEASUREMENT AND PAYMENT

- .1 Payments will be made on the basis of the lump sum prices bid and the unit prices bid in the Tender, and in accordance with the General Conditions of the Contract or the specifications.
- .2 The prices bid for various items of work, unless specifically noted otherwise, shall include the costs of materials, transportation, taxes, testing, labour, plant, installation, supervision, contractor's overhead and profit, coordination of work, and products and equipment necessary to construct the work in accordance with the specifications and drawings, as well as all incidental work for which separate payment is not specified elsewhere.
- .3 Connection to water live sources will be completed by the Contractor under supervision of District forces. The Contractor will coordinate the connection with the District a minimum of 14 calendar days prior to completing the connection.
- .4 The prices bid for supply and installation shall be full compensation for supplying, hauling, installing, cleaning, testing, and placing in service together with all other work subsidiary including hydroelectric costs prior to turnover (substantial completion) to the District and incidental thereto for which separate payment is not provided elsewhere.
- .5 The method of measurement of the quantities for payment and the basis for payment will be in accordance with the following items of this section. All measurements will be done by the Contractor using generally accepted field survey methods. Grid interval for volume calculations shall not exceed 1.0 m. Contractor to submit quantities calculated in excel and pdf format.
- .6 Other materials on site, whether existing structures, vegetation, topsoil, gravel, sand or other excavated of pile materials, are the property of the Owner or of the owner of the land on which the work is located. Only those materials specifically noted in the specification or on drawings as belonging to the Contractor shall become the Contractor's property.
- .7 Where there are excess excavated materials, unsuitable materials excavated or materials of any kind that are excavated but not used the work, such materials are not

the property of the Contractor unless authorized in writing by the Engineer or specified to be disposed of by the Contractor.

- .8 Payment for Unit Rate items will be based on the actual quantity measured in the field that do not exceed design intent. No payment for unit rate cost sums shall be made unless authorized in writing by the Engineer prior to the commencement of the work. The Contractor shall have no claim for loss of profit or loss of anticipated revenue from this item. There will be no re-negotiation for revising the Unit Cost and / or the Provisional Work Item Unit Rate cost irrespective of variation plus or minus the quoted quantity. The Contractors quoted price will be held firm irrespective of the final quantity.

1.2 TRAFFIC CONTROL AND TEMPORARY WORKS

- .1 Traffic Control and Temporary Works shall include preparation and submission of a Traffic Management Plan acceptable to the Owner, MoTI, and the Owner's Representative. Works shall include permits and notification of agencies of lane closures and detours, supply of flag persons, temporary signs and traffic signals, barriers, temporary surfacing and paving, pavement markings, etc., and all incidental work to provide safe traffic control through the project areas and to maintain the minimum traffic lanes, on all stretches of the roadways at all times during the construction period.

1.3 SITE PREPARATION

- .1 The Contractor is responsible for site preparation to the neat lines of the design documents including necessary excavations and backfills for footing, retaining wall, and access roadway construction within the limits identified by the contract documents. The Contractor will bear the cost associated with excavation and backfills required for roadways and footing construction that may be required as an addition to the neat lines of the construction documents.

1.4 TEMPORARY POWER

- .1 Fort Rupert Reservoir site: The closest power connection for temporary power is on Fort Rupert Road. The contractor will be responsible for providing temporary power to the site by which ever means are preferred by the Contractor. Coordination with BC Hydro and the District of Port Hardy will be the responsibility of the contractor including all incurred costs for coordination, connections, and / or supply of a temporary power device.
- .2 Water Treatment Reservoir site: The closest power connection for temporary power is at the utility pole near the reservoir locations. The contractor will be responsible for providing temporary power to the site by which ever means are preferred by the Contractor. Coordination with the District of Port Hardy (and BC Hydro if required) will be

the responsibility of the contractor including all incurred costs for coordination, connections, and / or supply of a temporary power device.

1.5 ALL OTHER WORK

- .1 All other work includes all work not covered by the associated measurement and payment and unit rate items but is included and required on the contract documents (drawings) and for all incidental work for which payment is not specified elsewhere.

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1.0 GENERAL

- .1 SS Section 01 01 01 refers to specific portions of the work not addressed elsewhere within the specifications. Section includes Mobilization and Demobilization.

1.1 MEASUREMENT AND PAYMENT

- .1 Mobilization and demobilization shall include the *Contractor's* costs of mobilization at the beginning of the project; and the costs of demobilization at the end of the project.
- .2 Included in mobilization are such items as bonding, insurance, permits, moving personnel, materials and equipment to the site, setting up temporary facilities and all preparation for performing the *Work*.
- .3 Included in demobilization are preparation and submission of operation and maintenance manuals, removal of all personnel, materials and equipment, and cleanup of the site and the *Work*.
- .4 The lump sum price bid for this work shall be relative to the costs involved but **shall not exceed ten percent (5%) of the Total Price (excluding GST)**.
- .5 Payment will be made as follows, as approved by the *Contract Administrator*.
 - .1 60% of the quotation bid will be included in the first progress payment certificate;
 - .2 40% of the quotation bid will be included in the final progress payment certificate.
 - .3 The *Contract Administrator* may at his discretion recommend partial payment if mobilization or demobilization are not complete.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

1.1 RELATED REQUIREMENTS

- .1 MMCD General Conditions 5.0 – Shop Drawings
- .2 Section 01 33 01 – Project Record Documents
- .3 Section 01 34 00 – Shop Drawings and Product Data.
- .5 Section 01 78 00 – Closeout Submittals

1.2 ADMINISTRATIVE

- .1 Work affected by submittals shall not proceed until review is complete.
- .2 Shop drawings, product data, samples and mock-ups shall be in SI Metric units. Where items or information is not produced in SI Metric units converted values are acceptable.
- .3 Review submittals prior to submission to Engineer. This review represents that necessary requirements, have been determined and verified, or will be, and that each submittal has been checked and coordinated with requirements of the Work and Contract Documents. Submittals not stamped, signed, dated by the Contractor and identified as to specific project will be returned without being examined and shall be considered rejected.
- .4 Notify Engineer in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .5 Verify field measurements and affected adjacent Work are coordinated.
- .6 Shop drawing review by the Engineer is solely to ascertain conformance with the general design concept. Contractor's responsibility for errors and omissions in submission from requirements of Contract Documents is not relieved by the Engineer's review of submittals. Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer's review.
- .7 Keep one reviewed copy of each submission on site.

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 "Shop Drawings" mean custom drawings in latest AutoCAD Release, product data, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by the Contractor to illustrate details of a portion of the Work.
- .2 Arrange for the preparation of clearly identified shop drawings as specified or as the Engineer may reasonably request. Shop drawings are to clearly indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of the Work. Where articles or equipment attach, or connect to other articles or equipment, clearly indicate that all such attachments and connections have been properly coordinated, regardless of the trade under which the adjacent articles or equipment will be supplied and installed. Shop drawings are to indicate their relationship to design drawings and specifications. Notify the Engineer in writing of any deviations in shop drawings from the requirements of the Contract Documents.
- .3 Submit shop drawings with reasonable promptness and in an orderly sequence so as to cause no delay in the Work. Failure to submit shop drawings in ample time is not to be considered sufficient reason for an extension of Contract Time and no claim for extension by reason of such default will be allowed.
- .4 The Engineer will review and return shop drawings within 5 business days in accordance with the schedule agreed upon or otherwise with reasonable promptness so as to cause no delay in the Work.
 - .1 If multiple drawings package submitted within short time span allow additional time for review, reasonable to the size of submittal(s) received.
- .5 Responsibility for verification and correlation of field dimensions, fabrication processes, techniques of construction, installation and coordination of all parts of the Work rests with the Contractor.
- .6 Shop drawings will be returned to the Contractor with one of the following notations:
 - .1 When stamped "REVIEWED", distribute additional copies as required for execution of the Work.
 - .2 When stamped "REVIEWED AS MODIFIED", ensure that all copies for use are modified and distributed, same as specified for "REVIEWED".
 - .3 When stamped "REVISE & RESUBMIT", make the necessary revisions, as indicated, consistent with the Contract Documents and submit again for review.

- .4 When stamped "NOT REVIEWED" or "REJECTED", submit other drawings, brochures, etc. for review consistent with the Contract Documents.
- .5 Only shop drawings bearing "REVIEWED", or "REVIEWED AS MODIFIED" shall be used on the Work unless otherwise authorized by the Engineer.
- .7 After submittals are stamped "REVIEWED" or "REVIEWED AS MODIFIED"; no further revisions are permitted unless re-submitted to the Engineer for further review.
 - .1 Though the contractor is not required to resubmit any REVIEWED AS MODIFIED drawings the products require the changes to be made as noted in the reviewed drawings sets.
- .8 Any adjustments made on shop drawings by the Engineer are not intended to change the Contract Price. If it is deemed that such adjustments affect the Contract Price, clearly state as such in writing prior to proceeding with fabrication and installation of work.
- .9 Make changes in shop drawings which the Engineer may require consistent with Contract Documents. When re-submitting, notify the Engineer in writing of any revisions other than those requested by the Engineer.
- .10 Shop drawings indicating design requirements not included in the Contract Documents require the seal of a qualified Professional Engineer, registered in the province of British Columbia. Design calculations shall accompany shop drawings and shall be submitted for review and sealed by a qualified Professional Engineer.

1.4 SAMPLES

- .1 Submit samples for the Engineer's review as requested or as the Engineer may reasonably request. Clearly label samples as to origin and intended use in the Work. Reference samples to drawings and specifications.
- .2 Notify the Engineer in writing, at the time of submission, of any deviations in samples from requirements of Contract Documents.
- .3 The Engineer's review will be for conformity of design concept and general arrangement only. Such review is not to be considered relief of responsibility for errors or omissions in samples or of responsibility for meeting all requirements of the Contract Documents.
- .4 Any adjustments made on samples by the Engineer are not intended to change the Contract Price. If it is deemed that such adjustments affect the Contract Price, clearly state as such in writing prior to proceeding with fabrication and installation of the Work.
- .5 Make changes in samples which the Engineer may require consistent with Contract Documents.

1.5 RECORD DRAWINGS

- .1 After award of Contract, the Engineer will provide a complete set of drawings for the purpose of maintaining project record drawings. Accurately record significant deviations from Contract Documents caused by site conditions and changes ordered by the Engineer. Update daily and keep the copy on site.
- .2 Record elevation and locations in UTM Coordinates of concealed elements of mechanical and electrical services and all underground pipework.
- .3 Identify drawings as "Project record copy." Maintain in good condition and make available for inspection on site by Engineer at all times.
- .4 On completion of the Work and prior to final inspection submit record drawings to Engineer for review. (Refer to Section 01780 –Closeout Submittals.)

1.6 MIX DESIGNS

- .1 Submit asphalt and concrete mix designs as specified in specific specification sections.

1.7 TEST REPORT

- .1 Submit material test reports for materials specified in specific specification sections.

1.8 OPERATION AND MAINTENANCE MANUALS

- .1 Provide product supplier cut sheets in digital format, written operation and maintenance procedures of all valves and fittings incorporated into the work.

1.9 SCHEDULES

- .1 Submit detailed construction schedule.

1.10 PHOTOGRAPHS AND PUBLICITY

- .1 No publication or use of photographs of the site or of any portion of the Work will be permitted without prior approval of the Owner.
- .2 No press or publicity releases will be permitted without prior approval of the Owner.

1.11 CERTIFICATES AND TRANSCRIPTS

- .1 All monthly progress claims (after the initial claim) shall be accompanied by WorkSafe BC clearance letter and Statutory Declaration that sub-contractors and suppliers have been paid for all work invoiced.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

1.1 RELATED SECTIONS

- .1 General Conditions of Contract
- .2 Section 01 01 00 – Summary of Work

1.2 DEFINITIONS

- .1 Activity: element of Work performed during course of Project. Activity normally has expected duration, and expected cost and expected resource requirements. Activities can be subdivided into tasks.
- .2 Bar Chart (GANTT Chart): graphic display of schedule-related information. In typical bar chart, activities or other Project elements are listed down left side of chart, dates are shown across top, and activity durations are shown as date-placed horizontal bars. Generally, Bar Chart should be derived from commercially available computerized project management system.
- .3 Baseline: original approved plan (for project, work package, or activity), plus or minus approved scope changes.
- .4 Construction Work Week: Monday to Friday, inclusive, will provide five (5) day work week and define schedule calendar working days as part of Bar (GANTT) Chart submission.
- .5 Construction Work outside of routine hours. Work that takes place outside of regular work periods of Monday to Friday 07:00 to 17:00 hours.
- .6 Duration: number of work periods (not including holidays or other nonworking periods) required to complete activity or other project element. Usually expressed as workdays or workweeks.
- .7 Master Plan: summary-level schedule that identifies major activities and key milestones.
- .8 Milestone: significant event in project, usually completion of major deliverable.
- .9 Project Schedule: planned dates for performing activities and the planned dates for meeting milestones. Dynamic, detailed record of tasks or activities that must be

accomplished to satisfy Project objectives. Monitoring and control process involves using Project Schedule in executing and controlling activities and is used as basis for decision making throughout project life cycle.

1.3 REQUIREMENTS

- .1 Ensure Master Plan and Detail Schedules are practical and remain within specified Contract duration.
- .2 Plan to complete Work in accordance with prescribed milestones and time frame.
- .3 Limit activity durations to maximum of approximately 10 working days, to allow for progress reporting.
- .4 It is understood that Award of Contract or time of beginning, rate of progress, Substantial Performance Certificate and Total Performance Certificate as defined times of completion are of essence of this contract.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 30 00 – Submittals.
- .2 Submit to Consultant within 14 working days of Award of Contract Bar (GANTT) Chart as Master Plan for planning, monitoring and reporting of project progress.
- .3 Submit Project Schedule to Consultant within 5 working days of receipt of acceptance of Master Plan.

1.5 MASTER PLAN

- .1 Structure schedule to allow orderly planning, organizing and execution of Work as Bar Chart (GANTT).
- .2 Consultants will review and return revised schedules within 10 working days.
- .3 Revise impractical schedule and resubmit within 5 working days.
- .4 Accepted revised schedule will become Master Plan and be used as baseline for updates.

1.6 PROJECT SCHEDULE

- .1 Develop detailed Project Schedule derived from Master Plan.
- .2 Ensure detailed Project Schedule includes as minimum milestone and activity types as follows:

- .1 Award
- .2 Shop Drawings, Samples
- .3 Permits
- .4 Mobilization
- .5 WTP disassembly & Geotechnical investigation
- .6 Excavation/Trenching
- .7 Site Servicing
- .8 Building Mechanical
- .9 Backfill/Compaction
- .10 Pavement
- .11 Building Footings
- .12 Relocated Structures
- .13 Electrical
- .14 Testing and Commissioning
- .15 Mandatory Schedule Milestones

1.7 PROJECT SCHEDULE REPORTING

- .1 Update Project Schedule on monthly basis reflecting activity changes and completions, as well as activities in progress. Submit updated schedule with payment application.
- .2 Include as part of Project Schedule, narrative report identifying Work status to date, comparing current progress to baseline, presenting current forecasts, defining problem areas, anticipated delays and impact with possible mitigation.

1.8 PROJECT MEETINGS

- .1 Discuss Project Schedule at regular site meetings, identify activities that are behind schedule and provide measures to regain slippage. Activities considered behind schedule are those with projected start or completion dates later than current approved dates shown on baseline schedule.
- .2 Weather related delays with their remedial measures will be discussed and negotiated.

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1.7 RECORDING ACTUAL SITE CONDITIONS

1.7.5 (*Add Clause 1.7.5 as follows*)

The *Contractor* shall take regular photographs of the construction from the beginning of the project through to final close out of the project. These photos shall be submitted to the *Contract Administrator* on a weekly basis.

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1.0 GENERAL

- .1 This section specifies general requirements and procedures for Contractors submissions of shop drawings, product data, samples and mock-ups to Engineer for review.
 - .1 Additional specific requirements for submissions are specified in individual sections.
 - .2 Do not proceed with work until relevant submissions are reviewed by Engineer.
 - .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 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submissions.
 - .6 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
 - .7 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer's review of submission, unless Engineer gives written acceptance of specific deviations.
 - .8 Make any changes in submissions which Engineer may require consistent with Contract Documents and resubmit as directed by Engineer.
 - .9 Notify Engineer, in writing, when resubmitting, of any revisions other than those requested by Engineer.

1.1 RELATED REQUIREMENTS

- .1 Section 01 30 00 - Submittals.

1.2 SUBMISSION REQUIREMENTS

- .1 Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.
- .2 Allow ten (10) days for Engineer's review of each submission.

- .3 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .4 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractors 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 and control diagrams.

- .9 Single line and schematic diagrams.
- .10 Relationship to adjacent work.
- .6 After Engineer's review distribute copies as required.

1.3 PRODUCT DATA

- 1.3.1 Product data: manufacturers catalogue sheets, brochures, literature, performance charts/curves and diagrams, for each product, system or piece of equipment used to illustrate standard manufactured products. Ensure that the exact model number is shown and highlighted on the shop drawings.
 - .2 Submit one (1) copy of product data. Contractor to make copies of all reviewed drawings including the review notes and stamped cover page for O&M manuals.
 - .3 Sheet size: 215 x 280 mm, maximum of three (3) modules.
 - .4 Delete information not applicable to project from all catalogue data and highlight on any tables the exact product supplied. Shop drawings will be returned "REJECTED" if it is not clearly marked on catalogue data which equipment and accessories are being supplied.
 - .5 Supplement standard information to provide details applicable to project.
 - .6 Cross-reference product data information to applicable portions of Contract Documents.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

1.1 REQUIREMENTS INCLUDED

- .1 Inspection and testing, administrative and enforcement requirements.
- .2 Testing and mix designs.
- .3 Commissioning and testing of diaphragm pump & pipe system
- .4 Geotechnical testing of backfill materials and compaction testing.

1.2 INSPECTION SERVICES

- .1 The Owner and the Engineer shall have access to the Work. If parts of the Work are in preparation at locations other than the Place of the Work, access shall be given to such work whenever it is in progress.
- .2 Give timely notice (1-week advanced notice with 2 business days (48hrs) confirmation prior) requesting inspection if Work is designated for special tests, inspections or review by Engineer's instructions, or the law of the Place of the Work.
- .3 If the Contractor covers or permits to be covered Work that has been designated for special tests, inspections or reviews before such is made, uncover such Work, have the inspections or tests satisfactorily completed and make good such Work at the Contractors expense.
- .4 The Engineer may order any part of the Work to be examined if such work is suspected to be not in accordance with the Contract Documents. If, upon examination, such work is found not in accordance with the Contract Documents, correct such work and pay the cost of examination and correction. If such Work is found in accordance with the Contract Documents, the Owner shall pay the cost of examination and replacement.

1.3 QUALITY ASSURANCE TESTING BY OWNER

- .1 Independent Inspection/Testing Agencies may be engaged by the Owner for the purpose of inspecting and/or testing portions of Work to confirm that specific requirements for materials and workmanship are being met. The Owner is not responsible for ensuring Contractors' Quality Control.

- .2 Provide equipment required for executing inspection and testing by the appointed agencies.
- .3 Employment of inspection/testing agencies does not relax the responsibility to perform Work in accordance with the Contract Documents.
- .4 If defects are revealed during inspection and/or testing, the appointed agency will request additional inspection and/or testing to ascertain full degree of defect. Correct defect and irregularities as advised by Engineer at no cost to the Owner. Pay costs for retesting and re-inspection.
- .5 Allow inspection/testing agencies access to the Work, off site manufacturing and fabrication plants.
- .6 Cooperate to provide reasonable facilities for such access.
- .7 Notify the appropriate agency and Engineer in advance of the requirement for tests, in order that attendance arrangements can be made.
 - .1 one (1) week advanced notice with two (2) business days (48hrs) confirmation prior.
- .8 Submit samples and/or materials required for testing, as specifically requested in specifications or by the Engineer. Submit test results specifying that material requirements are being met. Submit with responsible promptness and in an orderly sequence so as not to cause delay in the Work.
- .9 Provide labour and facilities to obtain and handle samples and materials on site. Provide sufficient space to store and cure test samples.

1.4 QUALITY CONTROL TESTING BY THE CONTRACTOR

- .1 The Contractor shall retain the services of an independent testing agency under supervision of a registered professional engineer, and pay the cost of testing services for quality control including, but not limited to, the following:
 - .1 Concrete mix designs.
 - .2 Concrete testing.
 - .3 Commissioning and testing of diaphragm pump and piping in accordance with Section 01 81 00 - Commissioning.
 - .4 Any product testing that is required and is specified under various sections and specifications.

- .5 Compaction testing shall be completed by the contractor at the contractors expense for quality control testing as prescribed in Section 31 23 01 Excavating, Trenching and Backfilling.
- .2 Testing shall be in accordance with pertinent codes and regulations, and with selected standards of the American Society for Testing and Materials (ASTM), Canadian Standards Association (CSA), and the Hydraulic Institute.
- .3 The Contractor shall promptly process and distribute all required copies of test reports and test information and related instructions to all of his Sub-Contractors and Suppliers to ensure that all necessary retesting and replacement of construction can proceed without delay.
- .4 The Contractor shall promptly provide the Engineer with copies of all test results.

1.5.1 REJECTED WORK

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

1.6 TESTS AND MIX DESIGNS

- .1 Furnish tests results and mix design as required by contract documents and in accordance with drawing S001-S301.
- .2 The costs of tests and mix designs beyond those called for in the Contract Documents or beyond those required by the law of the Place of Work shall be appraised by the Engineer and may be authorized as recoverable.

1.7 MOCKUPS

- .1 Prepare mock-ups for all piping, valves, fittings and pump to ensure proper and accurate fit and alignment of all components.

1.8 MILL TESTS

- .1 Submit mill tests as required, or indicated on the drawings.

1.8 COMMISSIONING AND TESTING

- .1 Refer to Sections 01 81 00 - Commissioning and 01 82 00 – Demonstration and Training for requirements.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

1.0.6 *(Add Clause 1.0.6 as follows)*

Traffic Control and Temporary Works shall include preparation and submission of a Traffic Management Plan acceptable to the *Owner* and the *Contract Administrator* and notification of agencies of lane closures and detours, supply of flag persons, temporary signs and traffic signals, barriers, temporary surfacing and paving, pavement markings, etc., and all incidental work to provide safe traffic control through the site and to maintain the minimum traffic lanes, on all stretches of the roadways at all times during the construction period. Traffic management plan is to be submitted to Contract Administrator five (5) days prior to any lane closures or detours.

1.0.7 *(Add Clause 1.0.7 as follows)*

For all work on or near Ministry roads, Traffic Management shall be in accordance with Ministry standards as set out section 321 of the 2012 Standard Specifications for Highway Construction and all subsequent interim revisions and updates.

Abide by the terms outlined by the Ministry of Transportation and Infrastructure Permit provided during tender.

1.3 TEMPORARY PARKING AREAS

1.3.1 *(Delete Clause 1.3.1 and replace as follows)*

Construction vehicles and equipment shall not be parked on public roads open to the public.

1.5 PAYMENT

1.5.1 *(Delete Clause 1.5.1 and replace as follows)*

Payment for all materials and work performed under this Section will be made at the respective unit prices bid for traffic control.

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1.6 PAYMENT

1.6.1 *(Delete Clause 1.6.1 and replace as follows)*

Payment for all materials and work performed under this Section will be made at the respective lump sum bid for environmental protection.

3.0 EXECUTION

3.0 *(Delete clause 3.0 and replace as follows)*

Environmental Management Plan and Erosion and Silt Control shall include completion and submission of the Environmental Management Plan acceptable the Owner and the Owner's Representative, compliance with the all requirements of the Environmental Management Plan including erosion and silt control, and all incidental work.

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1.0 GENERAL

1.1 REFERENCES

- .1 If there is question as to whether products or systems are in conformance with applicable standards, Consultant reserves right to have such products or systems tested to prove or disprove conformance.
 - .1 Cost for such testing will be borne by Owner in event of conformance with Contract Documents or by Contractor in event of non-conformance.

1.2 QUALITY

- .1 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.
- .2 Defective products, whenever identified prior to completion of Work, will be rejected, regardless of previous inspections. Inspection does not relieve responsibility. Contractor to remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
- .3 Should disputes arise as to quality or fitness of products, decision rests strictly with Consultant based upon requirements of Contract Documents.
- .4 Unless otherwise indicated in specifications, maintain uniformity of manufacture for any particular or like item throughout building.
- .5 Permanent labels, trademarks and nameplates on products are not acceptable in prominent locations, except where required for operating instructions, or when located on mechanical or electrical equipment.

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 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 Consultant at commencement of Work and should it subsequently appear that Work may be delayed for such reason, 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, and lumber 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 Consultant.
- .9 Touch-up damaged factory finished surfaces to Consultant's satisfaction. Use touch-up materials under direction of manufacturer 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 in writing, of conflicts between specifications and manufacturer's instructions, so that Consultant will establish course of action.
- .3 Improper installation or erection of products, due to failure in complying with these requirements, authorizes 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 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 reserves right to require dismissal from site, workers deemed incompetent or careless.
- .3 Decisions as to standard or fitness of Quality of Work in cases of dispute rest solely with 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 REMEDIAL WORK

- .1 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.
- .2 Perform remedial work by specialists familiar with materials affected. Perform in a manner to neither damage nor put at risk any portion of Work.
- .3 Cost of Remedial Work to be borne by Contractor.

1.10 LOCATION OF FIXTURES

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

1.11 PROTECTION OF WORK IN PROGRESS

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

1.12 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 other lease holders.
- .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.

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1.0 GENERAL

1.1 RELATED REQUIREMENTS

- .1 Section 01 78 00 – Closeout Submittals
- .2 Section 01 73 00 - Operating/Maintenance Data.
- .3 General Conditions of the Contract: fiscal provisions, legal submittals and other administrative requirements.

1.2 INSPECTION AND DECLARATION

- .1 Contractor's Inspection: Contractor and all Subcontractors shall conduct an inspection of Work, identify deficiencies and defects, and repair as required to conform to Contract Documents.
 - .1 Notify Engineer in writing of satisfactory completion of Contractor's Inspection and that corrections have been made.
 - .2 Request Engineer's Inspection.
- .2 Engineer and Contractor will perform inspection of Work to identify obvious defects or deficiencies. Contractor shall correct Work accordingly.
- .3 Completion: submit written certificate that following have been performed:
 - .1 Work has been completed and inspected for compliance with Contract Documents.
 - .2 Defects have been corrected and deficiencies have been completed.
 - .3 Equipment and systems have been tested, adjusted and balanced and are fully operational.
 - .4 Certificates required by Boiler Inspection Branch, Fire Commissioner and Utility companies have been submitted.
 - .5 Operations of systems have been demonstrated to Owner's personnel.
 - .6 Work is complete and ready for Final Inspection.

- .4 Final Inspection: when items noted above are completed, request final inspection of Work by Engineer and Contractor. If Work is deemed incomplete by Engineer complete outstanding items and request re-inspection.
- .5 Declaration of Substantial Performance: when Engineer considers deficiencies and defects have been corrected and it appears requirements of Contract have been substantially performed, make application for certificate of Substantial Performance.
- .6 When Engineer concurs that the Work has been Substantially Performed, he will:
 - .1 Verify that the Contractor demonstrates seven (7) consecutive days of faultless operation. Substantial performance will not be reached unless this is met.
 - .2 Prepare a Certificate of Substantial Performance accompanied by the list of items to be completed or corrected.
 - .3 Submit the Certificate to the Owner and Contractor for their written acceptance of the responsibilities assigned to them as described in the General Conditions.
- .7 At time of Certificate of Substantial Performance, Contractor shall submit the following:
 - .1 Guarantees and Warranties required by associated engineering specifications and standard drawings.
 - .2 Operating and Maintenance Data Manuals.
 - .3 Project Record Documents.
- .8 Commencement of Lien and Warranty Periods: date of Engineer's acceptance of submitted declaration of Substantial Performance shall be date for commencement for warranty period and commencement of lien period unless required otherwise by lien statute of Place of Work.
- .9 Final Payment: When Engineer considers final deficiencies and defects have been corrected and it appears requirements of Contract have been totally performed, make application for final payment. If Work is deemed incomplete by Engineer, complete outstanding items and request re-inspection.
- .10 Payment of Holdback: After issuance of certificate of Substantial Performance of Work, submit an application for payment of holdback amount.

1.3 FINAL CLEANING

- .1 When the Work is Substantially Performed, remove surplus products, tools, construction machinery and equipment not required for the performance of the remaining Work.

- .2 Remove waste products and debris and leave the Work clean and suitable for occupancy by Owner.
- .3 When the Work is Totally Performed, remove surplus products, tools, construction machinery, equipment, waste products and debris.
- .4 Leave the Work broom clean before the final inspection process commences.
- .5 Remove dirt and other disfigurations from exterior surfaces.

1.4 SYSTEM DEMONSTRATION

- .1 The Contractor demonstrates seven (7) consecutive days of faultless operation.
- .2 Prior to final inspection demonstrate operation of system to Owner and Engineer.
- .3 Instruct personnel in operation, adjustment, and maintenance of equipment and systems, using provided operation and maintenance data as the basis for instruction.

1.5 DOCUMENTS

- .1 Collect reviewed submittals and assemble documents executed by Subcontractors, suppliers and Manufacturers.
- .2 Submit material prior to final Application for Payment.
- .3 Provide warranties and bonds fully executed and notarized.
- .4 Execute transition of Performance and Labour and Materials Payment Bond to warranty period requirements.
- .5 Submit a final statement of accounting giving total adjusted Contract Sum, previous payments and monies remaining due.
- .6 Engineer will issue a final charge order reflecting approved adjustments to Contract Sum not previously made.

1.6 REMOVAL OF TEMPORARY FACILITIES

- .1 Prior to application for Certificate of Substantial Performance remove all temporary construction facilities, and all other items used to aid the performance of the Work. Make good surfaces.

1.7 PROJECT COMMISSIONING

- .1 Expedite and complete deficiencies and defects identified by the Engineer.

- .2 Submit required documentation such as statutory declarations, Workers' Compensation Certificates, certificates of approval or acceptance from regulating bodies.
- .3 Review inspection and testing reports to verify conformance to the intent of the documents and that changes, repairs or replacements have been completed.
- .4 Review maintenance manual contents (operating, maintenance instructions, record "as-built" drawings, spare parts, materials) for completeness.
- .5 Attend "end-of-work" testing and break-in or start-up demonstrations.
- .6 Meet with other Engineers to co-ordinate completion and testing approvals.
- .7 Review condition of equipment, which have been used in the course of the work to ensure turning over a completion is in "as new condition" with warranties dated and certified from time of Substantial Performance of the Work.
- .8 Arrange and coordinate instructions of Owner's staff in care, maintenance and operation of systems.
- .9 When partial occupancy of uncompleted project is required by the Owner, coordinate Owner's uses, requirements, access, with Contractor's requirements to complete the Project.
- .10 Provide on-going review, inspection and attendance to building call-back, maintenance and repair problems during the Warranty periods.

1.8 INSPECTION/TAKEOVER PROCEDURES

- .1 Prior to application for certificate of Substantial Performance, carefully inspect the Work and ensure it is complete, that major and minor construction deficiencies are complete and/or corrected. Notify the Engineer in writing, of satisfactory completion of the Work and request a final inspection.
- .2 Broom clean and vacuum floor of control building. Remove all dust, grit, dirt from pump and piping and touch up damaged paint on all components.
- .3 During the final inspection, a list of deficiencies and defects will be tabulated. Correct same.
- .4 When the Engineer considers deficiencies and defects have been corrected and it appears all requirements of the Contract have been performed, make application for final payment.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

- .1 Compile product data and related information as specified in each section appropriate for the Owner's maintenance and operation of products furnished under the Contract using the standard template for O&M manuals.
- .2 Prepare operating and maintenance data as specified in this Section, and as referenced in other pertinent Sections of the Specifications.
- .3 Instruct Owner's personnel in the maintenance of products and in the operation of equipment and systems.
- .4 Refer to General Conditions re: holdback until complete compliance with the performance of the Work of this Section.
- .5 Submit two sets of operating and maintenance manuals for all equipment, valves, and fittings described herein or as requested by the contract. Include descriptive and technical data, all shop drawings, operating procedures, routine and preventative maintenance, wiring diagrams, spare parts lists, warranties, service companies, suppliers for replacement parts, test results, fire alarm certificate of verification, electrical inspection authority certificate and contract guarantee.
 - .1 Additionally Contractor to provide electronic copy in Word format. Capable of being edited for future work.

1.1 QUALITY ASSURANCE

- .1 Preparation of data shall be done by personnel:
 - .1 Trained and experienced with knowledge in maintenance and operation of the described products.
 - .2 Completely familiar with requirements of the Section.
 - .3 Skilled as a technical writer to the extent required to communicate essential data.
 - .4 Skilled as a draftsman competent to prepare required drawings.

1.2 FORM OF SUBMITTALS

- .1 Prepare data in the form of an instructional manual for use for Owner's personnel.
- .2 In the format required by the standard template for O&M manuals.
- .3 Submit two (2) complete copies for review. Once Owners comments have been incorporated, provide two (2) complete copies and an electronic copy. Provide the electronic copy in MS Word format and sections, such as, manufacturer's information may be in PDF format. O&M shall include "As-Constructed" drawings of the completed works provided in AutoCAD and PDF format complete with plot style table (CTB file), a DWF file(s) containing all drawings and a reproducible copy to NAD83 UTM coordinates.
- .4 Format:
 - .1 Each system shall be bound in a separate binder.
 - .2 Size: 215 mm x 280 mm
 - .3 Cover: Identifying each volume with types of printed title "OPERATING AND MAINTENANCE INSTRUCTIONS".
 - .4 List:
 - .1 Title of Project
 - .2 Identity of general subject matter covered in the manual
 - .5 Binders:
 - .1 Two D-Ring binders with clear view pockets on front and side for each manual.
 - .2 Binders to fit 215 mm x 280 mm size paper.
 - .3 When multiple binders are used, correlate the data into related consistent groupings.

1.3 CONTENT OF MANUAL

- .1 Neatly typewritten table of contents for each volume, arranged in systematic order where applicable following specification format.
 - .1 Contractor, name of responsible principal, address and telephone number.
 - .2 Names of subcontractors and suppliers.

- .3 A list of each product required to be included, indexed to the content and the volume. Relate Index and Contents to sequence of the 16-Division Master Format.
- .2 Include only those product data sheets pertinent to the specific product. On each sheet clearly identify the data applicable to the installation, or delete inapplicable references.
- .3 Include the following information plus data specified:
 - .1 List all equipment which will require regular inspections and servicing.
 - .2 Maintenance instructions for all equipment and materials.
- .4 Drawings: do not use Project Record Drawings as Maintenance Drawings.
- .5 Adjusting tools, keys, spare parts: necessary adjusting tools, wrenches, brushes, keys, spares and the like as stipulated shall be provided at no additional cost to the Owner.
- .6 Equipment and Systems:
 - .1 Each Item of Equipment and Each System: include description of unit or system, and component parts;
 - .2 Panelboard 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 routing normal operating instructions and sequences. Include registration, control, stopping, shut-down and emergency instructions. Include any special operating instruction;
 - .5 Maintenance Requirements: include routine procedures and guide for troubleshooting, disassembly, repair and reassemble instructions; and alignment, adjusting, balancing and checking instructions;
 - .6 Provide servicing and lubrication schedule, and list of lubricants required;
 - .7 Include manufacturers 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 coordination drawings, with installed colour code piping diagrams;
 - .12 Provide list of original manufacturer's spare parts, current price and recommended quantities to be maintained in storage;
 - .13 Include test reports as specified in Section 014000 – Quality Control or other sections;
 - .14 Additional Requirements: as specified in individual specification sections.
- .7 Warranties and Bonds
- .1 Compile specified warranties and bonds;
 - .2 Co-execute warranty submittals when so specified;
 - .3 Review submittals to verify compliance with Contract Documents;
 - .4 Submit to Engineer for review and onward transmittal to the Owner;
 - .5 Assemble warranties, bonds and service and maintenance contracts, executed by each of the respective manufacturers, suppliers and subcontractors;
 - .6 Number of original copies required: one (1) each.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

1.1 INTENT

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

1.2 RELATED WORK

- .1 Section 01 30 00 – Submittals
- .2 Section 01 33 01 – Project Record Documents
- .3 Section 01 34 00 - Shop Drawings and Product Data
- .4 Section 01 40 00 - Quality Control
- .5 Section 01 70 00 - Contract Closeout
- .6 Section 01 73 00 - Operating and Maintenance Data
- .7 Section 01 81 00 - Commissioning
- .8 Section 01 82 00 - Demonstration and Training

1.3 SUBMISSION

- .1 Prepare instructions and data by personnel experienced in maintenance and operation of described products.
- .2 Copy will be returned after final inspection, with Engineer's comments.

- .3 Revise content of documents as required prior to final submittal.
- .4 Two weeks prior to Substantial Performance of the Work, submit to the Engineer, a draft copy of the operating and maintenance manuals in English. The draft operating and maintenance manual will be reviewed and commented on by the Owner and the Contractor shall complete the manual as directed and submit three copies as final.
- .5 Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work.
- .6 If requested, furnish evidence as to type, source and quality of products provided.
- .7 Defective products will be rejected, regardless of previous inspections. Replace products at own expense.
- .8 Pay costs of transportation.

1.4 FORMAT

- .1 Organize data in the form of an instructional manual in the format required by the standard template for O&M manuals.
- .2 Binders: two D-Ring binders with clear view pockets on front and side for each manual.
- .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 flyleaf for each separate product and system, with typed description of product and major component parts of equipment. Do not overload binder.
- .7 Text: Manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

1.5 CONTENTS - EACH VOLUME

- .1 Table of Contents:

- .1 Provide title of project;
 - .2 Date of submission; names,
 - .3 Addresses, and telephone numbers of Engineer and Contractor and SubContractors with name and phone numbers of responsible parties;
 - .4 Schedule of products and systems, indexed to content of volume.
- .2 For each product, system, or installed piece of equipment:
- .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
 - .2 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; **delete inapplicable information**.
 - .3 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - .4 Typewritten Text: provide information on the installation operation and maintenance of each product, system or piece of equipment as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
 - .5 Training: Refer to Section 018200 - Demonstration and Training.

1.6 RECORD DOCUMENTS AND SAMPLES

- .1 In addition to requirements in General Conditions and specifications, maintain at the site for the Engineer, one record copy of:
 - .1 Contract Drawings. With updated mark ups.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.

- .2 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 Engineer.

1.7 RECORDING ACTUAL SITE CONDITIONS

- .1 Record information on set of blue line opaque drawings, and in copy of Project Drawings, provided by Engineer.
- .2 Provide 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. Legibly mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.
 - .4 Field changes of dimension and detail.
 - .5 Changes made by change orders.
 - .6 Details not on original Contract Drawings.
 - .7 References to related shop drawings and modifications.
- .5 Specifications: legibly mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.

.2 Changes made by Addenda and change orders.

.6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.

1.8 EQUIPMENT AND SYSTEMS

.1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with Engineer's data and tests, and complete nomenclature and commercial number of replacement parts.

.2 Include installed colour-coded wiring diagrams.

.3 Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instruction. Include summer, winter, and any special operating instructions.

.4 Maintenance Requirements: Include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

.5 Provide servicing and lubrication schedule, and list of lubricants required.

.6 Include manufacturer's printed operation and maintenance instructions.

.7 Include sequence of operation by controls manufacturer.

.8 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

.9 Provide installed control diagrams by controls manufacturer.

1.9 WARRANTIES AND BONDS

.1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.

.2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.

.3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.

.4 Except for items put into use with Engineer's permission; leave date of beginning of time of warranty until the Date of Substantial Performance is determined.

- .5 Verify that documents are in proper form, contain full information, and are notarized.
- .6 Co-execute submittals when required.
- .7 Retain warranties and bonds until time specified for submittal.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

- .1 Includes general requirements for commissioning facilities and facility systems.

1.1 RELATED WORK

- .1 Section 01 40 00 - Quality Control
- .2 Section 01 73 00 - Operating and Maintenance Data
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 01 82 00 - Demonstration and Training
- .5 Section 11 41 50 - Pipes, Valves and Fittings

1.2 QUALITY ASSURANCE

- .1 Engage the services of specialized personnel to conduct commissioning and testing as specified by other sections.
- .2 Comply with applicable procedures and standards of the certification sponsoring association.
- .3 Perform services under direction of supervisor qualified under certification requirements of sponsoring association.

1.3 SUBMITTALS

- .1 Prior to start of Work, submit name of organization proposed to perform commissioning and testing services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.
- .2 Submit documentation to confirm organization personnel compliance with quality assurance provision.
- .3 Fifteen days prior to Substantial Performance, submit "Commissioning Plan" together with three (3) copies of final reports on applicable forms.
- .4 Submit three (3) preliminary specimen copies of each of report forms proposed for use.

1.4 PROCEDURES - GENERAL

- .1 Comply with procedural standards of certifying association under whose standard services will be performed.
- .2 Notify Engineer 7 days prior to beginning of operations.
- .3 Accurately record data for each step.
- .4 Report to Engineer any deficiencies or defects noted during performance of services.
- .5 The commissioning period shall be 14 days during which time the complete system will be continuously operated satisfactorily without fault. Contractor shall rectify any faults which occur during the commissioning period and restart the commissioning period.
- .6 During the commissioning period, the Contractor shall monitor all systems for vibration, overloading, overheating and function.

1.5 FINAL REPORTS

- .1 Organization providing commissioning and testing services to provide reports.
- .2 Ensure each form bears signature of recorder, and that of supervisor of reporting organization.
- .3 Identify each instrument used, and latest date of calibration of each.

1.6 CONTRACTOR RESPONSIBILITIES

- .1 Prepare each product, piece of equipment and system for testing.
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

1.7 PREPARATION

- .1 Provide instruments required for testing, adjusting, and balancing operations.
- .2 Make instruments available to Engineer to facilitate spot checks during testing.
- .3 Retain possession of instruments and remove at completion of services.

- .4 Verify systems installation is complete and in continuous operation.
- .5 Verify equipment such as computers, and electronic equipment are in full operation.

1.8 SYSTEMS REQUIRING COMMISSIONING (TESTING)

- .1 The objective of the commissioning process is to bring the mechanical, electrical and other systems and components from a state of static completion to a state of dynamic operation.
- .2 Verify conformance to contract requirements.
- .3 Confirm the installations fully function in accordance with all specifications and defined operational requirements.
- .4 Fully train and equip the owner's personnel to operate, maintain and troubleshoot the systems.
- .5 Provide a detailed record of verification and functional performance testing of each system confirming that the observed and measured operation satisfies all required criteria.
- .6 Provide the Engineer with a written certification that the systems are constructed and are operating to meet the requirements of the design and the performance specification.
- .7 Provide the owner with a final written statement that the systems, together as a completed project, meet the requirements of the contract.
- .8 Systems requiring commissioning and testing is by no means to be considered all-encompassing are as follows:
 - .1 Piping, Valves and Fittings:
 - .1 Pressure test all piping, valves and fittings to 1034 kPa (150 psi). Pressure to be maintained for 2 hour durations with no loss of pressure.
 - .2 Electrical Components and Generator
 - .5 Flow Meter
 - .1 Check that equipment has been properly installed to AWWA and Hydraulic Institute (HI) standards and in accordance with manufacturer's recommendations
 - .2 Check operation of flow meter alarm

- .3 Check approximate flow meter calibration at zero flow and at normal pump operation

- .6 Valves
 - .1 Operate all valves. Certify that valves have been properly installed to AWWA and HI standards and lubricated in accordance with manufacturer's recommendations

- .7 Air Valves
 - .1 Prove air valve operation

- .8 Pressure Instrumentation
 - .1 Certify that equipment has been properly installed to AWWA and HI standards and in accordance with manufacturer's recommendations
 - .2 Check that all pressure gauges are working properly

- .9 Check Valves
 - .1 Certify that valves have been properly installed to AWWA standards and lubricated in accordance with manufacturers' recommendations

- .10 Receptacles/Switches
 - .1 Check type of fixture and bulbs provided to meet specifications

- .11 Pressure Reducing Valve
 - .1 Verify the operation of the pressure reducing valve at the design set point

- .12 Instrumentation
 - .1 Confirm calibration of pressure transmitters against dial gauges

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

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1.0 GENERAL

1.1 INTENT

- .1 Procedures for demonstration and instruction of equipment and systems to Engineer's and Owner's personnel.

1.2 RELATED WORK

- .1 Section 01 40 00 - Quality Control
- .2 Section 01 78 00 - Closeout Submittals
- .3 Section 01 81 00 - Commissioning
- .4 Section 33 11 01 – Waterworks
- .5 Section 11 57 00 – Chlorine Injection

1.3 DESCRIPTION

- .1 Demonstrate operation of equipment and systems to Engineer prior to date of substantial performance.

1.4 QUALITY CONTROL

- .1 Provide authorized representative to demonstrate operation of equipment and systems, instruct Owner's personnel, and provide written report that demonstration and instructions have been completed.

1.5 SUBMITTALS

- .1 Submit schedule of time and date for demonstration of each item of equipment and each system one week prior to designated dates, for Engineer's approval.
- .2 Submit reports within one week after completion of demonstration, that demonstration and instructions have been satisfactorily completed.
- .3 Give time and date of each demonstration, with list of persons present.

1.6 CONDITIONS FOR DEMONSTRATIONS

- .1 Equipment has been inspected and put into operation.
- .2 Testing, adjusting, and balancing have been performed in accordance with Section 01 81 00 - Commissioning, and equipment and systems are fully operational.
- .3 Provide copies of completed operation and maintenance manuals for use in demonstrations and instructions.

1.7 PREPARATION

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

1.8 DEMONSTRATION AND INSTRUCTIONS

- .1 Demonstration and Instruction shall be done as follows:
 - .1 Demonstrate start-up, operation, control and adjustment of each new item of equipment at agreed upon times.
 - .2 Instruct personnel in all phases of operation and maintenance using operation and maintenance manuals as the basis of instruction.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

DIVISION 07

**THERMAL AND MOISTURE
PROTECTION**

1.0 General

1.1 SECTION INCLUDES

- .1 Pre-applied membrane waterproofing below slab.
- .2 Protective covering of foundation walls.

1.2 RELATED SECTIONS

- .1 Section 013000 – Submittals
- .2 Section 016000 – Transport, Handle, Store, and Protect Products
- .3 Section 017800 – Closeout Submittals

1.3 REFERENCES

- .1 CAN/CGSB-37.2: Membrane, Elastomeric, Cold Applied.
- .2 ASTM D624 - Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
- .3 ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- .4 ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings.
- .5 ASTM D1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
- .6 ASTM D2240 - Test Method For Rubber Property - Durometer Hardness.
- .7 ASTM E96 - Test Methods For Water Vapour Transmission of Materials.
- .8 NRCA (National Roofing Contractors Association - USA) - Roofing and Waterproofing Manual.

1.4 SYSTEM DESCRIPTION

- .1 Type 2 Waterproofing System: Horizontal slab pre-applied material to prevent moisture migration to interior.

1.5 QUALITY ASSURANCE

- .1 Applicator: Company specializing in performing the work of this section with minimum 3 years experience.

- .2 Materials: Fluid applied waterproofing material shall be two part synthetic rubber based system free of isocyanates and bitumen. For each type of material required for the work of this section, provide primary materials which are the products of one manufacturer.
- .3 Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

1.6 MOCK-UP

- .1 Construct mock-up 5 sq. m vertical waterproofed panel; to represent finished work including internal and external corners, construction joints and protective cover.
- .2 Locate as appropriate for viewing and construction schedule as determined by the DCC Representative.
- .3 Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.
 - .1 Do not double-stack pallets of waterproofing material on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
 - .2 Store drainage composite or protection board flat and off the ground. Provide cover on top and all sides.
 - .3 Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.
- .2 Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
- .2 Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.

1.9 WARRANTY

- .1 Self-Adhering Sheet Membrane Waterproofing: Provide written 5 year material warranty issued by the membrane manufacturer upon completion of the work.

2.0 Products

2.1 MANUFACTURERS

- .1 Acceptable Materials/Products: Pre-Applied Waterproofing Membranes:
 - .1 Grace Preprufe 300R by Grace Construction Products;
 - .2 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

2.2 MEMBRANE COMPOUND MATERIAL

- .1 Adhesive-Coated HDPE Sheet Waterproofing

Adhesive-Coated HDPE Sheet: Preprufe 300R by Grace Construction Products. Sheet shall be 1.2-mm thick, uniform, flexible sheets consisting of 0.76-mm thick, HDPE sheet coated with a pressure-sensitive rubber adhesive, a protective adhesive coating, a detackifying surface treatment, an uncoated self-adhering side lap strip, and a release liner with the following physical properties:

- .1 Lateral Water Migration Resistance: Pass at 71 m (231 ft) of hydrostatic head pressure, ASTM D 5385 Modified
- .2 Tensile Strength, Film: 27.6 MPa ASTM D412.
- .3 Low-Temperature Flexibility: Pass at minus 23 C ASTM D1970.
- .4 Peel Adhesion to Concrete: 875 N/m ASTM D903, modified.
- .5 Lap Adhesion: 440 N/m ASTM D1876, modified.
- .6 Hydrostatic-Head Resistance: 70 m ASTM D5385, modified.
- .7 Puncture Resistance: 990 N (221 lbs), ASTM E154
- .8 Vapor Permeance: 0.6 ng/Pa x s x sq.m ASTM E96, Water Method.
- .9 Water Absorption: 0.5 percent; ASTM D570.

2.3 ACCESSORIES

- .1 General: Furnish auxiliary materials recommended by waterproofing manufacturer for intended use and compatible with sheet waterproofing.
- .2 Liquid Membrane: Elastomeric, two-component liquid, cold fluid applied, trowel grade or low viscosity. Provide Bituthene Liquid Membrane by Grace Construction Products.
- .3 Mastic, Adhesives, and Tape: Liquid mastic and adhesives, and adhesive tapes recommended by waterproofing manufacturer.

- .1 Detail Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 100 mm wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side. Provide Preprufe Tape by Grace Construction Products.
- .2 Joint Tape: Two-sided, pressure-sensitive, self-adhering reinforced tape, 200 mm wide, with a tack-free protective adhesive coating on one side and release film on self-adhering side. Provide Preprufe CJ Tape by Grace Construction Products.
- .3 Tieback Covers: Prefabricated ABS plastic covers with waterproof flexible membrane covering as recommended by waterproofing manufacturer for sealing tie back anchors in soil retention systems. Provide Preprufe Tie-Back Covers by Grace Construction Products.
- .4 Sealing Strip: Double sided waterproofing sealing strip of flexible polyethylene coated on both sides with rubberized asphalt and used as detailing aid and bedding strip for externally placed waterstops. Provide Bitustik Tape by Grace Construction Products.
- .4 Waterstops: Provide active or passive waterstops recommended by waterproofing membrane manufacturer for expansion joints and additional protection at construction joints providing single source responsibility. Provide Serviseal AT 240, Servitite AT 200 and Adcor 500S PVC and hydrophilic rubber waterstops by Grace Construction Products.
- .5 Pile Head Treatment: Cementitious, non-shrink grout for re-profiling of pile heads used in conjunction with three part epoxy grout for waterproofing pile heads. Provide Preprufe Grout CEM 100 and Preprufe Grout EG 75 by Grace Construction Products.
- .6 Primer: Liquid solvent based primer recommended for substrate by manufacturer of sheet waterproofing material. Provide Bituthene Primer B1 by Grace Construction Products.
- .7 Protection Course: Robust bitumen boards comprising a hard bitumen compound coated one side with asphaltic paper and one side with printed polyethylene form. Provide Bituthene Protection Board by Grace Construction Products.

3.0 Execution

3.1 PRE-APPLIED ADHESIVE-COATED HDPE SHEET WATERPROOFING INSTALLATION

- .1 Examination: Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.
 - .1 For applications over blinding, a concrete mud-slab, compacted subgrade or vertical soil retention system, verify that compacted sub-grade or

- concrete mud-slab is dry, smooth, and sound; and ready to receive adhesive-coated HDPE sheet.
- .2 Verify that vertical soil retention systems are prepared using drainage composite, plywood, shotcrete or other approved means to achieve a uniform, sound and continuous substrate ready to receive the adhesive-coated HDPE Sheet.
 - .3 Proceed with installation only after unsatisfactory conditions have been corrected.
- .2 Installation:
- .1 Vertical Applications: Install adhesive-coated HDPE sheets according to manufacturer's written instructions. Place and secure molded-sheet drainage panels over substrate. Lap edges and ends of geotextile to maintain continuity. Install adhesive-coated HDPE sheet with HDPE face against substrate. Accurately align sheets and maintain uniform 75-mm lap widths and end laps. Overlap and seal seams and stagger and tape end laps and T-joints to ensure watertight installation. Roll seams and end laps firmly. Mechanically fasten to substrate at 0.6 m intervals centered in the self-adhesive selvedge prior to making the side lap. If the membrane is installed in vertical lifts and will tie into subsequent sheets of membrane, install the upper sheet behind the lower to insure that laps shed water before taping and rolling the end laps. Securely fasten final top termination of membrane with continuous metal termination bar anchored into substrate and cover with detailing tape.
 - .2 Horizontal Applications: Install adhesive-coated HDPE sheets according to manufacturer's written instructions. Place and secure molded-sheet drainage panels over substrate. Install adhesive-coated HDPE sheet with HDPE face against substrate. Accurately align sheets and maintain uniform 75-mm lap widths and end laps. Overlap and seal seams. Overlap, stagger, and seal end laps and T-joints with detail tape to ensure watertight installation. Roll seams and end laps firmly with a heavy metal seam roller.
 - .3 Corners: Seal lapped terminations and cut edges of sheet waterproofing at inside and outside corners with detail tape.
 - .4 Seal penetrations through sheet waterproofing to provide watertight seal with prefabricated plastic covers, or detail tape patches or wraps and a liquid-membrane troweling as recommended by membrane manufacturer.
 - .5 Construction Joints: Apply 200 mm joint tape to the surface of the membrane and centered along the line of all horizontal and vertical concrete pour joints.
 - .6 Install sheet waterproofing and auxiliary materials to produce a continuous watertight tie into adjacent waterproofing.
 - .7 Repair tears, voids, and lapped seams in waterproofing not complying with requirements. Tape perimeter of damaged or nonconforming area extending 150 mm beyond repaired areas in all directions. Apply a patch of sheet waterproofing and firmly secure with detail tape.

- .8 Correct deficiencies in or remove waterproofing that does not comply with requirements; repair substrates, reapply waterproofing, and repair sheet flashings.

3.2 FIELD QUALITY CONTROL

- .1 Engage a full-time independent site representative qualified by waterproofing membrane manufacturer to inspect substrate conditions; surface preparation; membrane application, flashings, protection, and drainage components; and to furnish daily reports to DCC Representative.

3.3 PROTECTION AND CLEANING

- .1 Do not permit foot or vehicular traffic on unprotected sheet membrane.
- .2 Protect waterproofing from damage and wear during remainder of construction period.
- .3 Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.
- .4 The installer shall examine conditions of substrates and other conditions under which this work is to be performed and notify the contractor, in writing, of circumstances detrimental to the proper completion of the work. Do not proceed with work until unsatisfactory conditions are corrected.

END OF SECTION

1.0 General

1.1 SECTION INCLUDES

- .1 Fluid applied two component synthetic rubber membrane waterproofing to foundation walls.
- .2 Protective covering.

1.2 RELATED SECTIONS

- .1 Section 071320 – Self Adhering Sheet Membrane Waterproofing

1.3 REFERENCES

- .1 CAN/CGSB-37.2: Membrane, Elastomeric, Cold Applied.
- .2 ASTM D624 - Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomer.
- .3 ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- .4 ASTM D822 - Standard Practice for Filtered Open-Flame Carbon-Arc Exposure of Paint and Related Coatings.
- .5 ASTM D1004 - Test Method for Initial Tear Resistance of Plastic Film and Sheeting.
- .6 ASTM D2240 - Test Method For Rubber Property - Durometer Hardness.
- .7 ASTM E96 - Test Methods For Water Vapour Transmission of Materials.
- .8 NRCA (National Roofing Contractors Association - USA) - Roofing and Waterproofing Manual.

1.4 SYSTEM DESCRIPTION

- .1 Type 1 Waterproofing System: Vertical foundation wall cold application fluid applied material to prevent moisture migration to interior.

1.5 QUALITY ASSURANCE

- .1 Applicator: Company specializing in performing the work of this section with minimum 3 years' experience.
- .2 Materials: Fluid applied waterproofing material shall be two part synthetic rubber based system free of isocyanates and bitumen. For each type of material

required for the work of this section, provide primary materials which are the products of one manufacturer.

- .3 Pre-Installation Conference: A pre-installation conference shall be held prior to commencement of field operations to establish procedures to maintain optimum working conditions and to coordinate this work with related and adjacent work. Agenda for meeting shall include review of special details and flashing.

1.6 MOCK-UP

- .1 Construct mock-up 5 q m vertical waterproofed panel; to represent finished work including internal and external corners, construction joints and protective cover.
- .2 Locate as appropriate for viewing and construction schedule as determined by the Engineer.
- .3 Mock-up may remain as part of the Work.

1.7 DELIVERY, STORAGE AND HANDLING

- .1 Deliver materials and products in labeled packages. Store and handle in strict compliance with manufacturer's instructions, recommendations and material safety data sheets. Protect from damage from sunlight, weather, excessive temperatures and construction operations. Remove damaged material from the site and dispose of in accordance with applicable regulations.
 - .1 Do not double-stack pallets of waterproofing material on the job site. Provide cover on top and all sides, allowing for adequate ventilation.
 - .2 Store drainage composite or protection board flat and off the ground. Provide cover on top and all sides.
 - .3 Protect waterproofing materials from freezing. In cool temperatures, store the material for several hours at room temperature to facilitate mixing and application.
- .2 Sequence deliveries to avoid delays, but minimize on-site storage.

1.8 ENVIRONMENTAL REQUIREMENTS

- .1 Perform work only when existing and forecasted weather conditions are within the limits established by the manufacturer of the materials and products used.
- .2 Proceed with installation only when substrate construction and preparation work is complete and in condition to receive membrane waterproofing.

1.9 WARRANTY

- .1 Fluid Applied Waterproofing Membrane: Provide written 5-year material warranty issued by the membrane manufacturer upon completion of the work.

2.0 Products

2.1 MANUFACTURERS

- .1 Acceptable Materials/Products: Fluid Applied Waterproofing Membranes:
 - .1 Procor® fluid applied membranes by Grace Construction Products;
 - .2 Other manufacturers offering products meeting or exceeding specified products and requirements may be considered.

2.2 MEMBRANE COMPOUND MATERIAL

- .1 Type 1 - Waterproofing Membrane: two part, self-curing, synthetic rubber based material; cold applied:
- .2 Waterproofing Membrane Physical Properties:

PHYSICAL PROPERTIES FOR PROCOR® FLUID APPLIED MEMBRANES:

Property	Test Method	Typical Value
Color		terra cotta
Cured Film Thickness	ASTM D 3767 Method A	1.5 mm (0.060 in.) nominal
Solids Content	ASTM D 1644	100%
Flexibility, 180° bend over 25 mm (1 in.) mandrel at 32°C (-25°F)	ASTM D 1970	Unaffected
Elongation	ASTM D 412	500% minimum
Peel Adhesion to Concrete	ASTM D 903 Modified1	880 N/m (5 lbs/in.)

Footnote:

Waterproofing membrane is applied to concrete and allowed to cure. Peel adhesion of the membrane is measured at a rate of 50 mm (2 in.) per minute with a peel angle of 90° at room temperature.

- .3 Prefabricated Drainage Composite: Hydroduct® 660 Drainage Composite by Grace Construction Products for horizontal surfaces. Hydroduct 220 Drainage Composite by Grace Construction Products for all vertical surfaces. Drainage composite shall be designed to promote positive drainage while serving as a protection course.
- .4 Waterstop: Adcor™ ES hydrophilic non-bentonite waterstop by Grace Construction Products for non-moving concrete construction joints.

2.3 ACCESSORIES

- .1 Prefabricated Drainage Composite: Hydroduct® 660 Drainage Composite by Grace Construction Products for horizontal surfaces. Hydroduct 220 Drainage Composite by Grace Construction Products for all vertical surfaces. Drainage composite shall be designed to promote positive drainage while serving as a protection course.

- .2 Waterstop: Adcor™ ES hydrophilic non-bentonite waterstop by Grace Construction

3.0 Execution

3.1 EXAMINATION

- .1 Verify substrate surfaces are free of frozen matter, dampness, loose particles, cracks, pits, projections, penetrations, or foreign matter detrimental to adhesion or application of waterproofing system.
- .2 Verify that substrate surfaces are smooth, free of honeycomb or pitting, and not detrimental to full contact bond of waterproofing materials.
- .3 Verify items which penetrate surfaces to receive waterproofing are securely installed.

3.2 PREPARATION OF SUBSTRATES

- .1 Tie-holes and “bugholes” larger than 13 mm (1/2”) in diameter or deeper than 3 mm (1/8”), or both, should be either pretreated with Procor or repaired with a lean concrete mix or Waterproofing Systems, for further details on substrate preparation.
Cracked, pitted, honeycombed or heavily bugholed surfaces can be filled by spraying from close in (10” to 12”) but high material usage with result. Under these circumstances it may be more efficient to fill the surface with a parge coat of lean mortar mix before application of the Procor. It is also acceptable to fill in gaps with a compatible sealant or caulk.
- .2 Cast-In-Place Concrete Substrates:
 - .1 Waterproofing application may commence as soon as the substrate can accept foot traffic. Surface shall be free of any visible water.
 - .2 Fill form tie rod holes with concrete and finish flush with surrounding surface.
 - .3 Repair bugholes greater than 1/2” (13 mm) in depth and 1/4” (6 mm) in diameter deep and finish flush with surrounding surface.
 - .4 Remove scaling to sound, unaffected concrete and repair exposed area.
 - .5 Grind irregular construction joints to suitable flush surface.
- .3 Related Materials: Treat joints and install flashing as recommended by waterproofing manufacturer.

3.3 INSTALLATION

- .1 Refer to manufacturer’s literature for recommendations on installation, including but not limited to, the following:

- .1 Apply minimum 1.5 mm (0.060 in.) in all areas to be waterproofed. Apply minimum 3 mm (0.120 in.) in all detail areas.
- .2 If area to be waterproofed is in direct sunlight and temperature is rising, apply "scratch coat" (a thin application of fluid applied waterproofing) prior to the full application of the waterproofing membrane.
- .3 In applications where a minimum slope of 11 mm/m (0.13 in./ft) cannot be achieved, a two coat application of Procor membrane is recommended to achieve the total thickness.
- .4 Apply protection board and related materials in accordance with manufacturer's recommendations.

3.4 CLEANING AND PROTECTION

- .1 Remove any masking materials after installation. Clean any stains on materials which would be exposed in the completed work.
- .2 Protect completed membrane waterproofing from subsequent construction activities as recommended by manufacturer.

1.0 General

1.1 SECTION INCLUDES

- .1 Sheet and sealant materials for controlling vapour diffusion.

1.2 REFERENCES

- .1 ASTM E96/E96M-05 - Test Methods for Water Vapour Transmission of Materials.
- .2 CGSB 19-GP-14M-1984 - Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .3 CAN/CGSB-19.13-M87 - Sealing Compound, One-component, Elastomeric, Chemical Curing.

1.3 DEFINITION

- .1 Vapour Retarder: A material or assembly of materials that resists water vapour diffusion through it.

1.4 SYSTEM DESCRIPTION

- .1 Materials and installation methods to provide continuity of vapour retarder:
 - .1 To seal gaps between enclosure components and opening frames.
 - .2 To seal between components not already sealed.

1.5 PERFORMANCE REQUIREMENTS

- .1 Maximum Vapour Permeability (Perm): 1 ng/S/m/pa measured in accordance with ASTM E96 Method E.

1.6 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination: Coordinate with other work having a direct bearing on work of this section.
- .2 Sequencing:
 - .1 Sequence Work to permit installation of materials in conjunction with other retardant materials and seals, and air barrier assemblies.
 - .2 Do not install vapour retarder until items penetrating it are in place.

2.0 Products

2.1 SHEET MATERIALS

- .1 Sheet Retarder Type 2: polyethylene film for slab on grade application, use 10mil polyethylene film with no reinforcing.

2.2 SEALANTS

- .1 Butyl Sealant: CGSB 19-GP-14M butyl rubber base, single component, solvent release, non-skinning:
 - .1 Elongation Capability: 5 percent.
 - .2 Service Temperature Range: -40 to 82 degrees C.
 - .3 Shore A Hardness Range: 10 to 30.
- .2 Polyurethane Sealant: CAN/CGSB-19.13, Type 1; single component, chemical curing, non-sagging:
 - .1 Elongation Capability: 25 percent.
 - .2 Service Temperature Range: -40 to 82 degrees C.
 - .3 Shore A Hardness Range: 20 to 35.
- .3 Primer: Recommended by sealant manufacturer to suit application.
- .4 Cleaner: Non-corrosive type; recommended by sealant manufacturer; compatible with adjacent materials.

2.3 ADHESIVES

- .1 Mastic Adhesive: asphalt type, compatible with sheet barrier and substrate, thick mastic of uniform consistency.
- .2 Adhesive: Compatible with sheet barrier and substrate, permanently non-curing.

2.4 ACCESSORIES

- .1 Tape: Polyethylene self-adhering type, 50 mm wide, compatible with sheet material.

3.0 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.
- .2 Verify condition of substrate and adjacent materials.

3.2 PREPARATION

- .1 Remove loose or foreign matter which might impair adhesion.
- .2 Clean and prime substrate surfaces to receive adhesive and sealants in accordance with manufacturers' written instructions.

3.3 INSTALLATION

- .1 Vapour Retarder for below slab: Lap sheet barrier from wall to wall. Overlap joints and tape. Position laps over firm bearing. Seal penetrations tight and tape.

1.0 General

1.1 SECTION INCLUDES

- .1 Preparing substrate surfaces.
- .2 Sealant and joint backing.

1.2 RELATED SECTIONS

- .1 Section 013000 – Submittals.

1.3 REFERENCES

- .1 ASTM C509-06 - Elastomeric Cellular Preformed Gasket and Sealing Material.
- .2 ASTM C834-05 - Latex Sealants.
- .3 ASTM C919-02 - Use of Sealants in Acoustical Applications.
- .4 ASTM C920-05 - Elastomeric Joint Sealants.
- .5 ASTM C1184-05 - Structural Silicone Sealants.
- .6 ASTM C1193-05a - Guide for Use of Joint Sealants.
- .7 ASTM C1311-02 - Solvent Release Sealants.
- .8 ASTM C1330-02(2007) - Cylindrical Sealant Backing for Use with Cold Liquid Applied Sealants.
- .9 ASTM E330-02 - Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- .10 CGSB 19-GP-5M-1984 - Sealing Compound, One Component, Acrylic Base, Solvent Curing.
- .11 CGSB 19-GP-14M-1984 - Sealing Compound, One Component, Butyl-Polyisobutylene Polymer Base, Solvent Curing.
- .12 CAN/CGSB-19.13-M87 - Sealing Compound, One-component, Elastomeric, Chemical Curing.
- .13 CAN/CGSB-19.17-M90 - One-Component Acrylic Emulsion Base Sealing Compound.
- .14 CAN/CGSB-19.24-M90 - Multi-component, Chemical Curing Sealing Compound.

1.4 PERFORMANCE REQUIREMENTS

- .1 Sealant Design: Design structural sealant to withstand specified loads without breakage, loss, failure of seals, product deterioration, and other defects.
- .2 Design installed sealant to withstand:
 - .1 Dead loads and live loads caused by positive and negative wind loads acting normal to plane of wall as calculated in accordance with British Columbia Building Code. as measured in accordance with ASTM E330.
 - .2 Movement from ambient temperature range of 49 degrees C.
 - .3 Movement and deflection of structural support framing.
 - .4 Water and air penetration.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Coordination:
 - .1 Coordinate with other work having a direct bearing on work of this section.
 - .2 Coordinate the work with all sections referencing this section.

1.6 SUBMITTALS FOR REVIEW

- .1 Section 013000 - Submittals.
- .2 Product Data: Provide data indicating sealant chemical characteristics, performance criteria, substrate preparation, limitations, and colour availability.
- .3 Samples: Submit two samples illustrating sealant colours for selection.

1.7 QUALITY ASSURANCE

- .1 Perform sealant application work in accordance with ASTM C1193 and ASTM C1481.
- .2 Perform structural sealant application work in accordance with ASTM C1401.
- .3 Perform acoustical sealant application work in accordance with ASTM C919.
- .4 Applicator Qualifications: Company specializing in performing the work of this section with minimum 3 years experience.

1.8 MOCK-UP

- .1 Provide mock-up to include sealant joints in conjunction with curtain wall, wall, air barrier system, and door frames.
- .2 Construct mock-up with specified sealant types and with other components noted.
- .3 Locate where directed.

- .4 Approved mock-up may remain as part of the Work.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

2.0 Products

2.1 SEALANTS

- .1 Butyl Sealant (Type A): ASTM C1311, single component, solvent release, non-skinning, non-sagging, black colour.
- .2 Acoustic Sealant (Type B): ASTM C920, Acoustic grade, single component; Grey colour.
- .3 Polyurethane Sealant (Type C): ASTM C920, Grade NS, single component, chemical curing, non-staining, non-bleeding, non-sagging self-leveling type; colour as selected.
- .4 Polyurethane Sealant (Type D): ASTM C920, multi-component, non-sagging type; colour as selected.
- .5 Silicone Sealant (Type E): ASTM C920, single component; colour as selected.

2.2 ACCESSORIES

- .1 Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- .2 Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- .3 Joint Backing: ASTM C1330; round, closed cell polyethylene foam rod; oversized 30 to 50 percent larger than joint width.
- .4 Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.
- .5 Masking tape: Non-staining, non-absorbent type compatible with sealant and adjacent surfaces.

3.0 Execution

3.1 EXAMINATION

- .1 Verify existing conditions before starting work.

- .2 Verify that substrate surfaces and joint openings are clean, dry, and free of frost and ready to receive work.
- .3 Verify that joint backing and release tapes are compatible with sealant materials.

3.2 PREPARATION

- .1 Remove loose materials and foreign matter which might impair adhesion of sealant.
- .2 Clean and prime joints in accordance with sealant manufacturer's written instructions.
- .3 Perform preparation in accordance with ASTM C1193 for solvent release and latex base sealants.
- .4 Protect elements surrounding the work of this section from damage or disfiguration.

3.3 INSTALLATION

- .1 Perform installation in accordance with ASTM C1193 for solvent release and latex base sealants, and ASTM C919 for acoustical sealants.
- .2 Measure joint dimensions and size materials to achieve required 2:1 width/depth ratios.
- .3 Install joint backing to achieve a neck dimension no greater than 1/3 of the joint width.
- .4 Install bond breaker where joint backing is not used.
- .5 Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- .6 Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- .7 Tool joints concave.

3.4 CLEANING

- .1 Clean adjacent soiled surfaces.

3.5 PROTECTION OF FINISHED WORK

- .1 Remove masking tape and excess sealant.
- .2 Protect sealants until cured.

DIVISION 08

OPENINGS

1.0 General**1.1 RELATED SECTIONS**

- .1 Section 013000 - Submittals
- .2 Section 079200 – Joint Sealants
- .3 Section 087100 – Door Hardware – General
- .4 Section 099110 - Painting

1.2 REFERENCES

- .1 American Society for Testing and Materials (ASTM International)
 - .1 ASTM A653/A653M-01a, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .2 ASTM E330 - 02 Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference
- .2 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
 - .2 CGSB 41-GP-19Ma-84, Rigid Vinyl Extrusions for Windows and Doors.
- .3 Canadian Standards Association (CSA International)
 - .1 G40.20/G40.21-98, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .2 CSA W59-M1989(R2001), Welded Steel Construction (Metal Arc Welding) (Metric Version).
- .4 Canadian Steel Door Manufacturers' Association, (CSDMA).
 - .1 CSDMA, Specifications for Commercial Steel Doors and Frames, 1990.
 - .2 CSDMA, Recommended Selection and Usage Guide for Commercial Steel Doors, 1990.
- .5 National Fire Protection Association (NFPA)
 - .1 NFPA 80-99, Standard for Fire Doors and Fire Windows.
 - .2 NFPA 252-99, Standard Methods of Fire Tests of Door Assemblies.
- .6 Underwriters' Laboratories of Canada (ULC)
 - .1 CAN4-S104-80(R1985), Fire Tests of Door Assemblies.
 - .2 CAN4-S105-85(R1992), Fire Door Frames Meeting the Performance Required by CAN4-S104.
 - .3 CAN/ULC-S704-01, Thermal Insulation, Polyurethane and Polyisocyanurate Boards, Faced.

1.3 DESIGN REQUIREMENTS

- .1 Design exterior frame assembly to accommodate to expansion and contraction when subjected to minimum and maximum surface temperature of -35°C to 35°C.
- .2 Maximum deflection for exterior steel entrance screens under wind load of 1.2 kPa not to exceed 1/175th of span.

1.4 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Section 013000 - Submittals.
- .2 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.
- .3 Indicate each type frame material, core thickness, reinforcements, glazing stops, location of anchors, exposed fastenings, reinforcing, fire rating and finishes.
- .4 Include schedule identifying each unit, with door marks and numbers relating to numbering on drawings and door schedule.
- .5 Submit test and engineering data, and installation instructions.

1.5 REQUIREMENTS

- .1 Steel fire rated doors and frames: labelled and listed by an organization accredited by Standards Council of Canada in conformance with CAN4-S104M NFPA 252 for ratings specified or indicated.
- .2 Provide fire labelled frame products for those openings requiring fire protection ratings, as scheduled. Test products in strict conformance with CAN4-S104, or 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.

2.0 Products**2.1 MATERIALS**

- .1 Hot dipped galvanized steel sheet: to ASTM 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 A653M, ZF75.

2.2 DOOR CORE MATERIALS

- .1 Honeycomb construction:
 - .1 Typical: Structural small cell, 24.5 mm maximum kraft paper 'honeycomb', weight: 36.3 kg per ream minimum, density: 16.5 kg/m³ minimum sanded to required thickness.

- .2 Stiffened:
 - .1 Typical: Face sheets laminated, insulated polyurethane core:: to CAN/ULC-S704 rigid, modified poly-isocyanurate, closed cell board. Density 32 kg/m³.
 - .3 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, or NFPA 252, covering Standard Method of Tests of Door Assemblies and listed by nationally recognized testing agency having factory inspection service.

2.3 ADHESIVES

- .1 Honeycomb cores and steel components: heat resistant, spray grade, resin reinforced neoprene/rubber (polychloroprene) based, low viscosity, contact cement.
- .2 Polystyrene and polyurethane cores: heat resistant, epoxy resin based, low viscosity, contact cement.
- .3 Lock-seam doors: fire resistant, resin reinforced polychloroprene, high viscosity, sealant/adhesive.

2.4 PRIMER

- .1 Touch-up prime CAN/CGSB-1.181.

2.5 PAINT

- .1 Field paint steel doors and frames in accordance with Section 099110 - Painting. Protect weatherstrips from paint. Provide final finish shall be free of scratches or other blemishes. Color to be provided by the District.

2.6 ACCESSORIES

- .1 Door silencers: single stud rubber/neoprene type.
- .2 Exterior and interior, 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: Metal with neoprene strip.
- .5 Metallic paste filler: to manufacturer's standard.
- .6 Fire labels: metal riveted.
- .7 Sealant: Type 8.

2.7 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: 1.6 mm welded, thermally broken type construction.
- .4 Interior frames: 1.6 mm welded type construction.
- .5 Blank, reinforce, drill and tap frames for mortised, templated hardware, and electronic hardware using templates provided by finish hardware supplier. Reinforce frames for surface mounted hardware.
- .6 Protect mortised cutouts 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.

2.8 FRAME ANCHORAGE

- .1 Provide appropriate anchorage to floor and wall construction.
- .2 Locate each wall anchor immediately above or below each hinge reinforcement on hinge jamb and directly opposite on strike jamb.
- .3 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.
- .4 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.

2.9 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.
- .7 Securely attach lead to inside of frame profile from return to jamb soffit (inclusive) on door side of frame only.

2.10 DOOR FABRICATION GENERAL

- .1 Exterior doors: hollow steel construction. Interior doors: honeycomb construction.
- .2 Fabricate doors with longitudinal edges welded. Seams: grind welded joints to a flat plane, fill with metallic paste filler and sand to a uniform smooth finish.
- .3 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.
- .4 Blank, reinforce, drill doors and tap for mortised, template hardware and electronic hardware.
- .5 Factory prepare holes 12.7 mm diameter and larger except mounting and through-bolt holes, on site, at time of hardware installation.
- .6 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.
- .7 Provide factory-applied touch-up primer at areas where zinc coating has been removed during fabrication.
- .8 Provide fire labelled doors for those openings requiring fire protection ratings, as scheduled. Test such products in strict conformance with CAN4-S104, 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.
- .9 Manufacturer's nameplates on doors are not permitted.

2.11 DOORS: HONEYCOMB CORE CONSTRUCTION

- .1 Form each face sheet for interior doors from 1.6 mm sheet steel with honeycomb or temperature rise rated core laminated under pressure to face sheets.

2.12 HOLLOW STEEL CONSTRUCTION

- .1 Form each face sheet for exterior doors from 1.6 mm sheet steel.
- .2 Form each face sheet for interior doors from 1.6 sheet steel.
- .3 Reinforce doors with vertical stiffeners, securely welded or laminated to each face sheet at 150 mm on centre maximum.
- .4 Fill voids between stiffeners of exterior doors with polyurethane core.

- .5 Fill voids between stiffeners of interior doors with honeycomb or temperature rise rated core where required.

3.0 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 Apply sealants in accordance with Section 07 92 10 - Joint Sealing.

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 087100 – Door Hardware – General.
- .2 Provide even margins between doors and jambs and doors and finished floor and thresholds as follows.
 - .1 Hinge side: 1.0 mm.
 - .2 Latchside and head: 1.5 mm.
 - .3 Finished floor, noncombustible sill and thresholds: 13 mm.
- .3 Adjust operable parts for correct function.

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.

1.0 General

1.1 RELATED SECTIONS

- .1 Section 013000 – Submittals.
- .2 Section 016000 – Transport, Handle, Store, and Protect Products.
- .3 Section 017800 - Closeout Submittals.

1.2 REFERENCES

- .1 Canadian Steel Door and Frame Manufacturers' Association (CSDFMA).
 - .1 CSDFMA Canadian Metric Guide for Steel Doors and Frames (Modular Construction): standard hardware location dimensions.
- .2 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-69.17-M86(R1993), Bored and Preassembled Locks and Latches.
 - .2 CAN/CGSB-69.18-M90, Butts and Hinges.
 - .3 CAN/CGSB-69.19-93, Exit Devices.
 - .4 CAN/CGSB-69.20-M90, Door Controls (Closers).
 - .5 CAN/CGSB-69.21-M90, Auxiliary Locks and Associated Products.
 - .6 CAN/CGSB-69.24-M90, Door Controls - Overhead Holders.
 - .7 CAN/CGSB-69.28-M90, Interconnected Locks and Latches.
 - .8 CAN/CGSB-69.29-93, Mortise Locks and Latches.
 - .9 CAN/CGSB-69.31-M89, Closer/Holder Release Device.
 - .10 CAN/CGSB-69.32-M90, Auxiliary Hardware.
 - .11 CAN/CGSB-69.33-M90, Self-closing Hinges and Pivots.
 - .12 CAN/CGSB-69.35-M89, Power Assist and Low Energy Power Operated Doors.
 - .13 CAN/CGSB-69.36-M90, Strap and Tee Hinges and Hasps.

1.3 SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and data sheet in accordance with Section 013000 – Submittals.
- .2 Samples:
 - .1 Submit samples in accordance with Section 013000 – Submittals.
 - .2 Identify each sample by label indicating applicable specification paragraph number, brand name and number, finish and hardware package number.
 - .3 After approval samples will be returned for incorporation in the Work.

- .3 Hardware List:
 - .1 Submit contract hardware list in accordance with Section 013000 – Submittals.
 - .2 Submit itemized hardware schedule prepared by a certified Architectural Hardware Consultant, including all doors listed by number in sequence and location with details of hardware supplied.
 - .3 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 017800 - Closeout Submittals.

1.4 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 Test Reports: certified test reports showing compliance with specified performance characteristics and physical properties.
- .3 Certificates: product certificates signed by manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.
- .4 Pre-installation Meetings: conduct pre-installation meeting to verify project requirements, manufacturer's installation instructions and manufacturer's warranty requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- .1 Packing, Shipping, Handling and Unloading:
 - .1 Deliver, store, handle and protect materials in accordance with Section 016000 – Transport, Handle, Store, and Protect Products.
 - .2 Package each item of hardware including fastenings, separately or in like groups of hardware, label each package as to item definition and location.
- .2 Storage and Protection:
 - .1 Store finishing hardware in locked, clean and dry area.

1.6 MAINTENANCE

- .1 Extra Materials:
 - .1 Provide maintenance materials in accordance with Section 017800 - Closeout Submittals.
 - .2 Supply two sets of wrenches for door closers locksets and fire exit hardware.

2.0 Products

2.1 HARDWARE ITEMS

- .1 Use one manufacturer's products only for similar items.

2.2 DOOR HARDWARE

- .1 Locks and latches - Typical:
 - .1 Bored and preassembled locks and latches: to CAN/CGSB-69.17.
 - .2 Interconnected locks and latches: to CAN/CGSB-69.28.
 - .3 Mortise locks and latches: to CAN/CGSB-69.29, series 1000 mortise lock, grade 1 designed for function and keyed.
 - .4 Lever handles: plain design.
 - .5 Escutcheons: round.
 - .6 Normal strikes: box type, lip projection not beyond jamb.
 - .7 Cylinders: key into keying system as directed.
 - .8 Finished to 626 – Brushed Stainless Steel.
- .2 Butts and hinges:
 - .1 Butts and hinges: to CAN/CGSB-69.18, designated by letter A and numeral identifiers, followed by size and finish.
 - .2 Self-closing hinges and pivots: to CAN/CGSB-69.33, designated by letter K and numeral identifiers listed in Hardware Schedule, with suffix letter F indicating listed for used on fire doors finished to C32D or C26D .
 - .3 Strap and tee hinges and hasps: to CAN/CGSB-69.36, designated by letter A and numeral, size in accordance with CAN/CGSB 69.36, table I, finished to 602 cadmium plated.
- .3 Exit devices: to CAN/CGSB-69.19, grade 1 conventional design, finished to 626 – Brushed chrome.
 - .1 Auxiliary item door co-ordinator, type 21, for pairs of doors with overlapping astragals.
- .4 Door Closers and Accessories:
 - .1 Door controls (closers): to CAN/CGSB-69.20, designated by letter C and numeral identifiers listed in Hardware Schedule, size in accordance with

- CAN/CGSB-69.20, table A1, finished to 689 – paint finish to match brushed chrome.
- .2 Door controls - overhead holders: to CAN/CGSB-69.24, designated by letter C and numeral identifiers listed in Hardware Schedule, finished to finished to 689 – paint finish to match brushed chrome.
 - .3 Closer/holder release devices: to CAN/CGSB-69.31, designated by letter C and numeral identifiers listed in hardware schedule finished to 689 – paint finish to match brushed chrome.
 - .4 Door co-ordinator: concealed for pairs of doors with overlapping astragal.
- .5 Door Operators:
- .1 NA
- .6 Door bottom seal: heavy duty, door seal of extruded aluminum frame and solid closed cell neoprene weather seal, recessed in door face, closed ends, adjustable automatic retract mechanism when door is open, clear anodized finish.
- .7 Thresholds: 100 mm wide x full width of door opening, extruded aluminum with thermal break of rigid PVC, with lip and vinyl door seal insert.
- .8 Weather stripping:
- .1 Head and jamb seal:
 - .1 Extruded aluminum frame and pile insert, clear anodized finish.
 - .2 Adhesive backed neoprene material.
 - .2 Door bottom seal:
 - .1 Extruded aluminum frame and closed cell neoprene, cell neoprene sweep, clear anodized finish.
- .9 Astragal: adjustable overlapping with pile insert, finished to match doors.

2.3 MISCELLANEOUS HARDWARE

- .1 Indexed key control system: to CAN/CGSB-69.21, designated by letter E and numeral identifiers, wall mounted multiple drawer system, colour enamel paint finish to match adjacent walls.
- .2 Padlocks: 70 mm size.

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. Prepare detailed keying schedule in conjunction with Engineer.
- .2 Provide keys in duplicate for every lock in this Contract.
- .3 Provide three master keys for each MK or GMK group.
- .4 Stamp keying code numbers on keys and cylinders.
- .5 Provide construction cores.
- .6 Provide all permanent cores and keys to Engineer.

3.0 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 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.
- .2 Where door stop contacts door pulls, mount stop to strike bottom of pull.
- .3 Install key control cabinet.
- .4 Use only manufacturer's supplied fasteners. Failure to comply may void manufacturer's warranties and applicable licensed labels. Use of "quick" type fasteners, unless specifically supplied by manufacturer, is unacceptable.

- .5 Remove construction cores locks when directed by Engineer; install permanent cores and check operation of locks.

3.3 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.

3.4 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.

3.5 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 Engineer.
- .2 Maintenance Staff Briefing:
 - .1 Brief maintenance staff regarding:
 - .1 Proper care, cleaning, and general maintenance of projects complete hardware.
 - .2 Description, use, handling, and storage of keys.
- .3 Demonstrate operation, operating components, adjustment features, and lubrication requirements.

3.6 DOOR HARDWARE SCHEDULE

- .1 Exterior Door:
 - .1 Astragal, weatherstrip, closer, coordinator, panic, hinges (3/LEAF), threshold, flush bolts, entry alarm.

DIVISION 09

FINISHES

1.0 General

1.1 SECTION INCLUDES

- .1 Surface preparation and field application of paints and coatings to the exterior of the building and the gypsum board inside the building.

1.2 RELATED SECTIONS

- .1 Section 013000 – Submittals

1.3 REFERENCES

- .1 MPI (Master Painters Institute) - Specifications Manual.
- .2 SSPC (The Society for Protective Coatings) (formerly SSPC - Steel Structures Painting Council) - Steel Structures Painting Manual.

1.4 SUBMITTALS FOR REVIEW

- .1 In accordance with Section 013000 – Submittals.
- .2 Product Data: Provide data on all finishing products.
- .3 Owner and Engineer will submit exterior paint colors 3 weeks (at latest) prior to painting the building exterior.
- .4 Samples: Submit two (2) samples, 200 x 200 mm in size illustrating selected colours for each colour selected. One set shall be kept on site by the Construction Manager for reference.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- .1 Extra Stock Materials:
 - .1 Provide four (4) L of each colour, and type, to Owner.
 - .2 Label each container with colour, type, and room locations, in addition to the manufacturer's label.

1.6 QUALITY ASSURANCE

- .1 Conform to MPI - Specification Manual. Premium Grade.

1.7 REGULATORY REQUIREMENTS

- .1 Conform to applicable code for flame and smoke rating requirements for finishes.

1.8 DELIVERY, STORAGE, AND PROTECTION

- .1 Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- .2 Container label to include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, colour designation, and written instructions for mixing and reducing.
- .3 Store paint materials at minimum ambient temperature of 7 degrees C and a maximum of 32 degrees C, in ventilated area, and as required by manufacturer's written instructions.

1.9 ENVIRONMENTAL REQUIREMENTS

- .1 Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- .2 Do not apply exterior coatings during rain or snow, or when relative humidity is outside the humidity ranges required by the paint product manufacturer.
- .3 Minimum Application Temperatures for Latex Paints: 7 degrees C for interiors; 10 degrees C for exterior; unless required otherwise by manufacturer's written instructions.
- .4 Provide lighting level of 860 lx measured mid-height at substrate surface.

2.0 Products

2.1 EXTERIOR FINISH SYSTEMS

- .1 Split face concrete block [will not be painted]: (Gabels and bargeboard, vertical surfaces, horizontal soffits)
 - .1 Exterior 4.2A – Exterior Latex over block and filler [G5 or as identified by the Owner] finish. Paint color to be confirmed.
- .2 Doors and Frames (Galvanized metal):
 - .1 Exterior 5.3B alkyd G4 finish.

2.2 INTERIOR FINISH SYSTEMS

- .1 Plaster and gypsum board: gypsum wallboard, drywall, "sheet rock type material", and textured finishes:
 - .1 INT 9.2 - Latex [G5] White finish (over latex sealer)

2.3 MATERIALS

- .1 Coatings: Ready mixed. Process pigments to a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating; good flow and brushing properties; capable of drying or curing free of streaks or sags.
- .2 Accessory Materials: Linseed oil, shellac, turpentine, paint thinners and other materials not specifically indicated but required to achieve the finishes specified, of commercial quality.

2.4 COLOUR

- .1 Colors directed by the Owner at time of finishing (Pending preferred developer colors).

3.0 Execution

3.1 EXAMINATION

- .1 Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- .2 Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially affect proper application.
- .3 Test shop applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

- .1 Correct defects and clean surfaces which affect work of this section
- .2 Shop Primed Steel Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
- .3 Wood and Metal Doors Scheduled for Painting: Seal top and bottom edges with primer.

3.3 APPLICATION

- .1 Apply products to manufacturer instructions.
- .2 Do not apply finishes to surfaces that are not dry.
- .3 Apply each coat to uniform finish.
- .4 Apply each coat of paint slightly darker than preceding coat unless otherwise approved.
- .5 Sand wood and metal lightly between coats to achieve required finish.

- .6 Vacuum clean surfaces free of loose particles. Use tack cloth just prior to applying next coat.
- .7 Allow applied coat to dry before next coat is applied.
- .8 Prime concealed surfaces of interior woodwork with primer paint.

3.4 CLEANING

- .1 Collect waste material which may constitute a fire hazard, place in closed metal containers and remove daily from site.

DIVISION 11

EQUIPMENT

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern.

1.0 GENERAL

1.1 INTENT

- .1 Supply and installation of process mechanical and water piping, valves and fittings as shown on the Contract Drawings and described herein. This includes all stainless steel piping, valves and fittings up to the connection to the PVC mains covered in Section 33 11 01 - Waterworks.

1.2 RELATED WORK

- .1 Section 013000 - Submittals
- .2 Section 013400 – Shop Drawings and Product Data
- .3 Section 014000 - Quality Control
- .4 Section 016000 – Transport, Handle, Store, and Protect Product
- .5 Section 017300 - Operating and Maintenance Data
- .6 Section 018100 - Commissioning
- .7 Section 018200 - Demonstration and Training
- .8 Section 331101 - Waterworks

1.3 REFERENCES

- .1 ANSI/AWWA C208, Dimensions for Fabricated Steel Water Pipe Fittings.
- .2 ANSI/AWWA C220, Stainless Steel Pipe
- .3 ANSI/AWWA C226, Stainless Steel Fittings for Waterworks Service
- .4 ANSI/AWWA C651, Disinfection of Watermains
- .5 ANSI/AWWA C110
- .6 ANSI/AWWA C207

.7 ANSI/ASME B16.9

1.4 MATERIAL CERTIFICATION

- .1 Unless otherwise specified, the pipe material to be used at the different areas of the system shall be as follows:
 - .1 Treated water process piping – Stainless Steel 304 L schedule 10
 - .2 Submit manufacturer's test data and certification that material meet requirements of this section at least two (2) weeks prior to commencing work. Include manufacturer's shop drawings and information.
 - .3 All valves, couplings, equipment, PRV, Altitude valve, Strainer, etc. to be rated for normal working pressure of 150 psi (1034 kPa).

1.5 RECORD DRAWINGS

- .1 Provide record drawings, including directions for operating valves, list of equipment required to operate valves, and details of pipe material.

1.6 SUBMITTALS

- .1 Provide completed shop (spool) drawings of all stainless steel pipe and fittings including material, thickness, welds, reinforcements, and pressure ratings prior to fabrication of pipe.
- .2 Provide shop drawings and manufacturer specifications for all valves, couplings, strainers, flow meter, and appurtenances.

2.0 PRODUCTS

2.1 PIPE – STAINLESS STEEL

- .1 Unless noted otherwise, all stainless steel piping shall be schedule 10 Type 304L, IPS outside diameter, to ASTM A312/A312M, AWWA C220, and ASTM A778.

2.2 FITTINGS

- .1 All stainless steel fittings shall conform to ANSI/AWWA C226, ASTM A403, and ASTM A774.
- .2 Stainless steel fabricated specials and fittings shall be fabricated based on the design criteria, fabrication code and equal specifications for original fittings. Reinforcement shall be provided where required to accommodate system operating pressures. Design

standard shall be to AWWA C226 and thickness of all reinforcement collars and pads will be determined by the appropriate formula in the latest edition of ASME B31.3

2.3 FLANGES

- .1 Flanges to be rated as shown on drawings. Stainless steel flanges shall be raised face except where connections to cast iron flat face flanges where they shall be flat face to match valves and fittings. Flanges shall conform to ANSI B16.5 and B16.1 in drilling and dimension.
- .2 All cast iron flanges shall be to ANSI/AWWA C110.
- .3 Stainless steel flanges shall be to AWWA C228, ASTM A182, ASTM A240, ASTM A774. Flanges to be Type 304L to ANSI CL 150 as identified on the drawings.
 - .1 Van Stone flanges are not permitted.

2.4 BOLTS, STUDS, GASKETS AND TIE RODS

- .1 Flanges assembly bolts and studs connecting stainless steel shall be stainless steel conforming to Grade 8 ASTM A193. All bolts to use Loctite C5-A copper grade anti-seize compound.
- .2 Flanges assembly nuts connecting stainless steel shall be stainless steel conforming to Grade 8 ASTM A194.
- .3 Flanges assembly bolts, studs, nuts and washers connecting stainless steel shall be provided with a flange isolation kit as indicated on the drawings.
- .4 Tie Rods shall be continuously threaded to ASTM A354 and fabricated in accordance with B1.1 (screw thread, coarse thread series). All tie rods shall be cadmium plated in accordance with ASTM B766.
- .5 Flange gaskets for flat face shall be full face type. Flange gaskets for raised face shall be ring type. Gaskets to conform to AWWA C228 Table 1. For working pressure up to 175 psi, gasket material shall be black or red natural rubber full face type and 3mm thick. For working pressure above 175 psi, gasket material shall be compressed non-asbestos blend of synthetic fibres, fillers, and elastomeric binders suitable for potable water ring type, 3mm thick.

2.5 MECHANICAL COUPLINGS

- .1 Couplings shall be furnished complete with all gaskets, bolts and nuts, followers and middle rings and shall be mechanically restrained to avoid pullout.

- .2 Couplings shall have normal working pressures as indicated on the drawings.
- .3 Approved products: As approved by the Engineer.
- .4 Pipe couplings shall be Teekay Type II or as approved by the Engineer.

2.6 DISMANTLING JOINTS

- .1 Dismantling joints shall be furnished complete with all gaskets, bolts and nuts, end ring, tie rods and shall be mechanically restrained to avoid pullout.
- .2 Dismantling joints shall have normal working pressures as indicated on the drawings.
- .3 Dismantling joints to include:
 - .1 Flange x Flange ends
 - .2 Ductile iron end ring and body made to ASTM A536 65-45
 - .3 Stainless steel 304 bolts and nuts
 - .4 Stainless steel 304 tie rods
 - .5 Fusion bonded epoxy NSF 61 certified coating
- .4 Approved products: Romac DJ405

2.7 DETECTABLE REINFORCED UNDERGROUND UTILITY MARKING TAPE

- .1 Reinforced detectable marking tape shall be installed a minimum of 300 mm directly above all water mains.
- .2 Tape shall be 150 mm wide, Safety Precaution Blue, marked "Caution Water Line Below".
- .3 Shall be 8 mil overall thickness, warp orientated, coated and closed woven 10 x 7 count, solid aluminum foil core with permanent printing beneath mylar layer.
- .4 Acceptable manufacturers: Thortec

2.8 PIPE SUPPORTS

- .1 All pipe supports shall be as shown on drawings.

- .2 Pipe supports to have 3 mm neoprene liner preventing contact between pipe support and metal flange.

2.9 VALVING

- .1 Valves shall be rated for a normal working pressure as shown on the drawings to ANSI/AWWA C509, with flanges drilled to ANSI B16.1.
- .2 Valves shall be standard cast iron body, bronze mounted, resilient wedge design.
- .3 Valves shall be coated internally and externally in accordance with AWWA C550-90 and certified NSF 61.
- .4 Valves shall be left hand opening and have a 31mm square operating nut for buried application and hand wheel for interior installations unless otherwise noted on the drawings.
- .5 Approved products: Valmatic or approved equivalent.

2.10 BALL VALVES

- .1 Ball valves shall be rated for a normal working pressure as shown on the drawings.
- .2 Ball valves to be full port, stainless steel, locking handle, with PTFE seat.
- .3 Approved products: Watts or approved equal by Engineer

2.11 CHECK VALVES

- .1 Check valves to conform to latest version of AWWA C508 with the following features:
 - .1 Flange x Flange ends
 - .2 Globe style, silent type
 - .3 Cast iron body to ASTM A-126
 - .4 Aluminum bronze door to ASTM B 148
 - .5 Stainless steel hinge pin and trim to ASTM A 276
- .2 Check valves shall be rated for a normal working pressure as shown on the drawings to ANSI/AWWA C509, with flanges drilled to ANSI B16.1.

- .3 Approved products: Valmatic globe style silent chack valve, NSF certified, lead free with Buna-N seat, or approved equivalent.

2.12 AIR RELEASE VALVES

- .1 Air release valves shall be rated for a normal working pressure as shown on the drawings and employ direct acting kinetic principle in conformance with ANSI/AWWA C512.
- .2 Valves to be fabricated of cast iron body and cover with bronze trim, stainless steel floats with shockproof synthetic seat.
- .3 Ends to be screwed.
- .4 Approved products:
 - .1 25mm Automatic Air Release Valve, Valmatic #22.9, NSF 61 certified c/w 180 degree vent pipe, 25mm SS valve, 25mm SS inlet, 12mm SS outlet piped to floor drain. As indicated on contract documents.
 - .2 25mm Automatic Air Release Valve, Valmatic #22.9, NSF 61 certified c/w 180 degree vent pipe, 25mm SS valve, 25mm SS inlet, 12mm SS outlet piped to floor drain. As indicated on contract documents.
 - .3 To CRD Integrated water services standard drawings and specifications.

2.13 STRAINERS

- .1 Strainer shall be an H style strainer rated for a normal working pressure of 1034 kPa (150 psi).
- .2 Strainer to be 304 L stainless steel. Body shall be 304L SS.
- .3 Flanges to be raised face and drilled in accordance with ASME B16.5.
- .4 Approved products: 150mm CLA-VAL x43H, H style strainer complete with stainless steel trim.

2.14 FLOW METERS

- .1 Flow meter shall be rated for a normal working pressure as shown on the drawings.
- .2 Flow meter to come with the following:
 - .1 Flange x Flange ends

- .2 Polypropylene liner
- .3 Stainless steel measuring electrode
- .4 Cable of suitable length to reach remote transmitter readout in electrical room
- .5 NSF 61 certification

- .3 Flanges to be raised face and drilled in accordance with ASME B16.5.
- .4 Approved products: per instrumentation specification.

2.15 PRESSURE GAUGE

- .1 Pressure gauges shall be rated for a normal working pressure as shown on the drawings
- .2 Approved products: WIKA Type 232-53 complete with 12mm SS welded nipple, SS tee, and SS bleed valve or as approved by the Engineer.

3.0 EXECUTION

3.1 PREPARATION FOR WELDING

- .1 The majority of stainless steel welding shall be in an approved fabrication shop that is set up to handle, fabricate and weld stainless steel using handling procedures that are designed to eliminate carbon contamination of the stainless steel. Such procedures shall include the use of stainless steel tools for preparing welds including wire brushes, chisels, files and hammers, welding gloves and grinding wheels used during the fabrication of stainless steel shall not have been used on previous carbon steel work.
- .2 Groove stainless steel in accordance with grooving machine manufacturer's instructions. If SS pipe is grooved, insert a piece of SCH40 SS in the pipe then groove this section to ensure it maintains strength.
- .3 Thread stainless steel in accordance with threading machine manufacturer's instructions.
- .4 Only 300 series stainless steel brushes or wheels shall be used on austenitic and nickel alloys. Areas used for the fabrication of austenitic and nickel alloys shall be separated from carbon steel areas by methods suitable to prevent contamination of carbon steel shavings, grinding dust and zinc dust from painting operations.
- .5 Where tape is used for backing purge gas the tape shall use an adhesive backing that allows for the complete removal of the tape.

- .6 Shop fabricated fittings made from rolled stock shall be in accordance with ASTM A240 shall be in a solution annealed condition. Shop fabricated fittings made from pipe shall be in accordance with AWWA C22, ASTM A312, ASTM A778. Design standard shall be in accordance with AWWA C226 and the thickness of all reinforcement collars and pads will be determined by the appropriate formula in the latest addition of ASME B31.3.

3.2 STAINLESS STEEL WELDING

- .1 All welding of the root pass of austenitic stainless steel pipe shall be done using the GTAW or GMAW process with appropriate filler metal and shielding gas.
- .2 Fabricator to provide the Engineer with a welding procedure prior to commencing any work.
- .3 Fabrication code shall be in accordance with ASME B31.3 and Inspection code shall be Normal Fluid Service (NFS). Shop visual inspection required at beginning of fabrication. Fabricator may be required to undertake 5-10% radiography of welds prior to installation (based on visual inspection and at discretion of the Engineer).
- .4 All shop fabrication welding to be TIG type welding.
- .5 Field welding shall be kept to a minimum and performed only with the prior consent of the engineer. Field welds to be MIG type welding. Welding shall not be performed when the quality of the completed weld would be impaired by the weather conditions. All welding shall be ceased until suitable protection can be erected. The Contractor will not be compensated for such delays. When ambient temperature is below 0°C, all welding shall cease until an appropriate welding procedure has been qualified and approved by the Engineer.
- .6 All stainless steel welds shall be pickled in accordance with AWWA C220, ASTM A380 and ASTM A967. Pickling paste shall be NSF certified. Any noticeable discolouration found on the stainless steel pipe shall be removed by pickling. Once sufficient pickling time has elapsed, the passivated surface shall be cleaned of all acids by thoroughly rinsing the pipe.
- .7 All welders shall be qualified for the particular welding procedure they will perform.

3.3 TOLERANCES

- .1 Fabricating tolerances for pipe fittings and assemblies shall conform to the Pipe Fabrication Institute.

- .2 Pipe diameter shall be true to dimensions and roundness for fabricated pipe. All other schedule pipe shall be as appropriate ASTM or AWWA specification.
- .3 Pipe straightness as measured at mid-point of length of pipe.

3.4 DELIVERY HANDLING AND STORAGE OF STAINLESS STEEL

- .1 During loading, transporting and unloading, care shall be exercised to prevent damage to the pipe and fittings. All damaged materials shall be replaced at the contractor's expense. The material shall be stored clear of the ground surface to prevent dirt from entering or otherwise contaminating the pipe joints.
- .2 The pipe interior shall be inspected prior to assembly and any foreign matter shall be removed. The open end of the pipe in the trench shall be suitably covered to prevent entrance of trench water or other foreign matter.
- .3 Fabricated pipe sections being stored or shipped have wooden plugs or plastic caps securely installed in each in order to prevent the pipe ends from being deformed out of round.
- .4 Flanged ends of each fabricated piece shall be protected with wooden fabricated blanks.
- .5 Fabricated pipe sections shall be stored in a manner that will prevent them from being damaged or contaminated with carbon steel during storage.

3.5 FLANGED JOINTS

- .1 Flanged joints shall be made up square, with uniform pressure upon the gaskets, and shall be perfectly square and watertight. Any flange face shall be in one plane and perpendicular to the axis of the pipe to which it is jointed. No lateral force shall be imposed on any bolt used in joining two flanges together.
- .2 Flanged gaskets shall be cloth reinforced and extend from the throat opening to at least the minimum diameter of the bolt circle with the stainless steel bolts isolated per details on the contract drawings.
- .3 Flange bolts shall be tightened progressively by the cross-over method and not in rotation around the joint.
- .4 When a flanged joint has been made up, it shall be possible for any bolt to be freely removed and reinstalled tightly. There shall be no axial stress imposed on pipe runs adjacent to flanges due to the tightening of the flange bolts to produce a watertight joint.

- .5 All buried flanged joints including nuts and bolts to be wrapped and coated with a petrolatum based wax and tape coating system approved for potable water use and conforming to ANSI/AWWA C217.

3.6 MECHANICAL JOINTS

- .1 A flexible joint shall be provided at all locations shown on the drawings.
- .2 Install flexible joints in accordance with manufactures instructions.

3.7 FLOW METER

- .1 The flow meters are to be carefully installed in accordance with the manufacturer's instructions.
- .2 Provide flange supports as shown on the drawings on the drawings.
- .3 Make electrical connections and perform start up commissioning and testing of the flow meter in accordance with manufactures instructions and the Contract documents.

3.8 VALVES AND FITTINGS

- .1 Installation shall be in accordance with the provisions, regulations and codes of the Province of British Columbia.
- .2 Installation of piping, fittings and valves shall be in accordance with the manufacturer's recommendations.

3.9 HYDROSTATIC AND LEAKAGE TESTING

- .1 Provide labour, equipment and materials required to perform hydrostatic and leakage tests hereinafter described.
- .2 Notify Engineer at least 24 hours in advance of all proposed tests. Perform tests in presence of Engineer.
- .3 All piping, valves and fittings shall be put together and bench tested prior to final installation and removal of existing pumps. Provide temporary thrust blocking and joint restraints.
- .4 Insure that all air is expelled by slowly filling system with potable water.
- .5 Apply a leakage test pressure as directed by engineer to all components for a period of two (2) hours.

- .6 Locate and repair defects if any leakage is observed.
- .7 Repeat test until no leakage is observed.

3.10 FLUSHING AND DISINFECTING

- .1 Flushing and disinfecting operations shall be to ANSI/AWWA C651 and witnessed by Engineer. Notify Consultant at least three (3) days in advance of proposed date when disinfecting operations will commence.
- .2 Flush water mains through available outlets with a sufficient flow of potable water to produce a velocity of 1.5 m/s, within pipe for 10 min, or until foreign materials have been removed and flushed water is clear.
- .3 Provide connections and pumps for flushing as required.
- .4 Open and close valves to ensure thorough flushing.
- .5 Operate valves and appurtenances while main contains chlorine solution.
- .6 Flush line to remove chlorine solution after 24 hours.
- .7 Dispose of all chlorinated water in accordance with fisheries and other regulations.

3.11 FIELD TESTING AND ADJUSTING

- .1 Prior to acceptance, an operational test of the pump and control systems shall be performed by the Contractor to verify the installed equipment meets the purpose and intent of the specifications. Test shall demonstrate that the equipment is not electrically, mechanically, structurally or otherwise defective; is in safe and satisfactory operating condition; and conforms with the specified operating characteristics. Tests shall include checks for excessive vibration, leaks in all piping and seals, correct operation of control systems and equipment, proper alignment, excessive noise levels, and power consumption.
- .2 Process mechanical pipework and fittings to be pressure tested to a pressure directed by the Engineer, and held for a period of two (2) hours. The pressure test will be deemed acceptable when no visible or audible leaks are detected.
- .3 Retesting
 - .1 If any deficiencies are revealed during any test, such deficiencies shall be corrected and the tests shall be re-conducted.

.4 Manufacturer's Services

.1 Provide services of a manufacturer's representative who is experienced in the installation, adjustment, and operation of the equipment specified.

.2 The representative shall supervise the installation, adjustment and testing of the equipment.

3.12 WARRANTY

.1 The Contractor shall warranty the piping, valves, fittings supplied and installed by the contractor against any defects in workmanship and materials for a period of one (1) year from the date of substantial completion. If any defect should appear, it should be reported in writing to the manufactures during the warranty period.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.0 GENERAL

- .1 This section refers to the supply and installation of one complete sodium hypochlorite system as shown on the drawings and specified herein including all pertinent equipment complete and ready for automatic operation.
 - .1 Metering Pump Package
 - .2 Metering Pumps
 - .3 Sodium hypochlorite solution lines
 - .4 Control cables
 - .5 Diffuser assembly
 - .6 Chlorine analyzer
- .2 Also included in this section are hypochlorite solution tanks, pallets and casing pipe for buried chlorine solution lines.
- .3 Any valves and control apparatus specified herein, indicated on the drawings and/or necessary for the complete and workable chlorination system but are not specifically described in this or other sections of the specifications shall be supplied and installed and shall be the standard products of the chlorination equipment manufacturer normally supplied for the intended service.
- .4 Chlorine analyzing equipment must use the DPD method for measuring residual chlorine levels in water.

1.1 RELATED WORKS

- .1 Division 25, 26, and 27 – Electrical

1.2 REFERENCE STANDARDS

- .1 The chlorine system shall conform to the standards established by the Chlorine Institute.

1.3 SUBMITTALS

- .1 The Contractor shall submit the shop drawings and the information for each component of the Sodium hypo-chlorination system. Information shall include, but not be limited to the following:
 - .1 General layout of the system.
 - .2 Detailed layout of each component with anchor bolt locations and dimensions.
 - .3 Detailed parts list.
 - .4 Installation manuals before shipment of any equipment.
- .5 Operation and maintenance manual 30 days prior to start-up of the system.

2.0 PRODUCTS

2.1 SODIUM HYPOCHLORITE METERING PUMP PACKAGE

- .1 The sodium hypochlorite metering pumps shall be supplied as a pre-assembled package including all piping, valves and other equipment as shown on the drawings. The package shall arrive on site ready to be wall-mounted.
 - .2 The sodium hypochlorite metering pumps shall be capable of supplying sodium hypochlorite at rates ranging from 0.4 to 8.1 l/hr
 - .3 1- Grundfos Metering Pump Package c/w back pressure valve
 - .4 1- Grundfos Digital S Metering Pumps
 - .5 2- 10m Control Cables

2.2 LOOP POWERED CHLORINE MEASUREMENT PACKAGE

- .1 The residual chlorine analyzer and all associated pipe work shall be mounted on the wall of the Ft Rupert Controls Building. The analyzer shall measure total chlorine only with a range of 0 to 10ppm.
- .2 All equipment to be mounted to backboard with ½" FNPT connections for inlet and outlet:
 - .1 Hach CL17 Pre-Assembled Monitoring Package Free Chlorine
 - .2 Hach CL17 (Transmitters)
 - .3 Hach CL17 (Sensor Housing)

- .4 1007540 (Free Chlorine Sensor 0-10ppm)
- .5 Hach CL17 (Control Cable)
- .6 Pressure Regulating Valve and connection piping
- .7 Hach CL17 (Backboard with piping for mounting of all equipment)

2.3 CHLORINE DIFFUSERS

- .1 Injection Lance (809712) c/w connection point check valve assembly. The Injection lance is to extend to the center of the watermain. Two injections lances are to be supplied, one for installation and one as a spare part.

2.4 SODIUM HYPOCHLORITE STORAGE TANK

- .1 a 90 Liter Graduated Cylindrical Tank, with lid, 1/2" bulk head fitting, and plug

2.5 SODIUM HYPOCHLORITE SOLUTION PIPING AND FITTINGS

- .1 PVC PIPING - The polyvinyl chloride pipe and fittings shall be Schedule 80, Type 1, Grade 1, conforming to ASTM-D 1784.
- .2 Joints shall be socket joints except where flanges are indicated on the drawings. Flanges shall be of the socket type.
- .3 PVC TUBING – PVC Tubing shall be 3/8" ID and 1/2" OD braided PVC tubing rated to 150PSI
- .4 No joints in the sodium hypochlorite solution piping will be allowed in the buried casing pipe between the chemical building and the flow meter chamber. All joints shall be exposed inside building or chamber.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern.

1.0 GENERAL

- .1 Section 11 60 00 refers to those portions of the work that are unique to the supply and installation of the Pressure Reducing Valve (PRV). This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
 - .1 The PRV shall be pilot operated, which will reduce a high inlet pressure to a low outlet pressure. The valve shall maintain a relatively constant downstream pressure regardless of fluctuations in supply pressure or flow rate.
 - .2 The pilot shall be a normally open pilot that reacts to small changes in downstream pressure, which acts to modulate the main valve bonnet pressure to hydraulically adjust the inner valve assembly position to maintain a constant downstream pressure.
- .2 All details of reservoir facilities not specifically covered in this section to comply with ASTM and CGSB standards and/or manuals of practice as specified in Contract Documents.
- .3 All required labour, materials, equipment, and construction services shall be included, and all incidental work for which separate payment is not specified elsewhere, and the contractor's overhead and profit.

1.1 RELATED WORKS

- | | | |
|----|---|----------|
| .1 | Excavating, Trenching and Backfilling Section | 31 23 01 |
| .2 | Manholes and Catchbasins Section | 33 44 01 |
| .3 | Concrete Reinforcement Section | 03 20 01 |
| .4 | Cast-in-Place Concrete Section | 03 30 53 |
| .5 | Aggregates and Granular Materials Section | 31 05 17 |

1.3 QUALITY ASSURANCE

- .1 The control valve shall be tested prior to shipment. The standard test shall include a functional stroke, pressure and leak test of valve body, seat, fitted pilots, and accessories.

- .2 The control valve shall be covered by a minimum three (3) year warranty against defects in materials and workmanship. The AISI 316-stainless steel seat ring shall be covered by a lifetime guarantee.
- .3 All control valve maintenance and repairs shall be possible without removing the main valve body from the line, when installed in accordance with manufacturer's recommendations.

2.0 DESIGN CRITERIA

2.1 MAIN VALVE

- .1 The valve shall be a single chamber, diaphragm actuated full port model.
- .2 Main valves shall provide smooth frictionless motion to ensure a low flow stability to 2 L/s, achieved using Single Rolling Diaphragm (SRD) technology (or similar).
- .3 The main valve, bonnet, and removable stem cap shall be constructed of ASTM A 536 (Grade 65/45/12) Ductile Iron.
- .4 Main valves shall have a removable stem cap for access to the main valve stem for alignment check, spring installation and ease of service and assembly.
- .5 The main valve bonnet shall be located using two or more locating guide pins to maintain the inner valve assembly alignment and for ease of maintenance.
- .6 The main valve trim, consisting of seat ring and stem shall be constructed of AISI 316 Stainless steel. The valve stem shall have wrench flats for ease of maintenance.
- .7 The main valve shall provide a drip tight seal using a mechanically retained resilient disc, having a rectangular cross section, against the stationary AISI 316 stainless steel seat ring.
- .8 The stationary AISI 316 stainless steel seat ring of main valves shall be held in place using self-locking screws and seat ring retainers.
- .9 All internal and external ferrous components, including all mating surfaces, shall be coated with an NSF 61 approved fusion bonded epoxy to a minimum of 10mils Dry Film Thickness (DFT).
- .10 The main valve elastomers: diaphragm, resilient disc and seals, shall be of EPDM.
- .11 All main valve fasteners (bolts, nuts, studs, cap screws) shall be supplied as AISI 304 Stainless steel. All bonnet bolts shall be fitted with SS washers to prevent damage to the bonnet coating.

- .12 Valve shall have flanged end connections. Flanged connections shall be ANSI/ASME B16.42 Class 150# flange drilled, faced and rated.
- .13 Due to the potential for noise, vibration and erosion damage from cavitation, the valve manufacturer shall provide, a computerized sizing and cavitation analysis, using independent third party software. Cavitation analysis shall provide the status of cavitation based on customer supplied parameters as to valve size, flow rate requirements and pressure conditions. The cavitation analysis shall also provide information as to C_v factor, percent of valve lift, cavitation index and noise level.
- .14 The valve manufacturer shall be able to supply cavitation control trim which shall be engineered to be optimized to the actual operating parameters of the control valve application and warranted to perform correctly and prevent main valve cavitation damage under the stated conditions. Orifice plates or other non-engineered cavitation control devices shall not be used to prevent or minimize valve cavitation.

2.2 PILOT CONTROLS

- .1 The pressure reducing pilot shall be a normally open pilot with a spring to adjust the pressure setting. The pilot shall be self-cleaning and self-flushing with the outlet of the pilot located at the bottom of the pilot flow with the pilot stem out of the waterway and guide free from any debris build-up.
- .2 The pilot trim, consisting of a seat ring, stem and yoke shall be constructed of AISI 316 stainless steel.
- .3 The pilot elastomers: diaphragm, inner valve and seals shall be EPDM.
- .4 The adjustable pilot spring range shall be supplied with a spring range of 20 to 200psi. The pilot shall be factory preset at specify set point 104 psi.
- .5 The pilot body and spring casing shall be constructed of specify material ASTM A351 CF8M stainless steel.
- .6 A fixed restriction shall be supplied as AISI 303 stainless steel with an orifice bore selected by the manufacturer based on the valve size and operation.
- .7 The adjustable flow stabilizer shall be a self-cleaning opening speed control, supplied as a stainless-steel assembly.
- .8 The pilot fittings shall be supplied as AISI 316 stainless steel.
- .9 The pilot tubing shall be supplied as AISI 316 stainless steel.

- .10 Three (3) pilot isolation ball valves shall be supplied as standard. Pilot isolation ball valve(s) shall be constructed of 316 stainless steel with stainless steel handle operator.

- .11 A pilot strainer shall be supplied as standard. Strainer material to be ASTM A351 CF8M stainless steel with a 80-mesh 316 stainless steel screen. The external pilot strainer shall have a removable plug for easy maintenance access to the pilot screen and have provision for installation of a ball valve for pilot screen flushing.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern.

1.0 GENERAL

- .1 Section 11 70 00 refers to those portions of the work that are unique to the supply and installation of the Altitude valve. This section must be referenced to and interpreted simultaneously with all other sections pertinent to the works described herein.
 - .1 the Valve shall be non-modulating flow altitude control valve which shall maintain a preset maximum reservoir level.
 - .2 the valve shall hydrostatically sense the reservoir head and react to changes in the reservoir level. When the reservoir level drops sufficiently below the maximum reservoir level the pilot acts to open and vent the main valve bonnet to atmosphere, opening the main valve and allowing water into the reservoir. When the reservoir reaches the preset maximum level, as sensed by the altitude pilot, the pilot acts to close, which closes the main valve. The valve shall close at an adjustable rate.
 - .3 If the altitude valve fails it shall be set to default to remain open. This will provide continued supply to the Fort Rupert Reservoir.
- .2 All details of reservoir facilities not specifically covered in this section to comply with ASTM and CGSB standards and/or manuals of practice as specified in Contract Documents.
- .3 All required labour, materials, equipment, and construction services shall be included.

1.1 RELATED WORKS

- .1 Excavating, Trenching and Backfilling Section 31 23 01
- .2 Manholes and Catchbasins Section 33 44 01
- .3 Concrete Reinforcement Section 03 20 01
- .4 Cast-in-Place Concrete Section 03 30 53
- .5 Aggregates and Granular Materials Section 31 05 17

1.3 QUALITY ASSURANCE

- .1 The control valve shall be tested prior to shipment. The standard test shall include a functional stroke test and pressure and leak test of valve body, seat, fitted pilots and accessories.
- .2 The control valve shall be covered by a minimum three (3) year warranty against defects in materials and workmanship. The 316-stainless steel seat ring shall be covered by a lifetime guarantee.
- .3 All control valve maintenance and repairs shall be possible without removing the main valve body from the line, when installed in accordance with manufacturer's recommendations.

1.4 MEASUREMENT AND PAYMENT

- .1 Payment for Altitude valve shall be Lump Sum together with process mechanical equipment, as shown in Schedule of Quantities.

2.0 DESIGN CRITERIA

2.1 MAIN VALVE

- .1 The valve shall be a single chamber, diaphragm actuated full port model.
- .2 Main valves shall provide smooth frictionless motion to ensure a low flow stability to 10 L/s, achieved using Single Rolling Diaphragm technology (or similar)
- .3 The main valve body, cover, flanges and all internal components shall be fabricated 304 Stainless Steel
- .4 Main valves shall have a removable stem cap for access to the main valve stem for alignment check, spring installation and ease of service and assembly.
- .5 The main valve bonnet shall be located using two or more locating guide pins to maintain the inner valve assembly alignment and for ease of maintenance.
- .6 The main valve trim, consisting of seat ring and stem shall be constructed of AISI 316 Stainless steel. The valve stem shall have wrench flats for ease of maintenance.
- .7 The main valve shall provide a drip tight seal using a mechanically retained resilient disc, having a rectangular cross section, against the stationary AISI 316 stainless steel seat ring.

- .8 The stationary AISI 316 stainless steel seat ring of main valves shall be held in place using self-locking screws and seat ring retainers.
- .9 All internal and external ferrous components, including all mating surfaces, shall be coated with an NSF 61 approved fusion bonded epoxy to a minimum of 10mils Dry Film Thickness
- .10 The main valve elastomers: diaphragm, resilient disc and seals, shall be of EPDM.
- .11 All main valve fasteners (bolts, nuts, studs, cap screws) shall be supplied as AISI 316 Stainless steel. All bonnet bolts shall be fitted with 316 SS washers to prevent damage to the bonnet coating.
- .12 Valve shall have flanged, end connections. Flanged connections shall be ANSI/ASME B16.42 Class 150# flange drilled, faced and rated.
- .13 Due to the potential for noise, vibration and erosion damage from cavitation, the valve manufacturer shall provide, a computerized sizing and cavitation analysis, using independent third party software. Cavitation analysis shall provide the status of cavitation based on customer supplied parameters as to valve size, flow rate requirements and pressure conditions. The cavitation analysis shall also provide information as to Cv factor, percent of valve lift, cavitation index and noise level.
- .14 The valve manufacturer shall be able to supply cavitation control trim which shall be engineered to be optimized to the actual operating parameters of the control valve application and warranted to perform correctly and prevent main valve cavitation damage under the stated conditions. Orifice plates or other non-engineered cavitation control devices shall not be used to prevent or minimize valve cavitation.

2.2 PILOT CONTROLS

- .1 A three-way altitude control pilot shall be used, with a spring to adjust the reservoir maximum level setting. The altitude pilot body shall be serviceable without removing the pilot from the valve.
- .2 The pilot trim, consisting of a replaceable inner valve shall be constructed of AISI 316 stainless steel.
- .3 The pilot control system shall utilize stainless steel tubing and fittings, and all pilot control system components, including valve accessories shall be stainless steel.
- .4 The pilot elastomers: diaphragm and seals shall be EPDM

- .5 The adjustable pilot spring range shall be supplied as specify 10 to 60 feet (3-18m). The pilot shall be preset at off at 12 metres and on at 9 metres.
- .6 The pilot tubing shall be supplied as AISI 316 stainless steel.
- .7 A closing speed control shall be provided. An adjustable needle valve closing speed control shall be constructed of 316 stainless steel with handle operator.
- .8 Pilot isolation ball valves shall be supplied as standard. Pilot isolation ball valves shall be constructed of 316 stainless steel with stainless steel handle operator.
- .9 A pilot strainer shall be supplied as standard. Strainer material to be ASTM A351 CF8M stainless steel with a 40-mesh or 80-mesh 316 stainless steel screen. The external pilot strainer shall have a removable plug for easy maintenance access to the pilot screen and have provision for installation of a ball valve for pilot screen flushing.
- .10 The control valve shall be supplied with a Singer Model X107 Position Indicator as standard. The valve position indicator shall provide a visual reference to the main valve open position. The indicator stem rod shall be AISI 316 stainless steel, threaded or pinned to the main valve stem. The indicator rod shall move within a 303 stainless steel hexagonal housing having a clear Pyrex sight glass. A cap and bleed valve shall be provided to purge any air that may become trapped within the main valve bonnet and stem cap.

DIVISION 15

MECHANICAL

1.0 GENERAL

1.1 CONFORMANCE

- .1 The General Conditions, Supplements and Amendments shall govern this Division (read in conjunction with Instructions to Tenderers / Bidders). This section covers items common to all sections of Division 15 and is intended to supplement the requirements of Division 01.

1.2 WORK INCLUDED

- .1 Provide complete, fully tested and operational mechanical systems to meet the requirements described herein, in complete accordance with applicable codes and ordinances.
- .2 The word "Provide" shall mean "Supply and Install" the products and services specified. "As Indicated" means that the item(s) specified are shown on the drawings.
- .3 Provide materials, equipment and plant, of specified design, performance and quality; and, current models with published certified ratings for which replacement parts are readily available.
- .4 Provide project management and on-site supervision to undertake administration, meet schedules, ensure timely performance, ensure coordination, establish orderly completion and the delivery of a fully commissioned installation.
- .5 Follow manufacturer's recommended installation details and procedures for equipment, supplemented by requirements of Contract Documents.
- .6 The most stringent requirements of this and other mechanical sections shall govern. Should inconsistencies exist such as the drawings disagreeing within themselves or with the specifications, the better quality and/or greater quantity of work or materials shall be estimated upon, performed and furnished unless otherwise ordered by the Consultant in writing during the bidding period.
- .7 All work shall be in accordance with the PROJECT Drawings and Specifications and their intent, complete with all necessary components, including those not normally shown or specified, but required for a complete installation.
- .8 Provide seismic restraints for all required equipment, piping and ductwork.
- .9 "Consultant" shall mean Stantec Consulting Ltd.

1.3 STANDARD OF ACCEPTANCE

- .1 Means that item named and specified by manufacturer and/or catalogue number forms part of specification and sets standard regarding performance, quality of material and workmanship and when used in conjunction with a referenced standard, shall be deemed to supplement the standard.
- .2 Where two or more items of equipment and/or material, of the same type, are required, provide products of a single manufacturer.
- .3 Install and test all equipment and material, in accordance with the detailed recommendations of the manufacturer.
- .4 A visible manufacturer's nameplate shall indicate manufacturer's name, model number, serial number, capacity data, electrical characteristics and approval stamps.

1.4 ADDITION OF ACCEPTABLE MANUFACTURERS

- .1 Addition of manufacturer's names to the specifications will be by addendum only.

1.5 TENDER INQUIRIES

- .1 All contractor queries during the tender period shall be made in writing to the consultant. Contractor queries will be collected and suitable addenda will be issued for clarification. No verbal information will be issued by the consultant's office during tender. All tender queries may be e-mailed, faxed, mailed or couriered to the consultant's office. No telephone questions will be answered.

1.6 EQUIPMENT LIST

- .1 Submit a completed Equipment List, showing the make of equipment and material included in the Tender, including the names of the subtrades, 10 days after the award of the Contract.
- .2 The equipment list shall be a full list of materials intended for installation.

1.7 SCHEDULING

- .1 Coordinate with Division 1, Construction Schedule.
- .2 Incorporate within the Construction Schedule, a complete and realistic schedule, integrated with, and recognizing the reliance on, other divisions of the work. Take into account the lead time for the review of operating and maintenance manuals, commissioning, verification of system operation by the Consultant and the demonstration and instruction to the Owner. The schedule shall include but not limited to the following items:
 - .1 Installation of duct systems and equipment.
 - .2 Control system installation.
 - .3 Air balancing
 - .4 Connection of electrical services to equipment by electrical contractor.
 - .5 Start-up of mechanical equipment and systems.
 - .6 Check-out of control systems.
 - .7 Commissioning of mechanical systems.
 - .8 Demonstration of systems and equipment to Owner.
 - .9 Preparation of maintenance manuals and as-built drawings.
 - .10 Submission of the various documents required prior to substantial performance.

1.8 RESPONSIBILITIES

- .1 Visit the site before tendering. Examine all local and existing conditions on which the work is dependent. No consideration will be granted for any misunderstanding, of work to be done, resulting from failure to visit the site.
- .2 Ensure that equipment does not transmit noise and/or vibration to other parts of the building, as a result of poor installation practice.
- .3 Where the Contract Documents do not contain sufficient information for the proper selection of equipment for bidding, notify the Consultant during the tendering period. If clarification is not obtainable, allow for the most expensive arrangement. Failure to do this shall not relieve the Contractor of responsibility to provide the intended equipment.
- .4 Examine carefully the mechanical, electrical, structural and architectural drawings and confirm that the work under this Sub-Contract can be satisfactorily carried out without changes to the building as shown on these plans.
- .5 Be responsible for prompt installation of this work in advance of concrete pouring or similar work. Provide and set sleeves where required.

- .6 During freezing weather, protect all materials in such a manner that no harm can be done to installations already in place and/or to materials and equipment on the job.
- .7 On completion of the work, all tools and surplus and waste materials shall be removed and the work left in a clean and perfect condition.

1.9 COORDINATION

- .1 Check drawings of all trades to verify space and headroom limitations for work to be installed. Coordinate work with all trades and make changes to facilitate a satisfactory installation. Make no deviations to the design intent involving extra cost to the Owner, without the Consultant's written approval.
- .2 The drawings indicate the general location and route to be followed by the piping and ductwork. Where details are not shown on the drawings or only shown diagrammatically, ductwork shall be installed in such a way as to conserve head room and interfere as little as possible with the free use of space through which they pass. Service lines shall run parallel to building lines. All ducts above the ceiling shall be kept as tight as possible to beams or other limiting members at high level. All ducts shall be coordinated in elevation to ensure that they are concealed in the ceiling or structural space provided unless detailed otherwise on drawings.
- .3 Work out jointly all interference problems on the site with other trades and coordinate all work before fabricating, or installing any material or equipment. Ensure that all materials and equipment fit into the allotted spaces and that all equipment can be properly serviced and replaced, if and when required. Advise the Consultant of space problems before fabricating, or installing any material or equipment. Demonstrate to the Consultant on completion of the work that all equipment installed can be properly, safely serviced and replaced, if and when required. Remove and replace improperly installed equipment to satisfaction of the Consultant at no extra cost. Extras for improper coordination and removal of equipment to permit remedial work shall not be allowed.

1.10 HOISTS AND SCAFFOLDS

- .1 Provide all necessary interior movable or roller scaffolds, platforms, lifts and ladders for the installation of the mechanical work.

1.11 INSPECTION OF WORK

- .1 The Consultant representative shall inspect all work prior to it being concealed.
- .2 All work shall be approved by all authorities having jurisdiction.

1.12 PERMITS

- .1 Obtain all required permits and pay all fees therefore and comply with all Provincial, Municipal, and other legal regulations and by-laws applicable to the work.
- .2 Arrange for inspection of all Work by the authorities having jurisdiction. On completion of the Work, furnish final unconditional certificates of approval by the inspecting authorities.

1.13 CODES, REGULATIONS, AND STANDARDS

- .1 Divisions 15 work shall conform to the following codes, regulations and standards, and all other codes in effect at the time of award of Contract, and any others having jurisdiction. The latest revision of each code and standard shall apply unless otherwise specified in the contract documents:
 - .1 By-laws
 - .1 Local Building By-laws.

- .2 Canadian Standards Association
 - .1 CAN/CSA-C22.1-09: Canadian Electrical Code, Part I
- .3 National Fire Codes
 - .1 NFPA 10: Standard for Portable Fire Extinguishers – 2013
- .4 Province of British Columbia
 - .1 B.C. Building Code 2012
 - .2 B.C. Fire Code 2012
 - .3 B.C. Safety Authority Safety Standards Act
 - .4 B.C. Amendment to Canadian Electrical Code
 - .5 B.C. Reg. 100/2004 Electrical Safety Regulation
 - .6 B.C. Electrical Safety Branch Bulletins
 - .7 B.C. Occupational Health & Safety (OHS) Regulations, WorkSafeBC
 - .8 R.S.B.C. 1996, c. 39 Safety Standards Act
- .5 Underwriter's Laboratories of Canada
 - .1 CAN/ULC-S110-07: Test for Air Ducts
- .6 SMACNA Publications
 - .1 ANSI/SMACNA 006 – 2006 H.V.A.C. Duct Construction Standards, Metal and Flexible
 - .2 Guidelines for seismic restraints of mechanical systems
- .7 Miscellaneous Standards
 - .1 ANSI/ASHRAE/IES Standard 90.1-2010 – Energy Standard for Buildings Except Low-Rise Residential Buildings
 - .2 Thermal Insulation Association of Canada – TIAC Best Practices Guide
 - .3 British Columbia Insulation Contractors Association – BC Insulation Contractors Association (BCICA) Standards Manual
- .2 Where multiple standards apply, the most stringent requirement shall be incorporated into the work.
- .3 Where these specifications specifically indicate requirements more onerous than the aforementioned codes, these specifically indicated requirements shall be incorporated into the work.

1.14 WARRANTY

- .1 Use of installed equipment during construction shall not shorten or alter the warranty period as specified in the General Conditions.
- .2 Take note of any extended warranties specified.
- .3 Furnish a written warranty stating that all work executed under this Division will be free from defects of material and workmanship for a period of one (1) year from the date of substantial performance, which shall include one (1) complete summer and one (1) complete winter of uninterrupted operation. Warranty shall include any part of equipment, units or structures furnished hereunder that show defects in the works under normal operating conditions and/or for the purpose of which they were intended.
- .4 The above parties further agree that they will at their own expense promptly investigate any mechanical or control malfunction, and repair or replace all such defective work, and all other damages thereby which becomes defective during the time of the guaranty-warranty.

1.15 ASBESTOS

- .1 All material / products installed shall be free of asbestos.

1.16 WORKMANSHIP

- .1 Workmanship shall be in accordance with well-established practice and standards accepted and recognized by the Consultant and the Trade.
- .2 The Consultant shall have the right to reject any item of work that does not conform to the Contract Documents and accepted standards of performance, quietness of operation, finish and appearance.
- .3 Employ only tradesmen holding valid Provincial Trade Qualification Certificates. Tradesmen shall perform only work that their certificate permits. Certificates shall be available for inspection by the Consultant.

1.17 DRAWINGS AND MEASUREMENTS

- .1 Drawings are generally diagrammatic and are intended to indicate the scope and general arrangement of work and are not detailed installation drawings. Do not scale the drawings. Obtain accurate dimensions from the Architectural and Structural drawings.
- .2 Where imperial units have been indicated in brackets [] following the requirements in SI units, the conversion is approximate and provided for convenience. The SI units shall govern.

1.18 SHOP DRAWINGS/PRODUCT DATA

- .1 Process
 - .1 Shop drawings/product data shall be reviewed, signed and processed as described in the General Conditions, in Division 1.
 - .2 Installed materials and equipment shall meet specified requirements regardless of whether or not shop drawings are reviewed by the Consultant.
 - .3 Do not order equipment or material until the Consultant has reviewed and returned shop drawings.
 - .4 Shop drawings shall be reviewed by the General Contractor and Mechanical Sub-Contractor indicating that the shop drawings have been reviewed, coordinated with the work and that the shop drawings are submitted without qualifications. Shop drawings shall bear the 'reviewed' stamp dated and initialled by the General Contractor and Mechanical Sub-Contractor prior to submitting the shop drawings to the consultant. Shop drawings, which do not bear the contractors and sub-trades 'reviewed' stamp, initials and date will be rejected and sent back as 'not reviewed'.
 - .5 If shop drawings are rejected technically after 3 submissions, the Contractor at no additional expense to the Owner shall revert to the specified product and manufacturer for this project.
- .2 Content
 - .1 Shop drawings submitted title sheet.
 - .2 Data shall be specific and technical.
 - .3 Identify each piece of equipment.
 - .4 Information shall include all scheduled data.
 - .5 Material for maintenance and operating manuals is not suitable.
 - .6 Advertising literature will be rejected.
 - .7 The project shall be identified on each document.

- .8 Information shall be given in S.I. units [Imperial Units optional in brackets].
- .9 The shop drawings/product data shall include:
 - .1 Clearly mark submittal material using arrows, underlining or circling to show differences from specified ratings, capabilities and options being proposed. Cross out non-applicable material. Specifically note on the submittal specified features such as special tank linings, pumps, seals, material, or painting.
 - .2 Mounting arrangements.
 - .3 Capacity and performance characteristics indicated on performance curves for fans and pumps.
 - .4 Sound Power Data, where requested.
 - .5 Control explanation and internal wiring diagrams for packaged equipment.
 - .6 Control system drawings including a written description of control sequences relating to the schematic diagrams.
- .3 Coordination
 - .1 Where mechanical equipment requires electrical connections, power or other services, the shop drawings shall also be circulated through the Electrical Contractor (or other "services" contractor(s)) prior to submission to the Consultants.
- .4 Keep one (1) copy of shop drawings and product data, on site, available for reference.

1.19 TEMPORARY HEATING

- .1 Use of permanent systems for temporary heat shall not modify terms of warranty.

1.20 TEMPORARY OR TRIAL USAGE

- .1 Temporary or trial usage by the Owner of mechanical equipment supplied under this contract shall not represent acceptance.
- .2 Repair or replace permanent equipment used temporarily.
- .3 Repair or otherwise rectify damage caused by defective materials or workmanship during temporary or trial usage.

1.21 DEFICIENCY HOLDBACKS AND DEFICIENCY INSPECTIONS

- .1 Work under this Division which is still outstanding when substantial performance is certified will be considered deficient and a sum equal to at least twice the estimated cost of completing that work will be held back.
- .2 It is expected that outstanding work will be completed in an expeditious manner and the entire holdback sum will be retained until the requirements for Total Performance of Division 15 work have been met and verified.

2.0 Products

2.1 OPERATING AND MAINTENANCE MANUALS

- .1 Prepare instruction manuals which include equipment manufacturers' operating and maintenance bulletins, a report on the balancing of the air and water systems and a report on chlorination of water mains.
- .2 The manufacturers' bulletins shall include:
 - .1 General description of the equipment and their operation.

- .2 Normal maintenance and minor trouble-shooting of each major item.
 - .3 Wiring diagrams.
 - .4 Control diagrams.
 - .5 Spare parts list.
 - .6 Local source of supply.
- .3 Submit three copies in suitably labelled stiff Accopress binders, to the Consultant at least 10 days prior to the substantial performance inspection date.

2.2 RECORD DRAWINGS

- .1 Comply with requirements indicated in Section 01780 – Closeout Submittals.
- .2 Maintain one set of contract drawing white prints, including all supplementary and revision drawings on site, solely for the purpose of recording, in red, any change and/or deviation from the Contract Drawings as it occurs. Include elevations and detailed locations of buried services.
- .3 The set of white prints will be provided to the contractor by the Consultant at the contractors cost.
- .4 The marked-up set of prints shall be reviewed on site monthly by the consultant during the construction process. This review will form a requirement for approval of the monthly progress claim.

3.0 Execution

3.1 ACCESSIBILITY

- .1 Install all work so as to be readily accessible for adjustment, operation and maintenance.

3.2 PROTECTION OF WORK

- .1 Protect equipment and materials, stored or in place, from the weather, moisture, dust and physical damage.
- .2 Mask machined surfaces. Secure covers over equipment openings and open ends of ductwork and conduits, as installation work progresses.
- .3 Equipment having operating parts, bearings or machined surfaces, showing signs of rusting, pitting or physical damage will be rejected.
- .4 Refinish damaged or marred factory finish.

3.3 CUTTING, PATCHING, DIGGING, CANNING, AND CORING

- .1 Lay out all cutting, patching, and coring required to accommodate the mechanical services. Coordinate with other Divisions.
- .2 Be responsible for correct location and sizing of all openings required under Division 15.

3.4 SERVICE PENETRATIONS IN NON-RATED SEPARATIONS

- .1 All tubing, ducts, wiring, conduits, etc. passing through non-rated fire separations and non-rated walls and ceilings shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent the passage of smoke and/or transmission of sound.

3.5 EQUIPMENT SUPPORTS

- .1 Provide stands and supports for equipment and materials supplied.

- .2 Support ceiling hung equipment with rod hangers and/or structural steel.

3.6 EQUIPMENT RESTRAINT

- .1 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.

3.7 MISCELLANEOUS METAL

- .1 Be responsible for all miscellaneous steel work relative to Division 15 of the Specifications, including but not limited to:
 - .1 Hanging, support, anchoring, guiding and relative work as it applies to ductwork, fans and mechanical equipment.
 - .2 Earthquake restraint devices - refer to Section 15242.

3.8 FLASHING

- .1 Flash and counterflash where mechanical equipment passes through weather or water proofed walls, floors, and roofs.

3.9 PAINTING

- .1 Clean exposed bare metal surfaces supplied under Division 15 removing all dirt, dust, grease and millscale. Apply at least one coat of corrosion resistant primer paint to all supports and equipment fabricated from ferrous metal.
- .2 Repaint all marred factory finished equipment supplied under Division 15, which is not scheduled to be repainted, to match the original factory finish.
- .3 Coordinate with Division 9.
- .4 Painting of all equipment and materials, supplied under Division 15, installed in mechanical equipment areas and inside finished areas of the building or exposed outside the building, is included under Division 9 of the Specification.

3.10 EQUIPMENT PROTECTION AND CLEAN-UP

- .1 Protect equipment and material in storage, on site and after installation until final acceptance. Leave factory covers in place. Take special precautions to prevent entry of foreign material into working parts of piping and duct systems.
- .2 All mechanical equipment stored on site shall be kept in a dry, heated and ventilated storage area.
- .3 Thoroughly clean ducts and equipment of dirt, cuttings, and other foreign material.
- .4 Provide, install and maintain 30% efficient temporary filters to return and exhaust air openings from ceiling spaces to prevent air born dust from entering ducts, plenums and coils. Install filters to return air grilles when fans are operated and building is not at a clean condition.

3.11 DEMONSTRATION AND INSTRUCTION TO OPERATING STAFF

- .1 Provide maintenance specialist personnel to instruct operating staff on maintenance and adjustment of mechanical equipment and any changes or modification in equipment made under terms of guarantee.
- .2 The demonstration shall include:
 - .1 Operation and sequencing of all automatic control devices.

- .2 Operation and maintenance requirements of all equipment under each mode of operation including:
 - .1 Fans
 - .2 Unit Heaters
- .3 Provide instruction during regular work hours prior to acceptance and turn-over to operating staff for regular operation.
- .4 Use Operating and Maintenance manuals for instruction purposes.
- .5 Finalize demonstration and instructions by obtaining a signed statement from the Owner that the demonstration and instructions have been given satisfactorily.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 01 30 00 – Submittals
- .2 Section 01 34 00 – Shop Drawing and Product Data
- .3 Section 01 78 00 – Closeout Submittals

1.2 REFERENCES AND REGULATORY REQUIREMENTS

- .1 British Columbia Building Code – 2012 (Restraints shall meet the requirements of the seismic zone in which equipment is installed. Building located in Port Hardy).

1.3 Submittals

- .1 Submit shop drawings of all restraining devices, not covered in the SMACNA Guidelines, including details of attachment to the structure, either tested in an independent testing laboratory or approved by a B.C. registered professional engineer.
- .2 Proposed inserts or connections to structure to follow directions of project structural consultant.

1.4 Application

- .1 Provide cable restraints on all isolated equipment and seismic restraint on all other equipment in general accordance with SMACNA Guidelines (see Products).

1.5 Scope of Work

- .1 Provide restraint on all equipment which is part of the building mechanical service systems to prevent injury or hazard to persons and equipment and to retain equipment in its normal position in the event of an earthquake. This specification covers equipment, which is not specifically covered in SMACNA.
- .2 Provide all seismic restraint related hardware, (including bolts and anchors) from point of attachment to equipment through to and including attachment to structure.
- .3 It is the entire responsibility of equipment manufacturers to design their equipment so that the strength and anchorage of internal components of the equipment exceeds the force level used to restrain and anchor the unit itself to the supporting structure.
- .4 Seismic restraints may only be omitted where permitted by SMACNA.

2.0 PRODUCTS

2.1 General

- .1 Mason Type SCB (Seismic Cable Brace) slack cable restraints supplied by Vibra-Sonic Control.
- .2 Restraint systems as indicated in 1998 SMACNA "Seismic Restraint Manual Guidelines for Mechanical Systems" (second edition), Seismic Hazard Level SHL A. If lesser restraint than recommended by SMACNA SHL A is proposed to meet local Code seismic requirements, provide shop drawings of details certified by a B.C. registered structural consultant.

3.0 EXECUTION

3.1 GENERAL

- .1 It is the responsibility of the contractor to ascertain that an appropriate size device be selected for each individual piece of equipment.

3.2 ISOLATED EQUIPMENT

- .1 Install cables using appropriate grommets, shackles, and other hardware to ensure alignment of the restraints and to avoid bending the cables at connecting points.
- .2 Connect slack cable restraints to ceiling hung equipment in such a way that the axial projection of the wires passes through the centre of gravity of the equipment.
- .3 Orient restraint wires on ceiling hung equipment at approximately 90 degrees to each other (in plan), and tie back to the ceiling slab at an angle not exceeding 45 degrees to the slab.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

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

1.2 GENERAL

- .1 Provide external thermal insulation for ductwork as called for. Note: items listed that do not require insulation.
- .2 Journeyman insulation applicators, skilled in this trade, shall perform the work.
- .3 Be responsible for ensuring that sufficient space is always provided to allow proper installation of insulation materials.
- .4 As applicable, use the latest edition of the "B.C. Insulation Contractors Association (BCICA) Standards Manual" as a reference standard if sufficient detail/information is not specified herein.

1.3 REGULATORY REQUIREMENTS

- .1 Flame spread ratings and smoke developed classifications shall be as required by the B.C. Building Code and NFPA 90A. Generally the flame spread rating throughout the material shall not exceed 25 and the smoke developed classification shall not exceed 50.
- .2 Insulation thickness and insulating values shall be in accordance with ASHRAE 90.1-2010.

1.4 DEFINITIONS

- .1 "CONCEALED" insulated mechanical services in furred spaces, shafts and hung ceilings considered to be concealed.
- .2 "EXPOSED" will mean not concealed.

2.0 PRODUCTS

2.1 EXTERNAL FLEXIBLE INSULATION

- .1 External flexible glass fibre insulation with integral vapour barrier.
 - .1 Minimum density - 12 kg/cu.m. [3/4 lbs/cu. ft.].
 - .2 Thermal Conductivity at 24 deg.C. - 0.042 W/m/deg.C.
 - .3 Acceptable Manufacturers:
 - .1 Certainteed STD Ductwrap FSK, Manson Alley-Wrap FSK, Owens Corning all service faced duct wrap, Knauf FSK Ductwrap, Schuller Micro Lite FSK.

2.2 ACCESSORIES

- .1 Insulation Adhesive
 - .1 Bakelite 230-39, Childers CP-82, CP-56W, Epolux Cadoprene 400, Foster 85-20, Polymer Glasstack #25, Robson Ticki-Tuff.
- .2 Insulation Coating
 - .1 Bakelite 120-09, Childers CP-50, Epolux Cadalag 336, Foster 30-36, Robson White Lag.
- .3 Reinforcing Membrane
 - .1 Glass reinforcing membrane as commercially available.
- .4 Seal Coating
 - .1 Bakelite 120-09, Childers CP-50, Epolux Cadalag 336, Foster 30-36, Robson White Lag.
- .5 Fabric Adhesive
 - .1 Bakelite 120-18, Childers CP-52, Epolux Cadalag 336, Foster 30-36.
- .6 Fabric Coating
 - .1 Bakelite 120-09, Childers CP-50, Epolux Cadalag 336, Foster 30-36.

2.3 SCOPE OF INSULATION

- .1 Scope 1: External Flexible Insulation:

Service	Thickness	
	Mm	[ins]
All exhaust air ductwork from outside wall or roof to 1.5 m [5 ft.] inside building or backdraft damper.	25	[1]

3.0 EXECUTION

3.1 APPLICATION

- .1 Apply external insulation to ductwork only after all tests have been made and systems accepted by the Consultant as airtight.
- .2 Apply insulation and insulation finish in a workmanlike manner so that the finished product is uniform, smooth in finish, pleasing to the eye and with longitudinal seams concealed from view. Apply ductwork insulation materials, accessories and finishes in accordance with manufacturer's recommendations.
- .3 Insulation shall be continuous through all non-rated separations.

3.2 DUCTWORK INSULATION FINISHES

- .1 "Concealed" ductwork insulation, in horizontal and vertical service spaces, will require no further finish.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

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

1.2 REFERENCE STANDARDS

- .1 Perform work in accordance with the recommendations and requirements of:
 - .1 National Fire Protection Association, NFPA 10 - Standard for Portable Fire Extinguishers.
 - .2 B.C. Building Code.

2.0 PRODUCTS

2.1 FIRE EXTINGUISHER FE-1 (10 LB NO CABINET)

- .1 Surface mounted extinguisher without cabinet.
- .2 Extinguisher: 4.54 kg [10 lb.] dry chemical, multipurpose ABC, fully rechargeable, steel cylinder with bottom skirt, polyester powder coat finish, waterproof stainless steel gauge, stainless steel or aluminum valve body, rivets and gauge, handles with polyester powder coat finish, steel pull pin, matching wall hook, hose strap, service info tag, hose and nozzle.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install fire extinguishers at locations indicated on the drawings.
- .2 Mount fire extinguishers such that the top of the extinguisher is at 1220 mm [4 feet] above the floor.

3.2 IDENTIFICATION

- .1 Identify fire extinguishers in accordance with the recommendations of NFPA 10.
- .2 Attach a tag or label to all fire extinguishers, indicating the month and year of installation, with space for recording subsequent service dates.

END OF SECTION

1.0 General

1.1 RELATED SECTIONS

- .1 Section 01300 – Submittals
- .2 Section 01340 – Shop Drawing and Product Data
- .3 Section 01780 – Closeout Submittals
- .4 Section 01820 – Demonstration and Training
- .5 Section 01810 – Commissioning

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No.46-M1988(R2001), Electric Air-Heaters.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01300 – Submittals.
- .2 Submit product data sheets for unit heaters. Include:
 - .1 Product characteristics.
 - .2 Performance criteria.
 - .3 Mounting methods.
 - .4 Physical size.
 - .5 kW rating, voltage, phase.
 - .6 Cabinet material thicknesses.
 - .7 Limitations.
 - .8 Colour and finish.
- .3 Submit product data sheets for unit heaters.
 - .1 Include product characteristics, performance criteria, physical size, limitations and finish.

1.4 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for unit heaters for incorporation into manual specified in Section 01780 – Closeout Submittals.

2.0 Products

2.1 UNIT HEATERS

- .1 Unit heater: to CSA C22.2 No.46, horizontal discharge complete with adjustable louvers finished to match cabinet.

- .2 Fan type unit heaters with built-in high-heat limit protection, fan-delay switches.
- .3 Fan motor: totally enclosed, type with resilient mount.
 - .1 Built-in fan motor thermal overload protection.
- .4 Hangers: as required.
- .5 Refer to equipment schedule on drawings.

2.2 CONTROLS

- .1 Wall mounted thermostats: supplied by equipment manufacturer. Coordinate low voltage or line voltage control with electrical before selecting controls.

3.0 Execution

3.1 INSTALLATION

- .1 Refer to Section 15242 for seismic restraint of unit heaters.
- .2 Suspend unit heaters from ceiling or mount on wall as indicated.
- .3 Install thermostats in locations indicated.
- .4 Make power and control connections.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 01810 – Commissioning.
- .2 Test cut-out protection when air movement is obstructed.
- .3 Test fan delay switch to assure dissipation of heat after element shut down.
- .4 Test unit cut-off when fan motor overload protection has operated.
- .5 Ensure heaters and controls operate correctly.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

- .1 This Section of the Specification forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Refer to Section 152420 for required seismic restraint of ductwork.

1.2 REFERENCE STANDARDS

- .1 The construction and installation of ductwork and plenums shall be in accordance with the latest edition of the following referenced SMACNA manuals and ASHRAE handbooks.
 - .1 SMACNA - H.V.A.C. Duct Construction Standards.
 - .2 SMACNA - H.V.A.C. Air Duct Leakage Test Manual.
 - .3 ASHRAE - Handbook - Equipment Volume.

1.3 GENERAL

- .1 Duct sizes on drawings indicate clear inside dimensions. For acoustically lined or internally insulated ducts, maintain inside duct dimensions.
- .2 Where duct sizes are shown in nominal metric sizes, round and oval duct sizes may be supplied in the nearest available sizes in equivalent imperial units.
- .3 The project drawings are diagrammatic and although efforts have been made to provide information regarding the number of offsets and transitions, not all are necessarily shown. Changes may be required in duct routings, elevation and duct shape to eliminate interference with structure and other services. All required adjustments shall be established when coordinating and field measuring the work prior to fabrication and must be provided as part of the contract and all associated costs must be considered and included.
- .4 Ductwork used on this project shall be clean and free from scale, corrosion and deposits. All ductwork shall be degreased and wiped clean of all oil and other surface films with appropriate solvents prior to installation.
- .5 All ductwork shall be delivered clean to the site and maintained in clean condition. Dirty ductwork shall be removed from site.
- .6 Provide seismic restraints for ductwork in accordance with SMACNA "Guidelines for seismic restraints of mechanical systems and plumbing piping systems".

2.0 PRODUCTS

2.1 GALVANIZED STEEL

- .1 Galvanized steel shall have a 380 g/sq.m. [1-1/4 oz/sq.ft] galvanizing coat both sides to ASTM A525 G90.

2.2 DUCTWORK AND PLENUM PRESSURES

- .1 Provide ductwork and plenums fabricated from galvanized steel for the static pressure categories listed below.
 - .1 500 Pa [2" W.G.] static pressure
 - .1 SMACNA Seal Class C
 - .2 All supply and exhaust ductwork.

2.3 DUCTWORK - 500 PA [2" W.G.] STATIC PRESSURE

- .1 SMACNA Seal Class C
- .2 Provide galvanized iron ductwork for system operating pressures 500 Pa [2" W.G.] and less. Ductwork shall be constructed, reinforced, sealed and installed to withstand 1-1/2 times the working static pressure.
- .3 Construct rectangular ductwork in accordance with Section I including Tables 1-5, 1-10, 1-11, 1-12, 1-13 and Figs. 1-4 through 1-18 of the SMACNA Duct Standards.
- .4 Nomasco "Ductmate System, Lockformer TDC " or Exanno "Nexus System" may be used for rectangular duct joints.
- .5 At least two opposite faces of all rectangular ductwork must be joined together using a type of joint, which cannot pull apart.
- .6 Construct rectangular duct fittings in accordance with Section II including Figs. 2-1 to 2-11 and Figs. 2-16 to 2-18 of the SMACNA Duct Standards.
- .7 Construct round ductwork in accordance with Section III including Table 3-2 and Figs. 3-1 and 3-2 of the SMACNA Duct Standards, but excluding beaded crimp joints and snaplock seams.
- .8 The use of duct sealing tape is not acceptable.

3.0 EXECUTION

3.1 GENERAL

- .1 Make the taper of diverging transitions less than 20 deg. and the taper of converging transitions less than 30 deg., in accordance with Fig. 2-9 of the SMACNA Duct Standards. Maximum divergence upstream of equipment to be 30 deg. and 45 deg. convergence downstream.
- .2 Make the inside radius of any rectangular duct elbow at least equal to the duct width, measured in the direction of the radius. If space conditions do not permit a full radius elbow to be installed, use square elbows with multi-blade turning vanes.
- .3 For 500 Pa [2"] pressure systems, install tie rods to limit the maximum unsupported vane length to 914 mm [36"]. Refer to Fig. 2-4 of the SMACNA Duct Standards.
- .4 Cross-break or bead all metal duct panels unless otherwise noted.
- .5 Do not cross-break bottom duct panels when ductwork is handling moisture.

- .6 Grade all ductwork handling moisture, a minimum of 1:120 [1" in 10 ft] back to the source or at low points in the ductwork, provide a 150 mm [6"] deep drain sump and 32 mm [1-1/4"] dia. drain connection with deep seal trap and pipe to drain.
- .7 Construct ductwork handling moisture with three sided bottom sections and a separate top panel. Install the three sided bottom sections and internally seal the transverse joints with CGE Silicone Sealant "Silpruf". Then install the top panels and seal the top panel seams and joints.
- .8 Support ductwork using galvanized steel straps, cadmium plated threaded rods, flat bar or angle hangers. Attachments to the structure shall be compatible with the structure and selected for the load of the ductwork. Install ductwork hangers in accordance with Section IV including Tables 4-1 through 4-3 and Figs. 4-1 through 4-9 of the SMACNA Duct Standards.
- .9 Prior to the fabrication of ductwork, co-ordinate and field measure all ductwork to ensure a complete installation respecting all other services. Provide all necessary fittings, offsets, and alternate construction methods to facilitate the installation.
- .10 Arrange ductwork so that duct mounted equipment can be easily removed.
- .11 Ducts passing through non-rated fire separations, sound insulated walls and through non-rated walls and floors shall be tightly fitted and sealed on both sides of the separation with silicon sealant to prevent passage of smoke and/or transmission of sound. (U.L.C. approved fire stop sealant is not a requirement). Where ducts are insulated provide a 0.61 mm [24 ga] thick galvanized steel band tightly fitted around insulation and then caulk to band.
- .12 During construction, protect openings in ductwork, from dust infiltration, by covering with polyethylene, and protect floor outlet duct openings with metal caps.
- .13 Provide drip pans under piping and shields for protection of electrical panels and equipment.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

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

1.2 QUALITY ASSURANCE

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards

2.0 PRODUCTS

2.1 DUCT CONNECTORS - VIBRATION ISOLATION

- .1 Provide flexible duct connections to provide vibration isolation at all duct and plenum connections to fan and air handling units. See Figure 2-19 SMACNA Duct Standards.
- .2 Minimum Requirements:
 - .1 Pre-assembled 75 mm [3"] minimum long flexible connection with 75 mm [3"] long 0.62 mm [24 ga] galvanized steel duct connectors on each side of the flexible connection. Flexible connector - fiber glass fabric with elastomer coating.
- .3 Centrifugal fans with 900 mm [36"] diameter and larger fan wheels, use 150 mm [6"] long flexible connection.
- .4 Do not install connectors on perchloric acid fume exhaust systems.
- .5 Standard of Acceptance: Duro Dyne "Durolon", Dynair "Hypalon", Ventfabrics "Ventlon".

2.2 DUCTWORK SEALERS

- .1 Provide duct sealing compounds for use in fabrication of all ductwork joints.
- .2 The use of duct sealing tapes is not acceptable.
- .3 Seal Classifications:
 - .1 Low Pressure Systems - SMACNA Seal Classification C.
 - .2 Exhaust Systems:
- .4 Standard of Acceptance:
 - .1 Foster 32-14, Hardcast Versa Grip, Hardcast Foil Grip 1402, Robson's Duct Seal-WB, United Duct Sealer, Trans Continental Multi-Purpose.
- .5 Where accessible, apply sealer to inside of joints on ducts under positive pressure - e.g. on the discharge side of fans.

- .6 Apply sealer to outside of joints on ducts under negative pressure - e.g. on the suction side of fans.

3.0 EXECUTION

3.1 DUCT CONNECTORS - VIBRATION ISOLATION

- .1 Ensure flexible duct connectors do not reduce duct free area on suction side of fans.

3.2 CLEANING

- .1 Upon completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

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

1.2 QUALITY ASSURANCE

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards.

1.3 SUBMITTALS

- .1 Fan shop drawings shall include sound rating data and fan curves showing operating point plotted on curves.
- .2 Fan shop drawings shall include motor efficiencies.

2.0 PRODUCTS

2.1 FANS - GENERAL

- .1 Fans: statically and dynamically balanced, constructed in conformity with AMCA-99-83. Dynamically balance fans to 1.5-mm/s vibration amplitude, maximum measured on bearing housings. Provide fan shafts with critical speed at least 1.5-times operational speed.
- .2 Ratings: based on tests performed in accordance with AMCA 210, and ASHRAE 51-85. Units shall bear AMCA certified rating seal.
- .3 Where required, fans shall be treated to suit the airstream in which they are used.
- .4 Provide secure attachment points for seismic restraints. Mounting brackets shall be suitable for seismic loading.

2.2 FANS - IN-LINE CENTRIFUGAL

- .1 Minimum Requirements:
 - .1 In-line centrifugal fan with axial flow construction.
 - .2 Square housing, steel with galvanized finish.
 - .3 Access panel to provide cleaning and service access.
 - .4 Backward inclined, non-overloading wheel.
 - .5 Drip-proof motor.
 - .6 Permanently lubricated pillow block ball bearings.
 - .7 Rust preventative coating on shafts.
 - .8 Belt or direct driven as scheduled.

- .2 Refer to equipment schedule on drawings.

3.0 EXECUTION

3.1 FANS

- .1 Install fans as indicated, complete with vibration isolators and seismic restraints as specified in Sections 15242.
- .2 Install fans with flexible connections on inlet ductwork and on discharge ductwork. Ensure metal bands of connectors are parallel with minimum 25 mm [1"] flex between ductwork and fan during running.
- .3 Install connectors such that connectors are clear of the air stream. Provide flange extensions as necessary. Ensure accurate alignment of duct to fan.
- .4 Provide safety screens where fan inlet or outlet is exposed.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

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

1.2 QUALITY ASSURANCE

- .1 Catalogued or published ratings shall be those obtained from tests carried out by manufacturer or those ordered by him from independent testing agency signifying adherence to codes and standards

2.0 PRODUCTS

2.1 AIR TERMINALS

- .1 General:
 - .1 Grilles, registers and diffusers shall be product of one manufacturer.
 - .2 Refer to drawings for sizes and air quantities.
 - .3 Refer to equipment schedule on drawings.
 - .4 Base air outlet application on space noise level of NC 30 maximum.
 - .5 All air terminals must be checked for compatibility with ceiling types. Refer to Architectural reflected ceiling plans.
 - .6 The manufacturer (other than the design listed) shall match performance data and indicate a specific comparison for each item, with the shop drawing submission.
 - .7 All ceiling mounted air terminals shall be provided with means for attachment of two seismic security wires at opposite corners of each air terminal.

2.2 LOUVRES - STATIONARY

- .1 General:
 - .1 Extruded aluminum frames and blades.
 - .2 All welded construction with exposed joints ground flush and smooth or mechanically fastened with stainless steel fasteners.
 - .3 Lower assembly sealed and watertight.
 - .4 Removable 1.6 mm dia. [0.063"] aluminum wire bird screen with 12 mm [1/2"] mesh.
 - .5 Birdscreen mounted in 0.66 mm [20 ga] thick aluminum folded frame. Frame to be installed inside louver.

3.0 EXECUTION

3.1 AIR TERMINALS

- .1 Install with cadmium plated screws in countersunk holes where fastenings are visible.
- .2 Install ductwork as high as practical, using offsets where required to obtain maximum duct neck lengths for diffusers.
- .3 Paint ductwork behind grilles with matte black paint where duct or insulation surfaces are visible.
- .4 Attach registers and grilles to branch ducts with duct necks having minimum length to prevent grille or register damper from protruding into branch duct.
- .5 Hand over door grilles to the General Contractor for installation.

3.2 LOUVRES

- .1 Provide all necessary flashing and counterflashing for louvres installed in walls.
- .2 Caulk louvre and flashing and counterflashing to make installation water tight.
- .3 Blank-off panels shall be constructed to SMACNA standards, minimum 20 Ga. Sandwich panel with 25 mm [1"] thick fibreglass insulation.
- .4 All blank-off panels shall have a painted flat black enamel finish.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

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

1.2 GENERAL

- .1 The controls system is to be complete with all necessary control components and connections to achieve the specified functions and to permit the H.V.A.C. systems to perform properly in the manner described and as hereinafter specified.
- .2 The control system is to be set up and adjusted to achieve optimum operation of the H.V.A.C. system.
- .3 This Section is a performance specification clarified in certain sections to establish minimum standard of equipment, installation or level of control. The specification describes the basic functions required but not all of the installation details or components. This Trade is expected to have sufficient experience to be able to design and estimate the cost of an appropriate control system. Materials and work necessary to achieve a satisfactory result will not be considered extra to the contract.
- .4 The contractor shall review all contract documents and visit the site if possible, prior to the closing date of the tender.
- .5 When preparing shop drawings, review the proposed sequences, suggest improvements and review these with the Consultant.
- .6 Work with the other parties involved in commissioning, assess how the programming can be modified to improve function, review this with the Consultant and modify the programming as instructed by the Consultant.

1.3 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with Sections 01300.
- .2 Shop drawings shall include:
 - .1 Manufacturer's descriptive technical literature for all equipment and devices.
 - .2 Wiring diagrams.
 - .3 Written description indicating sequence of operation. Shop drawings will be rejected if the written description is not included with the submission.

1.4 ELECTRICAL COMPONENTS, WIRING AND CONDUIT

- .1 By Control Contractor (Division 15).
 - .1 All control system components to make a complete and operable system, except those supplied as part of packaged equipment controls, but

- including all auto-sequencing devices and electrical interlocks required to accomplish the sequences specified hereafter. Refer to the electrical equipment schedule, the electrical drawings and the electrical specification, which describes the limits of the extent to the work in Division 16 serving mechanical systems. Materials, equipment, connections and power not provided by Division 16 but required for the Control System shall be provided under this section.
- .2 All control circuit transformers (120/1/60 or 24/1/60 and as designated).
 - .3 All control wiring and metallic conduit for mechanical system controls.
 - .4 Supply, installation and connection of all electric control items including: damper motors, relays, outside sensors, safety devices, electric thermostats, wiring to terminal strips, controllers, etc.
 - .5 Be responsible for coordinating with Division 16.
 - .6 Electrical work installed under Division 15 shall be to the standards specified under Division 16.
- .2 By Division 16.
- .1 All power wiring and conduit from power distribution system up to and including connection to all motors and starters.
 - .2 All disconnect switches required (unless specified in schedules as being integral with equipment).
 - .3 All motor protection switches, stop-start switches, magnetic starters, contactors and hand-off-automatic selector switches except those supplied as part of packaged equipment.
- .3 Note:
- .1 All magnetic starters for equipment shall have the following features supplied under Division 16.
 - .1 Hand-off-automatic selector or on-off selector, or start-stop buttons in cover with hand-automatic bridge if applicable.
 - .2 Pilot light.
 - .3 120 volt coils.
 - .4 120 volt control transformer.
 - .5 Four auxiliary dry contacts for interlocks; two normally open and two normally closed.
 - .2 The Controls Contractor is responsible for reading Division 16 plans and specifications to determine scope of responsibility and standards.
- .4 Wiring:
- .1 Carrier System – Open, exposed areas including mechanical, electrical and equipment rooms:
 - .1 All wiring shall be run in EMT conduit except the final 900mm of wiring to all operators and to all sensors subject to vibration, which shall be run in flexible metallic conduit.
 - .2 Provide steel fittings with nylon throats for all conduit connections.

- .2 Wire:
 - .1 Line voltage power or switched power wiring - #12 gauge copper wire minimum.
 - .2 Line voltage control wiring - #14 gauge copper wire, length not to exceed 50 meters; #12 gauge copper wire, lengths exceeding 50 meters.
 - .3 Low voltage - minimum #22 gauge wire as directed by applicable electrical codes and requirements. 24 gauge wire for thermostat cables
- .3 Note:
 - .1 Run carrier system parallel to building lines.
 - .2 Support conduit carrier system every one meter independent of piping, ductwork and equipment.
 - .3 Seal all penetrations through fire separations or walls as per code requirements.
 - .4 Identify all junction box covers with control company label.
 - .5 Identify with colour bands, all conduits at all junction and pullboxes, at both sides of wall and floors and at not more than 7.5 m [25 Ft] intervals along the length. Identification bands to be sprayed on and not less than 100mm [4"] wide. Bands to be pink in colour unless in conflict with Division 16 [26] colours.
 - .6 Use colour coded conductors.
 - .7 Adhere to all applicable electrical codes and regulations.
 - .8 Obtain electrical permit.
 - .9 For non-CSA equipment where required by electrical code, submit to Inspection Authorities and obtain approval prior to installation of equipment on site.

1.5 IDENTIFICATION

- .1 Identify all controls with symbols relating directly to the control diagram. Use plasticized tags, engraved brass, aluminum, metalphoto or lamicoïd labels and secure them to, or adjacent to, the control devices with key chains or cable ties.
- .2 All manual switches supplied by this trade, unless they come with standard nameplates, shall be labelled with engraved lamicoïd plastic nameplates to clearly indicate the service. Wording on nameplates shall be subject to approval by the Consultant.

1.6 SYSTEM COMMISSIONING AND CALIBRATION

- .1 Set up and calibrate all control loops and sensors during the initial start-up of the systems and check, recalibrate and readjust as necessary during the Owner's Demonstration and Instruction period.
- .2 Upon completion of the installation, perform all necessary testing and debugging operations satisfactorily.
- .3 Perform all modifications and alterations as required to correct any deficiencies

noted during these tests.

- .4 Check sensor calibration and control system operation during the first heating season and prior to the first cooling season.

1.7 MAINTENANCE SERVICE DURING THE WARRANTY PERIOD

- .1 The Contractor shall provide all services, materials and equipment necessary for the maintenance of the entire Control System, for a period concurrent with the warranty period. Any necessary material required for the maintenance work shall be provided by the Contractor.

END OF SECTION

1.0 GENERAL

1.1 RELATED WORK

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

1.2 GENERAL REQUIREMENTS

- .1 All external trim material shall be completely corrosion resistant with all internal parts assembled in watertight, shockproof, vibration proof, heat resistant assembly.
- .2 Use standard conduit box termination with screwdriver connector block unless otherwise specifically stated.
- .3 Operating conditions 0°C to 60°C with 10-90% RH (non-condensing) unless otherwise specifically stated.

2.0 PRODUCTS

2.1 ROOM HUMIDISTATS & THERMOSTATS

- .1 Minimum Requirements
 - .1 Adjustable sensitivity and set point.
 - .2 Electric.
 - .1 Low or line voltage as specified.
 - .3 Standard metal or Lexan covers.
 - .1 Visible thermometer (thermostats only) graduated in deg.C.
 - .2 Concealed set-point adjustment (or removable key adjustment).
 - .3 Lock key covers.

2.2 TIMECLOCKS

- .1 Acceptable Manufacturers:
 - .1 Intermatic, Paragon, Tork.
- .2 Minimum Requirements:
 - .1 150 mm (6") dia. dial, 7-day calendar type.
 - .2 Spring reserve (minimum of 10 hours) and manual reset.
- .3 Accessories:
 - .1 Accessible manual-automatic bypass switch (one for each switching circuit).
 - .2 Adjustable spring wound timer (0-12 hours) without "hold" (Intermatic F12H).

3.0 EXECUTION

3.1 GENERAL

- .1 All equipment shall be installed according to manufacturers' published instructions.
- .2 Thermostats and Humidistats:
 - .1 All sensors shall be stabilized to such a level as to permit on-the-job installations that will require minimum field adjustments or calibration.
 - .2 Sensor assemblies shall be readily accessible and adaptable to each type of application in such a manner as to allow for quick, easy replacement and servicing without special tools or skills.
 - .3 Locate instruments in the same vertical centreline as light switches.
 - .4 Where instruments are indicated on an outside wall install on a stand-off wall bracket which provides an air space between the instrument and the wall; or on an insulating base (e.g. a cork pad).
 - .5 Install protective metal guards on instruments in areas where they may be subject to damage. Bolt guards, independent of instruments to separate baseplates. Provide backing in wall for securing mounting bases.
- .3 All field devices to be properly identified.
- .4 Mount electrical instruments on standard electrical rough-in boxes fastened to structure.
- .5 Testing:
 - .1 All field devices shall be properly calibrated and tested for performance and accuracy. A report detailing test performed and results to be submitted to the consultant for approval. The consultant will verify results at random. Provide all testing equipment necessary. Provide manpower necessary to assist consultant's verification.

END OF SECTION

1.0 GENERAL – REFER TO SECTION 159100

2.0 PRODUCTS – REFER TO SECTION 159200

3.0 EXECUTION

3.1 HVAC CONTROL OBJECTIVES:

- .1 Program the system to meet the following objectives:
 - .1 Temperature & Humidity:
 - .1 Control the temperature and humidity in the space.
 - .2 Ventilation:
 - .1 Control the fan operation to meet code ventilation requirements under all operating conditions.
 - .3 Energy:
 - .1 Provide no more heating than is essential.

3.2 CONTROL BUILDING HVAC CONTROLS:

- .1 Unit Heater (UH-1 & 2)
 - .1 Wall mounted sensor shall energize unit to maintain a minimum space temperature of 10°C.
- .2 Exhaust Fan (EF-1)
 - .1 Wall mounted combined temperature/humidity sensor shall modulate ECM fan motor to maintain a maximum space temperature or 23°C.
 - .2 Wall mounted combined temperature/humidity sensor shall modulate ECM fan motor to maintain a maximum space humidity of 65°C.
 - .3 Wall mounted timeclock to enable fan for a 15-minute purge cycle (adjustable) starting at 7:00am, 365 days per year.

END OF SECTION

DIVISION 25

INTEGRATED AUTOMATION

1.0 GENERAL

1.1 DESCRIPTION

- .1 This section specifies the General Provisions for the supply, delivery, installation, calibration and commissioning of the process control and instrumentation system, including all control systems and instrumentation.
- .2 It is the intention of these specifications and drawings, to provide for a complete and fully operating control and instrumentation system, with facilities and services to meet the requirements described herein, and in complete accord with applicable codes and ordinances. The specifications do not purport to cover details entering into the design of the system which shall be the responsibility of the Contractor.
- .3 The work to be done shall include the provision of all labour, materials, tools and equipment as well as the application of a competent knowledge of construction, whether or not directly specified or shown on the plans, required for the installation testing and placing into service the complete control and instrumentation system, except when it is specifically mentioned that certain materials and/or labour are not part of the contract.
- .4 These specifications shall apply to and govern all trades doing control and instrumentation work and shall be read in conjunction with and form a part of the general specifications of the project.
- .5 The Control and Instrumentation work includes but is not limited to the following:
 - .1 Control panel.
 - .2 Primary Elements for chlorine, flow, level, pressure, temperature, etc.
 - .3 Control Wiring and conduit.
 - .4 Standby Generator.
 - .5 Indicators, annunciators, and PLCs.
 - .6 Communications systems (in Division 25 and 27)
- .6 The PLC programming is the responsibility of Stantec, and the contractor is responsible for wiring and programming all the instrumentation and commissioning of the entire system.

1.2 EQUIPMENT MANUFACTURERS

- .1 All equipment shall be manufactured by experienced manufacturers who can demonstrate experience for all equipment offered in similar facilities and processes.

- .2 Requests for approval of alternative suppliers shall be submitted for approval. Refer to Section 26 05 01 - Common Work Results for Electrical.
- .3 The majority of equipment shall be supplied by a single manufacturer, particularly where aesthetics are of concern, such as in panels.

1.3 CODES, PERMITS & FEES

- .1 The work shall comply with the requirements of the current edition of the Canadian Electrical Code, Part 1, and the regulations of the Province of British Columbia.
- .2 Obtain the required construction permits, arrange for inspections and supply the Prime Contractor, City and Engineer with approval certificates pertaining thereto including a certificate of final inspection

1.4 REFERENCE STANDARDS

- .1 Unless otherwise specified, equipment shall conform to appropriate standards and recommendations of:
 - .1 The Instrument Society of America, hereinafter referred to as ISA.
 - .2 The Canadian Standards Association, hereinafter referred to as CSA.
 - .3 The American Society of Mechanical Engineers, hereinafter referred to as ASME Standards.
- .2 All equipment shall be metric - SI Standard.

1.5 OPERATION MANUALS

- .1 Submit operation manuals in accordance with Section 26 05 01 - Common Work Results - Electrical.

1.6 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with 01 30 00 – Submittal Procedures and the specifications.
- .2 Shop drawings to indicate (where applicable):
 - .1 Completed instrument data sheets by Vendors.
 - .2 Instrument tag number(s).
 - .3 Available range.
 - .4 Materials of construction.
 - .5 Wetted materials.
 - .6 Accuracy.
 - .7 Rating of enclosure.

- .8 Other details listed on the Instrument Specification Sheet(s).
 - .3 Shop drawings for control panels shall include all the information described in Section 01 30 00 – Submittal Procedures.
 - .4 Attach a copy of the Instrument Specification Sheet to each shop drawing for field instruments.
 - .5 Clearly indicate on the shop drawing which model, features, materials, etc. are being provided, when more than one is shown.
- 1.7 RECORD DRAWINGS AND OPERATION AND MAINTENANCE MANUALS**
- .1 Record Drawings in accordance to the requirements of Section 01 33 00 – Project Record Documents.
 - .2 Mark up engineering drawings with construction details and submit to Engineer two (2) sets of drawings for plan of record.
 - .3 Operation and Maintenance Manuals in accordance with Section 01 33 00 – Project Record Documents.
- 1.8 INSTRUMENTATION SUB-CONTRACTORS**
- .1 The work as specified in this Section to be performed by a qualified control and instrumentation contractor.
- 2.0 PRODUCTS**
- 2.1 PROCESS PIPING CONNECTIONS**
- .1 Connections to be in accordance with instrument details shown on the drawings or attached to the instrument specification sheets and manufacturer recommended installation procedures.
 - .2 Pipe or tubing fittings and valves for process leads to instruments to be of the type, material and pressure standard as called for on the process piping standard of the line pressure being sensed.
 - .3 Process leads to be sloped, vented and sized in accordance with accepted instrument practices in the industry. Provide necessary unions in the pipe or tubing to allow removal of instruments for service.
 - .4 Piping and capillary tubing lines between instruments and points of connection to be supported and located so as to be protected from damage and deflection.

2.2 MATERIALS

- .1 All materials shall be new and in new condition.
- .2 All materials shall bear the approval of the Canadian Standards Association (CSA).
- .3 All materials shall be suitable for full operation within specified environments.

2.3 POWER SUPPLIES

- .1 Provide all necessary power supplies for controls and instruments.
- .2 Power wiring to field devices shall be minimum #12 AWG.

2.4 CONTROL WIRING

- .1 Unless specified otherwise, all conductors for control wiring shall be copper with RW90, X-link insulation, 300 Volts. For any control wiring run with power cabling, conductors shall be rated 600 Volts.
- .2 Neutral conductors shall be white, grounding conductors shall be green, DC conductors shall be red and AC conductors shall be black.
- .3 Instrumentation wiring for analog signals shall be individually shielded - multipair cable #16 AWG (7x16) tinned copper.
- .4 Control wiring for level and pressure switches shall be #14 THHN black.
- .5 Provide armor for wiring as required when installed near wiring of other systems or other voltages.
- .6 Provide shielding for signal and communication wiring.
- .7 Where dimensional details are required, work with the applicable structural and architectural drawings.
- .8 The Contractor is responsible for correcting any work completed contrary to the intent of the drawings and specification and shall bear all costs for correcting same.

2.5 CONDUIT, WIRING AND CABLE

- .1 Supply and install all conduit, wiring, control and instrumentation cables for the control, instrumentation and low voltage and line voltage control for building services, including those systems not specifically detailed in the drawings. This could include control of HVAC systems, etc.

- .2 Conduit and wiring for power, lighting, miscellaneous electrical systems and power supplies to control instrumentation and building service panels including other components requiring line voltage power supply shall be supplied and installed as specified here and in Division 26.

2.6 JUNCTION BOXES AND ENCLOSURES

- .1 All junction boxes and enclosures shall be rated NEMA 4X unless otherwise specified.
- .2 All wiring shall be terminated on terminal blocks as specified in Section 26 05 20 – Wire and Box Connectors.
- .3 120VAC and 24VDC wiring shall be isolated from each other and terminated on separate terminal strips.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install and interconnect all process control system equipment.
- .2 Install all equipment in accordance with the manufacturer's recommendations and in a manner that will ensure satisfactory operation upon completion.
- .3 Provide all labour and all necessary equipment including timbers, scaffolding, tools and rigging materials for installation of the equipment.
- .4 Contractor shall be responsible for coordinating all mechanical, electrical and other works for the equipment being installed.
- .5 Installation shall meet the minimum standards set forth by Standards and Practices for Instrumentation.
- .6 Use trained personnel to install systems and controls as per approved shop drawings and in accordance with manufacturer's recommendations.
- .7 Follow building lines with all piping and electrical wiring runs. Utilize proper separation and wiring techniques.

3.2 INSTRUMENT TAGGING

- .1 General
 - .1 Provide each instrument with a tag in accordance with Section 01 18 00 – Identification Systems.

- .2 Tags to be stainless steel and supplied by the instrument manufacturer wherever possible.
- .3 Affix tags to instruments with nylon tie-wraps or adhesive. Do not use adhesive on curved surfaces.
- .2 The Contractor shall tag each instrumentation and control cable conductor with unique identification as given on drawings. The tag at the end of a cable or conductor will identify where the opposite end of the cable or conductor is terminated.
- .3 The Contractor shall maintain accurate records during cable, conductor and conduit installation as to the tags which are to be installed. The Contractor's records shall be turned over to the Engineer for periodic review when requested.
- .4 In the event the Contractor must develop a conduit or cable identification not given on drawings the strategy to label all conduit, cable and conductors uniquely by incrementing a numeral behind a C (Control), I (Instrumentation), E (Element) or P (Power) prefix. Where a unique tag number cannot be developed, the Contractor shall advise the Engineer for clarification.
- .5 No two wires or cables shall have an identical tag.

3.3 COORDINATION OF WORK

- .1 Cooperate and coordinate with other trades on the project.
- .2 Check drawings and specifications of other trades for conflict and coordination with the control and instrumentation trade. If any conflicts are found, obtain a ruling from the City and Engineer before proceeding.

3.4 MOUNTING OF INSTRUMENTS, CONTROLS AND ACCESSORIES

- .1 Instruments to be installed in accordance with the drawings or as detailed in the installation manual for the equipment. Instruments shall be rigidly supported, level and plumb, and in such a manner as to provide accessibility, protection from damage, isolation from heat, shock and vibration, and freedom from interference with other equipment, piping and electrical work.
- .2 Do not install Instruments until heavy construction work adjacent to the instruments has been completed.
- .3 Locate instrument devices including accessories where they will be accessible from structural platforms, permanent ladders, or grade. Mount local indicating instruments facing toward, in line or sight and within reading distance of a normal operating area.
- .4 Sufficient clearance to be allowed for removal of equipment such as level displacers and floats, rotameter floats, control valve diaphragms and plugs.

- .5 Field located items of instrumentation to be mounted on building columns and walls where such building columns or walls are accessible. Pipe stands and/or other means of support to be provided where the mounting on columns or walls is not practical.
- .6 Manifolding for pressure sensing devices to be in accordance with installation detail drawings and as required to provide a functional system that allows maintenance of equipment without shutdown of main process equipment. Manifold details generally show a gauge as the pressure device, however, this will apply to pressure switches, recorders, transmitters and other pressure instruments.
- .7 Where a pressure gauge or other pressure device is supported by a manifold, and conditions of pulsating pressure or mechanical vibration exist, the manifold to be fastened so that no stress is exerted on the pressure connection from a vessel or line.
- .8 Pressure gauges which have a safety blowout feature in case of Bourdon tubes to be mounted so that the proper functioning of the blowout is not hindered in any way by mounting plates, insulation, etc.
- .9 Instrument housings to be capped, closed or covered with polyethylene when work is not in progress.
- .10 Panels, control stations, and other equipment to be protected against the entrance of dust, dirt, and moisture, and protected against mechanical injury while rough, dirty, wet or dusty work is in progress. Damage to equipment, including marring of painted surfaces caused by failure to properly protect the equipment, to be promptly repaired by the Contractor to the satisfaction of the Engineer.

3.5 PAINTING

- .1 Painted surfaces on material supplied or installed under this contract which are damaged in any way, i.e. by welding, scraping, cutting, etc., to be thoroughly cleaned, primed with a rust inhibiting primer and repainted to the original colour. The finished job to meet or exceed the original painting specification.

3.6 INSTRUMENTATION WIRING CHECKS

- .1 Prior to the installation of the remote I/O, the Contractor shall check each instrument wiring loop between the field instrument and the Control Panel. Verify and check off each wiring loop and correct termination address by initialing each loop on the drawings. Submit verification to Engineer for review. Contractor to supply all necessary power supply and instruments for testing.
- .2 Prior to startup, and after all field instruments and the PLC(s) are powered up, complete an Instrument Wiring Check Sheet (see end of Specification) for each PLC module and submit the sheets to the Engineer.

- .3 For each signal indicate the Rack, Slot, and Point to which the signal is connected. Indicate whether the signal is an Input to the PLC from a field device or an Output from the PLC to a field device, and briefly detail the signal (e.g. Door Switch ZSO-1A, Open Status ZSO-1A, 1=Open).
- .4 Test discrete input signals by jumpering the field instrument's output contact and noting whether the appropriate indicator light on the PLC input module operates.
- .5 Test discrete output signals by jumpering the PLC output at the module's terminals and noting the action of the field device (e.g. valve opens).
- .6 Test analog input signals by noting the reading on the field device and measuring the mA signal into the PLC. Check that the mA reading is appropriate for the process variable and the span of the instrument.

3.7 WELDING

- .1 Fabricate and install all brackets, hangers, etc., necessary to complete this contract. All welding and welding materials to conform to the requirements of the Owner, Engineer and local authorities.

3.8 CALIBRATION

- .1 Prior to start-up, submit to Engineer calibration sheets for each instrument which is adjustable, indicating the setpoint(s), and by whom the calibration was performed.
- .2 For microprocessor based instruments in which parameters must be entered as part of configuring or calibration, list all the values entered.
- .3 List the settings of all DIP-switches, jumpers, etc.
- .4 Contractor is to supply all test equipment to calibrate and test equipment and devices.

3.9 TESTING

- .1 Thoroughly test all control equipment, components, and systems for proper operation and report in writing to the satisfaction of the Contract Administrator.
- .2 Tests shall include:
 - .1 Complete operational test including interlocks, functions, features, options, etc., for all instrumentation, PLC, and computer system control operations.
 - .2 Operation of alarm initiating devices.
 - .3 Calibration of all instruments.

- .3 Supply all necessary test equipment and personnel to completely test the entire instrumentation and process control system.

3.10 START-UP AND COMMISSIONING

- .1 Perform all panel start-up and commissioning in accordance with Section 26 05 01.
- .2 Upon completion of the installation, the Contractor shall be responsible for testing to determine correct system operation and sequences as intended in the Contract Documents. Process Instruments such as flow, level, pressure transmitters, etc., shall be checked for operation prior to process start-up, by manipulating operating controls like set points, auto-manual selectors, etc. Status and alarm contacts to be checked by manipulation or jumpering at the sensing element.
- .3 Results of tests are to be logged by the Contractor and submitted to the City and Engineer. Any apparent defects shall be reported and corrected.
- .4 When preliminary checks have been completed and process equipment is operating or ready to operate, individual systems shall be calibrated in accordance with the latest ISA recommendation. After calibrations the system shall be placed in operation in conjunction with the Contractor, City, Engineer and designated operating personnel.

1.0 General

1.1 QUALITY ASSURANCE

- .1 CAN/CSA 22.1-2015, Canadian Electrical Code.
- .2 C22.2 No.14-95, Industrial Control Equipment.
- .3 C22.2 No.40-M1989 (R1994), Conduit, Junction and Pull Boxes.
- .4 C22.2 No.94-M91 (R1997), Special Purpose Enclosures.
- .5 NEMA 1-10-1979, Indoor enclosures, outdoor enclosures, ventilated enclosures, knock out and oil resistant gaskets.

1.2 SCOPE OF WORK

- .1 It is not the intent of this specification to completely specify all details of control panel design and construction.
- .2 The selection of all accessories, materials and methods of fabrication not specifically covered by these specifications, but which are necessary to complete the fabrication of the panels, shall be the responsibility of the Fabricator and shall be carried out in accordance with good engineering practices.
- .3 In case of conflict within this specification or between the specification, drawings, purchase order, the accompanying data sheets and any other supplemental specifications, the Contractor shall immediately submit the matter in writing to the Engineer who shall make a determination and written clarification.
- .4 Contractor shall have full responsibility for adhering to all local Codes and local inspector's requirements such that there shall be no impact to project schedule.
- .5 The scope of work will include fabrication of new panels and additions to existing panels as required. The Contractor will be provided construction drawings for all new panels, including PLC layouts and Card layouts with minimal Loop Drawings. The Contractor shall field verify all back pan and equipment dimensions prior to fabrication.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00 – Submittal Procedures. Include:
 - .1 Bill of Materials showing item reference, tag, quantity, description, manufacturer, model number, and whether the item is shipped loose or installed.

- .2 Separate shop drawings for the terminals, DC power supply, relays, control panel breakers, disconnects, motor starters, panel lighting, panel power bars etc.
 - .3 Loop drawings or schematics showing all internal and field wiring along with terminal numbers, equipment tags, wire tags, settings (for example timer relays) and calibrated ranges (if applicable).
 - .4 Internal elevation of all back panels and equipment.
 - .5 External elevation including enclosure rating and dimensions.
 - .6 List of Lamicoid labels.
 - .7 Drawings showing wire tags.
 - .8 Component shop drawings.
- .2 Include control panel literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results for Electrical.

1.4 CLOSEOUT SUBMITTALS

- .1 All submittals to be in accordance with Section 01 30 00.
- .2 Detailed instructions as required permitting effective operation, maintenance and repair.
- .3 Technical data:
 - .1 Schematic diagrams of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.
 - .3 Certified copy of factory test results.

2.0 Products

2.1 GENERAL

- .1 Supply the control panels in accordance with the general arrangement and dimensions indicated on the appropriate drawings. Panels must be complete with all instruments, meters, switches, indication lights, relays, etc., as specified herein or as indicated.
- .2 Provide removable lamacoid nameplates having letters not smaller than 6 mm to identify equipment.

2.2 PLC AND HMI EQUIPMENT

- .1 Contractor to construct a cabinet based on the provided drawings. The control system will be an Allen Bradley Compact Logix PLC with a 100mm to 200mm colour touchscreen HMI from Beijer Electronics. The BOM and wiring diagram will be revised during tender (currently shows SCADAPACK32). The Engineer will provide programming for both devices.

2.3 OPERATOR CONTROL STATIONS

- .1 All enclosures and devices shall be rated NEMA 12 in ordinary environments or NEMA 3R outdoor environments, NEMA 4X in corrosive environments, unless otherwise noted.
- .2 A Local Control Panel containing the plant PLC will be installed in the building, and contain equipment detailed in the drawings. This equipment will operate the entire facility, and be contained in a steel enclosure suitable for the environment. The contractor is responsible for the final design and proper sizing of the equipment enclosure to meet the intent of the drawings.

2.4 PUSHBUTTONS

- .1 Heavy-duty oil-tight, operator flush, black, with 1-NO and 1-NC contacts rated at 10 A, 120 VAC, labels as indicated. Stop pushbuttons coloured red.
- .2 Acceptable manufacturer shall be Allen-Bradley.

2.5 INDICATING LIGHTS

- .1 Heavy duty, push to test LED type
- .2 Lens colours: Red for running, Green for off, Red for alarm
- .3 Supply voltage: 120 V (AC)
- .4 Labels as specified in Section 26 05 01 – Common Work Results for Electrical
- .5 Acceptable manufacturer shall be Allen-Bradley.

2.6 SELECTOR SWITCHES

- .1 2 or 3 position as required, labelled as indicated heavy duty oiltight, operators as indicated, contact arrangement as indicated, rated 120 V (ac), 10 A.
- .2 Acceptable manufacturer shall be Allen-Bradley

2.7 SURGE PROTECTION DEVICE (SPD) – CONTROL POWER

- .1 UL1449 2nd Edition rated using metal oxide varistors.
- .2 120 V, 15 A, 2 wire grounded input.
- .3 MCOV: 150 V.
- .4 Surge Current: 45 kA per phase.
- .5 3 modes of protection.
- .6 Filtering Bandwidth: 10 kHz to 100 MHz.

- .7 Noise Attenuation: Normal Mode 75 dB at 100 kHz, Common mode 50 dB at 5 Mhz.
- .8 Let Through voltage: 6 V A3 ringwave, 9.6 V B3 Ringwave, 70 V, B3/C1 impulse.
- .9 Manufacturer: Cutler Hammer Aegis, or approved equal in accordance with B7.

2.8 GENERAL PURPOSE RELAYS

- .1 DIN rail mounted.
- .2 Coil voltage as required.
- .3 Contacts rated 5A, 120/240 V AC inductive, with two (2) N/O and (2) N/C contacts minimum.
- .4 Operating time to be 20 ms maximum or AC coil and 30 ms maximum for DC coil.
- .5 Rated for 100 000 operations at 5A, 120/240 VAC.
- .6 With socket, built in LED or neon lamp operation indicator and push to test push button.
- .7 Manufacturers: Allen-Bradley relays shall be type 700-HAX2Z24-1-4 with 700-HN125 relay base for 24 VDC coil voltages, and type 700-HAX2A1-1-4 with 700-HN125 relay base for 120 VAC coil voltage.

2.9 120VAC UPS

- .1 Stand-alone, installed within control cabinet
- .2 Input voltage 85-230 VAC.
- .3 Output voltage 85-230 VAC.
- .4 1000W, 10 minute runtime.
- .5 Eaton Powerware 9130 or approved equal.

2.10 DC POWER SUPPLY

- .1 DIN rail mounted.
- .2 Switched mode type.
- .3 Input voltage 85-230 VAC.
- .4 Output voltage 24 VDC output adjustable to + 10%.
- .5 Power output as required with 25% spare capacity.

- .6 Built-in overload protection.
- .7 0.5% voltage regulation Minimum-Maximum input voltage.
- .8 1.0% voltage regulation 10% to 100% load.

2.11 ETHERNET PATCH CABINETS, COMMUNICATIONS AND SWITCHES.

- .1 Contractor is responsible for all Ethernet / communications cabling and terminations. Contractor to provide all wall plates, patch panels and all other required equipment to provide a clean installation.
- .2 All Ethernet patch cables are to be of type 6 with properly terminated ends to ANSI/TIA/EIA 568A wiring standards to support gigabit Ethernet.
- .3 Termination equipment design based on Panduit
- .4 All Armoured Ethernet cable to follow applicable ANSI/TIA/AIA 568A wiring standards.
- .5 The facility will contain a communication modem, yet to be determined. The contractor will make allowance for a 24vdc powered modem, approximately 500\$.

2.12 WIRING

- .1 Internal Control Panel Wiring for 120 VAC Power Distribution Circuits
 - .1 Rated No. 14 AWG, 600V PVC type insulation rated for minus 40 deg. C. to +105 deg. C., CSA rating TR-32, UL Style 1015, tinned, stranded copper conductor, as manufactured by Atlas Wire, Copper Field, Noma Cables, or other approved manufacturers.
- .2 Internal Control Panel Wiring for PLC 120 VAC Discrete Signals and for PLC 24 VDC Discrete Signals.
 - .1 Maximum 8 A circuit protection: Rated No. 16 AWG, 600V PVC type insulation rated for minus 40 deg. C. to +105 deg. C., CSA rating TR-32, UL Style 1015, tinned, stranded copper conductor, as manufactured by Atlas Wire, Copper Field, Noma Cables, or other approved manufacturers.
 - .2 Maximum 15 A circuit protection: Rated No. 14 AWG, 600V PVC type insulation rated for minus 40 deg. C. to +105 deg. C., CSA rating TR-32, UL Style 1015, tinned, stranded copper conductor, as manufactured by Atlas Wire, Copper Field, Noma Cables, or other approved manufacturers.
- .3 Internal Control Panel Wiring for 24VDC Analog Signals.
 - .1 Stranded No.18 AWG tinned copper conductors, 300V with individual shielded twisted pairs. Use Belden Type 9318 for cables requiring 1 pair of individually shielded twisted pairs, Belden 9368 for cables requiring 2

- pairs of individually shielded twisted pairs, and Belden 9388 for cables requiring 4 pairs of individually shielded twisted pairs.
- .2 Manufacturers: Belden, Atlas Wire, Copper Field, Noma Cables, or other approved manufacturers.
 - .4 All wiring shall be color coded as follows:
 - .1 Analog signal pairs.
 - .1 White: DC positive.
 - .2 Black: Signal common.
 - .2 Analog signal triads:
 - .1 Red: DC supply to device.
 - .2 White: Analog signal from device.
 - .3 Black: Signal common.
 - .3 DC POWER WIRES
 - .1 Blue: DC positive.
 - .2 Brown: DC negative/common.
 - .3 Green: Grounding.
 - .4 AC POWER WIRES
 - .1 Black: AC supply/hot.
 - .2 White: AC neutral.
 - .3 Green: Grounding.
 - .5 PLC DISCRETE I/O (AC VOLTS)
 - .1 Red: AC Input
 - .2 Orange: AC Output
 - .6 PLC DISCRETE I/O (DC VOLTS)
 - .1 Violet: DC Input
 - .2 Grey: DC Output

2.13 GROUNDING

- .1 Provided grounding lug, suitable for termination of #2 AWG to #2/0 AWG copper grounding cable.
- .2 Separate grounding bars are to be provided for power grounds and instrument control system grounds (signal cable grounding, etc.).

2.14 SPARE PARTS

- .1 Provide in accordance with Section 01 78 00 Closeout Submittals, the following spare parts:
 - .2 30 fuses of each type and rating used.
 - .3 2 control relays of each type used.

2.15 TERMINAL BLOCKS

- .1 Screw connection terminals to be mounted on 35 mm DIN rails.
 - .1 Fused, 24 V DC shall be CSA approved for 300 V, accepting #12 - #16 AWG wire with blown-fuse indicator lamp. Weidmuller ASK-1 22276-0000 or similar.
 - .2 Unfused, 24 V DC shall be CSA approved for 300 V, accepting #12 - #16 AWG wire. Terminals shall be Weidmuller SAK 4 feed through type or similar.
 - .3 Fused, 120 V AC shall be CSA approved for 300 V, accepting #12 - #16 AWG wires, with blown-fuse indicator lamp. Weidmuller ASK-1 22556-0000 or similar.
 - .4 Unfused, 120 V AC devices shall be CSA approved for 300 V, accepting #12 - #16 AWG wires. Weidmuller SAK 4 feed through type or similar.
- .2 Terminals colors shall be as follows:
 - .1 Ground GREEN
 - .2 120V Line BLACK
 - .3 120 V Neutral WHITE
 - .4 +24 V DC BLUE
 - .5 -24 V DC BROWN

2.16 CONTROLS CIRCUIT PROTECTION

- .1 Fuses: size as required, to match terminal blocks.
- .2 Internal Control Panel Breakers:
 - .1 DIN rail mounted.
 - .2 CSA certified as a branch breaker protecting No.16 wire on load side of breaker.
 - .3 Size as required, maximum rating to be 80% of load side wire rating.

2.17 WIREWAYS

- .1 Plastic wiring raceway with removable covers.
- .2 Separate raceways shall be provided as follows:
 - .1 DC (24 V) White
 - .2 AC Black
 - .3 IS Blue
 - .4 Raceway shall be sized for 40% wire fill.

2.18 CONSTRUCTION

- .1 Minimum NEMA 12 construction for all panels unless otherwise specified.

- .2 Unless otherwise specified fabricate floor mounted panels, indicated, of high grade, cold rolled smooth sheet metal steel no thinner than 3 mm thick with all doors and edges neatly turned and finished smoothly. Visible welding seams will not be accepted.
- .3 Construct rigid panels and racks with an angle iron or channel supporting frame, suitably braced and stiffened to prevent any deformation during shipping or installation, and provide a surface free from dents, warping or other deformation. Provide a four-sided channel iron mounting base with front recess.
- .4 Provide flush fitting, gasketed doors hung on piano type hinges with three point latches and locking-type handles (CSA Type 12 construction).
- .5 Provide pans and rails for mounting terminal blocks, relays, wiring and other necessary devices.
- .6 Use rear connected fittings to hold equipment and instrument cases on the panel, but where not possible; any front fixing required shall be only by means of chrome-plated, brass or stainless steel machine screws.
- .7 Panel surfaces shall be thoroughly cleaned and degreased before painting. One primer coat shall be covered by two finished paint coats.
- .8 The surface finish shall be free of runs, drops, ridges, waves and laps. The paints shall be applied in such manner as to provide an even film covering corners and crevices. The interior finish shall be white and the exterior finished will be selected after award of the contract.
- .9 Panel Accessories: a metal pocket, 250 mm wide x 150 mm high x 25 mm deep, to hold pertinent drawings and manuals on the lower half of the inside door.

2.19 INTERNAL WORKS

- .1 Provide an individual switch for disconnection and a fuse for isolation of all panel mounted instruments requiring a 120-volt supply.
- .2 Make all wiring connections in the shop from the equipment mounted on the panel to numbered terminal blocks conveniently located in the panel, including the power supply for all instruments. Conductors shall be extra flexible stranded copper of gauges sufficient to carry the required currents, and shall in no case be smaller than #16 AWG extra flexible.
- .3 Wire connections to all relays and instruments shall be made using easily removable good quality mechanical clips.
- .4 Identify all wiring by means of plastic slip-on type markers. Install all wiring neatly and laced or bunched into cable form using plastic wire clips, and where practical, contained in plastic wiring channels with covers.

- .5 Provide Weidmuller terminal blocks #SAK 2.5, T7 Carrier & EK 2.5N Grounding, tubular clamp, 300 V, complete with track. Each terminal shall be clearly indelibly marked with the wire number connection to it. Each field connecting conductor shall be served by one terminal. Provide 20% spare unit terminals, with a minimum of two spare terminals. Provide all necessary terminal block accessories such as manufactured jumpers and marking tape.
- .6 Mount all internally mounted equipment on a hinged sub-chassis or mount on a rack and arrange for ease of access and removal when necessary.
- .7 Arrange all terminal blocks in the panel in groups such that all low level signals such as 4-20 mA DC are located in one area, followed by contact closure type signals (limit switches, etc.), that do not subsequently energize starters, etc. but are for status indication, and the remainder that contain powered circuits, 120 volt, 60 Hz, are to be arranged in such a manner and location so as to prevent interference into the low level signal.
- .8 Submit proposed terminal block layout and identification scheme for review prior to manufacture.
- .9 Provide suitable spaces around the terminal blocks for incoming and outgoing conductors or cable assemblies.
- .10 Provide plastic cable troughs equal to Panduit complete with snap-on covers for containing the cables. Cables are not to be bunched and tied, but laid in. Wire fill not to exceed 40%.

2.20 LABELLING

- .1 Panel terminal labels to be black writing on white background.
- .2 Wire labels to be PVC material with black writing on white background, securely fastened to prevent movement on wire or cable. Wieland type Z5 or Weidmuller type Z or similar.
- .3 Each major component inside and on the face of the control panel to be labeled with a Lamicoid label, white lettering on black background, minimum text size to be 5mm high.
- .4 Terminals shall be grouped for clarity and a Lamicoid label or DIN-rail mounted label block provided for each group. For example: Terminals for slot 2 discrete input PLC card may be grouped together with label as follows; TB1 (DI).
- .5 Each terminal block in a given group should be numbered with individual snap-in labels such as Weidmuller Dekterm markers or similar.
- .6 Label the front of the control panel with engraved Lamicoid nameplates, 20 mm x 75 mm, white lettering on black background.
- .7 WRITE ON LABELS ARE NOT ACCEPTABLE.

2.21 PANEL MANUFACTURER

- .1 Panel assembly, subcomponents and all internal components shall be CSA approved. Cabinet construction shall be performed by an established panel manufacturer who shall comply with all building codes, factory, and Department of Labour regulations and has CSA approval as manufacturer for all components of the work including control panels. Local approvals for panel construction including CSA will not be accepted.
- .2 Panel manufacturer shall have successfully completed a minimum of five (5) water and / or sewage treatment plant projects of a similar scope and complexity in the past 24 months.
- .3 Panel manufacturer shall have full CSA approval as manufacturer for all components of the work.
- .4 Acceptable panel manufacturer shall be located in British Columbia.

3.0 Execution

3.1 INSTALLATION

- .1 Install pushbutton stations, control and relay panels, control devices as indicated and interconnect as indicated.

3.2 GENERAL

- .1 Field measure all back pans and equipment to be relocated. Advise Engineer of changes and submit shop drawings. Modify panel layout to suit.
- .2 Install Ethernet taps cabling.
- .3 All AC, DC and intrinsically safe wiring shall be run in separate raceways.
- .4 Install a maximum of one wire per terminal.
- .5 Install terminal cross connects where required. Do not install jumper wires.
- .6 Label all terminals and devices.
- .7 Label all wire and cables as defined in related sections.
- .8 Mount Lamicoids using self-tapping Stainless Steel screws. Do not mount on removable covers.
- .9 All devices to be protected with either fuses or breakers.
- .10 All I/O to be protected with fuses including relay coils and contacts, discrete inputs and outputs and analog inputs and outputs.

- .11 Control panel junctions shall be made using terminal blocks. Wire splices shall not be allowed.
- .12 Communication and signal circuits shall not be installed in the same conduit with power and lighting circuits.
- .13 Only commercially prepared wire-pulling compounds approved by cable manufacturers will be used. The use of soaps, soap flakes, detergents or similar preparations will not be allowed.
- .14 Each wire entering a box shall be left with at least 200 mm of wire clear of the box after splicing to facilitate future alterations. Through wires in a box shall be 150 mm between the box and bottom of loop.
- .15 Each terminal shall be uniquely identified and labeled.
- .16 Each wire shall be tagged at both ends. The tag shall correspond with labels provided on engineering design drawings. Mark up one set of drawings with added/modified tags for review by the Engineer.

3.3 INSPECTION AND TESTING

- .1 The Owner and Engineer reserves the right to inspect and witness test the control panels.
- .2 Inspection:
 - .1 The Engineer shall be notified at least one (1) day prior to the completion of the panel layout so that arrangements can be made to inspect the panel before commencement of wiring. Provide progress photographs (digital format) to the Engineer at this stage. Progress photographs shall be sent via e-mail.
 - .2 The Engineer shall be notified at least seven (7) days prior to the completion of the panel so that arrangements can be made for final inspection and testing. Provide progress photographs (digital format) to the Engineer at this stage. Progress photographs shall be sent via e-mail.
 - .3 The inspection of the panel shall include but not be limited to the following:
 - .1 General workmanship (including physical dimensions).
 - .2 Panel painting.
 - .3 Arrangement of the panel.
 - .4 Nameplates and tagging of all panel components, instruments, control switches, indicating lights, wires, terminals, relays and auxiliary equipment.
- .3 Testing:
 - .1 Prior to the arrival of the Engineer, the panel shall have been completely tested by the Panel Fabricator as follows:

- .1 All electrical circuits checked for continuity, and compliance with the specification.
 - .2 All symbols and nameplates checked for correct spelling and size of letters.
 - .3 All lamps tested.
 - .4 Mechanical features (doors, hinges, latches, etc.) shall be free from defects.
 - .5 Finished surfaces shall be free from defects.
 - .6 The Panel Fabricator shall perform all other tests as required to place the panel in operating condition. Completion of these tests shall be submitted to the Engineer in writing.
- .2 The Contractor shall allocate adequate space, facilities and assistance to permit inspection and testing to the satisfaction of the Engineer. Test instruments and equipment, test leads, temporary wiring, tools, etc., shall be made available, by the Contractor, as required. All the above items are to remain the property of the Contractor.
 - .3 Provide a technician for two (2) eight (8) hour days to assist the Engineer in testing the panel.
 - .4 All calibration/test equipment shall have a current certification of calibration. All of the aforementioned facilities, assistance, equipment, materials, and arrangements shall be provided at no additional charge to the Engineer.
 - .5 During functional test, the Engineer shall develop a deficiency list of items to be completed before the panel is accepted and shipped.
 - .6 The test of the panel shall include but not be limited to the following:
 - .1 All circuits with timing relays.
 - .2 All interconnecting circuits with sequencing functions.
 - .3 AC and DC power distribution.
 - .4 All auxiliary equipment.
 - .5 All control switches and indicating lights.

3.4 PACKAGING AND SHIPPING

- .1 In accordance with Section 01 30 00 – Submittal Procedures.
- .2 The panels shall be prepared for shipment so as to protect it from physical damage. Assemblies shall be packaged in generously padded cartons or containers. Partial shipment shall only be allowed by written approval of the Engineer.
- .3 All shelf-mounted instrumentation shall be removed from the panel before shipment, and re-packaged in its original containers for shipment to the job site.
- .4 Any other "loose" components shall be taped or tied down, and/or supported with polyurethane foam so as to provide a tight, vibration free shipping unit.

- .5 In addition to the City's company name and the shipping destination, the outside of each crate or carton shall be marked with the Purchase Order and Item Number(s). A label listing contents and a duplicate listing shall be included inside the package.

3.5 TESTS

- .1 Thorough testing of the communications system shall be done prior to completion of field installation of equipment. The Contractor shall demonstrate that PLC components are operational and meet the specifications by means of tests carried out at different points of time.
- .2 The complete testing process shall follow this sequence:
 - .1 Contractor Testing of I/O back to PLC
 - .2 Contractor will support testing of control system
 - .3 Site Acceptance Test (SAT)
 - .4 14-Day Acceptance Period after Commissioning
- .3 Depending upon magnitude and complexity, divide control system into convenient sections, energize one section at a time and check out operation of section.
- .4 Upon completion of sectional test, undertake group testing.
- .5 Check out complete system for operational sequencing.
- .6 Record Network/Segment measurements on commissioning test forms and include in commissioning manuals.
- .7 Submit one copy of test results to the Engineer.

3.6 COMMISSIONING

- .1 The Contractor shall be responsible for the commissioning support of the systems during the project.
- .2 The Contractor shall perform all panel start-up and commissioning.
- .3 PLC programming is the responsibility of Stantec. The contractor will include Stantec in their construction insurance umbrella, and support the programmer in testing and commissioning.
- .4 Site Acceptance Test (SAT)
 - .1 System Test
 - .1 Test communication links for specified performance
 - .2 Test all wiring made to existing control panels
 - .3 Test all manual and automatic controls for complete operation

- .4 Test all alarms to PLC for proper operation - contacts to open on alarm
 - .5 Test PLC-imitated callout system on alarms
 - .6 Test all discrete PLC inputs for proper operation
 - .7 Test all analog PLC inputs for proper operation
 - .8 Force all discrete outputs to test for correct wiring and operation
 - .9 Test all automated sequences
- .5 14-Day Acceptance Period After Commissioning
- .1 A 14-Day Acceptance Period after Commissioning shall commence at the discretion of the Engineer and after successful completion of SAT. During this period, the system will be monitored for proper operation and to ensure compliance with the availability criteria.
 - .2 In the event of a malfunction or a failure to meet the reliability criteria, the Client will terminate the Site Acceptance Period until the Contractor remedies the deficiency. The Site Acceptance Period shall then begin again and continue for a period of fourteen (14) days. This process shall continue until the system performs satisfactorily for fourteen (14) consecutive days in complete compliance with the specifications.

END OF SECTION

1.0 GENERAL

1.1 UNIFORMITY OF INSTRUMENTS

- .1 Instruments of one manufacturer to be used throughout the installation to the extent practical. Instruments of similar make and model to existing site equipment to be used throughout the installation to the extent practical. Variations will be permitted only where the major supplier cannot supply a particular instrument as specified in the instrument specifications.
- .2 Note that where specifications specify a variety of instrument manufacturers, these are to establish standards of quality.

1.2 SCOPE

- .1 This section specifies the supply installation, field testing, and placing into operation of flow, pressure, temperature, level turbidity, and other instruments of control and instrumentation.

1.3 RELATED WORK

- .1 Section 26 05 01 – Common Work Results – Electrical.
- .2 Section 25 14 00 – Control Panels.
- .3 Section 27 05 13 – Communication Services.

1.4 DRAWINGS AND DESIGN

- .1 The drawings are intended to show the major details of the control and instrumentation work but it is the Contractor's responsibility to examine the electrical, mechanical, structural, and architectural drawings before beginning the work and report to the Engineer any discrepancies or interferences which may occur.
- .2 Control and instrumentation system layouts shown on the drawings are generally diagrammatic and the locations of equipment are approximate. Exact routing of conduits, cables, wiring, tubing and air headers to be governed by the mechanical, structural, and architectural conditions which prevail.
- .3 The Engineer reserves the right to change the location of any piece of equipment without extra payment therefore, providing only that the change is requested before installation and that the new location is within 3.0 m of the original location.

1.5 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00 – Submittal Procedures. Product data sheets to include:

- .1 Component electrical characteristics.
 - .2 Performance criteria.
 - .3 Physical size and limitations.
- .2 Include instruments literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results – Electrical. Manufacturer's Instructions to indicate special handling criteria, installation sequence, cleaning and maintenance procedures.

2.0 PRODUCTS

2.1 INSTRUMENTS

- .1 Provide each instrument with mechanisms that are corrosion resistant.
- .2 Provide each instrument with mechanisms enclosed in a dustproof and a moistureproof case.
- .3 Provide all indicator and gauge dials finished in permanent white with black graduations and figures.
- .4 Potentiometric signals shall have a "live" zero or positive minimum value in the signal range.
- .5 Each component shall be carefully selected and designed for a long lifetime with ample margin to withstand transient and other surge voltages, which may occur in the circuits from any source in the power supply.
- .6 Each component and composite instrument shall be suitable for the location and installation position at the attitude designated on the drawings, e.g., horizontal, vertical or sloped position.
- .7 The Contractor shall provide all power supplies. Provide each instrument having a 120 volt supply with a receptacle and plug assembly. Receptacles and plug to be of "twist-lok," type.
- .8 Provide each instrument with a circuit breaker.
- .9 All control panel mounted instruments shall be suitable for flush mounting and shall be furnished with bezel.
- .10 Unless otherwise indicated or specified, all signals shall be of the 4-20 mA DC type. This applies to both transmitting and receiving instruments.
- .11 All materials shall conform to the standards of the Canadian Standards Association (CSA).
- .12 A minimum of one paper copy of each unique manual shall be provided.

- .13 Where instruments require a hand-held programmer for setting up and calibrating, one of each unique programmer shall be provided.
- .14 Instruments of one manufacturer to be used throughout the installation to the extent practical.
- .15 Refer to Instrument Index and Instrument Data Sheets in this section.
- .16 Where indicated on P&ID drawings, provide instruments with block valves, block and bleed valves, or 3-valve manifolds.
- .17 Use 316 stainless steel valves on stainless steel piping, bronze-body valves on carbon steel or copper piping, and PVC ball valves on PVC piping unless specified otherwise.
- .18 All pressure gauges, transmitters and switches shall be installed with a gauge/root valve equal to Whitey SS-6NDGM12-F8 complete with bleed valve SS-BVM8 and SS-1/2 inch plugs as required.
- .19 All instrument tubing and fittings will 316 SS. All fittings will be Swagelok compression type unless otherwise specified.
- .20 Any instruments coming in contact with potable water that carries on through to distribution will have NSF 61 / ANSI 61 certification. Alternatively, they will be rated as hygienic or sanitary and a case will be made to treat them as equivalent to NSF 61 / ANSI 61.
- .21 Any instruments that are do not come in contact with potable water for distribution do not have to be NSF 61/ ANSI 61 certified.

2.2 MAGNETIC FLOW METERS

- .1 Magnetic flow meters for applications where there is at least three diameters of straight pipe upstream and two diameters of straight pipe downstream of the flow meter shall be complete with signal converters and shall be one of the following series or an approved alternative.
 - .1 ABB FXE4000 (COPA-XE/MAG-XE)
 - .2 Endress+Hauser PROline promag 50 W
 - .3 Toshiba LF430
 - .4 Krohne Optiflux
- .2 Flow meters shall have the following features:
 - .1 Continuous zero stability.
 - .2 Interchangeability with signal converters without calibration performance.
 - .3 End connections shall be compatible with process piping specifications and drawings.
 - .4 Grounding as specified by the flow meter manufacturer.

- .3 Flow meters shall have the following features:
 - .1 Signal converters shall have the following features:
 - .1 CSA Zone 2 Groups A, B, C & D certified and F.M. approved
 - .2 Flanges: Carbon steel, flanged each end
 - .3 Liner: Polyurethane
 - .4 Electrodes: 316 stainless steel
 - .5 Enclosure: NEMA 4X (Transmitter), IP68 (Element)
 - .6 Product temperature: -10 to 50°C
 - .7 Ambient temperature: 10 to 50°C
 - .8 Continuous zero stability.
 - .9 Solid state electronics.
 - .10 Direct reading range adjustment permitting precise manual selecting of maximum flow rate.
 - .11 A local indicator that simultaneously displays instantaneous flow and totalized flow.
 - .12 Output analog signal proportion to the instantaneous flow, 4-20mA.
 - .13 Interchangeability with any flow meter without affecting calibration performance.
 - .14 Local display: instantaneous flow in litres per minute and totalizer in cubic metres
 - .15 Field mounting design.
 - .16 The combined accuracy off the flow meter and converter shall be within 0.5% of the actual flow rate, when the actual flow rate is between 10% and 100% of the maximum flow setting.
 - .4 Provide pipe spool pieces for the in-line replacement of each flow meter. Spool piece tube and end connections shall conform to the process piping specifications and drawings.
 - .5 The in-line mechanical installation of magnetic flow meters and turbine meters is specified under process mechanical specifications and scope. Install per manufacturers installation instructions and process mechanical specifications.

2.3 BUILDING SMOKE DETECTORS

- .1 A smoke detector shall be installed in each functional area. All the output contacts are to be wired in series and connected to one input of the central PLC. Smoke detectors shall be powered from 24 Vdc, be dual ionization type and shall have one form C output contact. Smoke detectors shall be model ASD100KA as manufactured by American Sensors or an approved alternative.

2.4 BUILDING DOOR SWITCHES

- .1 A mechanical limit switch shall be installed at various locations to detect if a door/hatch is open. Datasheet provided (generic). Alternately to the datasheet,

switches may be a magnetic type that is sensitive to a ferrous metal target. This alternate device shall be model 11-12110-00 as manufactured by Topworx. Alternative models from Topworx that are more convenient to mount or have better delivery are acceptable, but switches from other manufacturers are not acceptable. The targets are to be fabricated in the field.

2.5 TEMPERATURE SWITCHES / TRANSMITTER

- .1 Provide building low temperature switches as indicated. Acceptable manufacturer shall be Siemens Building technologies.
- .2 Provide an interior temperature transmitter. Equipment to be loop powered through the 4-20mA output signal to the local PLC.

2.6 LEVEL MONITORING SYSTEMS

- .1 Ultrasonic Level Transmitter (Chemical Tank Only)
 - .1 Level monitoring Transmitters
 - .2 The level system shall be the following or equivalent product:
 - .1 Endress and Hauser Prosonic M series
 - .3 Controller shall have local display, analog output and adjustable high and low level alarm setpoints.
 - .4 Each alarm output shall be a Form C contact driven by a relay that de-energizes on the alarm condition.
 - .5 Output analog signal will be linearly proportional to the level.
 - .6 Indicator will have linear scale in units of mm.
- .2 Pressure Transmitter to Monitor Level (Water Tanks)
 - .1 Loop powered by 24 Vdc.
 - .2 Output analog signal shall be 4 to 20 mA and linearly proportional to the Level.
 - .3 Where an Indicator is required, it shall have a linear scale in units of mm.
 - .4 Pressure transmitters shall be manufactured by ABB, Endress + Hauser, Rosemount, or an approved alternative.
- .3 Sump Moisture Detection
 - .1 To detect leaks in the NaCL dosing system, contractor to supply and install a point level detection within the Secondary containment tank to provide level feedback to the control system. Equipment to withstand exposure to Sodium Hypochlorite (10% concentration).

2.7 ISOLATION VALVES

- .1 Each instrument sensing line shall be complete with an isolation valve. The isolation valves shall conform to Division 40 - Process Mechanical.

2.8 PRESSURE MONITORING SYSTEM

- .1 Pressure transmitters shall have the following features:
- .2 Loop powered by 24 Vdc.
- .3 Output analog signal shall be 4 to 20 mA and linearly proportional to the pressure.
- .4 Where an Indicator is required, it shall have a linear scale in units of kPa.
- .5 Pressure transmitters shall be manufactured by ABB, Endress + Hauser, Rosemount, or an approved alternative.

2.9 CHLORINE ANALYZER

- .1 The Contractor will supply and install a Chlorine analyzer to monitor residual chlorine in the water leaving the reservoir.
- .2 The equipment will be wired and plumbed as required and as shown on the drawings. Contractor to calibrate and commission the equipment.
- .3 Hard Specification HACH CL17 with free chlorine residual reagent to be used.

2.10 SODIUM HYPOCHLORITE INSTRUMENTATION

- .1 The sodium hypochlorite system instrumentation to be supplied by the vendor to the Contractor, and all instrumentation supplied with the systems is to be installed, wired and commissioned as required.

2.11 EQUIPMENT LIST

- .1 The following instruments are required to be purchased, installed and commissioned by the Contractor (New).

Drawing #	Tag	Equipment	System Location / Notes	New
E101	LIT-NEW	Level Transmitter	New Tank	YES
EI302	ZSO-X	Door Switch	Various (Five + one spare)	YES
EI302	SD-99	Smoke Detector	Building (no data sheet)	YES
EI302	TIT-3	Temperature Transmitter	Building	YES
EI302	LIT-4	Level Transmitter w/ Sensor	Chlorine Tank	YES
EI302	FIT-5	Flow Meter (magnetic)	Flow Meter Vault	YES
EI302	AIT-6	Chlorine Analyzer	Discharge CL2 Analyzer	YES
EI302	LIT-7	Level Transmitter w/ Sensor	Monitor New Tank	YES
P007	PG-xxx	Pressure Gauge	Various (no data sheet: 6" face, 0-500kPa, liquid filled, 316SS)	YES
P007	PIT-14	Pressure Transmitter	Tank Pressure	YES
P007	PIT-15	Pressure Transmitter	Discharge Pressure	YES

- .2 Contractor responsible for updating Instrument Specification Sheets (asbuilt) once equipment is ordered and installed. These asbuilt files will be provided back to the Engineer at the completion of the project.
- .3 This is not a complete list. Contractor responsible for confirming with all trades to ensure electrical discipline is made aware of all equipment that is to be wired and supported for commissioning.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Coordinate the work of this Section with the installation of the equipment specified in the relevant Sections and as shown on the Mechanical and Electrical drawings.
- .2 Perform all work in compliance with the relevant sections of this Section.
- .3 Ensure that exit light circuit breaker is locked in on position.
- .4 The Contractor to be responsible for the correct installation and assembly of all items of equipment. Manufacturer's instructions to be carefully read and rigidly adhered to in the installation. Any damage resulting from failure to observe the manufacturer's instructions or as a result of proceeding with the work without complete knowledge of a particular component will be the Contractor's responsibility. The Contractor to make good any loss or damage resulting from malpractice.
- .5 Where the manufacturer recommends the use of special tools or jigs for installation or calibration, use such tools.
- .6 Where the manufacturer requires to inspect the work before certifying the instrument, co-operate to permit such inspection.

3.2 CONDUIT AND CONDUCTOR INSTALLATION

- .1 Refer to Division 26 for conduit and conductor installation and precautions during construction.

3.3 CABLE INSTALLATION

- .1 Control and instrumentation cables shall be supported on horizontal cable trays by means of nylon cable ties at intervals not exceeding 1 m.
- .2 Control and instrumentation cables shall be supported on vertical cable trays by means of cable clamps. The Contractor shall be responsible for selecting the proper size clamp for each cable.

- .3 Cables leaving the cable tray system shall be supported to the building walls by means of c-channel and cable clamps or approved alternative.
- .4 Wall support not to exceed an interval of 1 m. The length of the supports to be 150 mm minimum.
- .5 Cable installation from the building wall to the control or instrumentation device exceeding 0.5 m shall be supported by means of c-channel, supported to the wall and at the device. Cross channel for the support of the Series M-5000 cable clamps to be bolted to the main channel. Cross channel not to be wider than is required for the cable clamp. All channels and supports painted black.
- .6 Channels for cable support from building walls shall be painted the same colour as the walls. Cables and cable clamps not to be painted.

3.4 FIELD INSTRUMENT MOUNTING

- .1 "Mounting" shall mean the positioning and fastening with proper brackets in the position required.
- .2 All equipment shall be mounted in accordance with manufacturer's recommendations.
- .3 Locations of all field instruments are subject to modification by the Engineer who reserves the right to move any item up to 3 meters from the position shown, without change to the contract price, provided notice is given before the related work has commenced.
- .4 Exact locations of all field instruments shall be site determined by the Contractor to the satisfaction of the Engineer to ensure proper operation of the device.
- .5 Employ any and all means of trade, skill, and workmanship to install all field instruments to the satisfaction of the Engineer.

3.5 COMMISSIONING

- .1 Instrument manufacturer's qualified field service representative shall be onsite as required to perform instrument calibration, testing and commissioning and to instruct Owner's representatives in all aspects of instrument operation and maintenance.
- .2 Follow all commissioning requirements of these specifications.
- .3 The Contractor is responsible for fully commissioning the installed equipment and providing a functional system to the Owner.

END OF SECTION



Chlorine Analyzer DATA SHEET

DATA SHEET No.	1 OF 1
Job. No.	111720046
Spec No.	253101
REQ.	P.O.

PLANT :	REV	DESCRIPTION	DATE	BY	CHK'D	APPR.
Fort Rupert Reservoir						
LOCATION :						
Port Hardy, BC	1	TENDER	20170926	SAL		
1 TAG NO.	AE/AIT-6					
2 VENDOR						
3 MANUFACTURER						
4 SERVICE	Potable Water					
5 P&ID NO.	EI302					
Operating Conditions						
6 Ambient Temp. (deg. C)	Minimum	10				
	Maximum	25				
7 Inlet Pressure PSI	Minimum	5				
	Maximum	10				
8 Sample Flow Rate ml/min	350-450					
Detector						
9 Detector Type	amperometric					
10 Measured Residual Type	free chlorine					
11 Electrode	3 electrode arrangement					
12 Wire Conductors (quantity)	integral					
13 Automatic Self Check Intervals	YES					
Monitor or Transmitter						
14 Model:						
15 Type Monitor	local	X				
	Remote					
16 Range mg/l	Max Span	0-60				
	Max Resolution	0.001				
17 Transmitter Output 4 - 20 mA Isolated	Span mg/l	0-5				
	Max Value @ 20mA	5				
	Min Value @ 4mA	0				
18 Housing Type / Class	NEMA 4X					
19 Wire Conductors (quantity)						
20 Power Supply	VAC	120VAC				
	VDC					
21 Running Lights	Power					
	Alarm					
22 Instant/Timed Response Relays						
23 Time Delay/Adjustable						
24 Alarm Relay	SPDT / Rating					
	DPDT / Rating					
25 Test Switch	Sensitivity Adj.					
26 Resp. Time (min)		2	2			2
Accessories						
27 Solution Buffer	pH Buffer (Free Chlorine) 16 weeks					
28 Sample Pump	NO					
29 PRV	On / Off Switch	YES				
30 Self-Flushing Y-Strainer	YES					
31 CSA Approved	YES					

NOTES :
1 Continuous Sample



DOOR SWITCH DATA SHEET

DATA SHEET No.	1 OF 1
SPEC. No.	253101
Prj No.	111720046
REQ.	P.O.

PLANT:		REV	DESCRIPTION	DATE	BY	CHK'D	APPR.
Fort Rupert Reservoir							
LOCATION :							
Port Hardy, BC		1	TENDER	20170926	SAL		
1	TAG NO.	ZSC-X					
2	VENDOR	Westburne					
3	MANUFACTURER	Allen Bradley					
4	SERVICE	Door Switch, tank, hatches					
5	Line No. & Spec	N/A					
6	P&ID NO.	Layouts					
Operating Conditions							
7	Ambient Temp. (deg. C)	Minimum	-40 degC				
		Maximum	40 degC				
8	Location	Indoors	Inside of an exterior door				
		Outdoors					
Equipment Body							
9	Body Type						
10							
11							
12							
13							
14							
15							
16							
17							
18							
Electrical							
19	Contact Style	FORM C					
20	Connection	1/2" NPT					
21	Signal	NC when door is closed					
22							
23							
24							
25							
26							
27							
Other							
28							
29							
30							
31							
32							
33							
Service Conditions							
34							
35							
36							
37							
38							
39							
40							
41							
42							
43	Area Classification	Class	Div	Group			
44	CSA Approval	YES					
45	Model Number						

NOTES :

- 1 Mounting Hardware to allow easy adjustment, with minimal impact on opening.
- 2 Spare unit to be provided and shelved at site
- 3 Typical shown for all switches required for site (five total + 1 spare)



FLOWMETER - MAGNETIC DATA SHEET

DATA SHEET No.	1 OF 2
SPEC. No.	25 31 01
Prj No.	111720046
REQ.	P.O.

PLANT: Fort Rupert Reservoir	REV	DESCRIPTION	DATE	BY	CHK'D	APPR.
LOCATION : Port Hardy, BC	1	Issued for Tender	20170926	SAL		

1 TAG NO. : SEE SHEET 2	VENDOR :
2 SERVICE : SEE SHEET 2	MANUFACTURER :

General	
3 Description	<input type="checkbox"/> Recorder <input type="checkbox"/> Indicator <input type="checkbox"/> Blind <input type="checkbox"/> Controller <input checked="" type="checkbox"/> Transmitter <input type="checkbox"/> Integ Other _____
4 Case	<input checked="" type="checkbox"/> Mfr.Std Nominal Size _____ (mm) Colour: <input type="checkbox"/> Mfr.Std Other _____
5 Mounting	<input checked="" type="checkbox"/> Flush <input type="checkbox"/> Surface <input type="checkbox"/> Yoke Other _____
6 Enclosure Class	<input checked="" type="checkbox"/> Gen.Purp <input type="checkbox"/> Weath.Prf <input type="checkbox"/> Exp.Proof Class _____ <input type="checkbox"/> IS System Other _____
7 Power Supply	<input checked="" type="checkbox"/> 120V 60Hz <input type="checkbox"/> Other <input type="checkbox"/> AC <input type="checkbox"/> DC Volts _____
8 Chart Type	<input type="checkbox"/> Strip <input type="checkbox"/> Roll <input type="checkbox"/> Fold <input type="checkbox"/> 12" Circular <input type="checkbox"/> Time Marks Range _____ No. _____
9 Chart Drive	<input type="checkbox"/> Spring <input type="checkbox"/> Electric <input type="checkbox"/> Pneumatic Chart Speed _____
10 Scales	Wind _____ Power _____ Air Pressure _____ (kPa) Type _____ Range 1 _____ 2 _____ 3 _____ 4 _____
11 CSA Approved	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> NO

Transmitter	
12 Transmitter Output	<input checked="" type="checkbox"/> 4 - 20 mA <input type="checkbox"/> 10 - 50 mA <input type="checkbox"/> 20 - 100 kPa (3 - 15 psig) Other _____ For Receiver See Spec. Sheet _____

Controller	
13 Control Modes	P=Prop (Gain), I=Integral (Auto Reset), D=Derivative (Rate), Sub: S=Slow F=Fast <input type="checkbox"/> P <input type="checkbox"/> PI <input type="checkbox"/> PD <input type="checkbox"/> IF <input type="checkbox"/> DF <input type="checkbox"/> DS Other _____
14 Action	On Measurement Increase Output: <input type="checkbox"/> Increases <input type="checkbox"/> Decreases
15 Auto-Man Switch	No. Positions _____ <input type="checkbox"/> External <input type="checkbox"/> Internal <input type="checkbox"/> Integral <input type="checkbox"/> Bumpless <input type="checkbox"/> Balance Gauge
16 Set Point Adj.	<input type="checkbox"/> Manual <input type="checkbox"/> Extrnal <input type="checkbox"/> Remote Other _____
17 Manual Regulator	<input type="checkbox"/> None <input type="checkbox"/> Mfr Std Other _____
18 Output	<input type="checkbox"/> 4 - 20 mA <input type="checkbox"/> 10 - 50 mA <input type="checkbox"/> 20 - 100 kPa (3 - 15 psig) Other _____

Differential Unit	
19 Service	<input checked="" type="checkbox"/> Flow <input type="checkbox"/> Level <input type="checkbox"/> Diff. Pressure Other _____
20 Element Type	<input type="checkbox"/> Diaphragm <input type="checkbox"/> Bellows <input type="checkbox"/> Mercury Other _____
21 Material	Body _____ Element _____ Drain/Vent _____
22 Rating	Body Rating _____ (kPa) Overrange _____ (kPa)
23 Diff. Range	<input type="checkbox"/> Fixed Adj. Range _____ (kPa) Calibrated Range _____ (kPa)
24 Process Data	Fluid _____ Elevation _____ Suppression _____ Flow Unit _____ Flow Normal _____ Full Scale _____ Max. Pressure _____ (psig) Max. Temperature _____ (deg. F)
25 Process Conn.	<input type="checkbox"/> 1/2" NPT Other _____

Accessories	
26 Alarm Switches	Quant. _____ Form _____ Rating _____
27 Function	<input type="checkbox"/> Meas.Var. <input type="checkbox"/> Deviation On Measurement Increase Contacts: <input type="checkbox"/> Open <input type="checkbox"/> Close
28 Options	<input type="checkbox"/> Pressure Element Range _____ (kPa) Material _____ <input type="checkbox"/> Temp. Element Range _____ (deg. C) Type _____ <input type="checkbox"/> Filtr.-Reg. <input type="checkbox"/> Supply Gauge <input type="checkbox"/> Output Gauge <input type="checkbox"/> Chart & Inkset <input type="checkbox"/> Valve Manifold <input type="checkbox"/> Cond. Pots <input type="checkbox"/> Adj. Damper <input type="checkbox"/> Integral Sq.Rt. Ext. <input type="checkbox"/> Integrator <input type="checkbox"/> Mounting Yoke Other _____

Notes :



PRESSURE TRANSMITTER INSTRUMENTS DATA SHEET

DATA SHEET N	1 OF 2
SPEC. No.	25 31 01
Prj. No.	111720046
REQ.	P.O.

PLANT:	REV	DESCRIPTION	DATE	BY	CHK'D	APPR.
Fort Rupert Reservoir						
LOCATION : Port Hardy, BC	1	Issued for Tender	20171004	SAL		

1 TAG NO. SEE PAGE 2	VENDOR :	
2 SERVICE: SEE PAGE 2	MANUFACTURER :	

General	
3 Description	<input type="checkbox"/> Recorder <input checked="" type="checkbox"/> Indicator <input type="checkbox"/> Blind <input type="checkbox"/> Controller <input checked="" type="checkbox"/> Transmitter <input type="checkbox"/> Integ Other _____
4 Case	<input checked="" type="checkbox"/> Mfr.Std Nominal Size _____ (mm) Colour: <input checked="" type="checkbox"/> Mfr.Std Other _____
5 Mounting	<input checked="" type="checkbox"/> Flush <input type="checkbox"/> Surface <input type="checkbox"/> Yoke Other _____
6 Enclosure Class	<input checked="" type="checkbox"/> Gen.Purp <input type="checkbox"/> Weath.Prf <input type="checkbox"/> Ex-proof Class _____ <input type="checkbox"/> IS System Other _____
7 Power Supply	<input type="checkbox"/> 117V 60Hz <input type="checkbox"/> Other <input type="checkbox"/> AC <input checked="" type="checkbox"/> DC Volts _____ 24V (loop)
8 Chart Type	<input type="checkbox"/> Strip <input type="checkbox"/> Roll <input type="checkbox"/> Fold <input type="checkbox"/> 12" Circular <input type="checkbox"/> Time Marks Range _____ No. _____
9 Chart Drive	<input type="checkbox"/> Spring <input type="checkbox"/> Electric <input type="checkbox"/> Pneumatic Chart Speed _____
10 Scales	Wind _____ Power _____ Air Pressure _____ (kPa)
11 CSA Approved	Type _____ Range 1 _____ 2 _____ 3 _____ 4 _____
	<input checked="" type="checkbox"/> Yes <input type="checkbox"/> NO



Transmitter	
12 Transmitter Output	<input checked="" type="checkbox"/> 4 - 20 mA <input type="checkbox"/> 10 - 50 mA <input type="checkbox"/> 20 - 100 kPa (3 - 15 psig) Other _____
	For Receiver See Spec. Sheet _____

Controller	
13 Control Modes	P=Prop (Gain) I=Integral (Auto Reset) , D=[D=Derivative (Rate) , Sub: S=Slow F=Fast
14 Action	<input type="checkbox"/> P <input type="checkbox"/> PI <input type="checkbox"/> PD <input type="checkbox"/> IF <input type="checkbox"/> DF <input type="checkbox"/> DS Other _____
15 Auto-Man Switch	On Measurement Increase Output: <input type="checkbox"/> Increases <input type="checkbox"/> Decreases
16 Set Point Adj.	No. Positions _____ <input type="checkbox"/> External <input type="checkbox"/> Internal <input type="checkbox"/> Integral <input type="checkbox"/> Bumpless <input type="checkbox"/> Balance Gauge
17 Manual Regulator	<input type="checkbox"/> Manual <input type="checkbox"/> Extrnal <input type="checkbox"/> Remote Other _____
18 Output	<input type="checkbox"/> None <input type="checkbox"/> Mfr Std Other _____
	<input type="checkbox"/> 4 - 20 mA <input type="checkbox"/> 10 - 50 mA <input type="checkbox"/> 20 - 100 kPa (3 - 15 psig) Other _____

Differential Unit	
19 Service	<input type="checkbox"/> Flow <input type="checkbox"/> Level <input type="checkbox"/> Diff. Pressure Other _____
20 Element Type	<input type="checkbox"/> Diaphragm <input type="checkbox"/> Bellows <input type="checkbox"/> Mercury Other _____
21 Material	Body _____ Element _____ Drain/Vent _____
22 Rating	Body Rating _____ (kPa) Overrange _____ (kPa)
23 Diff. Range	<input type="checkbox"/> Fixed Adj. Range _____ (kPa) Calibrated Range _____ (kPa)
	Elevation _____ Suppression _____
24 Process Data	Fluid _____ Flow Unit _____ Flow Normal _____ Full Scale _____
	Max. Pressure _____ (kPa) Max. Temperature _____ (deg. C)
25 Process Conn.	<input type="checkbox"/> 1/2" NPT <input type="checkbox"/> Other _____

Accessories	
26 Alarm Switches	Quant. _____ Form _____ Rating _____
27 Function	<input type="checkbox"/> Meas.Var. <input type="checkbox"/> Deviation On Measurement Increase Contacts: <input type="checkbox"/> Open <input type="checkbox"/> Close
28 Options	<input checked="" type="checkbox"/> Pressure Element Range _____ (kPa) Material _____ SS
	<input type="checkbox"/> Temp. Element Range _____ (deg. C) Type _____
	<input type="checkbox"/> Filt.-Reg. <input type="checkbox"/> Supply Gauge <input type="checkbox"/> Output Gauge <input type="checkbox"/> Chart & Inkset
	<input type="checkbox"/> Valve Manifold <input type="checkbox"/> Cond. Pots <input type="checkbox"/> Adj. Damper <input type="checkbox"/> Integral Sq.Rt. Ext.
	<input type="checkbox"/> Integrator <input type="checkbox"/> Mounting Yoke <input type="checkbox"/> Other _____ Diaphragm Seal

Notes :

 		TEMPERATURE TRANSMITTERS DATA SHEET			DATA SHEET No. 1 OF 2 SPEC. No. 25 31 01 Prj. No. 111720046 REQ. _____ P.O. _____		
PLANT : Fort Rupert Reservoir		REV	DESCRIPTION	DATE	BY	CHK'D	APPR.
LOCATION : Port Hardy, BC		1	TENDER	20170926	SAL		
1 TAG NO. : SEE SHEET 2		VENDOR :					
2 SERVICE : SEE SHEET 2		MFR. & MODEL NO. :					
General							
3	Description:		<input checked="" type="checkbox"/> Transmitter	<input checked="" type="checkbox"/> Indicator	<input type="checkbox"/> Blind		
4	Enclosure:		<input type="checkbox"/> General Purpose	<input checked="" type="checkbox"/> Weatherproof	<input type="checkbox"/> Explosion-proof		
5	CSA Approved:		<input checked="" type="checkbox"/> Yes	<input type="checkbox"/> No	Area Class: Class _____ Div. _____ Groups _____		
6	Mounting :		<input checked="" type="checkbox"/> Flush	<input type="checkbox"/> Surface	<input type="checkbox"/> Yoke	<input type="checkbox"/> Pipe Mount	
7	Sensor Type:		<input type="checkbox"/> Filled System	<input type="checkbox"/> Thermocouple	<input checked="" type="checkbox"/> RTD	<input type="checkbox"/> Other _____	
Transmitter							
8	Type :		<input type="checkbox"/> Pneumatic	<input checked="" type="checkbox"/> Electronic	<input type="checkbox"/> Smart		
9	Output :		<input type="checkbox"/> 20 - 100 kPa	<input checked="" type="checkbox"/> 4 - 20 mA	<input type="checkbox"/> Others _____		
Thermal Element							
10	Class :		<input type="checkbox"/> 1A	<input type="checkbox"/> 11A	<input type="checkbox"/> 111A	<input type="checkbox"/> VA	
			<input type="checkbox"/> 1B	<input type="checkbox"/> 11B	<input type="checkbox"/> 111C	<input type="checkbox"/> VB	
			<input type="checkbox"/> Thermocouple	<input type="checkbox"/> 11C	<input type="checkbox"/> 11D	<input type="checkbox"/>	
				<input checked="" type="checkbox"/> RTD PT100	<input type="checkbox"/> Others		
11	Range :		various _____ Deg. C		<input type="checkbox"/> Overrange Protection		
12	Bulb :		<input checked="" type="checkbox"/> Plain	<input type="checkbox"/> Union Conn.	<input type="checkbox"/> Sanitary		
13	Extension :		<input checked="" type="checkbox"/> Rigid	<input type="checkbox"/> Angle	<input type="checkbox"/> Bendable	<input type="checkbox"/> Other	
14	Insertion Length:		various _____ (mm)	Material: 316SS			
15	Capillary length :		various _____ (mm)	Sensitive Length: various _____ (mm)			
Thermowell							
16	Construction:		<input checked="" type="checkbox"/> Tapered	<input type="checkbox"/> Straight	<input type="checkbox"/> Drilled	<input type="checkbox"/> Built-Up	<input type="checkbox"/> Closed End Tube
17	Connection Type:		<input checked="" type="checkbox"/> Screwed	Size: 2-Jan NPT	<input type="checkbox"/> Flanged	Size: _____ Class _____	<input type="checkbox"/> Other RF
18	Material :		<input checked="" type="checkbox"/> 316 S.S.	<input type="checkbox"/> Other _____			
19	"U" Dim :		various _____ (mm)	"T" Dim: various _____ (mm)			
Accessories							
20	Burnout Drive:		<input type="checkbox"/> None	<input type="checkbox"/> Upscale	<input type="checkbox"/> Downscale		
21	Filter & Regulator		_____	Air Supply Gauge	_____	Local Indicator	_____
22	Portable Case Features		_____	Mounting Yoke _____			
Mounting Accessories for Wet & Dry Bulbs		_____					
NOTES :							
1 Contractor to confirm insertion lengths as required with Mechanical Contractor.							
2 Existing equipment to be verified, calibrated and updated on this datasheet by CONTRACTOR							



NON-CONTACT ULTRASONIC LEVEL DATA SHEET

DATA SHEET No.	1 OF 1
SPEC. No.	253101
Prj No.	111720046
REQ.	P.O.

PLANT:	REV	DESCRIPTION	DATE	BY	CHK'D	APPR.
Fort Rupert Reservoir						
LOCATION :						
Port Hardy, BC	1	TENDER	20170926	SAL		
1 TAG NO.		LIT-7				LIT-NEW
2 VENDOR						
3 MANUFACTURER						
4 SERVICE		Sodium Hypochlorite				
5 SOUR SERVICE		N				
6 LINE NO. / VESSEL NO.		N/A				
7 LINE SIZE / SCH. NO.		N/A				
8 P&ID NO.		EI302				
Operating Conditions						
9 Low Range Limit	High Range Limit	0.3m	4m			
10 Beam Angle	Max Lag	6 deg	365 m			
12 Temp. Min (deg. C)	Temp. Max.(deg. C)	-10	60			
13 Accuracy rating	0.25% range or 6mm					
Process Connection						
14 Body/Fitting Type	mounting nipple					
15 Process Connection nominal Size	1 "					
16 Process Connection Termin Type	threaded NPT(M)					
17 Wetted Material	PVDF (KYNAR)					
18 Flanged Material						
19 Seal/O-Ring Material						
Sensing Element						
20 Detector Type	ultrasonic waveguide					
21 Detector Style	manufacturer standard (XPS-15)					
22 Insertion Length						
23 Cable Length	5m					
24 Cer/Approvals	CSA Category 1					
25 Tag	LE-4					
26 Mounting Hardware	As required					
27 Submergence Shield	Yes					
Transmitter						
28 Type	Surface Mount Enclosure					
29 Output Signal	4-20mA + relays					
30 Enclosure type	4X					
31 Enclosure material	polycarbonate					
32 Singal Power Source	24Vdc					
33 Number of Inputs	2					
34 Number of Analog Outputs	2 (Level)					
35 Number of Relay Outputs	2 (Loss of Echo)					
36 Cer/Approvals	CSA General					
37 Tag	LIT-4					
38 Mounting Hardware	As required					
39 Connection to Element	Local to Element					
40 Analog Output (mm)	4mA					0
	20mA	tbd				
41 Level Settings	Span	tbd				
	Empty	tbd				
42 Other	Open / Close	LOE: Open				
	On Status	LOE: On Fail				
Accessories						
43 Breather Vent & Drain						
44 CSA Approved	Y					

NOTES :
1 Attached cable to fixed point at floor height

DIVISION 26

ELECTRICAL

1.0 GENERAL

1.1 GENERAL CONDITIONS

- .1 All Sections of General Conditions form a part of this Specification. They shall be read and fully adhered to exactly as if repeated here in full.
- .2 Refer to all other Sections of the Specifications and the Contract Documents to determine their effect upon the work of this Section.

1.2 SCOPE

- .1 A brief but not necessarily all inclusive list of work to be performed under this contract is given herein.
- .2 The Contractor shall supply all labor, material, equipment, transportation, services, and facilities necessary to make, test and place into operation a complete electrical installation as shown on the drawings and/or as specified herein.
- .3 Where the term "provide" is used herein, it shall mean "supply, install, adjust, test and place into operation".
- .4 All systems shall be completely assembled, adjusted, tested, and demonstrated to be ready for operation to the satisfaction of the Engineer.
- .5 The Contractor shall carefully examine the drawings and specifications and shall fully inform himself as to all existing conditions and limitations, including all laws, ordinances and regulations affecting the contract and the work and shall include in his tender all items implied or required to complete the work of this contract.
- .6 The Contractor shall satisfy himself as to working space, storage space, access facilities and all other conditions pertaining to the site, relating to the conduct of his operations, by the inspection of the site and examination of the drawings.
- .7 Provide all labor and materials as necessary to install, wire, connect and put into satisfactory operation the following electrical equipment, control panels and process and mechanical equipment supplied under this and other Sections of this specification:
 - .1 Main incoming breaker, including incoming utility requirements and coordination with BC Hydro.
 - .2 Outdoor, weatherproof, and acoustic controlled enclosed standby diesel generator.
 - .3 Electrical distribution equipment, such as automatic transfer switch, panel boards.

- .4 Various other electrical systems, including lighting, receptacles, switches, and controls.
- .5 Miscellaneous electrical for plumbing and HVAC equipment including fans, electric heaters, etc.
- .6 Supply and installation of all grounding systems, including installation of grounding required by BC Hydro,
- .7 Supply and installation of PLC-based control system, including programming services, and
- .8 See contract drawings for further details.

1.3 EXAMINATION OF DRAWINGS

- .1 The electrical drawings do not show all architectural, mechanical, and structural details. All electrical schematics are shown diagrammatically unless otherwise noted. The Contractor shall review the mechanical and structural drawings to obtain building dimensions and details. Verify dimensions accurately by measurements.
- .2 There are many underground conduits required. Contractor shall review the underground conduit requirements and provide sketch of proposed layout for Engineer review, prior to installing.
- .3 To change the location of electrical equipment, submit a request in writing to the Engineer for approval. If approved, such changes are to be made at no additional cost to the Owner.
- .4 No extra will be allowed for any additional labor or materials required for relocation of equipment due to interference with equipment of other trades, beams, joists, walls, etc., unless the conflict has been submitted to the Engineer in accordance with these Specifications.

1.4 APPROVED DESIGN AND INSTALLATION

- .1 Equipment and material to be of approved design and manufactured in accordance with all governing regulations such as "Canadian Standards Association", "Canadian Electrical Code", "Provincial Department of Labor", "Underwriters Laboratory", etc. Equipment and material must bear applicable acceptance labels of all associations and governing bodies recognized by the municipal, provincial, and federal authorities.
- .2 Install equipment in strict accordance with manufacturer's recommendations and governing rules, regulations, and codes.
- .3 Where requirement conflict occurs, install all materials in accordance with the most severe requirements.
- .4 Material installed under this Section to be new and of uniform construction.

- .5 All installation to ensure maximum headroom, minimum interference with free use of surrounding areas, and best access to equipment.
- .6 For any deviations of major service runs and/or feeder cabling from the locations shown on the drawings, Contractor shall submit to the Engineer suitable drawings showing such deviations together with reasons for deviations and obtain approval from the Engineer before proceeding with the installation.

1.5 CODES AND STANDARDS

- .1 Do complete installation in accordance with the latest edition of the Canadian Electrical Code, as adopted for the province of British Columbia, and Provincial, Municipal, and other codes, rules and regulations, and requirements of the local authorities having jurisdiction.
- .2 Perform all work in accordance with drawings, specifications, applicable municipal and provincial regulations, and any pertinent inspection bulletins issued by the electrical inspection authority having jurisdiction over the installation. In no instance shall the standard established by the drawings and specifications be reduced.
- .3 Provide a copy of all standards referred to in this Section for use on site.

1.6 PERMITS, FEES, AND INSPECTION

- .1 Submit to the Owner's authorities having jurisdiction, the necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Engineer of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from authorities having jurisdiction on completion of work to the Engineer.

1.7 ABBREVIATIONS

- .1 Abbreviations for electrical terms shall be to CSA Z85 1983.
- .2 Names used throughout these specifications are:
 - .1 EEMAC: Electrical & Electronic Manufacturers Association of Canada (formerly CEMA)
 - .2 CSA: Canadian Standards Association
 - .3 FM: Factory Mutual
 - .4 NEMA: National Electrical Manufacturers Association (U.S.)

- .5 JIC: Joint Industry Conference
- .6 IPCEA: Insulated Power Cable Engineers Association
- .7 ISA: Instrument Society of America
- .8 CEC: Canadian Electrical Code
- .9 IEEE: Institute of Electrical and Electronic Engineers
- .10 IES: Illuminating Engineering Society
- .11 NBC: National Building Code
- .12 ANSI: American National Standards Institute

1.8 SHOP DRAWINGS

- .1 Submit shop drawings in accordance with these Specifications and (01 30 00).
- .2 Submit shop drawings for all equipment as indicated, with the exception of conduits, standard conduit fittings and low voltage wiring.
- .3 Indicate on shop drawings details of construction, dimensions, capacities, weights and electrical performance characteristics of equipment or material.
- .4 Where applicable, include wiring, single line, and schematic diagrams.
- .5 Wiring drawings showing interconnection with work or other sections are required.
- .6 Indicate the numbered and lettered tags shown on the drawings for identification symbol(s) on submitted shop drawings and product data for panelboards, lighting fixtures and other electrical equipment.

1.9 OPERATION AND MAINTENANCE MANUALS

- .1 Include in the manuals information based on following requirements:
 - .1 Operation and maintenance instructions to be sufficiently detailed with respect to design elements, construction features, component function and maintenance requirements, to permit effective start-up, operation, maintenance, repair, modification, extension and expansion of any portion or feature of installation.
 - .2 Technical data to be in form of approved shop drawings, product data, supplemented by bulletins, component illustrations, exploded views, technical descriptions of items, and parts lists.
 - .3 Advertising or sales literature is not acceptable.
 - .4 Provide wiring and schematic diagrams and performance curves.
 - .5 Include names and addresses of local suppliers for all items included in the operation and maintenance manuals.

- .2 Submit six (6) complete copies of manuals and "as-constructed" drawings to the Engineer for review. Revise initial manual as required by the Engineer prior to final submission.

1.10 RECORD DRAWINGS

- .1 Submit record drawings in accordance with Section 01 78 00 - Closeout Submittals.
- .2 The Contractor shall record all changes made during construction and provide red-lined record drawings to the Owner upon completion of the work.
- .3 At the completion of the project, the Contractor shall submit one (1) set of record drawings on disk, accurately recording all changes, deviations and relocations necessitated by job conditions and equipment approved shop drawings all done with red pen to full sized drawings. A second copy to be left at site.
- .4 Include with the record drawings a list for each motor indicating motor or equipment number and name, nameplate voltage, horsepower and current, the size of overload and breaker or fuse protection provided.

1.11 DEFINITIONS

- .1 The following are definitions of terms and expressions used in the specification:
 - .1 "Inspection Authority" means agent of any authority having jurisdiction over construction and safety standards associated with any part of electrical work on site.
 - .2 "Supply Authority" means electrical power company or commission responsible for delivery of electrical power to project.
 - .3 "Electrical Code" means latest edition of the Canadian Electrical Code C22.1 or code in force at project location.
 - .4 "Indicated" means as shown on contract drawings or noted in contract documents.
- .2 Refer to CSA C22.2 for "Definitions and General Requirements".

1.12 COOPERATION AND COORDINATION

- .1 Schedule expediting of all materials and execution of work with associated work specified in other Sections.
- .2 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete shall be schedule 40 galvanized steel pipe, sized for free passage of conduit, and protruding 50 mm (2").
- .3 Cables, conduits and fittings to be embedded or plastered over neatly and close to building structure so furring can be kept to a minimum.

- .4 Arrange for holes through exterior walls and roof to be flashed and made weatherproof.

1.13 SOURCE QUALITY CONTROL

- .1 Arrange for a plant inspection by the Engineer where specified.
- .2 Inform the Engineer of manufacturing progress and arrange inspections at appropriate times.
- .3 Action required by factory inspection shall not be construed as final acceptance.
- .4 Obtain a Certificate of Acceptance from the inspection authority on completion of work and hand it to the Engineer.
- .5 The Engineer may carry out inspections and prepare deficiency lists for action by the Contractor, during and on completion of project.

1.14 CARE, OPERATION AND START-UP

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

1.15 APPROVAL OF ALTERNATE MATERIALS

- .1 Bid Opportunity shall be based on the materials, products, and manufacturers specified.
- .2 Alternates to materials, products, and manufacturers specified shall be in accordance with Section 1.
- .3 Supply and install all motor power wiring and conduit, all control wiring and conduit, all local and remote control devices, and all motor starters and contactors except where specified as components of "packaged" equipment.

2.0 PRODUCTS

2.1 MATERIALS AND EQUIPMENT - GENERAL

- .1 All materials shall be fully approved by the Canadian Standards Association (CSA) or by a Provincial Inspection Authorities approved agency, for use as installed. All materials shall meet the requirements of this specification in all respects.
- .2 Where there is no alternative to supplying equipment, which does not have CSA approval, submit such equipment to Provincial Inspection Authorities for special inspection and obtain approval. Pay all associated fees.
- .3 Materials and equipment shall be of Canadian manufacture except where specified otherwise or where Canadian made materials or equipment does not exist.
- .4 Where two or more units of the same class or type of equipment are required, the units shall be the product of a single manufacturer, although components of equipment need not be products of the same manufacturer.
- .5 Use material and equipment available from regular production of manufacturer.
- .6 Control panels and component assemblies to be shop manufactured, assembled, and CSA approved.

2.2 FINISH

- .1 Finish metal enclosure surfaces by removing rust and scale, cleaning, and applying rust resistant primer inside and outside with at least two coats of finish enamel.
- .2 Paint all outdoor electrical equipment "equipment green" finish to EEMAC Y1-2, unless noted otherwise.
- .3 Paint all indoor switchgear and distribution enclosure "light grey" to ASA 61 grey.
- .4 Clean, prime and paint exposed hangers, racks, fastenings, etc., to prevent rusting.

2.3 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235-83.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

2.4 WIRING

- .1 Lugs, terminals, screws used for termination of wiring must be suitable for copper conductors.

2.5 ENCLOSURES

- .1 Minimum enclosure type to be used is NEMA 12 for ordinary environments, NEMA 4X for corrosive environments and outdoor installations, unless otherwise specified.

2.6 MANUFACTURERS AND CSA LABELS

- .1 Manufacturers' nameplates and CSA labels are to be visible and legible after equipment is installed.

2.7 WARNING SIGNS

- .1 Provide warning signs with suitable background color and lettering as required to meet requirements of inspection authorities and Engineer. Use decal signs, minimum size 178 mm x 250 mm.

2.8 PLYWOOD MOUNTING BOARDS

- .1 Surface wall mounted panelboards and other electrical equipment shall be installed on plywood mounting boards. Boards shall be provided under this section of the specifications, sized to suit equipment indicated and/or implied.
- .2 Plywood mounting boards shall consist of 20 mm fir plywood fastened securely to wall.
- .3 Plywood mounting boards, strapping and trim shall be treated with wood preservative prior to installation and painted with one coat of primer and two coats of grey enamel ASA61. Painting shall be completed before any electrical equipment is mounted on the plywood.
- .4 Service entrance equipment shall be spaced from the plywood mounting boards to the satisfaction of the inspection authorities.

2.9 ELECTRIC MOTORS, EQUIPMENT, AND CONTROLS

- .1 Contractor and Sub-Contractor responsibility is indicated in Equipment Schedules on mechanical drawings.
- .2 Control wiring and conduit is specified in Sections 26 05 21 and 26 05 34 except for conduit, wiring and connections below 50 V which are related to control systems (HVAC equipment) and shown on mechanical drawings.

2.10 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
- .2 Nameplates:
 - .1 Lamacoid 3 mm thick plastic engraving sheet, black face, white core, mechanically attached with self-tapping screws.
 - .2
NAMEPLATE SIZES

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters
- .3 Allow for average of twenty-five (25) letters per nameplate.
- .4 Identification to be English.
- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Disconnects, starters and contactors: indicate equipment being controlled and voltage.
- .7 Terminal cabinets and pull boxes: indicate system and voltage.
- .8 Transformers: indicate capacity, impedance, primary and secondary voltages.

2.11 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or colored plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and color coding throughout.
- .3 Color code: to CSA C22.1.
- .4 Use color coded wires in communication cables, matched throughout system.

2.12 LOCATION OF OUTLETS

- .1 Do not install outlets back-to-back in wall; allow minimum 150 mm horizontal clearance between boxes, unless otherwise detailed in the drawing package.

- .2 Change location of outlets at no extra cost or credit, providing distance does not exceed 3000 mm, and information is given before installation.
- .3 Locate light switches on latch side of doors.

2.13 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: 1400 mm.
 - .2 Wall receptacles:
 - .1 General: 300 mm.
 - .2 Above top of continuous baseboard heater: 200 mm.
 - .3 Above top of counters or counter splash backs: 175 mm.
 - .4 In process areas, chemical rooms, and mechanical rooms: 1400 mm.
 - .3 Panelboards: as required by Code or as indicated.
 - .4 Voice and data communication outlets: same height as nearest receptacle.

2.14 LOAD BALANCE

- .1 Measure phase current to panelboards with normal loads (lighting) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.
- .2 Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of equipment.
- .3 Submit, at completion of work, report listing phase and neutral currents on panelboards, dry-core transformers and motor control centres, operating under normal load. State hour and date on which each load was measured, and voltage at time of test.

2.15 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.

- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

2.16 FIELD QUALITY CONTROL

- .1 All electrical work to be carried out by qualified, licensed electricians or apprentices as per the conditions of the Provincial Act respecting manpower vocational training and qualification. Employees registered in a provincial apprentices program shall be permitted, under the direct supervision of a qualified licensed electrician, to perform specific tasks - the activities permitted shall be determined based on the level of training attained and the demonstration of ability to perform specific duties.
- .2 The work of this section to be carried out by a contractor who holds a valid Master Electrical contractor license as issued by the Province that the work is being constructed.
- .3 Conduct and pay for following tests:
 - .1 Power distribution system including phasing, voltage, grounding and load balancing.
 - .2 Circuits originating from branch distribution panels.
 - .3 Lighting and its control.
 - .4 Emergency lighting.
 - .5 Motors, heaters, and associated control equipment including sequenced operation of systems where applicable.
 - .6 UV Systems.
 - .7 Outdoor Standby Generator.
- .4 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .5 Insulation resistance testing.
 - .1 Megger circuits, feeders, and equipment up to 350 V with a 500 V instrument.
 - .2 Megger 350-600 V circuits, feeders, and equipment with a 1000 V instrument.
 - .3 Check resistance to ground before energizing.
- .6 Provide instruments, meters, equipment, and personnel required to conduct tests during and at conclusion of project.
- .7 Submit test results for Engineer's review.

2.17 CO-ORDINATION OF PROTECTIVE DEVICES

- .1 Provide a coordination study report demonstrating selective tripping and proper functionality of the power distribution system with the devices and settings as installed.
- .2 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to required values and settings.
- .3 Select and adjust protective devices as required to ensure suitable coordination.
- .4 Provide a coordination study report demonstrating selective tripping and proper functionality of the power distribution system with the devices and settings as installed.

2.18 ARC FLASH SAFETY LABELING

- .1 Provide an arc flash study for power distribution system using devices and settings as installed.
- .2 Provide arc flash safety labeling on electrical equipment in accordance with CSA - Z462.

3.0 EXECUTION

3.1 WORKMANSHIP

- .1 All work to be carried out by qualified journeymen of the related trades.
- .2 Where sheet metal enclosures are not provided with knockouts, Greenlee punches shall be used in all cases. Cutting torches shall not be used for making holes.

3.2 INSTALLATION

- .1 Determine manufacturers' recommendations regarding storage and installation of equipment and adhere to these recommendations.
- .2 Check all factory joints and tighten where necessary to ensure continuity.
- .3 Coordinate the work of this Section with the installation of the equipment specified in the relevant Process and Mechanical Sections and shown on the Process, Mechanical and Electrical drawings.
- .4 Perform all work in compliance with the relevant sections of this Section.

3.3 SPECIAL PROTECTION

- .1 Accept the responsibility to protect those working on the project from any physical danger due to exposed electrically energized equipment such as panel mains, outlet wiring, etc. Shield and mark all live parts "LIVE 600 VOLTS" or with the appropriate voltage.
- .2 Arrange for the installation of temporary doors, barriers, etc., for all electrical equipment. Keep these doors locked at all times, except when under direct supervision.

3.4 FIREPROOFING

- .1 Where sleeves or openings are installed in walls, floors, roof or partitions to accommodate raceways, cables or bus duct, provide all necessary seals, fittings, barriers and fire resistant materials to restore the installation to its original fire rating to the satisfaction of the Engineer.

3.5 TOUCH-UP PAINTING

- .1 Be responsible for field touch up painting of all shop painted electrical equipment installed in this Contract.
- .2 All surfaces to be painted shall be dry, clean, and free from dust, dirt, grease, frost, rust, loose crystals or extraneous matter, tool, and machine marks. Feather out edges of scratch marks to make patch inconspicuous.
- .3 Apply one or more coats of paint until the damaged surface has been restored to original finish condition. Do not apply succeeding coats until preceding coat is dry and hard. Sand lightly between coats with No. 00 sandpaper.
- .4 Be responsible for obtaining the necessary touch up paint of the original type and quality from the equipment manufacturer.
- .5 Supervise priming and finish painting of all electrical equipment and material not shop painted.

3.6 SLEEVES AND OPENINGS

- .1 Provide sleeves and openings for exposed conduits, busways, and wireways, where they pass through walls or floors conforming to relevant fire codes where applicable.
- .2 Sleeves for individual conduits shall be galvanized steel in ordinary areas or stainless steel in corrosive environments.
- .3 Pack or fill sleeves and openings after the completed work is in place. Filling shall provide a waterproof seal to prevent leakage of water or other liquids through the sleeve or opening.

- .4 Sleeves and openings shall not displace reinforcing steel, and shall receive approval of the Engineer prior to placement.

3.7 CUTTING AND PATCHING

- .1 Do all drilling, cutting, fitting and patching necessary for the running and securing of conduits, wireways, and other electrical equipment.
- .2 Provide supports necessary for same.
- .3 Provide bracing and anchorage of work subject to Engineer's approval.
- .4 No cutting of the structural members or of the fireproofing shall be done without the written consent of the Engineer.
- .5 Caulk and flash all conduits passing through walls, roofs or other surfaces exposed to weather or as indicated on the drawings to prevent the passage of water and/or sewer gases.

3.8 HANGERS AND SUPPORTS

- .1 Provide hangers, angles, channels, and other supports necessitated by field conditions to install all items of electrical equipment. Design of supports and methods of fastening to building structures shall be subject to the Engineer's approval.
- .2 All local motor control devices are to be grouped and mounted on a free-standing frame of stainless steel construction easily accessible and as close to the motor as possible.
- .3 Provide weight-distribution facilities, where required, so as not to exceed the load-bearing capacities of floors or walls that bear the weight of, or support, electrical items.
- .4 Paint all exposed parts of hangers and supports with an anti rust inhibiting primer.
- .5 Equipment shall not be held in place by its own weight. Provide base anchor fasteners in each case.
- .6 Meet seismic requirements as defined in seismic specification section 16 05 50.

3.9 PROTECTION OF EQUIPMENT

- .1 Protect conduit and wireway openings against the entrance of foreign matter by means of plugs or caps.
- .2 Fixtures, materials, equipment, or devices damaged prior to final acceptance of the work shall be restored to their original condition or replaced by the Contractor.

3.10 TESTING OF ELECTRICAL SYSTEMS GENERAL

- .1 Prior to the Engineer's acceptance, all electrical equipment, materials, and systems installed shall be subject to an inspection and applicable performance tests supervised by the Engineer to ensure that the operation of the system and components satisfy the requirements of the Specifications. Refer also to Section 26 08 11 – Testing of Electrical Systems.
- .2 Ensure that the system and its components are ready prior to the inspection and test for acceptance.
- .3 All testing shall be conducted by fully qualified personnel only. Tests requiring initial power energization of a system shall not be made without notification of the Engineer. Tests, checks and the like carried out by or on behalf of the Contractor shall be documented and certified at no additional cost to the Owner. Submit six copies of the test certificates to the Engineer. Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.
- .4 Carefully check wiring for each system and/or part of a system to ensure that the system will function properly as indicated by wiring and schematic diagrams, description of operation, etc.
- .5 Manually operate alarms and control devices to check whether their operation during normal and abnormal operating conditions causes the proper effect.
- .6 In addition to tests on purely electrical systems, supply the necessary labor and equipment for operational tests required by other Sections where electrical services are involved and make final adjustments to the electrical controls at no additional cost to the Owner.
- .7 Perform tests on auxiliary or specialized systems with the assistance of the manufacturer's representative. Upon successful conclusion of the tests, obtain a certificate from the manufacturer stating that the system has been installed to their satisfaction and that it is in good working order.
- .8 Ensure circuit protective devices such as overcurrent trips, relays and fuses are installed to values and settings as indicated.
- .9 Supply all instruments, meters and personnel required for the tests.

3.11 CABLE AND WIRE 1000 VOLT AND BELOW

- .1 Tests on cables in this voltage range shall be limited to insulation resistance measurements using a 500V megger for systems up to 350V and a 1000V megger for 351 to 600V systems.
- .2 Record all test results in a log book and submit to the Engineer for reference. Replace or repair all circuits, which do not meet minimum requirements specified

in the CEC, Table 24. Insulation resistance of the following circuits shall be measured:

- .1 Power, lighting, and motor feeders (with equipment disconnected): phase to phase, phase to neutral and phase to ground.
- .2 Control circuits: measure to ground only.
- .3 Do not perform megger tests on control circuits containing transistorized or solid state components.
- .4 Where power factor correction equipment is installed, it may be necessary to disconnect the capacitors from the system prior to testing to avoid overvoltage.

3.12 GROUNDING SYSTEM

- .1 Test the grounding system efficacy for compliance with CSA Standard C22.1 and Supply Authority requirements.
- .2 Notify Engineer that they may be present to witness Contractor testing.

3.13 TRAINING

- .1 Provide for the training of the Owner in the operation, maintenance and testing of all systems and equipment including the provision of qualified manufacturer's technical representatives for specialized systems.
- .2 Provide these services for such period, and for as many visits as necessary to put installation in working order, and to ensure that operating personnel are conversant with all aspects of its care and operation.

3.14 DELIVERY AND STORAGE

- .1 Ship and store floor mounted equipment in upright position.
- .2 Ship channel bases and anchor stencils in advance of equipment.
- .3 Keep equipment doors locked. Protect equipment from damage and dust.
- .4 Block moving parts when necessary to prevent damage during movement and shipment of equipment. Instructions to remove blocking before putting equipment in service to be clearly and conspicuously displayed.
- .5 Store all electrical equipment indoors. Temperature sensitive equipment to be stored in heated spaces.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

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

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International):
 - .1 CAN/CSA-C22.2 No.18, Outlet Boxes, Conduit Boxes, Fittings, and Associated Hardware.
 - .2 CSA C22.2 No. 65, Wire Connectors.
- .2 Electrical and Electronic Manufacturers' Association of Canada (EEMAC).
- .3 National Electrical Manufacturers Association (NEMA).

2.0 PRODUCTS

2.1 MATERIALS

- .1 Pressure type wire connectors to: CSA C22.2 No.65, with current carrying parts of suitable material sized to fit conductors as required.
- .2 Fixture type splicing connectors to: CSA C22.2 No.65, with current carrying parts of copper sized to fit copper conductors 10 AWG or less.
- .3 Clamps or connectors as required to: CAN/CSA-C22.2 No.18.

3.0 EXECUTION

3.1 INSTALLATION

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

END OF SECTION

1.0 GENERAL**1.1 RELATED SECTIONS**

- .1 Section 26 05 20 - Wire and Box Connectors.

1.2 REFERENCES

- .1 CSA C22.2 No .0.3, Test Methods for Electrical Wires and Cables.
- .2 CAN/CSA-C22.2 No. 131, Type TECK 90 Cable.

2.0 PRODUCTS**2.1 BUILDING WIRES**

- .1 Compliance: CSA C22.2 No. 38.
- .2 Conductors: stranded copper for 14 AWG and larger.
- .3 Minimum conductor size: 12 AWG (for power wiring) and 14 AWG (for control wiring).
- .4 Copper conductors: size as indicated, with 1000 VAC insulation of chemically cross-linked thermosetting polyethylene material rated RW90.

2.2 TECK POWER AND CONTROL CABLES

- .1 Compliance with CSA C22.2 - No. 131 Type Teck 90 Cable.
- .2 Conductors:
 - .1 Grounding conductor, Copper;
 - .2 Circuit conductors, Copper, size as indicated on the drawings.
- .3 Insulation:
 - .1 1000 V chemically cross-linked thermosetting polyethylene rated type RW90.
 - .2 HL rating for hazardous location Zone 1 or 2, as required, with approved TECK connectors and sealing compound.
- .4 Inner jacket:
 - .1 Thermosetting Polyvinyl Chloride (PVC) compound.
- .5 Armour:
 - .1 Interlocking Aluminum.

- .6 Overall covering:
 - .1 Outer jacket of PVC material, rated -40°C and meeting low gas emission and FT 4 flame test requirements set forth in CSA C22.2 - No. 0.3 and IEEE 383.
- .7 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable. Dry-type not acceptable.

2.3 INSTRUMENTATION CABLES

- .1 Twisted Pair Shielded Cables (TPSH) shall be Teck type armoured, CSA FT4 rated, approved for installation in cable tray and shall meet conditions from 2.2 plus:
 - .1 Each pair shall have two copper conductors, stranded, minimum No. 18 AWG, PVC insulated, twisted in nominal intervals of 50 mm.
 - .2 Insulated for 600V, 90°C.
 - .3 100% coverage aluminum foil or taped shield for each pair.
 - .4 Separate bare stranded copper drain wire for each pair, minimum No. 18 AWG.
 - .5 Overall shield and bare stranded copper drain wire for multi-pair cable.
- .2 Continuous number coding for multi-pair cable.
- .3 Connectors and fastenings shall be as specified for Teck cables, and rated for hazardous areas, if required.
- .4 All analog signal cables to be TPSH.

2.4 ALUMINUM CONDUCTORS

- .1 Aluminum conductors shall NOT be used.

2.5 WIRING ACCESSORIES

- .1 Wire markers, black letters on white background, shall be heat shrink type as manufactured by Critchley.
- .2 Cable markers for cables or conductors greater than 13 mm diameter, shall be strap on type, rigid PVC, black letters on white background, with PVC covered aluminum straps, as manufactured by Electrovert Cat. No. 510.

- .3 Terminal blocks shall be minimum 600 volt rated, modular, sized to accommodate conductor size used, as manufactured by Weidmuller, Phoenix, Allen-Bradley.
- .4 Where screw type terminals are provided on equipment, field wiring shall be terminated with insulated fork tongue terminals, as manufactured by Thomas & Betts, Sta Kon.
- .5 Splicing of wiring and cables is not acceptable, unless approved by the Engineer. Where splices are required and approved use the following:
 - .1 Splice connectors for wire sizes #14 to #10 AWG inclusive, shall be of the compression spring type, as manufactured by Ideal Waterproof Type DP.
 - .2 Splice connectors for wire sizes #8 AWG and larger shall be split bolt type, sized to suit number and size of conductors, as manufactured by Burndy Servit Type KS.
- .6 Cable ties shall be nylon, one piece, self locking type, as manufactured by Thomas & Betts, Burndy, and Electrovert.
- .7 Electrical insulating tape as manufactured by 3M Scotch 88.
- .8 Cable grips shall be provided for all vertical and catenary cable suspension installations to reduce cable tension at connectors or at cable bends. The cable grips shall be selected to accommodate the type and geometry of cable supported and shall be of the single wave, variable mesh design, as manufactured by Kellems and Arrow-Hart.
- .9 Cable pulling lubricant shall be compatible with cable covering and shall not cause damage and corrosion to conduits or ducts.

3.0 EXECUTION

3.1 INSTALLATION – GENERAL

- .1 Install all wiring in accordance with the drawings, with a minimum size of #12 AWG for power cables unless indicated otherwise.
- .2 Pull wire into ducts and conduits in accordance with the manufacturer's recommendations, using patented wire grips suitable for the type of wire or using pulling eyes to be installed directly onto the conductors.
- .3 Limit pulling tensions to those recommended by the manufacturer to avoid overstressing wire.
- .4 Utilize adequate lubricant when pulling wires through ducts and conduits to minimize wear on cable jackets.
- .5 Make connections to equipment "pig tails" with mechanical, insulated, screw on connectors for wire sizes #14 to #10 AWG. For wire sizes #8 AWG and larger

utilize split bolt connectors, taped with three layers minimum of insulating tape. For all terminations, wire through the conductor, apply joint compound anti-oxidant, and torque to lug manufacturer's recommended torque levels.

- .6 No splices shall be permitted in cable or wiring runs without the written permission of the Contract administrator, and shall only be permitted in junction boxes.
- .7 Neutral conductors shall be identified. Paint or other means of colouring the insulation shall not be used.
- .8 Unless otherwise specified, make all wiring taps, splices and terminations with identified compression screw type terminal blocks, securely fastened to avoid loosening under vibration or normal strain. Make connections for interior and exterior lighting circuits and convenience receptacle circuits using screw on or split bolt connectors and insulating tape.
- .9 Determine the exact length of cable required to avoid splices.
- .10 Identify each conductor by specified markers at each termination indicating the circuit designation or wire number.
- .11 Identify each cable by attaching a suitable marker, stamped or indelibly marked with the cable number, at each end of the cable and in all junction boxes and pull boxes.

3.2 INSTALLATION OF TECK AND INSTRUMENTATION CABLES

- .1 Install cables.
 - .1 Group cables wherever possible on cable trays.
- .2 Install cable in trenches in accordance with Section 26 05 44.
- .3 Provide appropriate watertight connectors and terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Supply and installation of complete grounding system as specified herein and in accordance with Canadian Electrical Code and local inspection authority.

1.2 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results for Electrical.

1.3 REFERENCES

- .1 American National Standards Institute (ANSI) / Institute of Electrical and Electronics Engineers (IEEE)
- .2 Canadian Standards Association (CSA).

2.0 PRODUCTS

2.1 EQUIPMENT

- .1 Grounding conductors: bare stranded copper, soft annealed, sized to suit system amperage.
- .2 Non-corroding accessories necessary for grounding system, type, size, material to suit equipment, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Rod electrodes, copper-clad steel, 19 mm diameter by 3 m long.
 - .3 Inspection Test Wells.
 - .4 Protective type clamps.
 - .5 Bolted type conductor connectors.
 - .6 Compression type conductor connectors.
 - .7 Bonding jumpers, straps.
 - .8 Pressure wire connectors.

3.0 EXECUTION

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including rod electrodes, conductors, connectors, and accessories as indicated or required to conform to requirements of the Canadian Electrical Code, Owner's Representative, and local authority having jurisdiction over installation.

- .2 Provide grounding grid for new facility as indicated on the drawings.
- .3 Install connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors from mechanical injury.
- .5 Make buried connections and connections to electrodes, using approved compression-type connections.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Soldered joints not permitted.
- .8 Install bonding wire for flexible conduit, connected at one end to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .9 Connect building structural steel and metal siding to ground by welding copper to steel in at least the four corner locations around the building.
- .10 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.2 EQUIPMENT GROUNDING

- .1 Install grounding connections to equipment included in, but not necessarily limited to the following list: Service equipment, transformers, stand-by generator frame, switchgear, duct systems, cable trays, frames of motors, motor control centers, starters, control panels, building steel work, steel platforms and stairwells, distribution panels and outdoor lighting.

3.3 GROUNDING BUS

- .1 Extend grounding to equipment from ground bus of the service entrance MCC.
- .2 Ground items of electrical equipment in electrical room to ground bus with individual bare stranded copper connections size #6 AWG, or larger where required by CEC.

3.4 COMMUNICATION SYSTEMS

- .1 Install grounding connections for voice/data communication, and security systems in accordance with CEC and specific equipment manufacturer's recommendations.

3.5 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 - Common Work Results for Electrical.

- .2 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Owner's representative and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.
- .4 Provide test results to Owner's Representative for review.

3.6 FIELD CHECK LIST

- .1 Grounding conductors are adequately protected from mechanical damage.
- .2 Where buried, grounding conductors are deep enough to meet or exceed minimum code depths.
- .3 Grounding conductors are mechanically and electrically secure.
- .4 Grounding conductors are free of damage.
- .5 Grounding connections are examined to determine if connection is both electrically and mechanically acceptable.
- .6 Check that only copper conductors are used for grounding system.
- .7 Confirm size of grounding conductors meets code standards.
- .8 Connections to artificial or natural electrodes are electrically and mechanically secure.
- .9 Connections to system distribution equipment is adequate and secure.
- .10 Bonding of all metallic electrical equipment (motors, luminaires, welders, etc.) has been accomplished.
- .11 Bonding of all metallic raceways (conduits, cabletrays, wireways, etc.).
- .12 Bonding of metal gas lines, water lines, sewer lines and telecom systems has been done.
- .13 Isolated grounds have been connected to the bonding bus of the distribution system.
- .14 Structural steel and steel supports have been bonded.
- .15 The bonding screw of the identified conductor terminal (neutral) has been removed from all distribution panelboards.
- .16 Service neutral conductor is grounded.
- .17 Neutral conductors on the secondary of transformers are grounded.

- .18 Transformer cores and cases are bonded.
- .19 All flexible raceways have a separate bonding conductor placed within the flexible raceway.
- .20 A bonding jumper is present between the metal outlet box and the receptacle. A bonding conductor is present for the receptacle.
- .21 Mounting straps of receptacles and switches must be bonded. Spacers used on mounting screws must not impede bonding of mounting strap.
- .22 Continuity of the entire grounding and bonding system.
- .23 Surge arrestors are grounded to earth.
- .24 Alternate power supplies (standby generators, UPS, etc.) are adequately grounded and or bonded.
- .25 Secondary of instrument transformers are grounded.
- .26 Cables supplying motors have adequately sized bonding conductors.
- .27 Metallic raceways placed in the ground or in concrete contain a bonding conductor.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

- .1 Furnish all labour, materials, equipment and services specified, indicated or requested to install the electrical boxes specified herein and as indicated on the drawings.

1.2 REFERENCES

- .1 Refer to Section 26 05 01 – Common Work Results for Electrical.

2.0 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 in splitters less than 400 A.

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.

2.3 CABINETS

- .1 Type E: sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounting.
- .2 Type T: sheet steel cabinet, with hinged door, latch, lock, 2 keys, containing 19 mm plywood backboard for surface mounting.

3.0 EXECUTION

3.1 SPLITTER INSTALLATION

- .1 Install splitters and mount plumb, true and square to the building lines.

- .2 Extend splitters full length of equipment arrangement except where indicated otherwise.

3.2 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Only main junction and pull boxes are indicated. Install pull boxes so as not to exceed 30 m of conduit run between pull boxes.

3.3 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results for Electrical.
- .2 Install size 2 identification labels indicating system name voltage and phase.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 Section 26 05 01 - Common Work Results for Electrical.

2.0 PRODUCTS

2.1 OUTLET AND CONDUIT BOXES GENERAL

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

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel single and multi gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Electro-galvanized steel utility boxes for outlets connected to surface-mounted conduit, minimum size 102 x 54 x 48 mm.
- .3 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .4 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.

2.3 MASONRY BOXES

- .1 Electro-galvanized steel masonry single and multi gang boxes for devices flush mounted in exposed block walls.

2.4 CONCRETE BOXES

- .1 Electro-galvanized sheet steel concrete type boxes for flush mount in concrete with matching extension and plaster rings as required.

2.5 FLOOR BOXES

- .1 Concrete tight electro-galvanized sheet steel floor boxes with adjustable finishing rings to suit floor finish with brushed aluminum faceplate. Device mounting plate to accommodate short or long ear duplex receptacles. Minimum depth: 28 mm for receptacles; 73 mm for communication equipment.

2.6 CONDUIT BOXES

- .1 Cast FS or FD boxes with factory-threaded hubs and mounting feet for surface wiring of switches and receptacles.

2.7 FITTINGS - GENERAL

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

3.0 EXECUTION

3.1 INSTALLATION

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 For flush installations mount outlets flush with finished wall using plaster rings to permit wall finish to come within 6 mm of opening.
- .4 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.

END OF SECTION

1.0 GENERAL

1.1 SCOPE

- .1 Refer to Section 26 05 01 Common Work Results for Electrical.
- .2 Furnish all labour, materials, supervision, equipment, and services specified, indicated or requested to install a complete conduit raceway system. The raceway systems shall be comprised of the supply and installation of all conduits, fittings, supports, hangers and miscellaneous support materials and hardware required.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 56, Flexible Metal Conduit and Liquid-Tight Flexible Metal Conduit.
 - .3 CSA C22.2 No. 211.2, Rigid PVC (Unplasticized) Conduit.

1.3 LOCATION OF CONDUIT

- .1 The drawings do not show every specific conduit run. All wiring shall be surface and as run in the slab unless otherwise indicated in the specifications and/or shown on the drawings. All devices shall be surface mounted type except as shown.

2.0 PRODUCTS

2.1 CONDUITS

- .1 Conduit in ordinary areas and humid corrosive environments shall be Rigid PVC. Minimum size to be 19 mm.
- .2 Conduit in hazardous areas shall be threaded rigid aluminum epoxy coated conduit with zinc coating and corrosion resistant epoxy finish inside and outside. Minimum size to be 19 mm.
- .3 Liquid-tight flexible metal conduit for motor and equipment connections.
- .4 EMT conduit shall not be utilized anywhere in the installation.

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.
- .2 Beam clamps to secure conduits to exposed steel work.
- .3 Channel type supports for two or more conduits.
- .4 Threaded rods, 6 mm dia., 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.

2.4 EXPANSION FITTINGS FOR CONDUIT

- .1 All conduits entering outlet boxes and devices that are located in walls subject to movement shall be terminated by means of liquid-tight flexible conduit, approximately 450 mm in length between the conduit and the outlet box or device which is being supplied. All conduits, bus duct, wireways, etc., passing through or across expansion joints of the building shall be installed with the use of approved expansion fittings.

2.5 FISH CORD

- .1 Polypropylene.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Conceal conduits except in mechanical and electrical service rooms and in unfinished areas.
- .3 Use rigid pvc conduit unless otherwise noted.
- .4 Use rigid pvc conduit underground and in cast concrete.
- .5 Use flexible metal conduit for connection to motors.
- .6 Use liquid tight flexible metal conduit for connection to motors or vibrating equipment in damp, wet or corrosive locations.

- .7 Minimum conduit size: 19 mm.
- .8 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
- .9 Mechanically bend steel conduit over 19 mm dia.
- .10 Install fish cord in empty conduits.
- .11 Remove and replace blocked conduit sections. Do not use liquids to clean out conduits.
- .12 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended channels.
- .5 Do not pass conduits through structural members except as permitted by the Contract Administrator
- .6 Do not locate conduits less than 75 mm parallel to steam or hot water lines with minimum of 25 mm at crossovers.

3.3 CONCEALED CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in masonry walls.
- .3 Do not install conduits in terrazzo or concrete toppings.

3.4 CONDUITS IN CAST-IN-PLACE CONCRETE

- .1 Locate to suit reinforcing steel. Install in centre one third of slab.
- .2 Protect conduits from damage where they stub out of concrete.
- .3 Install sleeves where conduits pass through slab or wall.
- .4 Provide oversized sleeve for conduits passing through waterproof membrane, before membrane is installed. Use cold mastic between sleeve and conduit.

- .5 Do not place conduits in slabs in which slab thickness is less than 4 times conduit diameter.
- .6 Encase conduits completely in concrete with minimum 25 mm concrete cover.
- .7 Organize conduits in slab to minimize cross-overs.

3.5 CONDUITS UNDERGROUND

- .1 Slope conduits to building to provide drainage.
- .2 Waterproof joints (PVC excepted) with heavy coat of bituminous paint.

END OF SECTION

1.0 GENERAL

1.1 DESCRIPTION

- .1 Cable tray to form a complete system, including straight lengths, horizontal and vertical elbows, tees, crosses, reducers, couplers, covers and accessories as detailed in this specification an as shown on drawings.

1.2 SUBMITTALS

- .1 Submit shop drawings and product data in accordance with Section 01 30 00 – Submittals and Section 260501 – Common Work Results for Electrical.

2.0 PRODUCTS

2.1 TRAY

- .1 Ladder type, Class D1 to CSA C22.2 No. 126.
- .2 Extruded aluminum tray.
- .3 Horizontal elbows, end plates, drop outs, vertical risers and drops, tees, wyes, expansion joints and reducers where required. Fittings: manufactured accessories for cable tray supplied.
- .4 Solid covers for cable tray system located below 2000mmm above finished floor, under platform grating, and outdoors.
- .5 Barriers where different voltage systems are in the same cable tray.
- .6 Cable tray width as indicated with a minimum cable loading depth of 100 mm.

2.2 SUPPORTS

- .1 Provide supports, hangers, and securing devices as required for complete installation.

2.3 ACCEPTABLE MANUFACTURERS

- .1 Electro-Tray.
- .2 Canstrut Products
- .3 Cooper B-Line
- .4 Unitray Systems Inc.
- .5 Unless otherwise approved by the Engineer, provide cable trays of the same manufacturer throughout the contract.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install complete cable tray system.
- .2 Support cable tray as shown on drawings and as recommended by manufacturer.
- .3 Remove sharp burrs or projections to prevent damage to cables or injury to personnel.
- .4 Coordinate supports and tray location with work of other trades. Notify Engineer of any conflicts and obtain a ruling before proceeding with the installation. Prepare roughing-in drawings illustrating the locations and methods of supports of all components.
- .5 Where terminations are indicated, provide a grommet or protective bushing to protect exiting cables.
- .6 Provide cable tray covers on all trays at floor level and up to 2000 mm above floor level or finished grade, under platforms, and outdoors.
- .7 Ground cable tray as required in section 260528.

3.2 CABLES IN CABLE TRAY

- .1 Install cables individually.
- .2 Lay cables into cable tray. Use rollers when necessary to pull cables.
- .3 Secure cables in cable tray at 3 m centers, with nylon ties.
- .4 Where cable trays are mounted vertically on wall, secure cables at 1.5 m intervals with P type clamp fasteners.
- .5 Control and instrument cables shall be random fill with a barrier separation between power cables.
- .6 Selected feeder cables shall have an air gap between them equal to 100% of the largest cable diameter. Refer to cable schedule for details.

END OF SECTION

1.0 GENERAL

1.1 GENERAL CONDITIONS

- .1 Refer to Section 26 05 01 Common Work Results for Electrical.
- .2 Furnish all labour, materials, equipment and services specified, indicated or requested to install the trenches and underground conduits as specified herein and on the drawings.

1.2 SCOPE

- .1 Furnish all labour, materials, supervision, equipment, and services specified, indicated or requested to provide all trenching and backfilling as necessary for the installation of all underground conduits and cables, as indicated.
- .2 Direct buried cables are not expected to be required on this project and shall only be installed with approval by the Engineer.

1.3 QUALITY ASSURANCE

- .1 Installation of cables in trenches and ducts shall meet the requirements of the latest edition of CSA C22.1 – Canadian Electrical Code.

2.0 PRODUCTS

2.1 TRENCHING AND BACKFILLING

- .1 Trenching shall be approximately 1000 mm in depth, width to suit proper installation.
- .2 Backfill for trenches for all ducts, conduits, and cables shall consist of fine sand (minimum 100 mm below and above cables, etc.) and firmly compacted
- .3 All ducts, and conduits crossing over each other or over/under other types of underground service shall be separated by minimum of 150mm and surrounded by wood planks treated with pentachlorophenol.
- .4 Frozen earth, large lumps or boulders shall not be used for backfill material.
- .5 Where direct buried cables are approved by the Engineer provide treated wood planks over all such cables installed under existing or future roads and sidewalks, and provide sleeves under all parking, concrete and traffic areas for cables.

2.2 CABLE PROTECTION

- .1 Provide identification tape labeled as indicated showing location of direct buried cables.

3.0 EXECUTION

3.1 INSTALLATION OF UNDERGROUND CONDUITS AND DIRECT BURIED CABLES

- .1 After specified sand bed is in place, lay conduits or cables in trench, maintaining a 75 mm minimum clearance from each side of trench to nearest conduit or cable. Do not pull cable into trench.
- .2 For cables, provide offsets for thermal action and minor earth movements. Offset cables 150 mm for each 60 M run, maintaining minimum cable separation and bending radius requirements.
- .3 Underground cable splices are not acceptable
- .4 Minimum permitted radius of conduits is 300mm. Cable bends for rubber, plastic or lead covered cables, 8 times diameter of cable; for metallic armoured cables, 12 times diameter of cables or in accordance with manufacturer's instructions.

3.2 CABLE INSTALLATION IN CONDUITS

- .1 Install cables and wiring as indicated in underground conduits.
 - .1 Do not pull spliced cables inside ducts.
- .2 Install multiple cables in underground conduit simultaneously.
- .3 Use CSA approved lubricants as specified as part of the cable manufactures cable pull design to reduce pulling tension.
- .4 To facilitate matching of colour coded multiconductor control cables reel off in same direction during installation.
- .5 After installation of cables and wiring, seal duct ends with duct sealing compound.
- .6 Seal all spare conduits at entry to buildings using permanent pressure resistant long term plugs. Plugs must be constructed with rubber gaskets that can be compressed to form a permanent seal of the conduit.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 01 – Common Work Results - Electrical.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check phase rotation and identify each phase conductor of each feeder.
- .4 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuit is not less than 50 megohms.
- .5 Pre-acceptance tests:
 - .1 After installing cable but before terminating, perform insulation resistance test with 1000V megger on each phase conductor
 - .2 Check insulation resistance after each splice and/or termination to ensure that cable system is ready for acceptance testing.
- .6 Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.
- .7 Remove and replace entire length of cable if cable fails to meet any of test criteria.
- .8 Contractor responsible for making all necessary repairs to installation resulting from improper backfilling, compactions, etc.

END OF SECTION

1.0 GENERAL

1.1 WORK INCLUDED

- .1 This section of the specifications forms part of the Contract Documents and is to be read, interpreted, and coordinated with all other parts.
- .2 Provide seismic restraint and anchorage for all equipment and services in accordance with the current edition of the BC Building Code except that the seismic loads shall be determined in accordance with the current edition of the National Building Code of Canada.
- .3 The total electrical seismic restraint design and field review and inspection will be by an APEGBC-registered professional structural engineer who specializes in the restraint of building elements. Contractor shall allow for coordination, provision of seismic restraints, as well as all costs for the services of the Seismic Restraint Engineer. This engineer, herein referred to as the Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.
- .4 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.
- .5 The Contractor's Seismic Consultant shall submit original signed BC Building Code "Letters of Assurance", "Schedules B1, B2, and C-B" to the Prime Contractor or Electrical Consultant.

1.2 REFERENCE STANDARDS

- .1 Conform to the following reference standards (editions as enforced in the Province of Alberta at time of facility construction):
 - .1 BC Building Code.
 - .2 National Building Code of Canada.

1.3 SUBMITTALS

- .1 Shop Drawings: Submit with the related items of equipment in accordance with Section 01 30 00 and Section 26 05 01.
- .2 Submit shop drawings of all seismic restraint systems including details of attachment to the structure, either tested in an independent testing laboratory or approved by the seismic consultant.
- .3 Submit all the proposed types and locations of inserts or connection points to the building structure or support slabs. Follow the directions and recommendations of the Seismic Consultant.

2.0 PRODUCTS

2.1 GENERAL

- .1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.
- .2 Provide restraint on all equipment and machinery, which is part of the facility electrical services and systems, to prevent injury or hazard to persons and equipment in and around the structure. Restrain all such equipment in its normal position in the event of an earthquake.
- .3 The Seismic Consultant shall provide detailed seismic restraint installation shop drawings to the Contractor. Copies of the shop drawings to be included in the final project manual.
- .4 Provide seismic restraints on all equipment, and/or installations or assemblies, which are suspended, pendant, shelf mounted, freestanding and/or bolted to the building structure or support slabs.

3.0 EXECUTION

3.1 FLOOR MOUNTED EQUIPMENT

- .1 Bolt all equipment, e.g. transformers, switchgear, motor control centres, free standing panel boards, control panels, etc. to the structure. Design anchors and bolts for seismic force applied horizontally through the center of gravity as instructed by the Seismic Consultant.

3.2 CONDUITS AND CABLE TRAY

- .1 Provide restraint installation information and details on conduit and equipment as indicated below:
 - .1 Vertical Conduit:
 - .2 Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring. Stacks shall be supported at their bases and, if over 2 stories in height, at each floor by approved metal floor clamps.
 - .3 At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m.
 - .4 Riser joints shall be braced or stabilized between floors.
 - .2 Horizontal Conduits:
 - .1 Supports - Horizontal conduit shall be supported at sufficiently close intervals to keep it in alignment and prevent sagging.

- .2 Metal conduits shall be supported at approximately 1.2 m intervals for this metal tubing.
- .3 Provide transverse bracing for cable trays and conduit racks at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90° bend assemblies, and pull box locations.
- .4 Provide longitudinal bracing for cable tray and conduit racks at 24.4 m o.c. maximum unless otherwise noted.
- .5 Do not brace cable trays stacks or conduit rack runs against each other. Use separate support and restraint system.
- .6 Support all cable trays and conduit racks in accordance with the capability of the selected material to resist seismic load requirements indicated or as instructed by the Seismic Consultant.
- .7 Trapeze hangers may be used. Provide flexible conduit connections where conduits pass through building seismic or expansion joints, or where rigidly supported conduits connect to equipment with vibration or seismic isolators.
- .8 A tray system (tray stack) or conduit system shall not be braced to dissimilar parts of a building or two dissimilar building systems that may respond in a different mode during an earthquake event. Examples: wall and a roof; solid concrete wall and a metal deck.
- .9 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with fire-stopping where required.
- .10 It is the responsibility of the contractor to ascertain that an appropriate size restraint device be selected for each individual piece of equipment. Submit details on shop drawings. Review with Seismic Consultant and submit shop drawings to consultants for their reference.

END OF SECTION

1.0 GENERAL

1.1 GENERAL CONDITIONS

- .1 Refer to all other Sections of the Specifications and these Documents to determine their effect upon the work of this Section.
- .2 In case of a conflict with another specification, use the more stringent of the two standards. In addition, contact the Engineer for further clarifications.

1.2 INTENT

- .1 The Contractor shall provide testing and commissioning of the electrical and control systems for the facility. The testing and commissioning process will be used to bring the facility to a fully operational state, free of deficiencies, in the most efficient and timely manner achievable.
- .2 The testing and commissioning process for the work consists of:
 - Stage 1: Contractor Supplied Verification Forms
 - Stage 2: Component and Equipment Verification & Testing.
 - Level 1: Equipment Verification
 - Level 2: Point Verification
 - Stage 3: Starting and Testing of Subsystems.
 - Stage 4: Facility Startup testing and fine tuning
 - Level 1: System Verification
 - Level 2: Integrated Systems Verification.
- .3 Defined in this Section are the Contractor's and Engineer's responsibilities relating to the coordination and implementation of the commissioning process.

2.0 PRODUCTS
NOT APPLICABLE

3.0 EXECUTION

3.1 GENERAL

- .1 The process to be utilized for this project consists of EQUIPMENT, SYSTEM, and INTEGRATED SYSTEMS verification tests to be documented on Contractor developed verification forms. Submit forms for Engineers review.
- .2 Prior to starting and testing of equipment or subsystems, prepare a schedule for the required testing. Review with Engineer.
- .3 Schedule Facility Startup tests with the Engineer to minimize impact on processes or systems.
- .4 Arrange for manufacturers to submit copies of all factory test records prior to commissioning.
- .5 Have all verification sheets and testing sequences approved by the Engineer prior to starting.
- .6 The Contractor shall conduct testing in conjunction with the Engineer. Contractor will ensure all the necessary subcontractors are available to correct any problems during testing. The Engineer may witness all of any portion of testing, commissioning, and starting procedures performed by the Contractor.
- .7 Provide two-way radios, ladders and other equipment as required to complete the commissioning as outlined.
- .8 Contractor's personnel shall be equipped with Contractor provided tools and equipment necessary for the testing and commissioning. This will include but not be limited to:
 - .1 Multimeter
 - .2 AC Current Meter
 - .3 Loop Current Generator
- .9 Obtain certificates of approval, acceptance and comply with rules and regulation of authorities having jurisdiction. Provide copies of certificates to Engineer.
- .10 Submit completed verification forms immediately after tests are performed.
 - .1 Record all data on site on approved verification forms.
 - .2 Provide Engineer with the original record of each completed verification form, make any necessary corrections and resubmit as requested by Engineer.
 - .3 Maintain one completed copy on site during starting and testing period.
 - .4 Maintain one copy of all final starting, testing balancing and adjusting reports on site up to substantial performance of the work for reference purposes.

- .5 All final verification forms are to be typewritten.
- .11 Thoroughly overhaul and restore to new condition all equipment that has been operated by contractor during construction phase.
- .12 Permanently mark all settings in such a manner that they cannot be eradicated or obliterated in any way.
- .13 Record all final settings on record drawings.

3.2 STAGE 1: CONTRACTOR SUPPLIED VERIFICATION FORMS

- .1 Verification forms generated by the Contractor will supplement any factory provided test data.
- .2 Component Verification forms shall be provided for each piece of equipment, after receipt of approved shop drawings, and forwarded to the Engineer for review, revisions and finalization.

3.3 STAGE 2 – COMPONENT/EQUIPMENT VERIFICATION AND TESTING

- .1 Level 1 – Equipment Verification Forms:
 - .1 The Contractor is responsible for performing all tests and measurements and recording results on the component verification forms.
 - .2 Where additional verification forms are required, the Contractor shall develop appropriate forms and submit them to Engineer for review prior to use.
- .2 Level 2 – Point Verifications:
 - .1 The Contractor shall prove all wiring and loops between the various components.
 - .2 Confirmation that the loop test has been completed shall be recorded on the verification forms.

3.4 STAGE 3: SUBSYSTEM VERIFICATIONS:

- .1 All Subsystem verification and testing is to be executed by the Contractor.
- .2 All related components verification must be completed and approved prior to executing subsystem verifications.
- .3 Subsystem verifications will be detailed on verification forms provided by the Contractor, unless otherwise instructed by the Engineer.
- .4 The Verification tests are intended to prove the integrity of the hardware and software for each individual subsystem. Tests to include (but not limited to) the following:
 - .1 Operation of system in “Remote” and/or “Auto” mode (PLC).

- .2 Operation of system in "Local" and/or "Hand" mode (Operator Initiated).
- .3 Emergency Manual Mode (PLC Failed).
- .4 Safe shutdown in response to a power failure.
- .5 Quality and quantity of desired product.

3.5 STAGE 4: FACILITY STARTUP TESTING AND FINE TUNING

- .1 For new water mains and specific treatment processes the Engineers guidelines for acceptance testing must be followed as provided in the specification package.
- .2 Prior to Facility Startup testing the Contractor must have the following documentation complete and on hand during the testing:
 - .1 All test reports (Manufacturers, as well as equipment, per respective division, and subsystems).
 - .2 Shop Drawings and Product Data.
 - .3 The Contract Documents and any Contractor marked up redline (as-built) drawings developed during construction.
- .3 Responsibilities:
 - .1 Engineer will do the following during System and Integrated Systems Testing and fine-tuning.
 - .1 Assist in the coordination of the preplanned integrated system performance tests under conditions simulating, the extent possible, full and partial operating loads and emergency load conditions.
 - .2 Review Contractor documentation of test results.
 - .3 Diagnose problems and determine whether they are the result of Contract Deficiencies.
 - .4 Request repeat tests as required following correction of Contract Deficiencies and execution of Change Orders by Contractor and verify results.
 - .5 Provide direction and instruct in the fine-tuning of the systems under test to satisfy the operating requirements.
 - .2 Contractor will do the following during System and Integrated Systems Testing and fine-tuning.
 - .1 Conduct Integrated System testing and document results.
 - .2 Modify operating parameters of the systems to satisfy the fine turning requirements outlined by the Engineer, so as to ensure proper system operation. For Example:
 - .1 Make adjustments that may become apparent as testing proceeds.
 - .2 Modifications to suit changes as equipment settles down during the "running in" period;
 - .3 Documentation of results;
 - .4 Diagnosis of problems;

- .5 Correct Contract Deficiencies previously outstanding and those identified during Integrated Systems verification and fine-tuning;
- .6 Execute Change Orders issued by the Engineer.
- .3 Fine-tuning will provide for the adjustment of the systems and integrated systems testing have shown a need.
- .4 Start-Up Progress Meetings:
 - .1 Start-up meetings will be held prior to each SYSTEMS and INTEGRATED SYSTEMS tests.
 - .2 The Contractor is to put forward the agenda, chair the meeting as well as record and distribute the minutes.
 - .3 Meetings will introduce, monitor progress, and resolve any issues or deficiencies relating to the Startup Process.
 - .4 Based on the requirements of the agenda the attendees shall include but not be limited to:
 - .1 Contractor's representatives: Contractor's site superintendent, mechanical and electrical subcontractors, controls subcontractor and when so requested by the Engineer: suppliers, inspection and testing companies and their parties involved in the Work. Contractor's representatives shall be qualified and authorized to act on behalf of the party each represents.
 - .2 Owner's representatives: Project Managers, Consulting Engineers, Operations and Maintenance representatives as required.
- .5 Provide sufficient notice (minimum 72 hours) prior to commencing tests.
- .6 Coordinate all sub-trades, other divisions, manufacturers, suppliers and other specialists as required to ensure all phases of work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary staffing requirements.
- .7 Coordinate starting of mechanical equipment and systems with testing and demonstration and instruction of:
 - .1 Electrical equipment and systems as specified.
 - .2 Mechanical equipment and systems as specified.
 - .3 Other equipment and systems as specified.

3.6 LEVEL 1: SYSTEM VERIFICATIONS

- .1 System tests will verify proper operation of each system individually, including operation of ancillary subsystems.
- .2 All related component and subsystem verifications must be completed and approved prior to the execution of the system verifications.
- .3 To ensure system operations conform with the contract documents:

- .1 Each system is operated for as long as required to commission the project and to verify performance.
- .2 Results of testing and procedures are checked and verified to be correct within stated tolerances. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

3.7 LEVEL 2: INTEGRATED SYSTEM VERIFICATIONS

- .1 The Intent of these tests is to prove proper operation of the completed facility operating as an integrated system.
- .2 All related component, subsystem and systems verifications must be completed and approved prior to the execution of the integrated system verifications.
- .3 Tests shall include:
 - .1 Behavior during plant power failure;
 - .2 Behavior during PLC failure;
 - .3 Failure of critical components in worst case scenarios;
 - .4 System interlocks;
 - .5 Operation in Auto, Manual, and Emergency Manual modes.
- .4 To ensure operation conforms to the contract documents:
 - .1 Verify performance of system operating in conjunction with one another under all conditions and modes of operation. Each system is operated for as long as required to commission the project and to verify performance.
 - .2 Results of testing and procedures are checked and verified to be correct within stated tolerances. If inconsistencies appear between reported results and demonstrated values, the relevant testing procedures are repeated and adjustments made until satisfactory results are obtained.

3.8 COMPLIANCE WITH DEFINED PROCEDURES:

- .1 Failure to follow the specific instructions defined herein pertaining to correct starting procedures may result in re-evaluation of equipment by independent testing agency selected by Engineer at the Contractor's expense. Should results reveal that equipment has not been started in accordance with specified requirements, equipment may be rejected. If rejected, remove equipment from site and replace. Replacement equipment shall also be subject to full starting procedures, using same procedures specified on the originally installed equipment.
- .2 Performance testing of any system by Engineer does not reduce the Contractor's obligations for complete testing and start-up systems as specified.

END OF SECTION

1.0 GENERAL

1.1 GENERAL CONDITIONS

- .1 Refer to all other Sections of the Specifications and these Documents to determine their effect upon the work of this Section.
- .2 In case of a conflict with another specification, use the more stringent of the two standards. In addition, contact the Engineer for further clarifications.

1.1 INTENT

- .1 Provide demonstration and instruction sessions to familiarize the Owner's operation and maintenance personnel with electrical systems and their operation and maintenance.

1.2 MANUFACTURER'S SITE SERVICES

- .1 Arrange and pay for appropriately qualified manufacturer's representatives to provide or assist in providing electrical equipment and systems demonstration and instruction as specified herein.

1.3 CONTRACTOR

- .1 The Engineer will chair demonstration and instruction sessions.
- .2 Establish agendas for demonstration and instruction sessions in conjunction with the Engineer. Coordinate scheduling of sessions with the Engineer and the Owner.

1.4 DEMONSTRATION AND INSTRUCTION SEMINARS

- .1 Prepare a schedule identifying the proposed sequence of demonstration. Sequence of demonstration shall correspond to full system starting.
- .2 Include a description of each system, and each piece of equipment.
- .3 Instruct the Owner and his maintenance staff on operation and maintenance procedures of all major electrical systems. This instruction shall be performed twice, once when systems are being energized and tested and once before building is turned over to the Owner.
- .4 Answer all questions raised by Engineer at demonstrations. If unable to satisfactorily answer questions immediately, provide written response within three days.

2.0 PRODUCTS
NOT APPLICABLE

3.0 EXECUTION

3.1 SYSTEMS DEMONSTRATIONS

- .1 Generator and Transfer Equipment:
 - .1 Operation during Utility Power Outage;
 - .2 Operation for maintenance testing;
 - .3 Open transition transfer, see also para 3.1.3 below.
- .2 Variable Frequency Drives:
 - .1 Selecting and reading information from operator interface;
 - .2 Local – Remote operation of the VFD;
 - .3 Reading and interpreting VFD error codes;
 - .4 Basic troubleshooting methods to assist service representative in assessing problem over phone prior to coming to site.
- .3 Motor Control Center:
 - .1 Instruct operators on locking out 600 Volt power circuits.
 - .2 Local and Remote operation of motor starters;
 - .3 Manual and Auto operation of transfer switch, timer settings and adjustments.
- .4 Control Panel
 - .1 Location of fuses and circuit breakers for various instrument

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

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

1.2 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results - Electrical.

1.3 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No.42, General Use Receptacles, Attachment Plugs and Similar Devices.
 - .2 CSA-C22.2 No.42.1, Cover Plates for Flush-Mounted Wiring Devices (Bi-national standard, with UL 514D).
 - .3 CSA-C22.2 No.111, General-Use Snap Switches (Bi-national standard, with UL 20, latest edition).

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00 - Submissions.
- .2 Include wiring devices literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results for Electrical.

2.0 PRODUCTS

2.1 MANUFACTURER

- .1 Wiring devices shall be of one manufacturer throughout the project.
- .2 Acceptable Manufacturers: Hubbell, Bryant, or Pass & Seymour.

2.2 DEVICES

- .1 The catalogue numbers shown below are for the particular manufacturer's series and all necessary suffixes shall be added for the requirements as stated. For all devices, use the specification grade minimum.

2.3 SWITCHES

- .1 Extra heavy duty specification grade.
- .2 20 A, 120 V, single pole, double pole, three-way, four-way switches as indicated.

- .3 Manually-operated general purpose ac switches as indicated and with following features:
 - .1 Terminal holes approved for No. 10 AWG wire.
 - .2 Silver alloy contacts.
 - .3 Urea or melamine moulding for parts subject to carbon tracking.
 - .4 Suitable for back and side wiring.
 - .5 White toggle (red toggle for emergency power circuits).
- .4 Toggle operated fully rated for tungsten filament and fluorescent lamps, and up to 80% of rated capacity of motor loads.
- .5 Standard of acceptance:
 - .1 Hubbell HBL.1221 20A series.
 - .2 Leviton 1221-20A 120V series.
 - .3 Pass & Seymour PS20AC1 120V series.

2.4 RECEPTACLES - GENERAL

- .1 Extra heavy duty specification grade.
- .2 Duplex receptacles, NEMA 5-20R, 125 V, 20 A, U ground, to: CSA-C22.2 No.42 with following features:
 - .1 White nylon molded housing (red for emergency power circuits).
 - .2 Suitable for No. 10 AWG for back and side wiring.
 - .3 Break-off links for use as split receptacles.
 - .4 Eight back wired entrances, four side wiring screws.
 - .5 Triple wipe contacts and riveted grounding contacts.
 - .6 Dual 15/20A configuration.
- .3 Other receptacles with ampacity and voltage as indicated.
- .4 Receptacles of one manufacturer throughout project.
- .5 Standard of acceptance:
 - .1 Hubbell 5362 heavy duty, construction series;
 - .2 Leviton 5362 series;
 - .3 Pass & Seymour 5362 series;
 - .4 Or as indicated on drawings.

2.5 RECEPTACLES – PARTICULAR APPLICATION

- .1 Ground Fault Interrupter type: 15 Amp or 20 Amp as indicated, 125 V, duplex receptacles to be 2 pole, 3 wire hospital grade, white face, parallel blade, U ground, impact resistant nylon face, complete with breaker and reset button. Equal to:

- .1 Hubbell GFR-5262TR (15A) and GFR-5263TR (20A) series.
- .2 Leviton or Pass & Seymour equivalent.

- .2 All other single outlet and special purpose receptacles to be similar to the grade and series indicated above. Confirm ampacity, voltage and pin configuration prior to installation.

2.6 COVER PLATES

- .1 Stainless steel: Type 302 or 304, No. 4 finish, 1mm thick, accurately die cut, protective cover for shipping. For general interior flush mounted wiring devices and surface type FS or FD type boxes. Cover plates from one manufacturer throughout project.
- .2 Nylon plates: Heavy duty, unbreakable and flush. All nylon plates to match wiring device color.
- .3 Steel: sheet steel hot dip galvanized with rolled edges for surface mounted utility boxes.
- .4 Wall plates to be flush mounting with "positive bow" feature to ensure that all edges of plate are flush with wall or surface box when installed.
- .5 All plates to be bevelled type with smooth rolled outer edge and smooth face. Exposed sharp edges are not acceptable.
- .6 Cast metal: die cast profile, ribbed for strength, flash removed, primed with grey enamel finish and complete with four mounting screws to box for special purpose wiring devices.
- .7 Weatherproof double lift spring-loaded cast aluminum cover plates, complete with gaskets for wiring devices as indicated. Double doors for standard duplex receptacles. Cover plates to fasten to box by four screws.
- .8 Gaskets: resilient rubber or close cell foam urethane.
- .9 Cover plates for all wiring devices to be from one manufacturer throughout project.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Provide identification label on switch cover plate complete with circuit number.
- .2 Switches:
 - .1 Install single throw switches with handle in "UP" position when switch closed.

- .2 Install switches in gang type outlet box when more than one switch is required in one location.
- .3 Mount toggle switches at height in accordance with Section 26 05 01 - Common Work Results for Electrical.
- .3 Receptacles:
 - .1 Provide identification label on receptacle cover plate complete with circuit number.
 - .2 Install receptacles in gang type outlet box when more than one receptacle is required in one location.
 - .3 Ground fault interrupter duplex receptacles to be used, adjacent sinks or water sources.
 - .4 Mount receptacles at height in accordance with Section 26 05 01 - Common Work Results for Electrical.
- .4 Cover plates:
 - .1 Protect stainless steel cover plate finish with paper or plastic film until painting and other work is finished.
 - .2 Install suitable common cover plates where wiring devices are grouped.
 - .3 Do not use cover plates meant for flush outlet boxes on surface-mounted boxes.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 24 19 – Motor Control Centre.
- .2 Section 26 24 17 – Panelboards Breaker Type.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA):
 - .1 CSA-C22.2 No. 5, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).
 - .2 ANSI C37.13, C37.16, C37.17, C37.50.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with 01 30 00 - Submittals.
 - .1 Include time-current characteristic curves for breakers.
- .2 Include circuit breaker literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results for Electrical.

1.4 COORDINATION

- .1 Breakers with adjustable trip units must be set as per the settings included in the protective device coordination study supplied and completed by the Contractor and reviewed by the Engineer.

2.0 PRODUCTS

2.1 MOULDED CASE CIRCUIT BREAKERS (GENERAL)

- .1 Bolt-on moulded case circuit breaker to CSA C22.2 No.5: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position.
- .3 Common-trip: with through-the-door single handle mechanism for multi-pole applications.

- .4 Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings. Breakers shall be fully-rated; series-rated interrupting ratings will not be accepted.
- .5 MCC main incoming circuit breaker shall be complete with solid state LSIG electronic trip unit and to operate by means of the solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, and instantaneous tripping for phase to ground fault short circuit protection.
- .6 MCC feeder circuit breakers are to be assembled in draw-out unit wrappers.
- .7 Thermal magnetic moulded case feeder circuit breakers up to 250 Amp are to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.
- .8 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Instantaneous trip settings on breakers with adjustable trips to range from 3 - 10 times current rating.
- .9 Circuit breakers with interchangeable trips as indicated.
- .10 Ground fault interrupter breakers for circuits feeding heat tracing cables and as otherwise indicated on drawings.
- .11 Shunt trip circuit breakers shall be as indicated on drawings c/w 120 VAC duty coils and two SPDT auxiliary switches.
- .12 Where indicated on drawings, include the following circuit breaker options as specified;
 - .1 Shunt trip.
 - .2 Auxiliary position contacts NO/NC.
 - .3 Under-voltage release.
 - .4 On-off locking device.
 - .5 Solid state trip units.

2.2 MOULDED CASE CIRCUIT BREAKERS (MOTOR PROTECTION)

- .1 Moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40°C ambient.
- .2 Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.
- .3 Motor circuit protectors (MCP) are to be assembled in draw out unit wrappers.

- .4 Common-trip: with through-the-door single handle mechanism for multi-pole applications.
- .5 Magnetic instantaneous trip elements in motor protection circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from 6 -15 times current rating.
- .6 Motor Circuit Protectors (MCP) shall be provided complete with 120 VAC contactor coils and minimum of two SPDT auxiliary switches, or as otherwise indicated on the drawings.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.
- .2 Identification: Provide lamicoid plate on each MCC circuit breaker showing breaker tag number and load being fed.
- .3 Adjust trip setting for system and feeder protections, motor circuit protection, and as per the protective device coordination study.

3.2 TESTING AND COMMISSIONING

- .1 Perform tests and document results in accordance with Section 26 05 01 – Common Works Results for Electrical, Section 26 08 11 – Testing of Electrical Systems, and as per manufacturer’s recommendations.

END OF SECTION

1.0 GENERAL

1.1 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results for Electrical.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4, Enclosed Switches.
 - .2 CSA C22.2 No.39, Fuseholder Assemblies.

1.3 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00 - Submittals.
- .2 Include circuit breaker literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results for Electrical.

2.0 PRODUCTS

2.1 DISCONNECT SWITCHES

- .1 “Heavy Duty” class, enclosed manual air break switches to CSA C22.2 No.4.
- .2 Fuseholder assemblies to CSA C22.2 No.39.
- .3 Fusible and non-fusible disconnect switch in CSA Type NEMA 4x enclosure in process areas and outdoors, and CSA Type NEMA 12 enclosure all other locations.
- .4 Provision for padlocking in off switch position.
- .5 Fuses as indicated. Allow for Class J or L for general circuits, Class RK5 for transformer, motor or other high inrush current circuits
- .6 Fuseholders in each switch suitable without adaptors, for type of fuse as indicated.
- .7 Quick-make, quick-break action.
- .8 ON-OFF switch position indication on switch enclosure cover.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 01 - Common Work Results for Electrical.
- .2 Indicate name of load controlled on size 4 nameplate.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses where indicated or required.
- .2 Provide and locate safety disconnect switches to isolate individual items of equipment in accordance with Canadian Electrical Code CSA 22.1 where indicated on the drawings.

END OF SECTION

1.0 GENERAL**1.1 WORK INCLUDED**

- .1 Supply, delivery, installation, testing, and commissioning of one (1) new 15kW, 240V 1phase, standby-rated diesel-engine generator.
- .2 The new generator shall be installed on a new concrete housekeeping pad at the location indicated on the drawings. Construction of the concrete pad as per Section 03 30 00 - Cast-in-Place Concrete of these specifications.
- .3 The work also includes, but is not limited to, the following:
 - .1 Source quality control, including factory testing.
 - .2 Field quality control, including site testing, inspection, and startup services.
 - .3 On-site commissioning services by manufacturer authorized representatives.
 - .4 On-site training by manufacturer authorized representatives.
 - .5 Submittals, including shop drawings and Operations and Maintenance Manuals.
 - .6 Extended warranty.

1.2 SYSTEM DESCRIPTION

- .1 Provide completely assembled, wired, tested and operational unit, required accessories, with weatherproof and sound attenuated enclosure including, but not limited to, the following:
 - .1 Diesel engine prime mover directly coupled to synchronous generator.
 - .2 Alternator.
 - .3 Alternator output breaker.
 - .4 Solid-state genset control panel and control devices.
 - .5 Steel mounting base.
 - .6 Vibration Isolation.
 - .7 Seismic restraints.
 - .8 Fuel supply system including a double-walled, sub-base tank sized to store sufficient fuel for 24 hours of full load operation.
 - .9 Exhaust system.
 - .10 Engine cooling and enclosure ventilation air system.
 - .11 Panelboard for 120/240VAC supply to heaters, lighting, battery charger, and such.
 - .12 Weatherproof, quiet-site (Level 3), aluminum lockable enclosure suitable for mounting the genset assembly on a reinforced concrete base.
 - .13 Batteries, battery rack, and battery charger.

- .14 System designed to operate as emergency standby service to operate automatically upon failure of utility service supply.
- .2 System shall be designed to operate as an unattended standby service and automatically energize upon failure of normal service supply.
 - .1 Arrange so facility loads are automatically transferred to engine generator upon loss of normal power, after engine generator has reached normal running speed and voltage.
 - .2 Upon return of normal power, system is to automatically re-transfer to normal power source(s) via the automatic transfer switch.
 - .3 After re-transfer, the system is to return to normal operation and the system shall be reset and ready for the next operation.
 - .4 Refer to Section 26 36 23 – Automatic Transfer Switches for further details.
- .3 Generator shall be constructed to the latest revision of NEMA MG1. Overload capability shall be as specified by the standard.
- .4 Generator engine shall be certified to EPA Tier 3, or the minimum acceptable at time of this Tender.
- .5 The equipment shall be produced by a manufacturer who has produced this type of equipment for a period of at least 10 years and who maintains a service organization available twenty-four hours a day throughout the year.
- .6 The Contractor is to provide all fluids required, including coolant, lubricants, and sufficient fuel for all testing. After testing and commissioning is completed, Contractor shall top up all fluids and a full tank of fuel.

1.3 RELATED WORK

- .1 Section 26 36 23 - Automatic Transfer Switches.
- .2 Section 26 28 23 - Distribution Panelboards.

1.4 REFERENCES

- .1 ISO 3046/1 Specification for Reciprocating Internal Combustion Engines: Performance.
- .2 ANSI/NEMA MG1, Motors and Generators.
- .3 ULC-S601, Steel, Above Ground Horizontal Tanks for Flammable and Combustible Liquids.
- .4 CAN/CGSB 3.6, Regular Sulphur Diesel Fuel.
- .5 ANSI/API 650, Welded Steel Tanks for Oil Storage.

- .6 CAN3-C13, Instrument Transformers.
- .7 CAN3-C17, Alternating-Current Electricity Metering.
- .8 ANSI/NEMA ICS 2, Industrial Control Devices, Controllers, and Assemblies.
- .9 CSA C282 - Emergency Electrical Power Supply for Buildings.
- .10 CSA 22.2 No. 14 M91 Industrial Controls.
- .11 ISO 8528-4: Compliance, Control Systems for Reciprocating Engine-driven Generator Sets.
- .12 UL508 Listed, Category NIWT7 for US and Canada
- .13 IEEE 446: Recommended Practice for Emergency and Standby Power Systems for Industrial and Commercial Applications.
- .14 IEEE 587: Surge Immunity

1.5 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submittals are required to determine whether the specified material and product are furnished and installed in accordance with design intent as expressed in this technical specification.
- .2 Until submissions are reviewed, fabrication may not proceed.
- .3 Where the phrase "or approved equivalent" occurs in the specification, do not assume that material, product, or methods will be accepted as equal by the Engineer unless the item has been specifically accepted in writing.
- .4 Identify each submittal and resubmittal by showing at least the following information:
 - .1 Project reference number, supplier name, address and telephone number, and a name of an individual for contact.
 - .2 Whether an original submittal or resubmittal.
 - .3 Confirmation of prior review by the Supplier of conformance to the specification.
 - .4 Date of submittal or resubmittal.
 - .5 Authorized signature of the Supplier.
- .5 Allow at least ten (10) working days for the review after receipt of submittals.
- .6 Include:
 - .1 Engine: make and model, with performance curves.
 - .2 Governor type and model.

- .3 Main generator circuit breaker.
- .4 Battery: make, type and capacity.
- .5 Battery charger: make, type and model.
- .6 Alternator: make and model.
- .7 Gen-set control panel: make, model and type of meters and controls.
- .8 Fueling System.
- .9 Continuous full load output of set at 0.8PF lagging.
- .10 Dimensioned drawing showing complete generating set mounted on sub-base fuel tank, including vibration isolators; exhaust system, drip trays, enclosure, and total weight.
- .11 Dimensioned drawing of gen-set control panel showing all meters, switches, lamps, and labels.
- .12 Wiring diagrams showing all field connections and 120/240V panelboard distribution.
- .13 Description of set operation including:
 - .1 Automatic starting and transfer to load and back to normal power, including time in seconds from start of cranking until unit reaches rated voltage and frequency.
 - .2 Manual starting.
 - .3 Automatic shut down and alarm on.
 - .4 Overcranking.
 - .5 Overspeed.
 - .6 High engine temperature.
 - .7 Low lube oil pressure.
 - .8 Short circuit.
 - .9 Alternator overvoltage.
 - .10 Lube oil high temperature.
 - .11 Over temperature on alternator.
- .14 Remote emergency start and stop.
- .15 Flow diagrams for:
 - .1 Diesel fuel.
 - .2 Cooling air.
 - .3 Muffler and exhaust pipes.
 - .4 Fueling system.
 - .5 Enclosure ventilation system.
 - .6 Cooling air requirements in m /s.

1.6 CLOSE OUT SUBMITTALS

- .1 Provide operation and maintenance data for diesel generator for incorporation into an Operations and Maintenance manual.

- .2 Include in Operation and Maintenance Manual instructions for all supplier components, including but not limited to:
 - .1 Operation and maintenance instructions for engine, alternator, control panel, battery charger, battery, coolant and oil heaters, fuel system components, lighting, generator protection breaker, exhaust system and accessories, to permit effective operation, maintenance, and repair.
 - .2 Technical data:
 - .1 Illustrated parts lists with parts catalogue numbers.
 - .2 Schematic diagram of electrical controls and power.
 - .3 Precise details for adjustment and setting of time delay relays or sensing controls which require on site adjustment.
 - .4 Maintenance and overhaul instructions and schedules.
 - .5 Certified copy of factory test results.
 - .3 Flow diagrams for:
 - .1 Fuel System.
 - .2 Lubricating oil.
 - .3 Cooling System.

1.7 EXTRA MATERIALS

- .1 Provide maintenance materials.
 - .1 Include:
 - .1 2 – Fuel filter replacement elements.
 - .2 2 – Lube oil filter replacement elements.
 - .3 2 – Air cleaner filter elements.
 - .4 2 – Sets of fuses for control panel.
 - .5 Special tools for unit servicing (detail exact components within contract submission to confirm equipment to be supplied).

1.8 WARRANTY

- .1 Manufacturer shall provide extended warranty to 60 months or 1500 operating hours, whichever occurs first.
- .2 The warranty shall include at no extra cost to the Owner: All parts, labor and expenses to make necessary repairs and replace components as required.
- .3 The warranty period shall not begin until site acceptance testing has been completed to the satisfaction of the Owner.

1.9 TRAINING

- .1 Provide services of fully trained manufacturer's technician to instruct Owner's staff in care and operation of generating set.

- .2 Instruction and training program shall include basic theory of engine operation, procedures for operation of generator and accessories, preventative maintenance, troubleshooting and major component replacement.

1.10 MAINTENANCE

- .1 Ship with unit spare parts required for complete start-up, field commissioning and testing, including special tools required for same purpose. Special tools shall become property of Owner as part of final acceptance.
- .2 Spare parts shall be clearly identified with unique equipment identification numbers that can be easily cross-referenced to manufacturer's drawings furnished for review.
- .3 Submit maintenance requirements in relation to operating hours and calendar months.

2.0 PRODUCTS

2.1 DIESEL ENGINE

- .1 Diesel engine: to ISO 3046-1.
- .2 Standard product of current manufacture, from company regularly engaged in production of such equipment.
- .3 Turbo charged, 4 cycle, radiator and fan cooled, rated speed 1800 r/min. Two cycle engine is not accepted.
- .4 Capacity:
 - .1 Rated standby power at 120/240 volts, 1 phase, 3 wire to 15kW at 0.8 power factor, after adjustment for system losses in auxiliary equipment necessary for engine operation.
 - .2 Accept 100% of the nameplate standby rating in one step.
- .5 Governor with:
 - .1 Steady state speed band of plus or minus 0.5%.
 - .2 Speed regulation no load to full load 5% maximum.
 - .3 Electronic type, electric actuator, speed droop externally adjustable from isochronous to 5%, temperature compensated with steady state speed maintenance capability of plus or minus 0.25%.
 - .4 Governor packaged in the gen-set control panel is acceptable.
- .6 Starting system:
 - .1 Positive shift, gear engaging starter 24V DC.

- .2 Cranking limiter to provide 3 cranking periods of 10 second duration, each separated by 5 second rest.
- .3 Calcium/Lead antimony acid, 24V storage battery with sufficient capacity to crank engine for 1min at 0°C without using more than 25% of ampere hour capacity. Provide with required cables, cell interconnection ties, and rack.
- .4 Battery charger:
 - .1 Constant voltage, solid state, two stage from trickle charge at standby to boost charge after use.
 - .2 Regulation: plus or minus 1% output for plus or minus 10% input variation. Automatic boost for 6 hours every 30 days.
 - .3 Equipped with DC voltmeter, DC ammeter, on-off switch, overload protection and breaker protection on input.
 - .4 Minimum charger capacity: 10 Amps.
 - .5 The charger to be completed with float, taper, 12 hour equalize charge times and settings.
 - .6 All battery cables shall be clearly color coded on both sides.
 - .7 The battery charger to have the following visual indicators:
 - .1 Loss of AC power – red light.
 - .2 Low battery voltage – red light.
 - .3 High battery voltage – red light.
 - .4 Power ON – green light.
 - .5 Status for all of the above shall be monitored at the gen-set control panel.
- .7 Cooling Systems:
 - .1 Liquid cooled: heavy duty industrial radiator with electrically driven fan.
 - .2 To maintain Manufacturer's recommended engine temperature range at 10% continuous overload in ambient temperature of 40°C
- .8 Fuel system: solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
 - .1 Fuel: Type A Fuel Oil to CGSB 3-GP-6c.
- .9 Lubrication system:
 - .1 Pressure lubricated by engine driven pump.
 - .2 Lube oil filter: replaceable, full flow type, removable without disconnecting piping.
 - .3 Lube oil cooler.
 - .4 Engine sump drain valve.
 - .5 Oil level dip-stick.
- .10 Vibration isolated engine instrument panel with:
 - .1 Lube oil pressure gauge.

- .2 Lube oil temperature gauge.
- .3 Lube oil level gauge.
- .4 Coolant temperature gauge.
- .5 Coolant level gauge.
- .6 Running time meter: non-tamper type.
- .7 Instrument panel packaged in the gen-set control panel is acceptable.
- .11 Guards to protect personnel from hot and moving parts. Locate guards so that normal daily maintenance inspections can be undertaken without their removal.
- .12 Drip tray.

2.2 ALTERNATOR

- .1 Alternator: to ANSI/NEMA MG1.
- .2 Rating: 1 phase, 120/240 V, 3 wire, 60Hz, at 0.8PF; kW rating as indicated on the drawings and above.
- .3 Output at 40°C ambient:
 - .1 100% full load continuously.
- .4 Capable of sustaining 300% rated current for period not less than 10 seconds permitting selective tripping of down line protective devices when short circuit occurs.
- .5 Revolving field, brushless, single bearing.
- .6 Drip proof.
- .7 Amortisseur windings.
- .8 Synchronous type.
- .9 Exciter: rotating brushless permanent magnet.
- .10 NEMA MG1 class H insulation on windings. Actual temperature rise measured by resistance method at full load shall not exceed 125 degree C.
- .11 Thermistors embedded in stator winding and connected to alternator control circuitry.
- .12 Voltage regulator: Thyristor controlled rectifiers with phase controlled sensing circuit:
 - .1 Load from no load to full load.
 - .2 Regulation: 2.5% maximum voltage deviation between no-load steady state and full-load steady state.
 - .3 Transient: 25% maximum voltage dip on one-step application of full load.

- .4 Transient: 15% maximum voltage rise on one-step removal of full load.
- .5 Transient: 1 s maximum voltage recovery time with application or removal of full load.
- .6 Voltage regulator packaged in the gen-set control panel is acceptable.

2.3 GENERATOR MAIN CIRCUIT BREAKER

- .1 The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that shall positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

2.4 GEN-SET CONTROL PANEL

- .1 Drip-proof, totally enclosed, vibration isolated from diesel generator.
- .2 Instruments:
 - .1 Microprocessor digital metering equipment measuring current, voltage, power, PF both maximum and instantaneous values and kWh.
 - .2 Local Display to include Voltage, Current, Power (kVA and kW), power factor as a minimum.
 - .3 2 % accuracy, rectangular face, flush panel mounting:
 - .1 Voltmeter: ac, scale 0 to 750 V.
 - .2 Ammeter: ac, scale 0 to 200% of generator rated ampere.
 - .3 Wattmeter: scale 0 to 200% of generator rated KW.
 - .4 Frequency meter: scale 55 to 65Hz.
 - .5 "Phase AB-Phase BC-Phase CA-Phase AN-Phase BN-Phase CN" on either digital or analog meter.
 - .4 Amperage indication:
 - .1 "Phase A-Phase B-Phase C- Phase N" on either digital or analog meter.
 - .2 Maintained contacts designed to prevent opening of current circuits if mechanical switch used.
 - .5 Instrument Transformers:
 - .1 Potential- Dry type for indoor use:
 - .1 Ratio: As required.
 - .2 Rating: 240V, 60Hz, BIL 25KV.
 - .2 Current- Dry type for indoor use:
 - .1 Ratio: As required.
 - .2 Rating: 240V, 60Hz, BIL 25 KV.

- .3 Positive action automatic short-circuiting device in secondary terminals.
- .3 Controls
- .1 Provide audio and visual alarms in accordance with Section 46 of the Canadian Electrical Code and the electrical inspection authority.
 - .2 Engine start button.
 - .3 Selector switch: Off-Auto-Manual-Test.
 - .4 Provision for remote starting from the automatic transfer switch.
 - .5 Internally mounted emergency stop button and provision for remote emergency stop.
 - .6 Voltage control rheostat: mount on the inside of the control panel.
 - .7 Solid state indicator and controller for automatic shutdown and alarms with one (1) set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 - .1 Engine overcrank.
 - .2 Engine overspeed.
 - .3 Engine high temperature.
 - .4 Engine low lube oil pressure.
 - .5 Short circuit.
 - .6 AC over voltage.
 - .7 Fail to crank.
 - .8 AC under Voltage.
 - .9 Under frequency.
 - .10 Emergency Stop.
 - .8 Solid state indicator lights for alarm with one (1) set manually reset NO/NC contacts wired to terminal block for remote annunciation on:
 - .1 Ground Fault.
 - .2 Synchronizing failure.
 - .3 Low fuel level.
 - .4 Low battery voltage.
 - .5 Ventilation failure.
 - .6 Low coolant temperature.
 - .7 Low DC voltage.
 - .8 High DC voltage.
 - .9 Fuel Leak.
 - .10 Sender failure: Engine speed, oil pressure and engine temperature.
 - .9 Lamp test button.
 - .10 Include provision for remote monitoring to allow for future ETHERNET/IP communication between the generator control panel and the site PLC to monitor generator system variables.

- .11 Supplier to provide all communication data mapping to the Contractor allowing the system integration into the site PLC.
- .12 The control system shall include sender failure monitoring logic for speed sensing, oil pressure and engine temperature and be capable of discriminating between failed sender or wiring components and an actual failure conditions.
- .13 The control system shall include an idle mode control which allows the engine to run in idle mode in the Test position only. In this mode, the alternator excitation system shall be disabled.
- .14 The control system to have data logging and display provision to allow logging of the last ten (10) warning or shutdown indications on the generator set as well as the total time of operation at various loads as a percent of the standby rating of the generator set.
- .15 Five sets of NO/NC relays to be provided, one for fault, one for "trouble" condition, one for the running condition, one for fuel spill detection and one for low fuel condition.
- .16 Generator control panel shall accept 120VAC / 24VDC signals from each of the fuel tank level measurement instrument to annunciate on low-fuel level alarm and from fuel tank leak detection device.

2.5

STEEL MOUNTING BASE, ACCESS PLATFORMS AND ENCLOSURE

- .1 Complete generator set mounted on structural steel base of sufficient strength and rigidity to protect assembly from stress or strain during transportation, installation and under operating conditions on suitable level surface.
- .2 Assembly fitted with vibration isolators and control console resiliently mounted.
 - .1 Spring type isolators with adjustable side snubbers and adjustable for leveling.
- .3 Sound insulation pads for installation between isolators and sub-base fuel tank.
- .4 Enclosure to completely enclose all components of the engine, generator, and associated systems, and be suitable for mounted on a sub-base fuel tank. All access doors to be lockable, and hardware and hinges shall be stainless steel. All panels to be insulated to control enclosure temperature to a maximum of 30 degrees C and to mitigate equipment noise.
- .5 Total noise from the equipment to be limited to 72 dB(A) at 7m from the enclosure.
- .6 Supply all access platforms required to access any doors or generator maintenance entries into the enclosure, mounted on a sub-base fuel tank, at an ergonomic height for the operator. Product to be manufactured of steel or other suitable material for installation outdoors in Port Hardy, BC.
- .7 Enclosure shall be primed for corrosion protection and finish-painted, with the colour to be confirmed by the Owner, using a two-step electro-coating paint

process, or Engineer approved equal. Surfaces of metal parts shall be primed and painted.

- .8 Fasteners used shall be corrosion-resistant, and designed to minimize marring of the painted surface when removed for normal installation or service work.
- .9 The Contractor is responsible for coordinating with the supplier the dimensional and quantity data for anchor bolt locations plus supplying all washers, nuts, and bolt studs to be welded to bearing plates and set into the concrete base.

2.6 FUEL SYSTEM

- .1 Fuel storage tank: to ANSI/API 650, ULC labeled.
- .2 Fuel storage tank: Double-walled tank. Main tank shall be capable of supplying generator for 48 hours at full load. To meet containment requirements, submit solution to use a sub-base tank to maintain footprint to fit on site, and allow access by operations to all working and maintenance equipment.
- .3 The tank shall be completed with drain tap and fuel gauge (mark in liters and % full) for manually checking the fuel level.
- .4 The tank shall be completed with a locking (padlock) fuel fill cap.
- .5 Factory installed leak detection of tank and leak alarm kit.
- .6 Fuel tank level measurement instrument rated 120VAC / 24VDC to activate on low-fuel level.
- .7 Shut off cock, renewable cartridge filter, fire valve.
- .8 Solid injection, mechanical fuel transfer pump with hand primer, fuel filters and air cleaner, fuel rack solenoid energized when engine running.
- .9 The main tank to be fueled directly through a secured access point within the generator enclosure.

2.7 EXHAUST SYSTEM

- .1 Horizontally-mounted, heavy duty "Critical" grade exhaust silencer with condensate drain, plug, companion bolted flanges including flexible, stainless steel, bolted flange fitting. Size according to engine manufacturer's recommendation.
- .2 Silencer to have 32-42 dB(A) noise attenuation.
- .3 Heavy duty flexible exhaust pipe with flanged couplings as required.
- .4 Fittings and accessories as required.

- .5 Expansion joints: stainless steel, corrugated, of suitable length, to absorb both vertical and horizontal expansion as required.
- .6 Overall goal is to maintain < 72 dB(A) at 7 metres from the enclosure.

2.8 ENGINE COOLING AND ENCLOSURE VENTILATION AIR SYSTEM

- .1 Recirculating damper assembly with modulating motor.
- .2 Cold air inlet damper assembly with modulating motor.
- .3 Modulating thermostat.
- .4 Replaceable air intake filters.

2.9 SOURCE QUALITY CONTROL

- .1 Factory test generator set including engine, alternator, gen-set control panel, controller and accessories in presence of the Engineer.
- .2 Supplier to schedule to finish all tests required within one-working day.
- .3 Notify the Engineer fifteen (15) working days in advance of factory test schedule showing each test activity and time scheduled.
- .4 All test results to be approved by Manufacturer's Professional Engineer prior to the unit leaving the factory.
- .5 The test results with the original seal and signature of a manufacturer's Professional Engineer shall be submitted to the Engineer.
- .6 Test procedure:
 - .1 Prepare blank forms and check sheet with spaces to record data. At top of first sheet record:
 - .1 Date.
 - .2 Generator set serial no.
 - .3 Engine, make, model, serial no.
 - .4 Alternator, make, model, serial no.
 - .5 Voltage regulator, make and model.
 - .6 Rating of generator set, kW, kVA, V, A, r/min, Hz.
 - .7 Mark check sheet and record data on forms in duplicate as test proceeds.
 - .8 Manufacturer shall provide a Professional Engineer's signature on completed forms to indicate concurrence in results of test.
 - .9 Tests:

- .1 With 100% rated load, operate set for 4 hour, taking readings at 30 min intervals, and record following:
 - .1 Time of reading.
 - .2 Running hours.
 - .3 Ambient temp in C.
 - .4 Lube oil pressure in kPa.
 - .5 Lube oil temp in C.
 - .6 Engine coolant temp in C.
 - .7 Exhaust stack temp in C.
 - .8 Alternator voltage: phase 1, 2, 3.
 - .9 Alternator current: phase 1, 2, 3.
 - .10 Power in kW.
 - .11 Frequency in Hz.
 - .12 Power Factor.
 - .13 Battery charger current in A.
 - .14 Battery voltage.
 - .15 Alternator cooling air outlet temp.
- .2 After completion of 4 hour run, demonstrate following shut down devices and alarms:
 - .1 Overcranking.
 - .2 Overspeed.
 - .3 High engine temperature.
 - .4 Low lube oil pressure.
 - .5 Short circuit.
 - .6 Alternator overvoltage.
 - .7 Low battery voltage, or no battery charge.
 - .8 Manual remote emergency stop.
 - .9 High alternator temperature.
 - .10 Synchronizing Failure.
- .3 Next install continuous strip chart recorders to record frequency and voltage variations during load switching procedures. Each load change delayed until steady state conditions exist. Switching increments to include:
 - .1 No load to full load to no load.
 - .2 No load to 75% load to no load.
 - .3 No load to 50% load to no load.
 - .4 No load to 25% load to no load.
 - .5 25% load to 50% load
 - .6 50% load to 75% load
 - .7 75% load to 100% load
- .4 Demonstrate:

- .1 Automatic starting of set on failure of normal power.
- .2 Automatic shut down of engine on resumption of normal power.
- .3 That battery charger reverts to high rate charge after cranking.

2.10 WARRANTY

- .1 For the diesel engine driven generator set, the warranty period is to be 60 months or 1500 operating hours, whichever occurs first.
- .2 The warranty shall include at no extra cost to the Owner: all parts, labor and expenses to make necessary repairs and replace components as required.
- .3 Warranty to commence upon completion of satisfactory generator commissioning on site.

2.11 MANUFACTURERS

- .1 Acceptable Suppliers / Manufacturers include
 - .1 Cummins Western Canada – Hans Schaefer 604.455.3100,
 - .2 Kohler (Frontier) – Mike Garlinski, or
 - .3 Owner-approved equal.

3.0 EXECUTION

3.1 DELIVERY TO SITE

- .1 By the Contractor, in a single shipment as practicable, including off-loading and installation on concrete pad.

3.2 FIELD QUALITY CONTROL

- .1 The Contractor to notify the Engineer ten (10) working days in advance of on-site test date.
- .2 Contractor will provide fuel and load bank for on-site test.
- .3 The Contractor will demonstrate:
 - .1 Unit start, transfer to load, retransfer to normal power, unit shut down, on "Automatic" control.
 - .2 Unit start and shut down on "Manual" control
 - .3 Unit start and transfer on "Test" control.
 - .4 Unit start on "Engine start" control.
- .4 Run unit on load for minimum period of 4 hours to show load carrying ability, stability of voltage and frequency, and satisfactory performance of dampers in

ventilating system to provide adequate engine cooling. Record following at 30 minute intervals during the entire test:

- .1 Kilowatts
 - .2 Amperes
 - .3 Voltage
 - .4 Frequency
 - .5 Oil Pressure
 - .6 Coolant Temperature
 - .7 Room Temperature
 - .8 Noise level at 7m from unit.
- .5 At end of test run, check battery voltage to demonstrate battery charger has returned battery to fully charged state.

END OF SECTION

1.0 GENERAL

1.1 DESCRIPTION

- .1 Uninterruptible power source built to all current codes and standards.

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00 - Submittals. Product data sheets for equipment to include:
 - .1 Performance criteria.
 - .2 Physical size / dimension drawings.
 - .3 Wiring Schematics.
 - .4 Equipment finish.
- .2 Include literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results for Electrical. Manufacturer’s Instructions to indicate special handling criteria, installation sequence, cleaning and maintenance procedures.

2.0 PRODUCTS

2.1 SITE UPS UNIT

- .1 Acceptable manufacture is Always ON.
- .2 Acceptable model is GES-302N or Eaton Powerware 9130.
- .3 Alternates will be accepted for consideration after bid.
- .4 Battery to maintain power for >10 minutes at full load.
- .5 Cabinet to be enclosed, and installed in the electrical room.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install UPS as per manufacturer’s recommendations.
- .2 Provide testing and commissioning of the UPS system in accordance with Section 26 05 01 – Common Work Results for Electrical, and as per manufacturer’s recommendations.

END OF SECTION

1.0 GENERAL**1.1 SECTION INCLUDES**

- .1 This specification, and the electrical drawings, establish the requirement for the design, manufacture, fabrication, and shop testing of an automatic transfer switch to be included as a stand-alone unit, to be installed inside a heated building.
- .2 Transfer switch shall be complete with necessary controls and accessories to automatically supply standby electric power during utility power service interruption.

1.2 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results for Electrical.
- .2 Section 26 24 19 - Motor Control Centres.

1.3 REFERENCES

- .1 The assembly shall be designed, manufactured, and tested in accordance with all applicable sections of the latest revisions of the following regulations, codes, standards, and specifications. In all cases where more than one regulation, code or specification applies to the same condition, the most stringent shall apply.
 - .1 CSA, Canadian Standards Association.
 - .2 CSA C-22.1 Canadian Electrical Code Part 1.
 - .3 EEMAC Electrical and Electronic Manufacturers Association of Canada.
 - .4 NEMA, National Electrical Manufactures Association.
 - .5 NFPA 110, Emergency Power Systems: Level 1 Systems.
 - .6 Provincial Electrical Protection Acts.
 - .7 IEEE C62.41, Surge Voltage in Low Voltage AC power Circuits.

1.4 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00 - Submittals.
- .2 Include automatic transfer switch literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results for Electrical.

2.0 PRODUCTS**2.1 TRANSFER SWITCH**

- .1 The automatic transfer switch shall, upon detection of a utility power failure, initiate the operation of a standby power generator and transfer the source of system power from the utility supply to the standby generator. Upon restoration of

- utility power, the transfer switch shall automatically re-transfer back from generator power to utility power after an adjustable time delay.
- .2 The transfer switch shall be a 2-pole design with a solid neutral for 120/240VAC, 1 phase, 3 wire system, and the switch main contacts shall be rated for 100A, 600VAC minimum.
 - .3 Transfer switch shall be rated to continuously carry 100% of rated current.
 - .4 Transfer switch shall be continuously rated for ambient temperatures of -20°C to $+40^{\circ}\text{C}$, relative humidity up to 100% and altitudes up to 1000 m above sea level.
 - .5 Transfer switch equipment shall have a withstand closing rating (WCR) in RMS symmetrical amperes greater than the available fault current, and of at least 22 kA.
 - .6 Transfer switch shall be double throw, electrically and mechanically interlocked, and mechanically held in both positions.
 - .7 Transfer switches shall be equipped with permanently attached manual operating handle and quick-break, quick-make over-center contact mechanisms suitable for safe manual operation under load. Transfer switch shall be equipped with manual operator for service use only under de-energized conditions.
 - .8 Main switch contacts shall be fully enclosed high pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
 - .9 Two (2) sets of Form C auxiliary contacts shall be provided for each side of the transfer switch to indicate switch position. Contacts shall be rated for 5 A, 250 VAC, 30 VDC.
 - .10 Transfer switch control shall be solid state design for high level of immunity to power line surges and transients. The control system shall have optically isolated logic inputs, high isolation transformers for AC inputs and relays on all outputs.
 - .11 Solid-state under-voltage sensors shall simultaneously monitor all phases of both the utility and generator power sources. Pickup and dropout settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage.
 - .12 Transfer switch shall have adjustable time delay for power transfer, re-transfer, and generator exerciser under load.
 - .13 The transfer switch shall be provided with microprocessor based controller and door mounted electronic HMI panel.
 - .14 Transfer switch shall be an open-transition, break before make type.

2.2 GENERATOR CONTROLS

- .1 Controls of the automatic transfer switch shall have provision to signal the engine generator set to commence start sequence upon loss of signal from the normal source sensors. Solid-state time delay start, adjustable from 0 to 120 seconds shall avoid nuisance starts-ups.
- .2 Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field terminal block.
- .3 Upon restoration of utility power, the switch shall re-transfer from the emergency source to utility source after a time delay of one (1) min. This delay shall be adjustable from 0 to 30 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails and restored when power is restored.
- .4 The controls shall signal the engine-generator set to stop after a time delay adjustable from 0 to 10 minutes beginning on return to normal source.
- .5 The control shall include a remote transfer inhibit relay.
- .6 Transfer switch shall be equipped with a field adjustable neutral time delay during switching in both directions, during which time the load is isolated from both power sources to allow for residual voltage to decay before closure to the opposite source. The delay feature shall have an adjustable range of 0 to 30 seconds.
- .7 Pilot lights shall be included on the unit compartment door to indicate Normal and Emergency power switch positions, as well as pilot lights which indicate when a source is available (online). These indicators shall be wired to the auxiliary contacts of the switch for interface with the PLC.
- .8 The transfer switch controls shall have an AUTO/ OFF/ MANUAL selector switch.
- .9 Acceptable manufacturer is Thomson Technologies.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Provide all power and control circuit conduits and conductors to and from the generator. Include all auxiliary wiring for the PLC interface for remote monitoring.
- .2 Complete all insulation resistance tests prior to energizing circuits. Submit test report for review.
- .3 Ensure minimum working clearance of 1 meter in front of transfer switch is maintained.

3.2 COMMISSIONING AND START-UP

- .1 Demonstrate proper operation and function of the transfer switch.
- .2 Provide, in consultation with the transfer switch manufacturer, acceptable settings for the transfer switch and program these settings accordingly. Submit a list of proposed settings to the Owner's Representative for review prior to commissioning.
- .3 Simulate utility power failure and adjust all time delay circuits per instruction of the Owner's representative.

3.3 PROJECT COMPLETION

- .1 Submit operation and maintenance manual complete with all "as built" drawings including parts manual and wiring diagram

END OF SECTION

1.0 GENERAL**1.1 SECTION INCLUDES**

- .1 This Section forms part of the Contract Documents and is to be read, interpreted and coordinated with all other parts.
- .2 Provide surge protection device (SPD) at the service entrance and at panels, where shown on the drawings.

1.2 REFERENCE STANDARDS

- .1 Conform to the following reference standards:
 - .1 Canadian Electrical Code as adopted by the Province of British Columbia (CEC).
 - .2 ANSI/IEEE C62.41.
 - .3 ANSI/IEEE C62.45.
 - .4 UL 1449, latest edition.
 - .5 UL 1283.

1.3 SUBMITTALS

- .1 Shop Drawings: Submit with the related items of equipment in accordance with contract documents.
- .2 Provide verification that the SPD complies with the required ANSI/UL 1449 (Latest Edition) listing by UL.
- .3 Provide shop drawing information with the following at a minimum:
 - .1 Model Number.
 - .2 SPD Type.
 - .3 System Voltage.
 - .4 Phases.
 - .5 Modes of Protection.
 - .6 Voltage Protection Rating (VPR).
 - .7 Nominal Discharge Current.
 - .8 Electrical/Mechanical drawings showing unit dimensions, weights, installation instructions and wiring configuration.

1.4 CLOSEOUT SUBMITTALS

- .1 Operating and Maintenance Data: Provide with the related item of process equipment for incorporation in operation and maintenance manual as specified in Contract Documents.

1.5 COORDINATION

- .1 Section 26 24 17 – Panelboards.
- .2 Section 26 24 19 – Motor Control Centres.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

- .1 Preference is for Surge Protective Device (SPD) to be of the same manufacturer.

2.2 ELECTRICAL REQUIREMENTS

- .1 The MCC SPD shall be UL 1449 'Type 1' or 'Type 2' and installed after the main overcurrent protection device of the MCC. The SPD shall have integral overcurrent protection.
- .2 Power distribution systems; 120/240V, 1 phase, 3 wire grounded wye.
- .3 Maximum Continuous Operating Voltage of all Suppression Components:
 - .1 125% of facility's nominal operating voltage for 120 V systems.
 - .2 115% of facility's nominal operating voltage for 240, 347, 480, 600 V systems.
- .4 Operating frequency: from 50 to 62 Hz.
- .5 Protection Mode: The unit shall provide protection on wye configured systems for:
 - .1 line to neutral transients.
 - .2 line to ground transients.
 - .3 line to line transients
 - .4 neutral to ground transients.
- .6 Surge protection devices shall be designed, manufactured, and tested in accordance with UL 1449 (Latest Edition).
- .7 All SPDs applied to the system shall have a nominal discharge current of 20kA, regardless of their SPD Type or operating voltage.

2.3 SPARE PARTS

- .1 A list of customer replaceable spare parts shall be included with the installation, operating and maintenance instructions.

2.4 PERFORMANCE

- .1 Unit shall include an engineered solid-state high performance hybrid suppression system utilizing an array of selenium cells and/or non-linear voltage dependent

metal oxide varistors and capacitive filter components. The suppression system shall not utilize gas tubes, spark gaps, or silicon avalanche diodes.

- .2 The maximum UL 1449 3rd edition VPR for the device shall not exceed the following:

Modes	208Y/120	600Y/347
L-N; L-G; N-G	700	1500
L-L	1200	3000

2.5 ENCLOSURE

- .1 Integral to MCC and/or panelboards.

2.6 FILTERING

- .1 The unit shall contain a high performance EM/RFI noise rejection filter. The filter shall reduce fast rise-time, high frequency, error producing transients and electrical line noise to harmless levels. The filter shall provide minimum insertion loss utilizing MIL-STD-E220A 50 ohm methodology as follows:

Attenuation Frequency	100 kHz	1 MHz	10 MHz
Attenuation (dB)	50	56	54.

2.7 STATUS INDICATION

- .1 The unit shall include LED indicators, which provide indication of suppression component failure for all modes including neutral to ground. In addition to the LED indicators provide one (1) set of dry contacts for remote monitoring of protection failure. Contacts to activate upon failure of any one phase or degradation of total surge capacity to less than 75%.
- .2 All units shall be testable in the field in order to verify the exact level of protection remaining using either built-in features or a hand-held tester.

2.8 DIAGNOSTIC MONITORING

- .1 All units shall provide the following levels of diagnostic monitoring:
- .1 Continuous monitoring of internal fuses and be equipped with the ability to alarm in event of a failure or blown fuse.
 - .2 Internal sensor system for monitoring MOVs including neutral to ground.
 - .3 Monitoring and adequate protection for temporary over voltage (TOV) condition.

2.9 PROTECTION

- .1 Integral fusing shall be provided that provides proper fault protection per the CEC in the event of MOV failure but does not operate during normal operation where

the unit is required to conduct an $8 \times 20\mu\text{s}$ surge current equal to its per mode rating. Vendor shall provide independent single pulse test data verifying that the unit can withstand its advertised per mode surge rating per NEMA LS1 and IEEE/ANSI C62.45.

- .1 Fusing shall be rated to 200kAIC.
- .2 Thermal Protection: MOV's shall be equipped with thermal protection technology which allows disconnection of the suppression component at the overheated stage common during temporary over voltage condition. For small fault currents between 100mA to 30A, or if the occurrence is over a longer period of time, the thermal protection will disconnect first. Manufacturers that utilize fuse traces only shall not be approved.
- .3 All overcurrent protection components shall be tested in compliance with UL 1449 - Limited Current Test and AIC rating test.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install units integral to designated MCC.
 - .1 SPD shall be factory installed inside the MCC or panelboard at the assembly point by the original equipment manufacturer.
 - .2 Suppressor shall be installed on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
 - .3 The SPD shall be connected through a disconnecting means (30A circuit breaker). The disconnect shall be located in the immediate proximity of the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
 - .4 Suppressor's ground shall be bonded to the service entrance ground.
 - .5 All monitoring and diagnostic features shall be visible from the front of the equipment, without the need to expose any live parts.
- .2 Install units integral to distribution panelboards, where indicated on the drawings.
 - .1 Install one secondary suppressor at each location or as required.
 - .2 SPD shall be interfaced to the panel board via a direct bus bar connection
 - .3 The SPD shall not limit the use of through-feed lugs, sub-feed lugs and sub-feed breaker options.
 - .4 SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main-lug only panelboards shall be installed immediately following the incoming main lugs.
 - .5 The SPD shall be included and mounted within the panel board by the manufacturer of the panel board, and shall be of the same manufacturer as the panel board.

- .3 Provide, 2C #14 AWG connection from each unit to the PLC cabinet for monitoring by the facility control system.
- .4 Where units are mounted integral with panelboards, status LEDs shall be visible without removing covers.

3.2 TESTING AND COMMISSIONING

- .1 Perform tests and document results in accordance with Contract Documents.
- .2 For each item of equipment, attach test documentation.

END OF SECTION

1.0 GENERAL

1.1 SECTION INCLUDES

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

1.2 WORK INCLUDED

- .1 The Contractor shall furnish and install as shown or specified herein all conduit, wire, lighting luminaires, lighting systems and lighting controls. The section shall include but not be limited to:
 - .2 Lighting Luminaires and Supports.
 - .3 Lamps.
 - .4 Exterior Lighting Control.
 - .5 Ballasts.
 - .6 Accessories.

1.3 COORDINATION WITH OTHER SECTIONS

- .1 Coordinate with other Divisions to avoid conflicts between luminaires, landscaping, supports, fillings, civil works, and mechanical equipment.

1.4 SUBMITTALS

- .1 Submit Shop Drawings for all luminaires in accordance with Section 01 30 00 – Submittals, and indicates complete model number(s) and provides all pertinent physical characteristics.
- .2 Construction and performance of luminaires, subject to approval of the Engineer.
- .3 Provide, if requested by the Engineer, complete photometric data and heat dissipation reports from independent testing laboratory.

1.5 SAMPLE LUMINAIRES

- .1 Submit for approval of the Engineer one of each luminaire type if requested before manufacturing commences. If directed by Engineer, set up luminaire to show coordination with ceiling, mechanical diffuser assemblies, and other equipment. Luminaire, if approved, will be retained as a control standard. Luminaires not approved to be resubmitted.

2.0 PRODUCTS

2.1 PRODUCTS

- .1 Luminaires supplied shall be LED and in accordance with the luminaire schedule shown on the drawings.

3.0 EXECUTION

3.1 LIGHTING INSTALLATION CHECK LIST

- .1 Luminaires are mounted and secured in an approved manner.
- .2 Luminaires are free of scratches, dents, breaks, paint or defects.
- .3 Luminaires are clean and lamped.
- .4 Luminaires are fully operational.
- .5 Lighting levels appear to be adequate for the space, task and occupant type.
- .6 Lighting levels for areas requiring general illumination are uniform.
- .7 Color temperature and color rendering (CRI) of lamps agrees with specifications and drawings.
- .8 Lamp wattages conform to specifications and drawings.
- .9 Lamps are operating properly.
- .10 Ballast noise is not excessive or unusual. Ballasts are sound rated as per specification.
- .11 Luminaires are approved for the location in which they are placed.
- .12 Lighting equipment and lamps are new.
- .13 Luminaires are supplied and installed as per the luminaire schedule.
- .14 Spare lamps and parts are available as per specifications.
- .15 Luminaires that are required to be aimed or directed are aligned to produce the desired results.
- .16 Wattages recommended as maximums for use in a luminaire are not exceeded.
- .17 Overcurrent protection of lighting loads meets code standards.

- .18 Pendant mounted luminaires do not place undue strain on any part of the lighting support system. Ball aligners or a flexible fitting are used whenever conduit stems over 300 mm are encountered.
- .19 Recessed downlights are rated for mounting conditions (if recessed downlight is blanketed with insulation it must be approved as such).
- .20 Teck 90 rated conductors are used to supply the source to the luminaires.
- .21 Flexible wiring to recessed luminaires laid within a T-bar ceiling is independently supported.
- .22 Polarized lamp holders are properly connected (white wire goes to screw shell and the black wire goes to the center pin).
- .23 Luminaires are bonded.
- .24 Suitable guards, screens or materials are used on luminaires that are located in areas subject to mechanical damage.
- .25 Acrylic material or better to be used as lens material for luminaires. Styrene not permitted.
- .26 Illumination levels are adequately provided by the emergency lighting system in the event that normal power is lost.
- .27 Emergency lighting battery packs (unit equipment) are connected to an un-switched AC source.
- .28 Voltage drop to remote mounted emergency light within the allowable code limit.
- .29 Illuminated exit signs located as per code and as per the requirements of the specifications and drawings.
- .30 Exit signs are illuminated when normal power is lost.
- .31 LED type of illuminated exit signs are used wherever and whenever possible.
- .32 Emergency lighting system is tested.
- .33 Illuminated exit signs are supplied from a dedicated electrical circuit or circuits.
- .34 Outdoor pole mounted luminaires are adequately and effectively supported and protected against physical damage.
- .35 Poles supporting luminaires are free of defects, dents, scratches, and other imperfections.

END OF SECTION

1.0 GENERAL

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CSA C22.2 No.141, Unit Equipment for Emergency Lighting.
 - .2 CSA C860, Performance of Internally-Lighted Exit Signs.
- .2 National Fire Protection Association (NFPA) requirements.

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 30 00 - Submittals. Product data sheets for exit lights to include:
 - .1 Performance criteria.
 - .2 Physical size / dimension drawings
 - .3 Equipment finish.
- .2 Include exit signs literature in electrical O&M manuals in accordance with Section 26 05 01 – Common Work Results for Electrical. Manufacturer’s Instructions to indicate special handling criteria, installation sequence, cleaning, and maintenance procedures.

2.0 PRODUCTS

2.1 STANDARD UNITS

- .1 Exit lights: to CSA C22.2 No.141 and CSA C860, packaged in accordance with the Canadian Code for Preferred Packaging guidelines.
- .2 Housing: extruded aluminum housing, brush aluminum finish.
- .3 Face and back plates: extruded aluminum.
- .4 Lamps: LED.
- .5 Operation: designed for 100,000 hours of continuous operation without relamping.
- .6 Replaceable chevron green “running man” faceplate.
- .7 Downlight: translucent acrylic in bottom of unit.
- .8 Face plate to remain captive for relamping.

3.0 EXECUTION

3.1 INSTALLATION

- .1 Install exit lights.
- .2 Connect fixtures to exit light and emergency circuits as specified on drawings.
- .3 Ensure that exit light circuit breaker is locked in the "on" position.

END OF SECTION

DIVISION 27

COMMUNICATIONS

1.0 GENERAL

1.1 DESCRIPTION

- .1 The Contractor will be responsible for coordinating a hard line telephone connection to the building with Telus. The termination point shall be located in the building. BIX block to allow distribution to entire building (assume minimum 8 connection cables throughout the building terminating to this board). Place equipment on a ¾ inch fibreglass board.
- .2 Communications cables to be put in place between the BIX block of TELUS and the control panel.
- .3 Provide integrated and functional telecommunications and data networks between all designated devices.
- .4 Provide markups for as-builts of wiring layouts, cable tagging and termination blocks. Coordinate with Division 25 and 26.
- .5 All cable shall be installed in a neat and functional manner, with final approval by the Owner and Engineer.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Supply, install and terminate all data and telecommunication cabling. Provide all wall plates, patch panels and other components as required in order to provide a clean installation.
- .2 Supply and install conduit and cable tray as required for communications cable routing.
- .3 Ethernet cable is to be of type Cat-6A with properly terminated ends to ANSI/TIA/EIA 568A wiring standards to support gigabit Ethernet.

3.0 EXECUTION

3.1 TELUS CONNECTION

- .1 Coordinate Telus wiring at site. One (1) land line connection is required to be turned over to the Owner's for use with the SCADA systems.

3.2 COMMISSIONING

- .1 All CAT-6A cable to be tested to applicable standards.

END OF SECTION

DIVISION 31

EARTHWORK

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.0 GENERAL

1.0.2 (Add Clause as follows)

Trenches within MOTI roadways must be backfilled with granular material that meets Ministry standards as set out in Section 202.02 (Table 202-C), 2009 Standard Specifications for Highway Construction and all subsequent interim revisions and updates in accordance with the following minimum requirements:

- .1 Sub-base material must meet or exceed specified requirements for Select Granular Sub Base aggregates.
- .2 Crushed Base Course depth is to match existing depth, but must not be less than 300mm compacted thickness and consist of "25 mm minus" WGB (or IGB) crushed aggregate.

Backfill must be placed in layers not exceeding 150 mm compacted thickness and shall be compacted with approved tamping equipment to a minimum of 95 percent Standard Proctor density to within 300 mm of the surface and 100 percent for the final 300 mm.

1.0.3 (Add Clause as follows)

Abide by the terms outlined by the Ministry of Transportation and Infrastructure Permit.

- .1 To be provided during the Tender period.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.4 MEASUREMENT AND PAYMENT

1.4.2 *(Replace Clause as follows)*

Payment for all clearing and grubbing items within the Reservoir sites will be based on the Lump Sum bid for Site preparation.

Payment for clearing and grubbing elsewhere will be incidental to payment for work described in other sections.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.0 GENERAL (Add Clauses as follows)

1.0.2 Contractor to abide by the maximum trench width as shown in Contract Drawings. The use of shoring or supports may be necessary to achieve

- .1 Contractor to bear all additional costs for work outside of the contract drawings If contractor excavates outside of the widths shown, unless otherwise approved in writing by the Contract Administrator.

1.0.3 Excavating, Trenching and Backfilling shall be in accordance with Ministry standards as set out in 2012 Standard Specifications for Highway Construction and all subsequent interim revisions and updates.

Abide by the terms outlined by the Ministry of Transportation and Infrastructure Permit.

- .1 To be provided during the Tender period.

1.0.4 Compaction testing to be performed by a qualified Geotechnical Firm on every lift at a maximum of every 50 lineal metres of trench and in 3 locations, on every lift, within the footprints of each of the building and reservoir foundations.

- .1 If works are filled in, Contractor to uncover works to provide Geotechnical engineer with access to each lift to be tested.
- .2 Provide compaction results to Stantec immediately upon receipt
- .3 Compaction reports must clearly state the location (using drawing stationing or grid lines) and lift depth.
- .4 If compaction reports are outside of required maximum lineal distance, the Contract Administer may direct the Contractor to expose various sections for retesting. At a cost borne by the Contractor.
- .5 Minimum required compaction for trench regardless of location is 95% Modified Proctor Density.
 - .1 For specific sections of work within MoTI ROW's Ministry specifications require a minimum of 95% SPMDD to within 300 mm of the surface and 100 % SPMDD for the final 300 mm.

.1 To be confirmed in MoTI permit provided during Tender Period.

1.0.5 In any location where existing surfaces are exposed to perform permanent pavement restorations the road materials are required to be recompacted to 95% MPD or to MoTI specifications (whichever is higher).

- .1 This may require additional base materials to achieve even grades
- .2 All organic materials found are to be removed and holes backfilled with approved road base materials.

1.7 DISPOSAL

1.7.1 *(Delete Clause 1.7.1 and replace as follows)*

Excess common excavation and unsuitable material shall be disposed of at an off-site location approved by the *Owner* by the Contractor at the Contractors expense.

3.0 EXECUTION

3.3 EXCAVATION (Add Clause as Follows)

.13 Subgrade Preparation:

- .1 Subgrade shall be protected from freezing, wetting, or drying. Any surfaces that dry or become wet must be scarified, moisture conditioned, and recompacted.
- .2 Remove all logs, trees, brush, stumps, roots, and other deleterious material from the specified areas except for trees or vegetation designated to be preserved.
- .3 Remove all stumps and roots and other deleterious materials to 900 mm below the ground surface.
- .4 Remove unsuitable organic soils, rubbish fills, concrete and other undesirable materials
- .5 Perform topsoil and subsoil stripping. Topsoil and subsoil are as described in the Canadian System of Soil Classification.
- .6 Drain surface water away from the stripped areas to prevent ponding and infiltration in fill placement areas

- .7 Remove debris, snow, ice, water, and loose material prior to starting fill placement. Do not place fill material when the material, the foundation, or the surface on which it would be placed is frozen.
- .8 Moisten if required, and scarify the foundation surface to a minimum depth of 200 mm to obtain a good bond prior to placing the first lift of fill. [Scarification of bedrock foundation surfaces is not required.]
- .9 Grade and compact the scarified foundation surface to the same density specified for the overlying fill.
- .10 Remove all projecting knobs of rock to facilitate operation of compaction equipment and avoid differential settlement if bedrock discovered.
 - .1 if bedrock discovered, notify CA immediately.

3.5 BACKFILL AND COMPACTION

(Replace 3.5.1 as follows)

- 3.5.1 General: Place backfill carefully in trench to prevent damage to installed pipe. For reservoir, building and vault installations the Fill Placement will meet the following requirements, where applicable:
 - .1 Do not place fill material on any surface until the prepared surface has been inspected by the Engineer's Representative. Rectify any defects, including any identified by the Engineer.
 - .2 Stump holes must be filled and hand compacted.
 - .3 Construct fill zones at the locations, and to the lines, grades, slopes, and elevations specified in the Contract Documents, or as established by the Engineer, using fill materials that are placed, conditioned, and compacted to the specified requirements.
 - .4 Overbuild final fill slopes and then trim them to the lines, grades, slopes, and elevations specified in the Contract Documents.
 - .5 Maintain the top surface of fill zones approximately horizontal. During spreading and compaction, provide the surface of the fill zone with a gentle transverse gradient of 3% to 5% so that water from precipitation will drain freely toward the extremities of the fill zone but away from any filter materials.

- .6 Place and spread fill materials in continuous and approximately horizontal layers of uniform thickness in such a manner as to prevent segregation and stratification and to obtain a homogeneous mass.
- .7 Moisten each previously placed lift, if necessary, and work with discs to a minimum depth of 50 mm to provide a bonding surface prior to placing the overlying lift of fill material except when such work cannot be performed because of cold weather.
- .8 Protection:
 - .1 Suspend fill placement operations at any time when work cannot be performed in accordance with the specifications on account of rain, flooding, cold weather, or other unsatisfactory conditions.
 - .2 Immediately prior to any suspension in fill operations, slope the fill surface as specified and roll with rubber tire equipment or smooth cylindrical roller so as to leave the surface area in a smooth, even condition for drainage.
 - .3 Protect compacted fill and foundation surfaces that have been prepared for receiving fill from freezing by using a temporary layer of soil or insulating materials, where necessary. Remove protection only when the Contractor is ready to place fill.
 - .4 If necessary, condition, rework, and re-compact or remove and replace any portion of the fill or foundation that has suffered a reduction in quality due to drying, frost, rain, or any other reason to the specified requirements before placing succeeding layers.

3.5.5 (Add 3.5.5 as follows)

All subgrade surfaces to be protected from wetting, drying, and freezing before and during placement. Any surfaces that dry or become wet must be scarified, moisture conditioned, and recompacted.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.5 BLASTING OPERATION PROPOSAL

1.5.1 *(Delete Clause 1.5 in its entirety and replace as follows)*

Blasting is prohibited.

1.6 MEASUREMENT AND PAYMENT

1.6.3 *(Delete Clause 1.6.3 and 1.6.4 and replace as follows)*

Measurement for trench rock removal will be calculated as follows:

- .1 Depth - from top of rock to bottom of rock averaged every 3 metres; or where rock extends below the pipe invert from the top of rock to 150 mm below the pipe invert and averaged every 3 metres.
- .2 Trench Width – Pipe diameter plus 450mm.
 - .1 For twin mains in common trench – Pipe diameters plus 600mm
- .3 Length - measured along the horizontal centreline and grade of the pipe, the full length of rock excavated.
- .4 Measurement for individual rocks over 0.25 cubic metre in volume shall be after the rock is excavated from the trench.
- .5 for rock found under foundations to be measured and calculated by survey, retained by Contractor.

The supply and placement of suitable backfill material to replace the rock excavated and removed is under the waterworks unit rates and not payable through this provision item. Payment will be made only when authorized by the Contract Administrator. **This is a Provisional Work item.**

Payment will be made at the respective provisional unit prices bid for trench rock removal.

DIVISION 32

ROADS AND SITE IMPROVEMENTS

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern.

1.0 GENERAL

1.0.2 (Add Clause as follows)

For all Ministry of Transportation roadways, Hot Mix Asphalt Concrete Paving shall be in accordance with Ministry standards as set out in section 502 of the 2012 Standard Specifications for Highway Construction and all subsequent interim revisions and updates.

Abide by the terms outlined by the Ministry of Transportation and Infrastructure Permit.

1.0.3 (Add Clause as follows)

For all municipal roadways, Hot Mix Asphalt to abide by MMCD specifications for Upper Course #2 and Lower Course #2.

1.0.4 (Add Clause as follows)

The owner is anticipating fair and reasonable pricing. If pricing for Asphalt/Concrete work is not deemed reasonable by the Owner then they may take on the works themselves. As such all quantities for asphalt paving are provisional.

1.0.5 (Add Clause as follows)

Asphalt work is to be kept within the limits shown on the contract drawings. Saw cut lines shown in the watermain details sheets indicate the maximum allowable width for lower course. Asphalt areas shown in plan view on drawings indicates the maximum upper course to be ground down to depth shown on drawings for final paving.

1.5 MEASUREMENT AND PAYMENT

1.5.1 (Add to Clause)

The contractor is to adhere to the maximum trench widths and asphalt parameters shown in the contract drawings. Refer to drawing details for saw cut maximum offset location. If the contractor goes outside the stipulated trenching width, any and all additional cost for works (which may include, but not be limited to: backfilling, compaction, testing, traffic management, and paving) will be borne by the Contractor, unless otherwise approved in writing by the Contract Administrator.

Provisional unit rates to be measured and paid based on the square meter areas shown in the drawings for upper course and lower courses.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.0 GENERAL

1.0.1 *(Add to Clause as follows)*

This specification shall govern the pavement markings required wherever roadways are municipally owned, otherwise MOTI specifications are to be used.

1.0.2 *(Add Clause as follows)*

Pavement Markings for all Ministry of Transportation roads (Drawings C107 & C108) shall be in accordance with Ministry standards as set out section 321 of the 2012 Standard Specifications for Highway Construction and all subsequent interim revisions and updates.

Abide by the terms outlined by the Ministry of Transportation and Infrastructure Permit.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern.

1.0 GENERAL

- .1 this section includes materials and installation for chain link fences.

1.1 RELATED SECTIONS

- .1 Section 01 30 00 – Submittals
- .2 Section 03 30 00 – Cast in Place Concrete

1.2 MEASUREMENT PROCEDURES

- .1 Measurement for chain link security fence shall be made in metres following the contour of the ground of the actual length of fence erected and shall include the length of brace panels.
- .2 Measurement for end, corner, and straining posts shall be made for each post erected but not line posts.

1.3 REFERENCES

- .1 Canadian General Standards Board (CGSB).
 - .1 CAN/CGSB-138.1 Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2 Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3 Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4 Gates for Chain Link Fence.
 - .5 CAN/CGSB-1.181 Ready-Mixed Organic Zinc-Rich Coating.
- .2 Department of Justice Canada (Jus).
 - .1 Canadian Environmental Protection Act (CEPA), 1999, c. 33.
- .3 Health Canada/Workplace Hazardous Materials Information System (WHMIS).
 - .1 Material Safety Data Sheets (MSDS)

1.4 SUBMITTALS

- .1 Shop drawings required for any change in materials or procedure for erection of chain link fence for approval prior to installation.

1.5 DELIVERY, STORAGE, AND DISPOSAL

- .1 Material can be stored on site.

2.0 PRODUCTS

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 – Cast in Place Concrete.
 - .1 Nominal coarse aggregate size: 20 5 mm.
 - .2 Compressive strength: 25 MPa minimum at 28 days.
 - .3 C1 exposure class Mix Design
- .2 Chain link fence fabric:
 - .1 Fabric to be 50 x 50 mm zinc diamond mesh (9 gauge). Type 1, Class 'A', Style 2, Grade 2. Fabric to be vinyl coated
 - .2 Height of fabric: 2470mm (8').
- .3 Posts, braces and rails: to CAN/CGSB 138.2, black vinyl coated galvanized steel pipe. Dimensions as indicated.
- .4 Top and bottom tension wire: to CAN/CGSB 138.2, single strand, black vinyl coated galvanized steel wire.
- .5 Tie wire fasteners: steel wire (9 gauge) 500mm O.C. Black vinyl coated.
- .6 Tension bar: 5 mm x 30 mm black vinyl coated galvanized steel.
- .7 Fittings and hardware: to CAN/CGSB 138.2, black vinyl coated galvanized steel.
 - .1 Tension bar bands: minimum of three (3) per tension bar, 500 mm spacing and secure with nuts and bolts.
 - .2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.

- .3 Overhang tops to provide waterproof fit, to hold top rails.
- .4 Turnbuckles to be drop forged.
- .8 Grounding rod: 16 mm diameter copper well rod, 3 m long.

2.2 FINISHES

- .1 Vinyl coating:
 - .1 0.380 mm dry film thickness for chain link fabric
 - .2 All posts, rails, braces, fabric and fittings of fences and gates to be electrostatically painted with two coats of black carboxyl modified vinyl chloride/vinyl acetate UCAR paint.

3.0 EXECUTION

3.1 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Provide clearance between bottom of fence and ground surface of 30 mm to 50 mm.

3.2 ERECTION OF FENCE

- .1 Erect fence along lines as indicated and to CAN/CGSB 138.3.
- .2 Excavate post holes to dimensions indicated.
- .3 Space line posts 3,050 mm apart, measured parallel to ground surface.
- .4 Space straining posts at equal intervals not to exceed 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade, is greater than 150 m.
- .5 Install additional straining posts at sharp changes in grade and where directed by the Engineer.
- .6 Install corner post where change in alignment exceeds 10 degrees.
- .7 Install end posts at end of fence.
- .8 Place concrete in post holes then embed posts into concrete to depths indicated.

- .1 Extend concrete 50mm above ground level and slope to drain away from posts.
- .2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .9 Do not install fence fabric until concrete has cured minimum of 5 days.
- .10 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.
 - .1 Install braces on both sides of corner and straining posts in similar manner.
- .11 Install overhang tops and caps.
- .12 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops.
- .13 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.
- .14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 500 mm intervals.
 - .1 Knuckled selvedge at bottom.
 - .2 Twisted selvedge at top.
- .15 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 500 mm intervals.
 - .1 Give tie wires minimum two twists.
- .16 Install grounding rods as indicated.

3.3 TOUCH UPS

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc rich pain to damaged areas as indicated.

3.4 CLEANING

- .1 Clean and trim areas disturbed by operations.
 - .1 Dispose of surplus material and soil by the contractor at the contractors expense.

DIVISION 33

UTILITIES

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.8 MEASUREMENT AND PAYMENT

1.8.2 (*Delete Clause 1.8.2 and replace as follows*)

Payment for watermains will include support of adjacent piping, removal and reinstatement of culverts, saw cutting or grinding of asphalt and disposal off-site, saw cutting and disposal of concrete (sidewalks, curb and gutters, driveways, thrust blocks, etc.), trench excavation, frost removal, dewatering, disposal of surplus or unacceptable excavated material, bedding, supply and installation of pipe, bolts, gaskets, thrust blocks, couplings (HYMAX Couplers to be used, or approved equivalent), mechanical restraints and tie rods, approved native excavated backfill material compacted in place, cleaning, pressure and leakage testing, flushing, disinfection, granular sub base, granular base, asphalt patching, all surface restoration as specified under Section 31 23 01 – sub-section 3.6 and all other work and material necessary to complete installation as shown on the *Contract Drawings* and specified under this Section.

Measurement for watermain will be made along centerline of main, through valves and fittings, with no deduction for length of valves or fittings, over surface after work has been completed.

Native excavated material requested for re-use will be reviewed and approved by a Geotechnical Engineer reporting to the Engineer at the expense of the Contractor. Native excavated material approved for re-use as trench backfill shall have all cobbles greater than 150mm diameter removed and disposed off-site and shall be granular in nature and free from organic materials. Native excavated material shall not be used as backfill where moisture content does not permit compaction to specified density on *Contract Drawings*. Where native excavated material is unacceptable for the use of trench backfill, imported trench backfill shall be supplied and compacted to specified density on *Contract Drawings*.

1.8.3 (*Add to Clause 1.8.3 as follows*)

Thrust blocks, anchor and mechanical restraints for valves and fittings are included in the price of the valve or fitting.

1.8.4 (*Add to Clause 1.8.4 as follows*)

Removal of existing service saddles, corporation stops, meter box, piping and curb stops, risers and service boxes shall be incidental to the payment for the new service connection.

Various service connections installed will be larger than the existing. Reduce at property line to connect into existing where necessary. Payment for service connections will include all works associated with installation of service connection, including permanent asphalt, curb, and sidewalk restoration and payment will not be made until restoration work is complete to the Contract Administrators' satisfaction.

Pavement to include Lower Course #2 and Upper Course #2 as shown in pavement details.

1.8.5 (*Delete Clause 1.8.5 and replace as follows*)

Payment for new air release valves and chambers as separate items to include all materials, work and appurtenances from the point of tie in to the watermain as shown on the detail on the *Contract Drawings*, surface restoration as indicated in the requirements in 1.8.2 of this Section, and all other work necessary to complete installation as shown on the *Contract Drawings* and specified under this Section.

1.8.6 (*Delete Clause 1.8.6 and replace as follows*)

Payment for air release valve chambers as separate items are included in Section 1.8.5.

1.8.9 (*Delete Clause 1.8.9 and replace as follows*)

Payment for localized concrete encasement, thrust and anchor blocks and support blocks as shown on Contract Drawings or directed by Contract Administrator includes all necessary extra excavation and formwork and supply and placement of concrete. Payment will be based on each thrust block installed as detailed in the Contract Drawing. All formwork is required to be removed prior to backfilling.

1.8.14 (*Delete Clause 1.8.14 and replace as follows*)

Payment for new hydrants includes the Terminal City C71P hydrant body, c/w Stortz quick connect pump nozzle, lateral connections from mainline tee off watermain to hydrant, all new pipe, isolation gate valve, valve box and cover, valve stem and riser pipe, bends, couplings (Hymax Couplers), pipe extensions to achieved required hydrant height, concrete thrust blocks, tie rods, bedding material, drain gravel, testing, disinfection, saw-cutting pavement, surface restoration as indicated in the requirements in 1.8.2 of this Section and all other incidental work as shown on the detail on the *Contract Drawings*.

Measurement will be made at the unit price bid for each hydrant installed.

1.8.15 (Add Clause 1.8.15 as follows)

Payment for branch connections shall include saw cutting pavement, trench excavation, disposal of surplus excavated material, bedding supply and installation of all pipe, fittings, bolts, gaskets, restrainers, imported backfill, cleaning pressure and leak testing, flushing, disinfection, all surface restoration as specified under Section 31 23 01 - Excavation, Trenching and Backfilling – 3.6, except permanent asphalt pavement restoration, and all other work required to complete the installation as shown on the Drawings and specified under this section.

2.0 PRODUCTS

2.1.4 (Add Clause as follows)

All Underground utilities are being installed are to include Detectable Locating Warning Tape

- .1 Underground marking tape shall be a minimum 4" width, detectable marking tape, with a minimum 5.0 mil overall thickness. Tape shall be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and then laminated to a 3.75 mil clear virgin polyethylene film.
- .2 Tape shall be printed using a diagonally striped design for maximum visibility, and bear the words "Caution Buried Water Main Below" or similar.
- .3 Tape to be buried 300mm below Finished Ground, directly above every watermain for locating purposes.

2.2.7 (Add Clause as follows)

- .1 All stainless steel fittings shall conform to ANSI/AWWA C226, ASTM A403, and ASTM A774.
- .2 Stainless steel fabricated specials and fittings shall be fabricated based on the design criteria, fabrication code and equal specifications for original fittings. Reinforcement shall be provided where required to accommodate system operating pressures. Design standard shall be to AWWA C226 and thickness of all reinforcement collars and pads will be determined by the appropriate formula in the latest edition of ASME B31.3
- .3 Flanges:

- .1 Flanges to be rated to 150#Stainless steel flanges shall be raised face except where connections to cast iron flat face flanges where they shall be flat face to match valves and fittings. Flanges shall conform to ANSI B16.5 and B16.1 in drilling and dimension.
- .2 All cast iron flanges shall be to ANSI/AWWA C110.
- .3 Stainless steel flanges shall be to AWWA C228, ASTM A182, ASTM A240, ASTM A774. Flanges to be Type 304L to ANSI CL 150.
 - .1 Van Stone flanges are not permitted.

(Add Clause as follows)

2.2.8 Dismantling Joints:

- .1 Dismantling joints shall be furnished complete with all gaskets, bolts and nuts, end ring, tie rods and shall be mechanically restrained to avoid pullout.
- .2 Dismantling joints shall have normal working pressures as indicated on the drawings.
- .3 Dismantling joints to include:
 - .1 Flange x Flange ends
 - .2 Ductile iron end ring and body made to ASTM A536 65-45
 - .3 Stainless steel 304 bolts and nuts
 - .4 Stainless steel 304 tie rods
 - .5 Fusion bonded epoxy NSF 61 certified coating
- .4 Approved products: Romac DJ405 Class E Flange

2.6 HYDRANTS

2.6.1.6.3 *(Delete replace as follows)*

Pump nozzle shall be Terminal City Stortz "quick connect".

3.12 HYDRANTS

3.12.2 *(Delete Clause 3.12.2 and replace as follows)*

Install Terminal City C 71 P hydrant assemblies in accordance with AWWA M17 and in accordance with detail on *Contract Drawings*. Offset from property line to be directed by Contract Administrator, if required.

3.17 GENERAL PROCEDURE FLUSHING, TESTING, AND DISINFECTION

3.17.7 (*Add Clause 3.17.7 as follows*)

There shall be no testing or flushing of temporary and permanent water mains on Fridays, Saturdays, or Sundays.

3.23 CONNECTION TO EXISTING MAINS

3.23.1 (*Delete Clause 3.23.1 and replace as follows*)

Connections to existing waterworks will be made by the *Contractor*.

.1 Contractor to provide District with 1 week advanced notification for all tie ins.

3.23.2 (*Add Clause 3.23.2 as follows*)

Provide written notification to all affected residents a minimum of **48 hours** prior to service interruption. Service interruptions to be no longer than **2 hours** per each tie in to existing watermain.

3.23.3 (*Add Clause 3.23.3 as follows*)

Fittings used for the tie ins should be cleaned of foreign material and sprayed with a 1% sodium hypochlorite solution prior to assembly.

These Supplementary Specifications must be read in conjunction with the Master Municipal Specifications contained in the Master Municipal Construction Documents, Volume II, Platinum Edition 2009, including all updates and revisions. In instances where clauses within the Supplementary Specifications and MMCD documents disagree/differ the Supplementary Specifications shall govern

1.0 GENERAL

- .1 SS Section 33 11 10 refers to specific portions of the work not addressed elsewhere within the specifications. Section includes the *work* item for removal and disposal of AC watermain pipe.

1.1 RELATED WORK

- | | | |
|----|---------------------------------------|------------------|
| .1 | Waterworks | Section 33 11 01 |
| .2 | Excavating, Trenching and Backfilling | Section 31 23 01 |
| .3 | Environmental Protection | Section 01 57 01 |

1.2 MEASUREMENT AND PAYMENT

- .1 AC Watermain Disposal shall include packing, loading, hauling and disposal of AC pipe of all pipe diameters unearthed onsite during excavation for the new watermain and all incidental work for which payment is not specified elsewhere. All excavation, removal of excavated material from site and unloading will be paid under the supply and installation clauses in Schedule 2. Payment will be made only when authorized by the Contract Administrator under the direction of the Owner's Representative.
- .2 Field measurement in place of AC watermain to 0.1m accuracy. Payment will be made at the respective provisional unit prices bid for AC pipe removal.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

- .1 The work shall be in accordance with the Ministry of Environment, Hazardous Waste Legislation Guide, June 2005.