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PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA
Dr. W. G. YI
44371
2024-07-25
Stantec Permit #1002862

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DIVISION 16 - ELECTRICAL

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DIVISION 1
GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 GENERAL

1.1.1 The laws and regulations of the Province of British Columbia shall govern.

1.1.2 If the National Building Code of Canada and British Columbia Building Code applies to the work, the standards of the work shall conform to or exceed the minimum standards of the National Building Code of Canada.

1.1.3 The Contractor shall ensure compliance on his part and on the part of all of his subcontractor with the British Columbia Workers' Compensation Act and regulations thereunder. Where the Contractor is required by the British Columbia Workers' Compensation Act or by the regulations to retain professional consultants and to obtain a professional Engineer's signature and seal on the design of temporary structures, concrete forming, shoring and bracing of excavations, and the methods of executing these designs, the Contractor shall retain such consultants and comply with the Act and the regulations, all at his own expense, and there shall be no extra payment on this account.

1.1.4 "Owner" shall mean the Sunshine Coast Regional District or its appointed representative.

1.1.5 "Engineer" shall mean Stantec Consulting or their appointed representative.

1.1.6 The "Site" shall mean the place of work.The word "supply" as used in these specifications shall be taken to mean that the so noted equipment is to be purchased, assembled, and shipped to the site. The Supplier of the equipment is responsible to confirm functionality of equipment at site prior to the commissioning of the system. Where an item is noted as supplied by Owner, by others or by another division, the work of mounting, connecting and commissioning the item shall be included in the Contract Documents unless specifically noted otherwise.

1.1.7 The word "provide" as used in these specifications shall be taken to mean that the so noted equipment is to be supplied, mounted, connected, adjusted and placed into service.

1.1.8 The word "approved" as used in these specifications shall be taken to mean that the so noted equipment is to be approved by the Engineer prior to fabrication.

1.1.9 The word "install" means all work and material necessary to place the specified item into full and safe operation, securely fastened and to give a presentable finished appearance. "Install" also includes all necessary connections and conductors.

1.1.10 The word "coordinate" means to make all arrangements directly with agencies, trades, sub-trades, and individuals, confirm schedules, be in attendance at the time the Work is carried out, take full responsibility for having the Work carried out correctly and in a timely manner to meet the construction schedule.

1.1.11 Abide by Transport Canada regulations for clearance and lighting requirements for any crane erection.

1.1.12 The attention of the Contractor is directed to requirements of the British Columbia Builders' Lien Act and the regulations thereunder.

1.1.13 Abide by the British Columbia environmental regulations for protection of the environment:

(1) British Columbia Water Sustainability Act

(2) British Columbia Wildlife Act

(3) British Columbia Environmental Management Act

(4) British Columbia Integrated Pest Management Act

(5) British Columbia Riparian Areas Protection Act

1.1.14 Abide by the Federal environmental regulations for protection of the environment:

(1) Fisheries Act

(2) Migratory Birds Convention Act

(3) Species at Risk Act

1.1.15 Abide by the Municipal environmental regulations for protection of the environment.

1.2 BURNING

1.2.1 Restrictions of federal, provincial and municipal authorities shall be complied with, and permits shall be obtained by the Contractor.

1.3 REGULATIONS, STANDARDS AND CODES

1.3.1 Codes, standards and regulations are specified in other sections of the specifications and the work shall be done in accordance with those codes, standards and regulations where applicable.

END OF SECTION

PART 1 GENERAL

1.1 The general contractor, as prime contractor, is responsible for all health and safety aspects on the work site.

PART 2 SUBMITTALS

2.1 Submit to the Engineer copies of the following documents, including updates issued, prior to the start of construction:

2.1.1 **Site Specific** Safety Management Plan (SMP). This SMP must be reviewed and approved by CRD and Stantec prior to commencement of work on the work site. The SMP must address the work, hazards and specific conditions of the Work Site, have been clearly communicated to all staff at Site, and be available onsite for the duration of the Work.

2.1.2 Contractor must submit a log of all hazards identified on site that may arise from the time of mobilization to the time of demobilization. The log shall include explanation of how each of the hazards will be mitigated.

2.1.3 If any identified hazards require exposure control plans, those plans must be included as part of the submittal package.

2.1.4 If any tasks require the person or persons completing that task to be certified, proof of training and certification must be provided as part of the submittal package.

2.1.5 Accident or Incident Reports, within 24 hrs of occurrence

2.2 Submit other data, information and documentation upon request by the Engineer as stipulated elsewhere in this section.

PART 3 COMPLIANCE REQUIREMENTS

3.1 Comply with the workers' compensation act of British Columbia and the BC provincial OHS.

3.2 Observe and enforce construction safety measures required by:

3.2.1 National Building Code of Canada (latest edition).

3.2.2 WorkSafeBC

3.2.3 Workers' Compensation Act of BC and the BC OHS Regulations and Guidelines

3.2.4 Municipal statutes and ordinances.

3.3 In event of conflict between any provisions of above authorities the most stringent provision shall apply.

3.4 Provide and maintain WorkSafeBC coverage for all employees for the duration of the contract. Prior to commencement of the work, at the time of interim completion and prior to final payment, provide to the Engineer a letter of clearance from WorkSafeBC indicating that the contractor's account is in good standing.

3.4.1 Should the Contractor be a sole proprietor, provide documented proof in a form acceptable to the Engineer, of an alternative means of personal coverage that meets or exceeds the requirements set out above for WorkSafeBC coverage.

PART 4 RESPONSIBILITY

4.1 The contractor is responsible for safety of persons and property on the work site and for protection of provincial employees, municipal employees and the general public circulating adjacent to work site operations to the extent that they may be affected by conduct of work.

4.2 The contractor is to enforce compliance by workers and other persons granted access to work site with safety requirements of contract documents, applicable federal, provincial, and local statues, regulations, and ordinances, and with the contractor's health and safety program.

4.3 Should an unforeseen or peculiar safety related hazard or condition become evident during performance of work, immediately take measures to rectify the situation andprevent damage or harm. Advise the Engineer verbally and in writing of the hazard or condition.

PART 5 SITE ACCESS CONTROL

5.1 Ensure persons granted access to the work area are in possession of and wearing the personal protective equipment (PPE) established by the contractor (prime contractor) in accordance with the requirements of BC OHS regulations, guidelines and policies.

5.2 Secure the work site at all times to protect against un-authorized access.

PART 6 FILING OF NOTICE

6.1 File notice of project and any other required notice. Notices with the British Columbia ministry of labour prior to commencement of the work. Provide the Engineer with a copy of the filed notice(s) prior to commencement of the work.

PART 7 PROJECT / SITE CONDITIONS

7.1 The following are the known hazardous substances and/or hazardous conditions at the work site which shall be considered as health or environmental hazards and shall be properly managed should they be encountered as part of the work:

7.1.1 Refer to contractor submittal regarding identified hazards from the time of mobilization to the time of demobilization

7.2 The above noted submission shall not be construed as being complete and inclusive of all safety and health hazards encountered as conditions change as a result of contractor's operations during the course of work, and therefore, should be considered a “live document”.

PART 8 MEETINGS

8.1 Conduct site specific occupational health and safety meetings as required by the WorkSafeBC, the workers’ compensation act of BC, BC OHS and the regulations made pursuant to the act. Meet with the user a minimum once per week to discuss operations.

8.2 Record and post minutes of all meetings in plain view on the work site. Make copies available to Engineer upon request.

PART 9 HEALTH AND SAFETY PROGRAM

9.1 Contractors are required under WorkSafeBC, the workers’ compensation act of BC and BC OHS regulations, guidelines and policies to have in place a health and safety program. Compliance requirements for the content, detail and implementation of the program resides with the provincial/territorial authority. For the purpose of this contract the health and safety program shall include a site-specific health and safety plan that acknowledges, assesses and addresses the hazardous substances and/or hazardous conditions known and identified, and on-going hazard assessments performed during the progress of work identifying and documenting new or potential health risks and safety hazards not previously known and identified. A copy of the health and safety plan should be maintained onsite for the duration of the work.

9.2 Provide one copy of the health and safety program to the Engineer prior to commencement of work on the work site. The copy provided to the Engineer is for the purpose of review against the contract requirements related to the known hazardous substances and/or hazardous conditions. The review is not to be construed to imply approval by the Engineer that the program is complete, accurate and legislatively compliant with the applicable health and safety act, and the regulations made pursuant to the act, and shall not relieve the contractor of their legal obligations under such legislation.

PART 10 ACCIDENT REPORTING

10.1 Investigate and report incidents and accidents as required by WorkSafeBC safety and health act, and the regulations made pursuant to the act.

10.2 For the purpose of this contract immediately investigate and provide a report to the Engineer on incidents and accidents that involve.

10.2.1 A resulting injury that may or may not require medical aid but involves lost time at work by the injured person(s).

10.2.2 Exposure to toxic chemicals or substances.

10.2.3 Property damage.

10.2.4 Interruption to adjacent and/or integral infrastructure operations with potential loss implications.

10.3 In the investigation and reporting of incidents and accidents, the contractor is required to respond in a timely fashion to correct the action that was deemed to have caused the incident and/or accident and advise in writing on the action taken to prevent a re-occurrence of the incident and or accident.

PART 11 RECORDS ON SITE

11.1 Maintain on site a copy of the safety documentation as specified in this section and any other safety related reports and documents issued to or received from the authorities having jurisdiction.

11.2 Upon request, make copies available to the Engineer.

PART 12 PRODUCTS

12.1 Safety Equipment

12.1.1 The contractor shall be responsible for acquiring all the necessary equipment required to complete the work in accordance with the above standards and procedures.

PART 13 EXECUTION

13.1 Qualified coordinator

13.1.1 In addition to WCB OH&S regulation section 20.3, the contractor shall provide at the work site a full-time qualified individual to be responsible for the contractor's health and safety activities and responsibilities. In addition to the duties identified in section 20.3, the workplace safety coordinator's duties shall include:

(1) Ensure that a joint health and safety (JHS) committee is formed for the workplace if required by the Workers Compensation act, and that the activities of the JHS committee meet the requirements of the Workers Compensation act.

(2) Advise the project manager, of any accidents or incidents at the workplace that must be reported to the WCB.

(3) Inform all persons, including corporation staff, working on the workplace of the health and safety requirements at the workplace.

13.2 Hazard Assessment

13.2.1 As defined in the WCB regulation, the contractor must complete a hazard assessment. The contractor is responsible for identification of any hazards generated from the work or pre-existing hazard that may be modified because of

the work. Pre-existing workplace hazards that the corporation is aware of have been identified to the contractor.

13.2.2 The hazard assessment shall be written for each working function and shall include inspection.

13.3 Confined space entry program

13.3.1 The qualified coordinator must have a site specific confined space entry program as defined in the WCB OH&S regulations section 9.5. The program must address the hazards identified for each work task, including inspection.

13.3.2 The confined space entry program must be prepared by a qualified person as defined in WCB OH&S regulations.

13.4 Safety Training

13.4.1 The contractor shall ensure that all his workers and his subcontractors have completed the necessary safety training.

13.4.2 In the event that work involving untrained individuals is being undertaken, the corporation will have the right to stop the work until properly trained individuals are assigned. Any costs incurred by the corporation as a result of the stoppage shall be borne by the contractor.

END OF SECTION

ABBREVIATIONS

PART 1 GENERAL

1.1 ABBREVIATIONS – SPECIFICATIONS, METHODS, STANDARDS

1.1.1 General:

(1)	ACI	American Concrete Institute
(2)	AISC	American Institute of Steel Construction
(3)	AISI	American Iron and Steel Institute
(4)	BCRCA	British Columbia Roofing Contractors Association
(5)	ASCE	American Society of Civil Engineers
(6)	ASTM	American Society for Testing and Materials
(7)	AWS	American Welding Society
(8)	CAN	National Standard of Canada
(9)	CCA	Canadian Construction Association
(10)	CISC	Canadian Institute of Steel Construction
(11)	CRCA	Canadian Roofing Contractors Association
(12)	CSA	Canadian Standards Association
(13)	CWB	Canadian Welding Bureau
(14)	Engineer	Stantec Consulting Ltd.
(15)	ISO	International Organization for Standardization
(16)	NBC	National Building Code
(17)	PMBC	Plywood Manufacturer's Association
(18)	SJI	Steel Joist Institute
(19)	SSPC	Steel Structures Painting Council
(20)	WCB	Worker's Compensation Board

1.1.2 Utilities:

(1)	AWWA	American Water Works Association
(2)	CGA	Canadian Gas Association
(3)	CGSB	Canadian General Standards Board

	(4)	CSPI	Corrugated Steel Pipe Institute
	(5)	IAO	Insurer's Advisory Organization
	(6)	RTAC	Roads and Transportation Association of Canada
	(7)	ULC	Underwriters Laboratories of Canada
	(8)	USA	United States of America Standards (ASA)

1.1.3 Mechanical:

	(1)	AMCA	Air Moving and Conditioning Association
	(2)	ANSI	American National Standards Institute
	(3)	ACR	Air Conditioning and Refrigeration Institute
	(4)	ASHRAE	American Society of Heating Refrigerating and Air Conditioning Engineers
	(5)	NFPA	National Fire Protection Association
	(6)	SAE	Society of Automotive Engineers

1.1.4 Electrical:

	(1)	AIEE	American Institute of Electrical Engineers
	(2)	CEC	Canadian Electrical Code
	(3)	EEMAC	Electrical and Electronic Manufacturers Association of Canada
	(4)	IEC	International Electrotechnical Commission
	(5)	IEEE	Institute of Electrical and Electronic Engineers
	(6)	IES	Illuminating Engineers Society
	(7)	IPCEA	Insulated Power Cable Engineer's Association
	(8)	LEMA	Lighting Equipment Manufacturer's Association
	(9)	NEC	National Electrical Code
	(10)	NEMA	National Electrical Manufacturers Association
	(11)	NESC	National Electrical Safety Code

1.2 USE OF ABBREVIATIONS

1.2.1 These abbreviations refer to Specifications, Methods and Standards issued by the respective Association, and the abbreviations are used in the specifications. Alphanumeric designations following the abbreviations denote the specification, method, or standard.

PART 2 ABBREVIATIONS – METRIC

2.1.1 General:

(1) The specifications are metric and metric usage is based upon SI units in accordance with CSA Standard CAN/CSA-Z234.1 Canadian Metric Practice Guide. In this specification SI units are abbreviated in accordance with the Metric Units and Abbreviations below.

2.1.2 Linear Measure:

(1)	Metre	m
(2)	Millimetre	mm
(3)	Kilometre	km
(4)	micrometre	micro-m

2.1.3 Area:

(1)	Square metre	m^2
(2)	Square millimetre	mm^2
(3)	Hectare	ha

2.1.4 Volume:

(1)	Cubic metre	m^3
(2)	Litre	L

2.1.5 Mass and Density:

(1)	Kilogram	kg
(2)	Gram	g
(3)	Tonne	t
(4)	Kilogram per metre	kg/m
(5)	Gram per metre	g/m
(6)	Kilogram per square metre	kg/m^2

	(7)	Gram per square metre	g/m^2
	(8)	Kilogram per cubic metre	kg/m^3
2.1.6	Temperature:		
	(1)	Degree Celcius	°C
2.1.7	Force, Pressure, Stress:		
	(1)	Newton	N
	(2)	Kilonewton	kN
	(3)	Pascal	Pa
	(4)	Kilopascal	kPa
	(5)	Megapascal	MPa
2.1.8	Velocity, Rate of Flow:		
	(1)	Metre per second	m/s
	(2)	Metre per hour	m/h
	(3)	Kilometre per hour	km/h
	(4)	Litre per second	L/s
	(5)	Cubic metre per second	m^3/s
2.1.9	Power, Energy, Heat, Work:		
	(1)	Watt	W
	(2)	Kilowatt	kW
	(3)	Kilowatt hour	kWh
	(4)	Joule	J
2.1.10	Electricity:		
	(1)	Ampere	A
	(2)	Volt	V

END OF SECTION

PROTECTION OF EXISTING STRUCTURES AND UTILITIES

PART 1 GENERAL

1.1 GENERAL

1.1.1 This section describes monitoring, surveys, and other work to document the existing condition, and evaluate any impacts on existing structures and utilities. These items may be located either on the existing sites within or outside the Phase 1 work, and outside the property lines of the existing pump stations.

1.1.2 The Contractor shall be responsible for damage to utilities, property, buildings, equipment, or structures adjacent to or in the general area of the Work, through the settlement of ground, vibration, shock, earthwork, or changes to groundwater level resulting from any cause related to the Work, and other related activities within this Contract.

1.2 PROTECTION OF EXISTING STRUCTURES AND PROPERTY

1.2.1 Where construction activities may impose loads onto any existing structures, including but not limited to earthen berms, sewers, or other structures, the Contractor shall review the structure for adequacy and provide protective measures to prevent damage to the existing structures or property.

1.2.2 Retain a professional engineer to assess and report on adequacy of protective structures, and design of protective measures. Submit report and design of protective measures bearing seal and signature of responsible Professional Engineer for information.

1.2.3 Control of Vibrations:

(1) Control vibration levels during construction to prevent damage to concrete work, existing structures, equipment and utilities.

(2) For existing structures, pipelines, utilities, control vibration producing equipment to a maximum peak particular velocity of 12.7 mm per second at the property line and at the pump station building and/or structures of the existing plant.

(3) The Engineer reserves the right to require additional restrictive limits for vibration control.

1.3 SELECTIVE DEMOLITION

1.3.1 The Owner will occupy portions of building immediately adjacent to selective demolition area:

1.3.2 Conduct selective demolition so the Owner's operations will not be disrupted.

1.3.3 Provide not less than 72 hours notice to Owner of activities that will affect operations.

1.3.4 Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities and as follows:

(1) Do not close or obstruct walkways, corridors, or other occupied or used facilities without written permission from authorities having jurisdiction.

(2) The Owner assumes no responsibility for condition of areas to be selectively demolished:

1.3.5 Discovery of Hazardous Substances: It is not expected that Hazardous Substances will be encountered in the Work; immediately notify the Owner and Consultant if materials suspected of containing hazardous substances are encountered and perform the following activities:

1.3.6 If materials suspected of containing hazardous materials are encountered, do not disturb; immediately notify the Owner and Consultant. Hazardous materials will be removed by the Contractor under a separate contract or as a change to the Work.

1.3.7 Do not disturb hazardous materials or items suspected of containing hazardous materials.

1.3.8 Storage or sale of removed items or materials on site will not be permitted.

1.3.9 Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1.3.10 Maintain fire protection facilities in service during selective demolition operations.

1.3.11 Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:

1.3.12 Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.

1.3.13 Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. Temporarily cover openings to remain.

1.3.14 Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.

1.3.15 Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame cutting operations. Maintain [fire watch and] portable fire suppression devices during flame cutting operations.

1.3.16 Maintain adequate ventilation when using cutting torches.

1.3.17 Remove decayed, vermin infested, or otherwise dangerous or unsuitable materials and promptly dispose of off site.

1.3.18 Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.

1.3.19 Locate selective demolition equipment and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

1.3.20 Dispose of demolished items and materials promptly.

1.3.21 Return elements of construction and surfaces that are to remain to condition existing before selective demolition operations began.

1.4 PRECONDITION SURVEY

1.4.1 Carry out a precondition survey of buildings, structures, pavement, equipment, utilities, berms/dykes, trees and other items that are likely to be affected by construction activities, such as excavation, installation of support structures, dewatering, temporary fill stockpiles, and permanent fill placement.

1.4.2 Document findings with digital photographs, digital video, and sketches and in writing submitted to the Engineer complete with tabulated log with item number, location and description. Record a description of all cracks, defects and other items that could be attributed to the Work.

1.4.3 Propose the methods, format and standards to be employed in the survey in a written description and submitted for approval by the Engineer. No work shall commence until this has been approved by the Engineer.

1.4.4 Make arrangements with the Owner to gain access to the facilities in order to carry out the required surveys.

1.4.5 The Contractor shall prepare necessary copies of the precondition survey report for submission to the Owners of the structures affected and for joint inspection with the Owners.

1.4.6 The precondition survey shall be submitted and approved before beginning any work as part of this contract including excavation, stone columns construction, jet grouting piling, dewatering, preload relocation, temporary fill placement, or permanent fill placement on the project site.

1.4.7 Area to be surveyed

(1) All areas directly impacted by the Work at the Work Site and adjacent off Work Site areas that could reasonably be assumed to be impacted by the Work.

(2) Where required to do so by the Owner, other property owners or utility owners or by Authorities having jurisdiction over adjacent structures or properties, the Contractor shall submit the precondition survey report and carry out joint inspections with the staff of these owners or authorities.

(3) The Engineer's acceptance of the Contractor's proposed methods, the manner in which he carries out the survey and the information presented in the final report in no way alleviates the responsibility of the Contractor for the cost of any damage arising from carrying out the construction of the Work.

1.5 POST CONDITION SURVEY

1.5.1 Complete a post-construction survey for all structures inspected prior to construction and for any new structures constructed by other parties within the limits described above after the completion of the preconstruction survey. The post construction survey shall also be completed for those additional structures outside the required distance limits that were surveyed prior to construction as directed by the Engineer.

1.5.2 The contractor shall also complete a post-construction survey on all structures where settlements were found to exceed the pre-construction activity predicted levels regardless if these had been surveyed previously or whether they lie outside the specified distance limits.

1.5.3 The post-construction survey, for each individual surveyed structure, shall start no sooner than six (6) weeks after completion of finished grade and all temporary support elements have been removed.

1.6 CONTINUITY OF WATER OPERATIONS

1.6.1 The Contractor's work shall not interrupt functions of the water system except as specified herein or as otherwise approved. The Contractor shall coordinate the Work with the Owner to avoid any interference with normal operation of the water system, equipment and processes.

1.6.2 Water system shutdowns beyond the specified limits will not be permitted.

1.6.3 In the event accidental discharge of water is caused by the Contractor's operations, the Owner may employ others or use its own forces to stop the discharge and cleanup the area(s) affected by water leakage, all at the Contractor's expense.

1.6.4 The work and sequences of work performed by the Contractor shall in no way reduce Owner's ability to meet required water demand.

1.6.5 The Contractor shall ensure that access is maintained for Owner's operations at the Site for maintenance requirements of the existing water systems at all times, housekeeping is maintained at the highest possible level to minimize interference.

1.6.6 Complete all connections to existing facilities in the shortest practical time frame to minimize interferences. Scheduling must reflect that priority.

END OF SECTION

SUBMITTALS

PART 1 GENERAL

1.1 GENERAL

1.1.1 Submittals are required in accordance with the provisions of this section, to determine whether the specified material and products are furnished and installed in accordance with design intent as expressed in the drawings and technical specification.

1.1.2 Individual submittals as required are detailed in other sections of the specifications.

1.1.3 Until submissions are reviewed, work involving relevant products or material may not proceed.

1.1.4 Where the phrase "or reviewed equivalent" occurs in the specification, do not assume that material, products or methods will be accepted as equal by the Engineer unless the item has been specifically accepted for the Work by the Engineer in writing.

1.2 IDENTIFICATION OF SUBMITTALS

1.2.1 Identify each submittal and resubmittal by showing at least the following information:

(1) Name, address and telephone number of the submitter, and a name of an individual for contact.

(2) Drawing number, tag number and specification number to which the submittal applies.

(3) Whether an original submittal or resubmittal.

(4) Confirmation of prior review by the Vendor and Contractor of conformance to the specification.

(5) Date of submittal or resubmittal.

(6) Authorized signature of the Submitter.

1.3 COORDINATION OF SUBMITTALS

1.3.1 Prior to submittal for the Engineer’s review, coordinate all material:

(1) Determine and verify field dimensions and conditions and conformance with specifications where applicable, including material, catalogue numbers, type numbers and similar data.

(2) Coordinate requirements between trades.

(3) Coordinate with requirements under laws, regulations, etc.

(4) Secure required approvals of public agencies, inspection agencies and standards agencies and show proof of approvals acquisition.

(5) Indicate any deviations from the intent of design as expressed in the drawings and technical specification and request specific review of these deviations. To facilitate this, a copy of the relevant specification sections are to be included in the submittal, indicating conformance or acceptance of each clause. Non-conformance or variation shall be indicated by a cross (x).

(6) Where required by the specifications provide professional certifications and stamps for certain components of the Work as part of the submittal process.

1.4 TIMING OF SUBMITTALS

1.4.1 Within twenty (20) days of the Notice to Proceed submit for information, a Submittal Control Document Listing of all submittals specified in the Contract Documents. Provide three lists grouped by category:

(1) Submittals for review.

(2) Submittals for information only.

(3) Operation and maintenance information.

1.4.2 Make submittals far enough in advance to allow adequate time for coordination, Engineer's review, revisions and resubmittals, and for supply and delivery in time for the scheduled installation in the Work.

1.4.3 Allow at least fifteen (15) working days for the Engineer's review after receipt of submittals.

1.4.4 Costs due to delays in making submittals shall be borne solely by the Contractor.

END OF SECTION

SHOP DRAWINGS

PART 1 GENERAL

1.1 REQUIREMENTS FOR SHOP DRAWINGS AND PRODUCT DATA

1.1.1 The Contractor shall arrange for the preparation of clearly identified shop drawings and submit shop drawings in the following forms:

(1) One (1) electronic copy to be retained by the Engineer plus the number of copies required by the Contractor.

(2) A PDF copy of the shop drawing is to be submitted and is to be bookmarked and tagged.

(3) The Contractor shall provide clearly identified product data and submit one (1) electronic copy to be retained by the Engineer plus the one (1) electronic copy required by the Contractor.

(4) Product data shall include but not be limited to:

(1) Product assembly drawings

(2) Materials list

(3) Principal dimensions

(4) Parts and components details

(5) Letters of compliance with recognized standards where required

(6) Operation data

(7) Operation curves

(8) Operation manuals where specified

(9) Product name and model number

1.1.2 Shop drawings shall be accurately drawn to a scale sufficiently large to show all pertinent features of the item, and its method of connection to the Work and shall have sufficient space for the Contractor's stamp and the Engineer's review stamp.

1.1.3 Shop drawings shall be in accordance with the International System of Units (S.I.) metric units.

1.1.4 Prior to submission to the Engineer the Contractor shall review all shop drawings. By this review, the Contractor represents that the Contractor has determined and verified all field measurements, field construction criteria, materials, catalogue numbers and similar data or will do so, and that the Contractor has checked and coordinated each shop drawing with the requirements of the Work and of the Contract Documents. The Contractor's review of each shop drawing shall be indicated by stamp, with the date and signature of a responsible person.

1.1.5 The Contractor shall submit shop drawings to the Engineer for the Engineer's review with reasonable promptness and in orderly sequence so as to cause no delay in the Work or in the work of other contractors. If either the Contractor or the Engineer so requests, they shall jointly prepare a schedule fixing the dates for submission and return of shop drawings.

1.1.6 At the time of submission, the Contractor shall notify the Engineer in writing of any deviations in the shop drawings from the requirements of the Contract Documents.

1.1.7 Include with the submittals, marked-up copies of the relevant specifications sections with addenda updates, and with each submission show deviation from requirements of the Contract Documents.

1.1.8 The Engineer will review and return shop drawings in accordance with a schedule agreed upon, or otherwise with reasonable promptness. The Engineer's review shall be for conformity to the design concept and for general arrangement only and such review shall not relieve the Contractor of responsibility for errors or omissions in the shop drawings or of responsibility for meeting all requirements of the Contract Documents. A specific deviation on the shop drawings from the design concept requested by the Contractor may be approved or rejected in writing by the Engineer.

1.1.9 The Contractor shall make any changes in shop drawings which the Engineer may require consistent with the Contract Documents and resubmit unless otherwise directed by the Engineer. When resubmitting, the Contractor shall notify the Engineer in writing of any revisions made by the Contractor other than those requested by the Engineer, in the Engineer's review.

1.1.10 Each reviewed shop drawing will be stamped by the Engineer with the following form of stamp:

Reviewed	( )
Reviewed as Noted	( )
Revise and Resubmit	( )
Received for Information	( )

This review by the Engineer is for the sole purpose of ascertaining conformance with the general design concept. This review shall not constitute approval of the detail design inherent in the shop drawings, responsibility for which shall remain with the Contractor submitting same. Review by the Engineer shall not relieve the Contractor of the Contract's responsibility for errors or omissions in the shop drawings or of the Contractor's responsibility for meeting all requirements of the Contract Documents. The Contractor is responsible for dimensions to be confirmed and correlated at the job site, for information that pertains solely to fabrication processes or to techniques of construction, for installation, and for co-ordination of the Work of all sub-trades.

Engineer _____

By: _____

Date: _____

1.2 DESIGN BY THE CONTRACTOR

1.2.1 When the Contractor is responsible for engineering design of portions of the Work, this shall be clearly and specifically indicated in the drawings or in the specifications of the Contract Documents.

1.2.2 Where the Contractor is required, either by law or regulation or by the contract to provide engineering design, the Contractor shall use the services of a Contractor's Registered Professional Engineer registered in the area in which the Work is to be performed, and the Contractor shall submit shop drawings bearing the seal and signature of the Contractor's Registered Professional Engineer.

END OF SECTION

CONSTRUCTION PHOTOS

PART 1 GENERAL

1.1 REQUIREMENTS FOR CONSTRUCTION PHOTOGRAPHS

1.1.1 The Contractor shall document the progress of the Work using photographs.

1.1.2 During the progress of the Work and during key items of the Work, as determined by the Engineer, the Contractor shall submit progress photographs to adequately cover the progress of the Work.

1.1.3 Submit to the Engineer 600 dpi digital camera progress photographs on a monthly basis.

1.1.4 Sufficient views of the Work shall be taken to show all parts of the Work being undertaken during the progress period being photographed.

1.1.5 Properly identify each photograph by separate means with file name to include area. All photographs shall be date stamped electronically on the image.

1.1.6 On completion of the Work, the Contractor shall submit copies of the entire construction project on USB drive, and include a USB drive in each Operation and Maintenance Manual.

END OF SECTION

DRAWING RECORD

PART 1 GENERAL

1.1 RECORDS DURING CONSTRUCTION

1.1.1 The Contractor shall keep one complete full size set of all construction drawings on the Site.

1.1.2 On the site set of drawings, the Contractor shall record any changes that are made during the actual construction of the Work. The purpose of recording these changes is to provide drawings of record at the end of the Work. The Contractor shall be responsible for the adequacy and the reliability of the information recorded on the drawings of record.

1.1.3 At the completion of the construction period, the Contractor shall turn over the set of red marked construction drawings which have been marked up with changes during the course of the Work to the Engineer to permit the Engineer to prepare Drawings of Record for the Work. The Contractor shall provide verification to the Engineer that the red marked as-built drawings accurately reflect the Work as constructed.

1.2 DAILY RECORD

1.2.1 From the day of commencement of the Work, the Contractor shall maintain a careful daily record of the progress of the Work on his standard record form, with applicable trades listed.

1.2.2 Contractor's diary shall record all pertinent data such as:

(1) Daily weather conditions, including maximum and minimum temperatures.

(2) Commencement, activity progress and completion of various portions of the Work.

(3) Dates of all site meetings.

(4) Dates of visits or inspections by government authorities, inspectors, and any other visitors to the Site.

(5) Record of work force employed.

(6) Record of Quality Control Tests.

END OF SECTION

QUALITY CONTROL

PART 1 GENERAL

1.1 GENERAL

1.1.1 The Contractor is totally responsible for the quality of material and product which he provides and for the Work.

1.1.2 The Contractor is responsible for quality control and shall perform such inspections and tests as are necessary to ensure that the Work conforms to the requirements of the specifications.

1.1.3 During the progress of the Work, a sufficient number of tests shall be performed by the Contractor to determine that material, product and installation meet the specified requirements.

1.1.4 Minimum requirements regarding quality control are specified in various sections of the specifications, however, the Contractor shall perform as many inspections and tests as are necessary to ensure that the Work conforms to the requirements of the specifications.

1.1.5 Testing shall be in accordance with pertinent codes and regulations, and with selected standards of the American Society for Testing and Materials (ASTM) and Canadian Standards Association (CSA).

1.1.6 Product testing, mill tests and laboratory reports to demonstrate that product and material supplied by the Contractor meet the specifications are specified under various sections of the specifications.

1.2 QUALITY CONTROL TESTING BY THE CONTRACTOR

1.2.1 The Contractor shall retain the services of an independent testing agency under supervision of a Contractor's Registered Professional Engineer, and pay the cost of testing services for quality control including, but not limited to, the following:

(1) Sieve analysis of sands and aggregates to be supplied to the Work.

(2) Aggregates and mix designs for asphaltic concrete.

(3) Aggregates and mix design for Portland Cement concrete.

(4) Standard Proctor Density curves for backfill materials.

(5) Standard Proctor Density curves for approved borrow materials.

(6) Compaction control tests for foundation, backfill and embankment material. Density tests of foundation base prior to slab preparation.

(7) Any product testing that is required and is specified under various sections of the specifications.

1.2.2 The Contractor shall promptly process and distribute all required copies of test reports and test information and related instructions to all of his subcontractors and suppliers to ensure that all necessary retesting and replacement of construction can proceed without delay.

1.2.3 The Contractor shall promptly provide the Engineer with copies of all test results. The Contractor will also compile monthly summary reports of all materials tests and non-conformance reports for review by the Engineer.

1.3 QUALITY ASSURANCE TESTING BY THE OWNER

1.3.1 The Owner may retain and pay for the services of an independent testing agency for testing for quality assurance, for the Owner's purposes.

1.3.2 The Owner's testing agency may inspect and test material, product and the Work for conformance with the requirements of the Contract Documents; however, they do not undertake to check the quality of the Work on behalf of the Contractor nor to provide quality control.

1.3.3 Inspections and tests by the Owner's testing agency do not relieve the Contractor of his responsibility to supply material and product and to perform the Work in accordance with the requirements of the Contract Documents.

1.3.4 The Contractor shall coordinate the scheduling of testing and inspection by the Owner's testing agencies, to enable testing to be done as necessary, without delay.

1.4 RETESTING

1.4.1 When tests on product, material or completed portions of the Work carried out by the Contractor or the Contractor's testing agency or by the Owner's testing agency yield results not meeting the requirements of the Contract Documents, the Contractor, in addition to carrying out remedial Work or replacement of the product or material shall provide for retesting of the remedied Work and the replacement product and material.

1.4.2 In every case where the Contractor has submitted test results which fail to meet the requirements of the Contract Documents, the Contractor shall submit within a practical and reasonable time results of a retest showing that the results are in accordance with the requirements of the Contract Documents.

END OF SECTION

PART 1 GENERAL

1.1 TEMPORARY UTILITIES

(1) Provide propane, gasoline and other fuels.

(2) Provide and pay all costs for propane, gasoline and other fuels required for the performance of the Work, in accordance with governing regulations and ordinances, and the Contract Documents.

(3) Furnish and install all necessary temporary piping and upon completion of the Work remove all such temporary piping.

1.1.2 Water

(1) Water required for the performance of the Work is available on site.

1.1.3 Electricity and Lighting

(1) Provide and pay all costs for electricity and artificial lighting required for the performance of the Work, in accordance with governing regulations and ordinances, and the Contract Documents.

(2) Furnish and install all necessary temporary wiring, distribution boxes, panels, etc., and upon completion of the Work, remove all such temporary installations.

1.1.4 Telephone

(1) Provide, maintain and pay all costs for a telephone for the Contractor’s use.

1.1.5 Heating And Ventilating

(1) Provide and pay all costs for heating and ventilating, coverings and enclosures as necessary to protect and perform the Work.

(2) Furnish and install all necessary temporary equipment, piping, wiring, ducting, and other materials to perform the Work and upon completion of the Work, remove all such temporary equipment.

(3) Temporary heating and ventilating shall be in accordance with all governing regulations and ordinances, and the Contract Documents.

(4) Temporary heating and ventilating shall be provided to:

(1) facilitate progress of the Work;

(2) protect the Work and product and material against dampness and cold;

(3) provide sufficient heat during winter concrete placement;

(4) prevent moisture condensation on surfaces;

(5) provide an atmosphere for curing material as required;

(6) provide adequate ventilation to meet safety regulations;

(7) prevent hazardous accumulation of dust, fumes, mists, vapours or gases in areas occupied during construction; and,

(8) ventilate storage spaces containing hazardous or volatile materials.

1.1.6 Sanitary Facilities

(1) Furnish and install all required temporary toilet buildings with sanitary toilets for use of all workmen; comply with all minimum requirements of the Health Department or other public agency having jurisdiction; maintain in a sanitary condition at all times.

1.1.7 Fire Protection

(1) Provide and pay all costs for adequate fire protection of the Work and adjacent property.

(2) Furnish and install temporary extinguishers, hydrants and other equipment, and upon completion of the Work remove all such temporary equipment.

1.2 CONSTRUCTION AIDS

1.2.1 Temporary Plant

(1) Provide, arrange for, maintain and pay for all temporary items such as, but not limited to, stairs, ladders, scaffolding, ramps, transportation of labour and material, runways, chutes, hoists, tools, templates, as required for the completion of the Work.

(2) The location of such items shall be such as to prevent interference with, marking of, or damage to any portion of the Work.

(3) All such items shall conform to all applicable national and local ordinances regulating safety.

1.2.2 Temporary Enclosures

(1) Furnish, install, and maintain for the duration of construction all required scaffolds, tarpaulins, barricades, canopies, warning signs, steps, bridges, platforms, and other temporary construction necessary for proper completion of the Work in compliance with all pertinent safety and other regulations.

1.2.3 Falsework And Temporary Construction Supports

(1) The Contractor shall be responsible for means and methods used for the falsework and temporary construction supports.

(2) If required by the Contract, employ a qualified Registered Professional Engineer for the design of temporary Works, and design in accordance with CSA S269.1. The design of secant pile walls will be completed by the Contractor's Registered Professional Engineer and shall meet the requirements of WorkSafe BC. The Contractor's secant pile and falsework designer shall inspect the installation prior to placing personnel and equipment into the caisson excavation for the raw water pump station.

(3) Record design calculations and drawings to show that temporary Works are adequate. Provide design loads, material details, and dimensions. Sign and seal design calculations and drawings, and revisions thereto.

(4) The Engineer's approval to proceed with falsework and temporary construction supports shall not relieve the Contractor of his responsibility under the Contract. The Engineer's review shall be for general conformance to the intent of design and for permanent effects on the Site, or areas adjacent to the Site.

1.2.4 Temporary Excavation

(1) The Contractor is responsible for the means and methods of making temporary excavations in order to install components of the Work.

1.2.5 Winter Construction

(1) Special construction methods required to perform the Work in severe weather shall be the responsibility of the Contractor.

(2) Where the specifications call for Work to be performed within a given temperature range or above a minimum temperature, it shall be the Contractor's responsibility to provide all temporary enclosures and heat necessary to provide the conditions specified.

(3) Where compaction of backfill is specified, the Contractor shall perform the Work in a manner such that compaction can be achieved.

(4) Where weather conditions are such that compaction of backfill consisting of excavated materials is not possible, the Contractor shall provide unfrozen granular material for backfill, at the Contractor's expense.

1.2.6 Access Roads

(1) Construct temporary access roads as necessary to perform the Work, and maintain temporary access roads until construction is over or until permanent access is established.

(2) Locations and drainage facilities for temporary access roads are subject to the approval of the Engineer.

(3) No direct payment will be made to the Contractor for construction of temporary access roads.

1.3 PROTECTION

1.3.1 Remove trees, fences and other structures from the site of the Work, as necessary to perform the Work.

1.3.2 Remove only those items that must be removed or are clearly shown on the drawings to be removed.

1.3.3 Protect all remaining trees, plants, fences and other items from damage during construction.

1.4 EXISTING UTILITIES AND STRUCTURES

1.4.1 Existing utilities and structures include pipes, culverts, ditches or other items which are a part of an existing sewerage, drainage or water system; or which are a part of a gas, electrical, telephone, television, telecommunications or other utility system. Also included are sidewalks, curbs, gutters, swales, poles, fences or any other structures encountered during construction. The Contractor shall ensure the existing service is not disrupted or disinfection compromised.

1.4.2 The Contractor shall be responsible for location, protection, removal or replacement of existing utilities and structures, or for repair of any damage which may occur during construction.

1.4.3 Existing utilities and structures may be shown on the drawings, or described in the specifications. Such information is shown for design purposes and the existence, location and detail given is information that is obtained during the design period and is not necessarily complete, correct or current.

1.4.4 The Contractor shall pay all costs and be responsible for establishing locations and state of use of all existing utilities that may affect the Work. The Contractor shall make satisfactory arrangements with the utilities companies involved for the location, protection and inspection of existing utilities.

1.4.5 Notice in writing shall be given by the Contractor to the utilities companies at least 48 hours before Work commences in the vicinity of existing utilities.

1.4.6 The Contractor shall pay all the costs involved in protection of utilities, inspection of utilities, and all costs due to delays because of existing utilities and structures.

1.4.7 The Contractor shall provide for the uninterrupted flow of all water courses, sewers and drains encountered during the Work.

1.4.8 Access shall be maintained to all existing structures such as valves, hydrants, meter chambers and control structures at all times during construction.

1.4.9 If interruption of service provided by an existing utility is necessary, the planned shut down shall be approved by the Owners of the utilities. Requests for shut down shall be made by the Contractor in writing at least 48 hours in advance.

1.4.10 The Contractor shall notify all customers or make arrangements with the utility company to notify all customers 24 hours in advance of a shut down.

1.4.11 Unless otherwise specified the Contractor shall make arrangements for relocation of existing utilities that the Engineer requests to be relocated; and the actual relocation shall be constructed by the Owner of the utility. The Contractor will be reimbursed the invoiced cost of the relocation. No extra payment is permitted for delays, or standby time.

1.5 TEMPORARY CONTROLS

1.5.1 Noise Controls

(1) The Contractor shall comply with the requirements of the Owner's Noise Bylaw regarding noise abatement and take all necessary steps to ensure the generation and transmission of noise and vibration due to the Work are kept to a minimum as required by the Bylaw.

(2) Any noise or vibration which is found to be objectionable shall be corrected, at no additional cost to the Owner and to the satisfaction of the Owner and/or the Owner and the Engineer.

1.5.2 Cleaning Streets

(1) The Contractor shall maintain streets and sidewalks affected by the Work in a clean and tidy condition as required by the Owner's regulations and minimize disruption of use and/or access to such streets and sidewalks.

(2) In the event the Contractor does not maintain streets and sidewalks to the satisfaction of the Owner, the Owner will arrange with the Owner to carry out such maintenance at the Contractor's cost.

1.5.3 Pollution Control

(1) Perform the Work in conformance with the applicable sections of the Provincial regulations with respect to air and water pollution control requirements.

1.5.4 Disposal Of Wastes

(1) Burying of rubbish and waste on site is not permitted.

(2) Disposal of waste or volatile materials into waterways, storm or sanitary sewers is not permitted.

(3) Pumping or draining water containing silt in suspension into waterways, sewers or drainage systems is prohibited.

(4) Abide by requirements of statute, Bylaw and regulations respecting disposal of wastes.

(5) Obtain required Permits for waste disposal.

1.6 WORK ADJACENT TO WATERWAYS

(1) Do not operate construction equipment in waterways, nor remove borrow material nor dump fill material into waterways, except as approved and permitted by the appropriate authorities. Obtain any required Permits.

1.7 TRAFFIC CONTROL

1.7.1 The Contractor shall be responsible for the regulation of traffic during construction, and shall perform the Work in a manner that will cause the least disruption of traffic.

1.7.2 The Contractor shall coordinate the Work with the Engineer, and the Owner to reduce traffic problems.

1.7.3 Provision of flagmen, traffic signs, and other traffic controls shall be the Contractor's responsibility and shall be in accordance with the TAC Manual of Uniform Traffic Control Devices.

1.7.4 The Contractor shall supply all barriers, barricades, warning signs, detours, fences, flagmen and all other devices to protect the public. All applicable safety standards shall be followed.

1.7.5 The Contractor shall obtain approval to block traffic temporarily if it is necessary to do so to perform the Work. Obtain the written approval of applicable municipal departments, the Owner and the Engineer. At least 48 hours prior to actually blocking traffic notify the following:

(1) Roadway Authority

(2) Public Works Departments

(3) Utilities Companies

(4) Fire Department

(5) Police Department

1.7.6 Adequate construction parking, meeting local regulations, shall be provided by the Contractor.

1.7.7 Haul routes shall be maintained by the Contractor. They shall be kept open to traffic and shall be clean at all times.

1.7.8 Obtain permits as required to use public roads or streets for haul routes.

1.8 PROJECT IDENTIFICATION

1.8.1 Construct, erect and maintain a project sign.

1.8.2 The sign shall show the name of the project, the Owner, the Operator, funding agencies, the Engineer and the Contractor.

1.8.3 Submit a shop drawing of the sign for review by the Engineer.

1.9 CONTRACTOR'S FIELD OFFICE

1.9.1 Furnish and install a field office building adequate in size and accommodation for all Contractor's offices, superintendent's office, supply and tool room throughout the entire construction period.

1.10 TEMPORARY USE OF OWNER'S FACILITIES AND THE WORK

1.10.1 If the Owner permits the Contractor to make temporary use of the Owner's facilities, the Contractor shall use the facilities with care, providing all maintenance and repair, and shall leave the facilities in good working order when he is finished.

1.10.2 If the Owner permits the Contractor to use facilities incorporated into the Work, the Contractor shall use them with care and be responsible for all maintenance and repair and for leaving the facilities in good order.

1.10.3 Permanent systems shall not be used by the Contractor without the written permission of the Engineer.

1.10.4 Permanent heating systems shall not be used for temporary heating without the written permission of the Engineer.

1.10.5 If the Contractor obtains written permission to use existing heating systems or other systems temporarily, before completion, the Contractor shall change lubricants, filters and other accessory items completely upon completion of the Work. Warranties shall be extended by the Contractor to ensure that the Owner receives the full warranty, as specified.

1.10.6 Temporary or trial usage by the Owner of any mechanical machinery, apparatus, equipment or any other work or materials supplied under the contract before final acceptance by the Engineer is not to be construed as evidence of acceptance. The Owner shall have the privilege of such temporary and trial usage as soon as the Contractor shall claim that said Work is completed.

END OF SECTION

ENVIRONMENTAL PROTECTION

PART 1 GENERAL

1.1 REQUIREMENTS

1.1.1 This Specification addresses general requirements for environmental protection.

1.2 COMPLIANCE

1.2.1 The Contractor and each Subcontractor, while performing the Work, shall comply with relevant statutes, regulations, laws and directives of legislative authorities in all matters relating to the protection of the environment. In addition, if, in the opinion of the Engineer or Environmental Monitor, the Contractor's construction practices or facilities require immediate modification to reduce the risk of environmental damage, the Contractor shall be required to stop Work and make the necessary changes prior to proceeding with the Work.

1.3 CONFLICTS AND OMISSIONS

1.3.1 If the Contractor finds or observes that there appears to be a conflict between the contents of this section or other sections of the Specifications and the requirements of legislative authorities, then such conflict shall be brought to the attention of the Engineer for resolution. Similarly, any omissions or apparent omissions from this section relevant to current legislation shall be referred to the Engineer. Omissions or apparent omissions shall in no way diminish the Contractor's responsibility to comply with the statutes, regulations, bylaws and directives of legislative authorities.

1.4 ENVIRONMENTAL MANAGEMENT AND PROTECTION PLAN

1.4.1 The Contractor shall prepare a Construction Environmental Management and Protection Plan. The plan shall address at a minimum the following:

(1) Applicable regulations that apply for all jurisdictions.

(2) Completion of a Wildlife Survey prior to commencing Work.

(3) List of all materials and products to be used on the Site.

(4) Environmental protection measures to be used for each material and product.

(5) List of environmental impacts that will be created in the course of construction.

(6) Protection measures to mitigate environmental impacts.

(7) Erosion and sediment control details and procedures.

(8) Emergency spill/emission response plan.

(9) Dewatering plan and discharge points including sediment control measures.

(10) Containment plans for equipment service areas.

(11) Liquid storage, fuelling, and equipment operation and maintenance procedures.

(12) Waste management including construction debris and demolition debris.

1.5 HAZARDOUS SUBSTANCES

1.5.1 The Contractor shall make itself fully aware of all Federal and Provincial legislation and restrictions on the storage and use of certain products or materials considered harmful to the environment or persons and shall comply with all applicable regulations and guidelines.

1.5.2 The Contractor shall promptly provide to the Engineer with copies onsite of all Material Safety Data Sheets (MSDS) relating to all hazardous substances brought to the Site. Refer to section 01065 – Safety and Health.

1.6 WATER MANAGEMENT

1.6.1 The Contractor shall comply with the water extraction requirements of the Water Security Agency.

1.7 SURFACE WATER QUALITY PROTECTION

1.7.1 The Contractor shall provide and maintain containment Works to ensure no material resulting from the construction activity enters any river, creek, stream, watercourse or storm drainage system. All such dewatering Works are to be designed and implemented in consultation with the Environmental Monitor. Detailed drawings and procedures that will be followed to ensure the watercourses' water quality will be protected are to be submitted to the Engineer for review by the Environmental Monitor at least three (3) days prior to the start of Work. Construction work shall not begin until the containment works have been reviewed and accepted by the appropriate governing authority.

1.7.2 All water containing a chlorine residual shall be dechlorinated before discharge into any watercourse.

1.7.3 Accidental chemical or fuel spills, which may enter a water body, shall be cleaned up immediately by the Contractor and reported as required.

1.8 EROSION AND SEDIMENT CONTROL

1.8.1 The Contractor will use sediment control consisting of settlement ponds, ditch check structures and siltation ponds.

1.8.2 Construction Work shall not proceed until the control Works have been reviewed and accepted by the Engineer and the appropriate governing authority.

1.8.3 Silt curtains shall be comprised of Terrafix 370 RF synthetic fibre fabric (or acceptable alternate), and shall be securely anchored.

1.8.4 The Contractor shall be responsible for the provision and maintenance of all erosion and sediment control installations at all points and areas of natural drainage.

1.9 SPILL CONTINGENCY PLANNING

1.9.1 As part of the Environmental Management Plan, the Contractor shall prepare a Spill Contingency. The main objectives of the Spill Contingency Plan shall be to comply with all regulatory requirements and provide the best response to a spill within the shortest possible time. To meet these objectives, the Plan shall include mechanisms for initiating and carrying out the required notifications, spill containment, clean-up and remedial actions.

1.9.2 The Contractor shall be familiar with all regulatory requirements and be adequately prepared to respond to a spill condition within the shortest possible time.

1.9.3 The spill contingency procedures must be posted in a visible location within the Contractor's site offices and worker trailers. These plans shall be reviewed by the Contractor's Spill Response Team, on a scheduled basis to ensure a thorough understanding.

1.9.4 The notices and actions detailed in the reviewed Spill Contingency Plan shall be followed by the Contractor.

1.9.5 Any spill greater than 0.5 litres shall be reported to the Engineer.

1.9.6 Drainage control measures shall be put in place as required by site drainage features to protect open water and watercourses from potential spill substances.

1.9.7 Sorbent material shall be on hand at Work areas as a means of containing and soaking up any spill substance before it reaches the groundwater table or open water.

1.9.8 Excess concrete, grout, drilling wastes and other liquid waste products shall be directed to secure containment facilities for subsequent removal and disposal by the Contractor.

1.9.9 Empty drums shall be provided by the Contractor at the Place of the Work for pre-disposal storage of spillable substances and for disposal of used sorbents, contaminated soil, and the like.

1.9.10 The Contractor shall supply and maintain an appropriate spill response kit at the Place of the Work.

1.10 WASTE MANAGEMENT

1.10.1 The Contractor shall comply with all requirements for managing waste through the course of the Work.

1.10.2 Waste types anticipated at the Site may include sanitary sewage, domestic garbage, construction garbage, rock and soil wastes, concrete, grout waste, reinforcing and other steel waste, recovered granular materials, formwork and falsework waste, operating fluid wastes from vehicles and construction equipment, collected sediment, and hazardous wastes.

1.11 WILDLIFE PROTECTION

1.11.1 The Contractor is advised that nesting birds and wildlife existing in close proximity to the site. The Contractor shall make efforts to minimize disturbance to nests or wildlife during the construction period.

1.11.2 Nuisance wildlife shall be reported to the Engineer.

1.12 FIRES AND FIRE PREVENTION

1.12.1 The Contractor shall not permit open burning on the Site or adjoining areas.

1.12.2 The Contractor shall protect the Site and adjoining areas from wildfires resulting from its activities. If directed by the Engineer, the Contractor shall run waterlines to all Work areas with water available in a quantity and pressure sufficient to suppress a moderate fire. Vegetation adjacent to the Work area shall be irrigated as required to minimize the risk of fire.

1.12.3 The Contractor shall identify personnel, fire suppression equipment, water sources and procedures to be followed to firstly, avoid fire situations and secondly, to fight any fire that occurs.

1.12.4 The Contractor shall supply and maintain on the Site adequate fire suppression equipment, including not less than eight (8) 20-lb ABC fire extinguishers. Such fire suppression equipment shall be consistent with good fire prevention/suppression practice and local municipal regulations.

1.12.5 During periods of extreme fire danger, the Work may be shutdown. The Owner shall not provide compensation for losses incurred as a result of the shutdown of Work.

1.12.6 When the fire hazard reaches a moderate rating and higher, the Contractor shall employ a watchman to patrol the Site for a minimum of one (1) hour after the Work ceases.

1.12.7 Smoking is to be restricted to designated areas only, effective on the third day of moderate hazard rating. The use of ashtrays while smoking in vehicles is mandatory.

1.13 VEGETATION PROTECTION

1.13.1 The Contractor shall avoid damage to vegetated areas adjacent to the Site, and shall be held responsible for any damage outside designated Work areas. No vegetation shall be removed without the approval of the Engineer. Damage to

vegetation in designated laydown or Work areas shall be kept to a minimum. Stripped areas shall be protected against erosion.

1.14 LIQUID STORAGE

1.14.1 Onsite fuel storage tanks and storage for other environmentally hazardous liquids shall be located as far away from open water, watercourses and other drainage courses as is practicable, and shall be contained within dikes or equivalent enclosures on flat ground in the laydown area. Enclosures in liquid storage areas shall be such as to contain the total volume stored plus precipitation. Protection against seepage shall be provided.

1.14.2 The Contractor shall follow the Spill Contingency Plan. Sorbent materials shall be on hand at liquid storage areas as a means of containing or soaking up errant spills. Empty drums shall be on hand for predisposal storage of spilled substances; sufficient drums shall be available to accommodate stored and in-service volumes of spillable substances.

1.15 REFUELLING AND EQUIPMENT OPERATION

1.15.1 Refuelling

(1) Readily mobile highway vehicles shall be refuelled at the Site as approved by the Engineer.

(2) Motorized mobile equipment and machinery shall be refuelled in a refuelling/service area to be developed in the laydown area. Care shall be taken to ensure that petroleum products do not spill during refuelling.

(3) Equipment, which is not readily mobile, may be refuelled at the Site location as far as possible from open water or watercourses. Drip trays shall be used and sorbent materials shall be immediately on hand for rapid deployment in the event of a spill.

1.15.2 Equipment Operation

(1) Equipment shall be cleaned and serviced as necessary to prevent deposition of soils, oil, grease, coolant, fuel and any other contaminants.

(2) Stationary equipment operating near open water or watercourses or in dewatered areas shall be equipped with drip trays to contain any fuel, oil, coolant or grease leakage. Drip trays for grout pumps and grout reservoirs shall be capable of containing all accidental spills/leakage during hose connection and operation.

(3) No equipment shall be washed in Work areas or near open water or watercourses.

(4) All equipment shall be in good operating condition and meet applicable statutory requirements for serviceability and exhaust emissions. Exhaust

systems shall function in a manner to control exhaust noise within acceptable levels.

(5) An equipment service area, if required by the Contractor, shall be on relatively flat ground in the laydown area. A granular mat overlying an impermeable liner shall be used in this service area and shall be placed so as to contain seepage. The Contractor shall take precautions to ensure that this liner does not become punctured. Drip trays shall be used to control on-ground spillage of fuels, oils, coolants and grease. The Contractor shall be responsible for any and all clean up of contamination resulting from its operations. Contaminated granular mat materials and other contaminated soils shall be carefully excavated and shall be disposed of at an appropriate location. These materials may be classified as hazardous waste as disposed of by the Contractor in accordance with provincial and federal regulations.

1.16 CONSTRUCTION DUST CONTROL

1.16.1 Environmentally acceptable dust suppressants or water shall be used as necessary to control dust on access roads, laydown, Work and disposal areas. Dust shall be controlled throughout the Work. No oils shall be used for dust control. Preference shall be given to the use of water, bearing in mind water conservation and drainage where appropriate.

1.16.2 Cover or wet down dry materials and rubbish to prevent blowing dust and debris. Provide dust control for temporary and permanent roads.

1.17 CONSTRUCTION NOISE CONTROL

1.17.1 Construction safety based on Workers' Compensation Board of British Columbia requirements and local municipal bylaws shall provide the regulatory basis for noise control and hearing protection. Noise bylaws or formal exemption therefore shall be used in setting hours of Work limitations.

1.17.2 Construction operations shall be performed to minimize noise.

1.18 AIR POLLUTION AND ODOUR CONTROL

1.18.1 Volatile liquids, including fuels and solvents, shall be stored in closed containers.

1.18.2 Equipment shall be properly maintained to reduce gaseous pollutant emissions.

1.19 SEDIMENTATION AND WATER HANDLING

1.19.1 Silts and fine materials introduced into creek systems can have adverse effects to the aquatic environment. This construction site is particularly sensitive due to its vicinity to fish habitat. Therefore, controlling sediment and run-off during construction Work will be of high priority during this Work.

PART 2 PRODUCTS

2.1.1 Not Applicable

PART 3 PART 3 EXECUTION

3.1.1 Not Applicable

END OF SECTION

CLEANING, HYDROSTATIC TESTING AND DISINFECTION

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 This Section refers to the cleaning, hydrostatic testing, disinfection of piping and treatment structures, as well as dechlorination and disposal of cleaning and testing waste.

1.1.2 Clean and disinfect all components in contact with water, prior to put into Work.

1.2 REFERENCES

1.2.1 American Water Works Association (AWWA):

(1) B300, Hypochlorites.

(2) B303, Sodium Hypochlorite.

(3) C200, Steel Water Pipe, 6 In. (150 mm) and Larger.

(4) C604, Installation of Buried Steel Water Pipe – 4-In (100 mm) and Larger.

(5) C651, Disinfecting Water Mains.

(6) C652, Disinfection of Water Storage Facilities.

(7) C653, Disinfection of Water Treatment Plants.

(8) C655, Field Dechlorination.

1.2.2 American Society of Mechanical Engineers (ASME):

(1) 31.3, Processing Piping.

1.2.3 American Concrete Institute (ACI):

(1) 350.1, Specification for Tightness Testing of Environmental Engineering Concrete Containment Structures.

1.2.4 National Sanitation Foundation (NSF):

(1) NSF 61, Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

1.3.1 In accordance with Section 01300.

1.3.2 Work plan and procedures 48 hours before Work, include:

(1) Cleaning, hydrostatic testing, disinfection, sampling, dechlorination and waste disposal, and post construction cleanup plan and procedures.

(2) Isometric diagram showing all structures, equipment, valves and piping with length to be disinfected, as well as the sampling, monitoring and chemical injection locations.

(3) Description of chemicals, tools and equipment used for Work.

(4) Material Safety Datasheet (MSDS) and NSF 61 certificates of all chemicals.

(5) Plans and Methods to address following requirements:

(a) Minimizing physical contamination of the internal surfaces of the existing and newly installed drinking water system components.

(b) Preventing chemical and biological contamination (e.g. oil, grease, residual lubricants, dirt, cross contamination, wastewater, etc.).

(c) Preventing the introduction and loss of foreign materials (construction debris, dirt, garbage, construction material, tools, etc.) into the potable water system.

(d) Preventing the ingress of vandals or wildlife (birds, rodents, animals, insects etc.) into the potable water system.

(e) Preventing the intrusion of non-potable water into the pipelines, tanks and appurtenances. The non-potable water source includes, but not limited to, surface water runoff, rainwater, contaminated drinking water, groundwater, etc.

1.3.3 Work report after completion.

(1) Contractor to prepare and have signed-off all work plans, procedures and reports by the Engineer, as per this specification and include in O&M Manual.

PART 2 PRODUCTS

2.1 WATER

2.1.1 Use potable water or screened lake water where potable water is not accessible.

2.2 DISINFECT AGENT

2.2.1 Sodium Hypochlorite Solution conform to AWWA B300 and B303.

2.3 DECHLORINATION AGENT

2.3.1 Conform to AWWA C655.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Exercise with care and prevent physical, chemical, biological and animal contamination of all components and facilities.

3.1.2 All materials stored on site shall be kept in a clean and undamaged condition. Hazardous materials shall be stored at least eight (8) metres away from all drinking water facilities (in service or out of service), on grounds where surface drainage slopes away from drinking water facilities and away from areas of standing water. All temporary human waste collection systems (i.e., portable toilets or holding tanks) shall be kept a minimum of eight (8) metres away from any potable water storage or conveyance system, and will be placed in a manner that will prevent any leakage from contaminating any part of the components/facilities storage or conveyance system.

3.1.3 Pipelines, valves and other appurtenances shall be kept capped, wrapped or housed to prevent unsanitary conditions, rust, animal nesting and other contamination hazards. Plugs of rags, wood, cotton, or similar materials are not acceptable.

3.1.4 Prior to installation of any facilities and/or components, all plugs, caps, dirt, debris, grease, and foreign material shall be removed. If dirt has entered a pipeline, or disinfection of the components (e.g., valves, small pipe sections, taps etc.) is required prior to installation, the Contractor shall spray or swab the interior surface using a nominal 1% to 5% sodium hypochlorite solution as the disinfectant as directed by the Project Representative. The solution should have at least 10,000 milligrams per liter (mg/L) chlorine concentration. For the purpose of preventing corrosion by the disinfectant, and upon request by the Project Representative, the Contractor may need to flush the interior surface with potable water to remove the disinfectant after the disinfectant has been in contact with the surface per AWWA Standards.

3.1.5 Once cleaned, all components and facilities shall be stored under controlled conditions to prevent re-contamination. If the Project Representative finds unacceptable care or cleanliness of the components and facilities prior to installation or being put into service, the Contractor will be required to clean the components and facilities to the satisfaction of the Project Representative. The Contractor shall be solely responsible for the cost of the required cleaning. As a minimum, all water retaining structure shall be pressure washed following construction completion and prior to disinfection. Pressure should be adequate to clean the surface without damaging the concrete or sealants.

3.1.6 If required to enter the interior of any in-service facility, all tools, equipment and boots shall be washed and cleaned to remove dirt, and disinfected with a nominal 200 mg/L sodium hypochlorite solution prior to entering the facility, or as directed by the Project Representative. Material and tools may be rinsed with potable water to remove residual disinfectant after 15 minutes of contact time, or as directed by the Project Representative.

3.1.7 Remove all dirt, dust, oil and foreign materials from all components and facilities after their installation and prior to the disinfection.

3.1.8 Take all safety and precautionary measures, including safe handling of chemicals, safe operation of equipment/tools, and the use of appropriate personal protective equipment during and at the end of construction.

3.1.9 Notify the Owner immediately of any suspected vandalism, chemical spill or construction activity that could cause contamination or otherwise compromise the integrity of the facilities.

3.2 CLEANING

3.2.1 In compliance with AWWA C651.

3.2.2 Clean piping greater than 150 mm and less than 600 mm by passing a tightly fitting cleaning ball or swab through the pipeline, unless specified otherwise.

3.2.3 Lines greater than 600 mm may be cleaned manually or with a cleaning ball or swab.

3.2.4 Give lines smaller or equal to 150 mm an initial flush or purge at a velocity equal to or greater than 2 m/s.

3.2.5 After initial cleaning, connect the piping systems to related process and mechanical equipment. Insert temporary screens, provided with visible locator tabs, in the suction of pumps, blowers and compressors.

3.2.6 Maintain the screens during testing, flushing/purging, initial startup, and the Pre-Commissioning period, expect for final performance testing of pumps, blowers and compressors.

3.2.7 Remove the screens and make the final connections after the screens have remained clean for a minimum of 24 consecutive hours of operation. Screens in solids handling systems are exempt; remove prior to placing the system in service.

3.2.8 In air or gas systems with pipe sizes less than or equal to 150 mm, purge with air and/or inert gases before testing. Upon completion of testing and cleaning, drain and dry the piping with a dry air stream.

3.2.9 For transmission mains:

(1) Install flushing points at locations and of a size to allow thorough movement of potential contaminates in both directions, where possible.

(2) Flushing is to continue until water sampled is at or below 1 NTU or matching that of the source water immediately upstream of the connection point, whichever is less.

3.3 HYDROSTATIC TESTING

3.3.1 In compliance with ASME B31.3.

3.3.2 Use water as testing medium.

3.3.3 Notify the Owner minimum 48 hours in advance of the testing, unless otherwise specified.

3.3.4 Refer to “piping schedule” for testing pressure, duration and acceptance criteria, unless otherwise specified.

3.3.5 Watermains and Process Piping:

(1) Provide written notice to the Owner at least four (4) Business Days in advance of any hydrostatic pressure testing.

(2) Before applying the specified test pressure, all air will be expelled from the pipe.

(3) Provide written notice to the Owner at least four (4) Business Days in advance of any hydrostatic pressure testing.

(4) Before applying the specified test pressure, all air will be expelled from the pipe.

3.3.6 Defects and Repair:

(1) Repair and retest any defects disclosed in the Work or replace the Work without additional cost to the Owner.

(2) Repair piping systems with new material. No caulking of screwed joints, cracks or holes will be accepted. Where it becomes necessary to replace pieces or pipe, replace pieces of pipe with the same lengths as the defective pieces. Where repairs are required to PVC pipe, replace the pipe as far as the first detachable fitting in each direction from the defect. Under no circumstances a new section of pipe is to be installed with solvent welded couplings.

(3) Repeat tests after any Work has been replaced.

3.4 DISINFECTION

3.4.1 In compliance with AWWA C651, C652, C653 and C655.

3.4.2 Perform disinfection after hydrostatic testing is accepted.

3.4.3 Notify the Engineer at least 1 week prior to a facility being ready for disinfection.

3.4.4 Water transmission mains and process piping are not to be disinfected until the main has passed the hydrostatic leakage test.

3.4.5 Upon failure of sample analysis, apply remedial measures and redo the disinfection.

3.5 DECHLORINATION

3.5.1 In compliance with AWWA C655.

3.5.2 After disinfection, dechlorinate and pH-adjust water prior to discharge. Take samples prior to discharge, and only discharge after water quality is confirmed of 0 mg/L free chlorine and of pH 6.5 to 8.5.

3.5.3 The discharge shall not cause pollution, contamination, or nuisance. The discharge shall cause no scouring or erosion at the point where discharged water enters the receiving water.

3.5.4 Notice the Owner 24 hours prior to the discharge and main a log for the discharging which shall record the time, volume and water quality of the discharge.

3.6 SAMPLING AND WATER QUALITY TESTING

3.6.1 In compliance with AWWA C651, C652, C653 and C655.

3.6.2 Treated Water Main and Process Piping.

(1) Complete bacteriological sampling and testing before the Piping is connected to the Existing Water System.

(2) Take samples within 1 m of all connection points, within 1 m of all isolation valves and stub ends, and at maximum intervals of 350 m along the new main.

(3) Testing laboratory is to be fully accredited in the Standard Methods for the Examination of Water and Wastewater.

(4) In order for samples to pass the test, the minimum requirement is for two (2) test samples, taken from the same location a minimum of 24 hours apart, to result in the absence of coliform (as verified by the testing laboratory). If either of the samples from that locations fails, the entire section of transmission main is considered failed and retesting and/or re-disinfection is required.

(5) Submit to the Owner a record of all the test results together with a letter of acceptance.

END OF SECTION

MATERIAL INSTALLATION

PART 1 GENERAL

1.1 QUALITY

1.1.1 Material and product supplied and installed shall be new.

1.1.2 Material and product supplied shall conform to these specifications and to specified standards.

1.1.3 Workmanship shall be the best quality, executed by workmen experienced and skilled in their respective trades.

1.1.4 Ensure full cooperation among all trades and coordination of the Work with continuous supervision.

1.1.5 Use product for which replacement parts and service are readily available.

1.1.6 Use product of one Manufacturer for product of the same type or classification. Do not mix different Manufacturer's product in the Work or in parts of the Work.

1.1.7 Where material or product requires specialized installation skills the Contractor shall obtain training from the Vendor or hire trades with specialized skills to complete the Work.

1.1.8 Should any dispute arise as to the quality or fitness of products, the decision rests solely with the Engineer based upon the requirements of the Contract Documents.

1.2 MANUFACTURE'S INSTRUCTIONS

1.2.1 Unless otherwise specified, comply with the Manufacture's/Supplier's instructions for material or product and installation methods.

1.2.2 Notify the Engineer in writing of any conflict between these contract specifications and the instructions of the Manufacture/Supplier.

1.3 FASTENINGS

1.3.1 Provide metal fastenings and accessories in the same texture, colour and finish as the base metal in which they occur. Prevent electrolytic action between dissimilar metals. Use non-corrosive fasteners, anchors and spacers for securing exterior Work, or Work that may be located in a corrosive atmosphere.

1.3.2 Space anchors within limits of load bearing or shear capacity and ensure that they provide positive permanent anchorage.

1.3.3 Space fastening evenly and lay out neatly.

1.4 DELIVERY AND STORAGE

1.4.1 Review product delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of products are foreseeable, notify the Engineer of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of Work.

1.4.2 Deliver, store and maintain packaged material and product with Manufacturer's seals and labels intact.

1.4.3 Prevent damage and soiling of material and product.

1.4.4 Store material and product in accordance with instructions of the Manufacture/Supplier.

1.4.5 Provide suitable areas or buildings where storage is weatherproof, if dry areas are recommended by the Manufacture/Supplier.

1.4.6 product shall have name plates displaying product data and serial numbers.

1.4.7 Comply with Work Place Hazardous Materials Information Systems requirements.

END OF SECTION

EQUIPMENT INSTALLATION

PART 1 GENERAL

1.1 INTENT

1.1.1 This section describes general requirements for process, hoisting, mechanical, and electrical equipment relating to supply, installation, testing, and commissioning; and the verification thereof.

1.2 DEFINITIONS

1.2.1 Manufacturer: The Manufacturer is the person, partnership, or corporation responsible for the fabrication of equipment provided by the Contractor for installation for the completion of the Work.

1.2.2 Manufacturer''s Representative: A Manufacturer's representative is a trained serviceman empowered by the Manufacturer to provide installation, testing, and commissioning assistance to the Contractor in the performance of these functions.

1.3 EXPERTISE AND RESPONSIBILITY

1.3.1 The Engineer recognizes the expertise of the Manufacturers.

1.3.2 Manufacturer’s will provide personnel who have sufficient expertise and training to provide advice to the Contractor for installation and start up of supplied equipment.

1.4 EQUIPMENT DELIVERY

1.4.1 The Contractor shall be responsible for receiving, unloading, loading, and storage of both Owner supplied equipment and Contractor supplied equipment.

1.4.2 The Contractor shall ensure that all necessary precautions are taken in the loading / unloading of equipment and its subsequent storage.

1.4.3 The Contractor shall inspect the contents of supplied equipment and any equipment delivery and be satisfied of the contents thereof and damage which may have occurred during transport.

1.5 INSTALLATION ASSISTANCE

1.5.1 Before commencing installation of equipment, where indicated in the Specifications, the Contractor shall arrange for the attendance of the Manufacturer's Representative to provide instructions in the methods, techniques, precautions, and any other information relevant to the successful installation of the equipment.

1.5.2 The Contractor shall inform the Engineer, in writing, of the attendance at the site of any Manufacturer's Representative for installation training at least 14 days prior to arrival.

1.5.3 When the Manufacturer's Representative is satisfied that the Contractor is aware of all installation requirements, the Manufacturer's Representative shall so certify by completing Form 101 that is attached to the Specification.

1.5.4 The completed form shall be delivered to the Engineer prior to installation and departure of the Manufacturer's Representative from the site.

1.5.5 Installation of the equipment shall not commence until the Engineer has advised that the completed Form 101 has been delivered.

1.6 INSTALLATION

1.6.1 If necessary, or if so directed by the Engineer during the course of installation, the Contractor shall contact the Manufacturer to receive clarification of installation procedures, direction, or any other additional information necessary to continue or complete the installation in an appropriate manner.

1.6.2 If it is found necessary, or if so directed by the Engineer, the Contractor shall arrange for the Manufacturer's Representative to visit the site to provide assistance during installation, all at no additional cost to the Owner.

1.6.3 Prior to completing installation, the Contractor shall inform the Manufacturer and arrange for the attendance at the site of the Manufacturer's Representative to verify successful installation.

1.6.4 The Contractor shall advise the Engineer in writing, at least seven (7) days prior, of the Manufacturer's Representative's scheduled arrival.

1.6.5 The Contractor shall ensure that all seismic support, bracing and anchorage is provided by the Vendor and meets the requirements of the BC Building Code for post disaster facilities.

1.6.6 The Manufacturer's Representative shall conduct a detailed inspection of the installation including alignment, electrical connections, belt tensions, rotation direction, running clearances, lubrication, workmanship and all other items as required to ensure successful operation of the equipment.

1.6.7 The Manufacturer's Representative shall identify any outstanding deficiencies in the installation.

1.6.8 In the presence of the Manufacturer's Representative, the Contractor, and the Engineer, the equipment shall then be given a one (1) hour trial run.

1.6.9 If deficiencies noted by the Manufacturer's Representative or which become evident in the trial run prejudice the successful completion of the trial run, the deficiencies will be rectified by the Contractor and the Manufacturer's Representative will be required to re-inspect the installation, at no additional cost to the Owner.

1.6.10 On successful completion of the trial run in the second or subsequent attempt, the Manufacturer's Representative will certify successful installation by completing Form 102 that is attached to the Specification.

1.6.11 The completed Form 102 shall be delivered to the Engineer prior to departure of the Manufacturer's Representative from the site.

1.6.12 Tag the equipment with a 100 mm by 200 mm blue card stating "Equipment Checked. Do Not Run." stenciled in large black letters. The Contractor shall sign and date each card.

1.7 OPERATION AND PERFORMANCE VERIFICATION

1.7.1 Both Owner supplied and Contractor supplied equipment will be subjected to a demonstration, running test, and performance tests after the installation has been verified and any identified deficiencies have been remedied.

1.7.2 The Contractor shall inform the Engineer at least 14 days in advance of conducting the tests and arrange for the attendance of the Manufacturer's Representative. The tests may be concurrent with the inspection of satisfactory installation if mutually agreed by the Contractor and the Engineer.

1.7.3 The Manufacturer's Representative will conduct all necessary checks to the equipment and if necessary, advise the Contractor of any further checking, flushing, cleaning, or other Work needed prior to confirming the equipment is ready to run.

1.7.4 The Contractor shall then operate the equipment for at least one (1) hour to demonstrate the operation of the equipment and any required ancillary services. Any remedial measures required to ensure satisfactory operation shall be promptly undertaken.

1.7.5 The Contractor shall then notify the Engineer of the readiness to demonstrate the operation of the equipment. The Engineer shall attend, as expeditiously as possible. The Owner’s representative, also shall attend if deemed appropriate by the Owner.

1.7.6 With the assistance of the Manufacturer's Representative, the Contractor will demonstrate that the equipment is properly installed. Alignment, piping connections, electrical connections, etc. will be checked and if appropriate, code certifications provided.

1.7.7 The equipment shall then be run for one (1) hour. Local controls shall be satisfactorily verified by cycling the equipment through several start-stop operations, modulating its output, or some combination. Operating parameters such as temperature, pressure, voltage, vibration, etc., will be checked to ensure that they are within the specified or Manufacturer's recommended limits, whichever is more stringent.

1.7.8 On satisfactory completion of the one (1) hour demonstration, the equipment will be stopped and critical parameters, such as alignment, will be rechecked.

1.7.9 The equipment will be restarted and run for five (5) days, of which the last forty-eight (48) hours shall be consecutive. During this period, as practicable, conditions will be simulated which represent maximum or most severe, average, and minimum or least severe conditions. These conditions will be mutually agreed to by the Contractor and Engineer on the basis of the information contained in the Specifications, as well as the methods utilized to create the simulated conditions and the time periods allotted to each.

1.7.10 Performance tests will be conducted either concurrent with or subsequent to the running test, as practicable and agreed between the Engineer and the Contractor.

1.7.11 Performance tests shall be as dictated in the Specifications for each item of equipment or as reasonably required by the Engineer to prove adherence to the requirements listed in the Specifications.

1.7.12 Results of the performance tests shall be as documented and summarized by the Contractor in a format acceptable to the Engineer.

1.7.13 All water, chemicals, temporary power, heating, or any other ancillary service required to complete the initial demonstration, running test and performance tests are the responsibility of the Contractor.

1.7.14 Should the initial demonstration, running test or performance tests reveal any defects, then those defects shall be promptly rectified and the demonstration, running tests, and/or performance tests shall be repeated to the satisfaction of the Engineer. Additional costs incurred by the Contractor, the Engineer, or the Owner, due to repeat demonstration, running tests, and/or performance tests shall be the responsibility of the Contractor.

1.7.15 On successful completion of the demonstration, running test, and performance tests, Form 103 that is attached to the Specification will be signed by the Manufacturer's Representative, Contractor, and the Engineer.

1.7.16 The Contractor shall affix to the tested equipment a 100 mm by 200 mm card reading "Operable Condition - Do Not Operate without Contractor's Permission." stenciled on in large black letters.

CERTIFICATE OF READINESS TO INSTALL

FORM 101

The undersigned has familiarized the Contractor of the specific installation requirements related to the equipment listed below and is satisfied that the Contractor understands the required procedures.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____

MANUFACTURER'S REPRESENTATIVE DATE

CERTIFICATE OF SATISFACTORY INSTALLATION

FORM 102

The undersigned has completed a check and inspection of the installation listed below and confirm that it is satisfactory and that defects have been remedied to my satisfaction except any as noted below:

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

REFERENCE SPECIFICATION: _____

OUTSTANDING DEFECTS: _____

_____ _____

MANUFACTURER'S REPRESENTATIVE DATE

CERTIFICATE OF EQUIPMENT SATISFACTORY PERFORMANCE

FORM 103

The undersigned certify that the equipment listed below has been operated for at least seven (7) days of which the last two (2) days are consecutive and that the equipment operates satisfactorily and meets its specified operating criteria. No defects in the equipment were found. The equipment is therefore classed as "conforming".

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

REFERENCE SPECIFICATION: _____

MANUFACTURER'S REPRESENTATIVE	DATE
CONTRACTOR'S REPRESENTATIVE	DATE
ENGINEER	DATE

END OF SECTION

TRAINING

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This Section contains requirements for training the Owner's designated Operator Staff, by persons retained by the Owner or Contractor specifically for the purpose, in the proper operation and maintenance of the equipment and systems installed under this Contract.

1.1.2 For equipment that is specified to include training, arrange for the attendance of the Manufacturer's Representative to provide classroom training session(s) to operating staff. Give the Engineer at least 30-days notice of the session(s). At no time schedule the sessions for more than three (3) weeks prior to commissioning.

1.1.3 Coordinate the training session(s) with the Manufacturer.

1.1.4 The presentations shall be given during the three (3) week period preceding the start of the operating period required for Form 103.

1.1.5 The intent is that the Operator Staff should receive sufficient training on the equipment system that they are going to operate and maintain. The Engineer shall have the authority to determine the duration and content of each training session required.

1.2 QUALITY ASSURANCE

1.2.1 Where required by the equipment specifications, provide on-the-job training of the Operator Staff. Training sessions will be conducted by qualified, experienced two (2) years minimum, factory-trained representatives of the various equipment suppliers. Training includes instruction of Operator Staff in equipment operation and preventive maintenance and instruction on mechanics, electronics, and instrumentation and communications equipment operators (technicians) in normal maintenance up to major repair.

1.2.2 The trainer(s) proposed by the Contractor shall be experienced in "training" plant operators and shall have relevant experience in similar work.

1.3 SUBMITTALS

1.3.1 Submit the following information in accordance with Section 01300. For phased testing and start-up activities, separate submittals can be prepared for equipment items or systems. The material will receive a "Reviewed" or "Reviewed as Noted" status by the Engineer no later than four (4) weeks prior to delivery of the training:

(1) Lesson plans and training manuals, handouts, visual aids, and other reference materials for each training session to be conducted by the Contractor's trainer(s).

(2) Date, time, and subject of each training session.

(3) Training schedule.

1.4 LOCATION

1.4.1 Where specified, conduct training sessions for the operator staff, operation and maintenance personnel, on the operation, care, and maintenance of the equipment and systems installed under this Contract. Training will take place at the site of the Work and under the conditions specified herein.

1.4.2 Field training sessions will take place at the site of the equipment. Classroom training to take place in the Administration Building. The Engineer may direct the classroom training to take place at another suitable location.

1.4.3 Inform the Engineer of any requirements for audio-visual aids five (5) days before training session.

1.5 LESSON PLANS

1.5.1 Prepare formal written lesson plans for each training session and coordinate with the Engineer. Lesson plans to contain an outline of the material to be presented along with a description of visual aids to be utilized during the session. Each plan will contain a time allocation for each subject. Furnish ten (10) copies of necessary training manuals, handouts, visual aids and reference materials at least two (2) weeks prior to each training session.

1.6 FORMAT AND CONTENT

1.6.1 Include time in the classroom and at the location of the equipment or system for each training session. Allow 30 minutes at the beginning of the first period for the Engineer to provide a summary of the design intent relating to that equipment. Following the engineering design overview, provide as a minimum, cover the following topics for each item of equipment or system:

(1) Familiarization

(2) Safety

(3) Operation

(4) Troubleshooting

(5) Preventive maintenance

(6) Corrective maintenance

(7) Parts

(8) Local representatives

1.7 VIDEO RECORDING

1.7.1 The Owner may record each training session. After taping, the material may be edited and supplemented with professionally produced graphics to provide a permanent record for the Owner's use. Advise all suppliers providing training sessions that the training material may be videotaped.

1.8 TRAINING

1.8.1 General Requirements

(1) Conduct initial training in conjunction with the Equipment Performance Testing periods. Schedule classes such that classroom sessions are interspersed with field instruction in logical sequence.

(2) Provide final Operating and Maintenance Manuals, as defined in Section 01300, for the specific equipment to the Owner at least four (4) weeks prior to the start of any training. Videotaping may take place concurrently with all training sessions.

1.8.2 Operator Classroom Training

(1) As a minimum, classroom equipment training for operations personnel will include:

(1) The equipment's specific location in the plant and an operational overview. Use slides and drawings to aid discussion.

(2) Purpose and plant function of the equipment.

(3) The operating theory of the equipment.

(4) Start-up, shutdown, normal operation, and emergency operating procedures, including system integration and electrical interlocks, if any.

(5) Safety items and procedures.

(6) Routine preventive maintenance, including specific details on lubrication and maintenance of corrosion protection of the equipment and ancillary components.

(7) Operator detection, without test instruments, of specific equipment trouble symptoms.

(8) Required equipment exercise procedures and intervals.

(9) Routine disassembly and assembly of equipment if applicable for purposes such as operator inspection of equipment.

1.8.3 Operator Hands-On Training

(1) As a minimum, hands-on equipment training for operations personnel will include:

(1) Identifying instrumentation: location of primary element; location of instrument readout; discuss purpose, basic operation, and information interpretation.

(2) Discussing, demonstrating, and performing standard operating procedures and daily visual inspection of system operation.

(3) Discussing and performing the preventive maintenance activities.

(4) Discussing and performing start-up and shutdown procedures.

(5) Performing the required equipment exercise procedures.

(6) Performing routine disassembly and assembly of equipment if applicable.

(7) Identifying and reviewing safety items and performing safety procedures, if feasible.

1.8.4 Maintenance Classroom Training

(1) Classroom equipment training for the maintenance and repair personnel will include:

(1) Basic theory of operation.

(2) Description and function of equipment.

(3) Routine start-up and shutdown procedures.

(4) Normal and major repair procedures.

(5) Equipment inspection and troubleshooting procedures including the use of applicable test instruments and the "pass" and "no pass" test instrument readings.

(6) Routine and long-term calibration procedures.

(7) Safety procedures.

(8) Preventive maintenance such as lubrication; normal maintenance such as belt, seal, and bearing replacement; and up to and including major repairs such as replacement of major equipment part(s) with the use of special tools, bridge cranes, welding jigs, etc.

1.8.5 Maintenance Hands-On Training

(1) Hands-on equipment training for maintenance and repair personnel will include:

(1) Locating and identifying equipment components.

(2) Reviewing the equipment function and theory of operation.

(3) Reviewing normal repair procedures.

(4) Performing routine start-up and shutdown procedures.

(5) Reviewing and performing the safety procedures.

(6) Performing Owner-approved practice maintenance and repair job(s), including mechanical and electrical adjustments and calibration and troubleshooting equipment problems.

(7) Reviewing and using Supplier's manuals in the hands-on training.

1.9 EQUIPMENT AND SYSTEMS FOR TRAINING

1.9.1 Provide training during the Equipment Performance Testing period for the following equipment and systems:

(1) UV Disinfection System.

(2) Coordinate and finalize with the Engineer on training schedules and duration of each training session.

1.10 TRAINING COMPLETION FORMS

1.10.1 Form T1: To be completed for initial training during Equipment Performance Testing.

1.10.2 Form T2: To be completed for final training during the Process Performance Testing.

1.10.3 A sample of **Forms T1** and **T2** are attached to this Specification section.

1.10.4 One copy of **Forms T1** and **T2** will be required for each major piece of equipment.

PART 2 PRODUCTS – (NOT APPLICABLE)

PART 3 EXECUTION – (NOT APPLICABLE)

FORM T1

CERTIFICATE OF SATISFACTORY TRAINING

We certify that the initial training for the equipment listed below has been provided as per the Specifications.

PROJECT: _____

ITEM OF EQUIPMENT: _____

_____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Owner) Date

FORM T2

CERTIFICATE OF SATISFACTORY TRAINING

We certify that the final training for the equipment listed below has been provided as per the Specifications.

PROJECT: _____

ITEM OF EQUIPMENT: _____

TAG NO: _____

REFERENCE SPECIFICATION: _____

_____ _____
(Authorized Signing Representative of the Owner) Date

END OF SECTION

PART 1 GENERAL

1.1 INTENT

1.1.1 This section describes the Contractor's responsibilities in the commissioning and handover of the process, electrical, and other systems to be installed as part of the Work.

1.2 DEFINITIONS

1.2.1 System: For the purpose of this Specification section, a System shall be defined as the equipment, piping, controls, ancillary devices, electrical power, etc. which together perform a specific function at the facility.

1.2.2 Acceptance: For the purpose of the Specification, acceptance shall be defined as the formal turnover of a System to the Owner for operation and maintenance and shall occur after the end of commissioning of each System, once the Engineer, the Owner, and the Contractor have signed the "**Certificate of System Performance**" (**Form 104**).

1.3 COMMISSIONING TEAM

1.3.1 The Work of commissioning will be conducted by teams comprised of personnel from the Contractor and the Engineer.

1.3.2 The plant operations staff shall represent process personnel and operating staff and/or maintenance staff.

1.3.3 The Contractor shall provide personnel representing the appropriate trades, including control and instrumentation personnel during the commissioning work. These personnel shall be skilled workmen, able to expedite any minor repairs, adjustments, etc. as are required to complete commissioning with as few delays as possible.

1.4 COMMISSIONING PLAN

1.4.1 The Commissioning Team shall develop a detailed methodology for the commissioning of each System at least 45 calendar days prior to planned start of commissioning work. The commissioning plan shall be drafted by the Contractor and include the following:

(1) Detailed schedule of events, including but not limited to the schedule for completion of testing of all component parts of the System in accordance with Section 01650 – Equipment Installation prior to commissioning of a System.

(2) Method for introducing flow, disposing of partially treated effluent, and disposing of any sludge or other residual solids generated during the

commissioning process. The Owner will take responsibility for the implementation of these measures.

(3) Planned attendance schedule for Manufacturer's Representatives.

(4) Contingency plans in the event of a process malfunction.

(5) Drawings and sketches as required to illustrate the planned sequence of events.

(6) List and details for all temporary equipment pumps, etc., required to facilitate commissioning work.

(7) List of all personnel who the Contractor plans for the commissioning work and hand-over with information indicating their qualifications.

(8) A plan for acceptance testing and performance testing for the treatment plant processes.

1.4.2 The Commissioning Plan shall be reviewed and agreed by the Commissioning Team prior to its implementation. The Engineer shall be the final arbiter.

1.5 EQUIPMENT

1.5.1 All process, mechanical, electrical, control and miscellaneous equipment related to a system shall be successfully installed and tested in accordance with Section 01650 – Equipment Installation and any specific requirements noted in other Divisions. Form 103 (see Section 01650 – Equipment Installation) shall be executed for each item.

1.5.2 Temporary equipment will be installed and tested as necessary to ensure that it functions reliably and consistently through the commissioning period.

1.6 CONTROLS

1.6.1 All controls which are the responsibility of the Contractor shall be installed and tested prior to commissioning.

1.6.2 The Engineer shall arrange for the simulation of the control sequences or shall allow for the operation of the System without the features included in the Work of Others. Every effort shall be made to ensure that the commissioning period provides for the full and comprehensive operation of the equipment under all anticipated normal and adverse operating conditions.

PART 2 PRODUCTS

2.1 PLANT UTILITY SERVICES

2.1.1 The Owner will provide power, chemicals, and other ancillary services as necessary to operate the plant through the commissioning period. Provision of these services shall be limited to reasonable levels.

2.2 MANPOWER

2.2.1 Supply all staff required during commissioning as necessary to assist the plant operations staff in the operation of the plant processes.

2.2.2 Supply competent staff capable of maintaining, repairing and adjusting the equipment and controls to achieve the intended design functions during the commissioning period.

2.3 OPERATING DESCRIPTIONS

2.3.1 Operating descriptions have been included in the drawings and specifications. The Contractor will review these descriptions and will be familiar with the requirements in order that the Contractor can undertake commissioning in an appropriate manner.

2.4 DESIGN PARAMETERS

2.4.1 Design parameters for the System to be commissioned shall be as defined in the Specifications and/or the operating descriptions; as modified by the Commissioning Team. The Commissioning Team will identify to the Contractor which parameters shall be modified prior to commissioning and shall be responsible for any subsequent changes during the commissioning period.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Each item of equipment included in the System to be commissioned shall be satisfactorily tested and **Form 103** (see Section 01650 – Equipment Installation) completed.

3.1.2 Piping, wiring, and other conduit systems shall be finished and tested.

3.1.3 Services such as seal water, process drains, process air, instrument air, etc. shall be completed and tested prior to the commissioning of any systems which require these services.

3.1.4 Electrical connections shall be completed and inspected to the satisfaction of the governing authorities.

3.1.5 Control systems shall be completed and the related control software debugged.

3.1.6 Finishes, heating and ventilation, and lighting shall be substantially complete.

3.2 SEQUENCE

3.2.1 The System shall be commissioned in a logical manner. Upstream components shall be commissioned first to the degree possible.

3.2.2 The following sequence of events shall be followed:

(1) Draft O&M Manual shall be available at least one (1) month prior to the performance tests stipulated in Section 01650 – Equipment Installation. Submit final copies before the 28 day test period.

(2) Operator training shall be undertaken three (3) weeks prior to commissioning.

(3) Equipment performance tests shall be conducted successfully **(Form 103)**.

(4) Water shall be introduced to the System.

(5) Start and run the System in manual mode.

(6) Turn separate items of equipment to automatic in a planned and logical manner. Ensure that the control system is operating the equipment in a manner which precludes damage of the equipment and which is consistent with the process operating requirements.

(7) Upon completing the commissioning period and required documentation, the System shall be granted acceptance by the completion of the "**Certificate of System Performance**" **(Form 104)**.

3.3 COMMISSIONING

3.3.1 Water will be introduced to the System in a manner which precludes the damage of any equipment or structures.

3.3.2 Twice during the commissioning period, plant component settings will be modified to ensure that the System is subjected to flows and loads as close to design conditions as possible. Where necessary to achieve this, flows being commissioned will be augmented to exaggerate the naturally occurring flows and loads. Where it is necessary to modify settings outside the limits of this Contract area within the plant, coordinate the changes with plant operations staff.

3.3.3 Assist in the operation of the plant to achieve the process objectives.

3.3.4 All components of the System shall be operated in the automatic / manual and the remote / local modes as required to prove proper operation.

3.3.5 Ensure all bypasses and backup provisions function satisfactorily.

3.3.6 All minor and major alarm conditions will be induced to ensure that the process reacts as intended, the applicable alarms are enunciated.

3.4 ACCEPTANCE

3.4.1 When the System has been commissioned satisfactorily, the System shall be formally accepted for operation and routine maintenance by plant operations staff.

3.4.2 The Contractor is advised that commencement of the two- (2-) year Warranty Period is tied to the issuance of the Notice of Acceptance and shall not commence until that milestone is achieved.

3.4.3 The “Certificate of System Performance” (**Form 104**) will be granted when the System has been commissioned and accepted, and all requirements of the General Conditions have been completed.

CERTIFICATE OF SYSTEM PERFORMANCE

FORM 104

We certify that the equipment listed below has been operated and tested as per the Specifications for at least 28 days and that the equipment meets its Performance Testing Criteria, including fully automatic controls. The equipment is therefore classed as "conforming".

Project: _____

Item of Equipment: _____

_____

Tag No: _____

Reference Specification: _____

_____ _____
(Authorized Signing Representative of the Supplier) Date

_____ _____
(Authorized Signing Representative of the Contractor) Date

_____ _____
(Authorized Signing Representative of the Engineer) Date

_____ _____
(Authorized Signing Representative of the Owner) Date

END OF SECTION

CONTRACT CLOSEOUT

PART 1 GENERAL

1.1 CLEANUP

1.1.1 The Contractor shall:

(1) Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris during construction and at Substantial Performance.

(2) Clean and polish glass, mirrors, hardware, floor tile, wall tile, stainless steel, chrome, baked enamel, plastic laminate, mechanical and electrical fixtures. Replace broken, scratched or disfigured glass.

(3) Remove stains, spots, marks and dirt from decorative work, electrical and mechanical fixtures, furniture fitments, walls and floors.

(4) Vacuum clean and dust building interiors, behind grilles, interior control panels, louvres and screens.

(5) Vacuum and clean floor surfaces.

(6) Clean, vacuum or seal, or prepare floor finishes, as recommended by the Manufacture and as specified.

(7) Inspect finishes, fitments and equipment and ensure specified workmanship and operation.

(8) Remove dirt and other disfigurations from exterior surfaces.

(9) Clean equipment and fixtures to a sanitary condition, clean or replace dirty filters of mechanical equipment.

(10) Clean off all marks and dirt from aluminum and clean and polish all glass.

(11) Clean up roofs, including spreading displaced gravel evenly and clearing of all drains.

(12) Clean grounds and exterior paved areas and leave these areas hosed down and swept and made ready for the Owner's use.

1.2 RECORD DOCUMENTS

1.2.1 The Contractor shall keep one (1) set of current white prints of all drawings and all addenda, revisions, clarifications, change orders, and reviewed shop drawings in the site office; and have them available at all times for inspection by the Engineer.

1.2.2 As the Work proceeds, the Contractor shall record, clearly and indelibly in red pencil, as-built conditions wherever they deviate from the original directions of the Contract Documents.

1.2.3 The Contractor shall present the as-built information for scrutiny at the project office and as may be required by the Consultant.

1.2.4 At completion of the Work, the Contractor shall employ competent personnel to transfer all deviations, including those called up by addenda, revisions, clarifications, shop drawings and change order, to a set of white prints. Each as-built print shall bear the Contractor's identification, the date of record and the notation, “We hereby certify that these drawings represent the Work 'as-built'.” The Contractor's signature shall be placed below that notation.

1.2.5 If required by the Contract Documents, the Contractor will prepare as-built drawings on AutoCAD computerized drafting system compatible with that used by the Owner.

1.3 OPERATION MANUALS

1.3.1 Prepare operation and maintenance manuals and submit four (4) copies and a PDF copy to the Engineer before the Completion Date.

1.3.2 Operation and maintenance manuals are specified in general in this section, with regard to numbers of binders, preparation, marking, general arrange¬ment, format and general contents. Requirements for mechanical, process equipment, electrical Work and other items may be specified in other sections of the specifications, however the general format shall be in accordance with this section.

1.3.3 Provide the services of qualified and experienced personnel to prepare manuals.

1.3.4 Prepare sets of manuals for various divisions using identical bindings, and the same indexing system and format for all manuals.

1.3.5 Provide 215 mm x 280 mm extension type catalogue binders bound with heavy weight bright red fabric, hot stamped in silver lettering front and spine. Acropress, Cerlox or similar light weight or special hole binders are not acceptable.

1.3.6 Letter each binder as follows:

(1) Front Face

(1) Full identification of title of project

(2) Prime Contractor full identification title

(3) Consultants full identification title

(4) Conctractor full identification title

(5) Subcontractors full identification title

(2) Spine

(1) Full identification of title of project

(2) Copy Number

1.3.7 Arrange each individual binder as follows, using coloured divider tabs which shall be laminated mylar plastic and which shall be coloured according to section of the manual.

Each division of the manual (i.e., mechanical, electrical, process equipment etc.) shall be a complete manual and shall in general be in the following format with the divider tabs as noted:

Tab 1.0 Title Page

(1) Job name & Owner's name

(2) Address, telephone number and complete name of:

(i) Prime Contractor

(ii) Subconsultant

(iii) General Contractor

(iv) Subcontractor

(v) Index of all divider tabs

Tab 1.1 List of drawings

Tab 1.2 Description of Systems

Tab 1.3 Operation of Systems

Tab 1.4 Maintenance & Lubrication

Tab 1.5 List of suppliers and addresses of same

Tab 2.0, 2.1 etc. Certifications

Tab 3.0, 3.1 etc. Manufactures data, Shop drawings, Bulletins

1.3.8 Provide preventive maintenance program if specified in applicable sections.

1.3.9 Provide, in addition to mechanical, electrical equipment details:

(1) Hardware and paint schedules, complete with the actual Manufacture, Supplier and identification names and numbers.

(2) All Manufactures' equipment, materials, products, data, details, identification, schedules of maintenance, operational and installation information as required in accordance with the specification.

(3) All extended warranties, maintenance bonds, certificates, letters of guarantees, registration cards, etc., as called for in the specification with the following information:

(1) name and address of subject;

(2) commencement date (Substantial Performance) of warranties;

(3) duration and expiry date of warranties;

(4) signature and seal of Contractor, Installer, Manufacture and/or Supplier;

(5) complete set of all final reviewed shop drawings;

(6) certificates of inspection;

(7) test reports and certificates; and,

(8) confirmation letters stating that all extra replacement materials in accordance with the specifications have been handed over to the Owner in good order.

(4) Valve lists giving numbers, types, service and location.

(5) Confirmation letters stating that all portable equipment, materials, (such as fire extinguishers, special tools, keys for all equipment and'/or panels, elevator pads/accessories, keys to millwork, casework, etc.) have been handed over to the Owner in good order.

END OF SECTION

DIVISION 2
EXISTING CONDITIONS

Sitework Demolition and Removal

PART 1 GENERAL

1.1 SUMMARY

1.1.1 This Section includes methods and procedures for saw-cutting, demolishing, recycling removing and disposing site work items including structures, facilities, utilities, and pavements designated to be removed in whole or in part, and for backfilling resulting trenches and excavations.

1.1.2 Structures, facilities to be demolished, and utilities to be removed are shown on the Drawings.

1.2 REFERENCES

1.2.1 WorkSafe BC Standards.

1.2.2 All demolition works shall conform to CSA S350 (Code of Practice for Safety in Demolition of Structures), the British Columbia Building Code and the Occupational Health and Safety Act.

1.3 DEFINITIONS

1.3.1 Demolition: Demolition is the tearing-down of buildings and other structures manually or mechanically using large hydraulic equipment

1.4 ADMINISTRATIVE REQUIREMENTS

1.4.1 Coordinate with Engineer prior to starting demolition work.

1.4.2 Coordinate with Engineer to sequence the demolition work.

1.4.3 Meeting: Schedule a meeting with the Engineer to discuss the demolition plan and schedule.

1.5 SUBMITTALS

1.5.1 Procedures: Section 01300

1.5.2 Informational Submittals:

(1) Submit drawings, diagrams or details showing sequence of demolition work and supporting structures and where required.

(2) Submit drawings stamped and signed by a qualified professional engineer registered or licensed in Province of British Columbia, Canada.

1.5.3 Provide written report indicating method of disassembling items for removal, protection methods, and storage facilities, whether on or off the work site, to be used in accordance with Section 01300. Do not commence work until report has been reviewed and accepted by Engineer and Owner.

1.6 QUALITY CONTROL

1.6.1 Perform all work in accordance with Section 01400.

1.6.2 Protect existing structures and utilities that can be affected by the Work. Be responsible for damage or disruption to structures and utilities through the settlement or displacement of ground, vibration, shock, earthwork, or changes to groundwater level resulting from any cause related to the Work, spillage of liquids and other related activities within the Contract. Repair the damage to structures and utilities at no cost to the Corporation. Restore to equal or better condition.

1.6.3 Protect existing items designated to remain. In the event of damage to such items, immediately replace or make repairs to the approval of the Engineer and at no cost to the Corporation.

1.6.4 In all circumstances ensure that demolition work does not adversely affect adjacent facilities, utilities, water courses, groundwater, and wildlife, or contribute to excess air and noise pollution.

1.6.5 Do not dispose, of waste or volatile materials such as mineral spirits, oil, petroleum-based lubricants, or toxic cleaning solutions into watercourses, storm or sanitary sewers. Ensure proper disposal procedures are maintained throughout the project.

1.6.6 Do not pump water containing suspended materials into watercourses, storm or sanitary sewers, or onto adjacent properties.

1.6.7 Control disposal or runoff of water containing suspended materials or other harmful substances in accordance with the requirements of local authorities. Refer to specification Section 01561.

1.6.8 Exercise all necessary precautions for fire prevention. Make acceptable fire extinguishers available at all times in areas where demolition work by burning torches is being done. Do not burn demolition debris on or near site.

(1) Protect persons and property throughout progress of work. Proceed in such manner as to minimize spread of dust and flying particles and to provide safe working conditions for personnel.

(2) Make necessary arrangements with the Corporation for discontinuance or interruption of utility services due to demolition work.

1.6.9 Prevent debris from blocking building accesses and exits.

1.6.10 Prevent debris from blocking any drainage system.

1.6.11 Ensure that removal procedures do not interrupt mechanical and electrical systems without due consideration to their ongoing operation.

1.6.12 Prevent unauthorized access to partly demolished structures and leave safe at end of each day’s work.

1.6.13 Provide dust protection for functioning equipment and protect equipment that will remain in place during construction period. Protect all items for removal and in transit to approved storage facility.

1.7 EXISTING CONDITIONS

1.7.1 The Contractor shall inspect the existing conditions of all structures and facilities scheduled to be demolished and utilities to be removed with the Engineer for any hazardous conditions and materials. Notify the Engineer if any hazardous material identified. Contractor shall not start demolition or utilities removal until hazardous conditions or materials are remediated in accordance with the applicable rules and regulations.

1.7.2 Drawings or descriptions, of the existing structures and equipment or their location that are given to the Contractor are intended only as an aid to the locations of these structures. Dimension and location of the existing underground structures shown on the Contract Drawings are not guaranteed to be accurate and shall be verified by the Contractor before proceeding with work.

PART 2 GENERAL

2.1 NOT USED.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Inspect the site with the Engineer and verify extent and location of items designated for saw cutting, removal, disposal, alternative disposal, recycling, salvage, and items to remain.

3.1.2 Inspect with the Engineer for any hazardous conditions and materials.

3.1.3 Prior to demolition, the Owner, Engineer and Contractor will conduct a walkthrough of the plant area scheduled for demolition to identify equipment, instrumentation, piping, panels, etc. that are to be salvaged. The Engineer will prepare a list of the items identified during the walkthrough that are to be salvaged. The transfer of these items will be administered by the Engineer throughout the construction process.

3.2 PREPARATION

3.2.1 Locate and protect utilities. Preserve active utilities traversing the site in operating condition.

3.2.2 Notify and obtain approval from the Corporation before starting demolition.

3.2.3 Review applicable regulations for disposal of all material.

3.2.4 Coordinate with Engineer to de-energize any power prior to disconnect any power cables connecting to the structure or facility to be demolished or utility to be removed.

3.2.5 Coordinate with Engineer to close any isolation valves to shut down supply in any utility to be removed or to remain.

3.3 DEMOLITION

3.3.1 Demolish and partially demolish structures as shown on Drawings.

3.3.2 Alterations to be done at such time and in such manner as will comply with approved time schedule.

3.3.3 Remove existing equipment services and obstacles where required for refinishing or making good of existing surfaces and replace as work progresses.

3.3.4 Set aside and safely store on-site items for relocation or reuse as shown on Drawings.

3.3.5 At end of each day's work, leave work in safe condition so that no part is in danger of trapping or falling.

3.3.6 Demolish in a manner to minimize dusting. To control dust, keep materials wetted or follow procedures as directed by Engineer.

3.3.7 Demolish masonry and concrete walls in pieces no larger than 250 mm x 250 mm. Dispose of all demolished materials off-site.

3.3.8 Demolish roof sections in large or whole sections to minimize the possibility of debris entering the primary tanks.

3.3.9 Do not sell or burn materials on site.

3.3.10 Notify Engineer if any hazardous material identified during work.

3.3.11 Cut off anchor bolts, reinforcement and structural steel 25 mm below final concrete surface and make good on completion to match existing finishes.

3.3.12 Use all necessary barriers and other protective measures to protect equipment and structures beyond work limits, from falling or flying debris.

3.3.13 Dismantle and remove any existing piping or equipment as is necessary for the performance of structural or piping alterations. Reinstate and make good to return facilities to condition prior to removal.

3.3.14 Cut existing pipelines in such a manner as to provide an approved joint. Provide flanges, fittings or other couplings as required to complete connection. Repair all linings and coatings on cut pipes.

3.3.15 Where existing piping or equipment is to be removed or relocated, remove all associated supports, anchorages, housekeeping pads and bases. Cut back embedded metal items 25 mm below final surface level. Patch and make good area to match existing facilities.

3.3.16 Where existing instruments or equipment is to be removed or relocated, remove all electrical lines/conduits back to source and make safe.

3.4 REMOVAL OPERATIONS

3.4.1 Carefully dismantle items containing materials for salvage. Reuse items as indicated on the Drawings. Stockpile salvaged materials not designated for re-use in the Work at locations indicated or as directed by the Engineer.

3.4.2 Remove items as indicated on the Drawings and as noted elsewhere in the Specifications.

3.4.3 Do not disturb items designated to remain in place.

3.4.4 Provide suppression of dust generated by the demolition and removal process.

3.4.5 Use equipment and methods of removal and hauling which do not tear, gouge, break or otherwise damage or disturb adjacent pavement or underlying granular material.

3.4.6 Removal of Pavements, Curbs and Gutters (if applicable)

(1) Provide suppression of dust generated by the removal process

(2) Square up adjacent surfaces to remain in place by saw cutting or other method approved by the Engineer

(3) Protect adjacent joints and load transfer devices

(4) Protect underlying and adjacent granular material

3.4.7 When removing asphalt pavement for subsequent incorporation into hot mix asphalt concrete paving, prevent contamination with base course aggregates.

3.4.8 When removing pipes under existing or future pavement area, excavate at least 300 mm below pipe invert.

3.4.9 Decommission water wells and monitoring wells in accordance with Provincial guidelines and regulations.

3.4.10 Seal pipe ends and walls of manholes or catch basins. Securely plug to form watertight seal.

3.4.11 Backfill in areas as indicated and in accordance with Section 02223.

3.5 RESTORATION

3.5.1 Restore areas and existing works outside areas of demolition to match conditions of adjacent, undisturbed areas.

3.5.2 Use soil treatments and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent watercourses or ground water.

3.6 SAFETY

3.6.1 Carry out demolition work in accordance with WorkSafeBC requirements.

3.6.2 Blasting operations are not permitted in the work area.

3.7 CLEAN UP

3.7.1 Ensure all haul routes are free from debris and dirt during and after construction activities, to the satisfaction of the Engineer.

3.7.2 Upon completion of the Work, remove debris, trim surfaces and leave work site clean.

3.7.3 Use cleaning solutions and procedures which are not harmful to health, are not injurious to plants, and do not endanger wildlife, adjacent watercourses or groundwater.

3.7.4 At end of each day's work, leave work in a safe condition so that no part is in danger of toppling or falling.

3.8 STORAGE AND HANDLING

3.8.1 All items identified for reuse are to be stored in an enclosed space, fully protected from weather, securely wrapped or crated with clear identification of contents, and in accordance with manufacturer/supplier requirements.

3.8.2 During transit from Site to approved storage facility, all items to be wrapped or crated with clear identification of contents, fully protected from weather.

3.8.3 Connection plates and fastening bolts to be separately wrapped or crated with clear identification of contents.

END OF SECTION

PART 1 GENERAL

1.1 SUMMARY

1.1.1 This section specifies requirements for:

(1) Excavation required for execution of the Work

(2) Excavation for trenches to install utilities, access road construction, and for existing pre-load removals

(3) Backfilling the excavations in the Work areas after completion of the Work

(4) Backfilling of utility trenches and other general excavations associated with the Work

(5) Excavation and offsite disposal of contaminated materials.

1.1.2 This section also specifies the requirements for any temporary utilities and yard piping to be installed in embankments.

1.2 RELATED SECTIONS

1.2.1 Section 02070 – Sitework Demolition and Removal.

1.3 REFERENCE STANDARDS

1.3.1 Industrial Health and Safety Regulations - WorkSafeBC

1.3.2 ASTM D698. Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3) (600 kN-m/m3) - Standard Proctor Maximum Dry Density

1.3.3 ASTM D4718. Standard Practice for Correction of Unit Weight and Water Content for Soils Containing Oversize Particles.

1.3.4 ASTM D1557. Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3) (2,700 kN-m/m3) - Modified Proctor Maximum Dry Density

1.3.5 ASTM D4318. Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.

1.3.6 ASTM D422. Standard Test Method for Particle-Size Analysis of Soils.

1.3.7 ASTM C136. Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

1.4 DEFINITIONS

1.4.1 Common Excavation: Excavation of materials of whatever nature, which are not included under the definition of rock material. Common excavation materials include dense tills, hardpan, cobbles and boulders, partially cemented materials, sand, silt, clay and frozen materials which can be ripped and excavated with heavy construction equipment.

1.4.2 Excavation: Excavation is generally defined as construction for structures, foundations, movement of stockpile and pre-load material, trenching for buried pipelines, concrete encased conduits, and for preparation of subgrades for access roads.

1.4.3 Over-excavation: Excavation below design elevation of bottom of specified bedding or structure as authorized by the Engineer of Record.

1.4.4 Rock Excavation:

(1) Rock is defined as all solid rock in the form of bedrock, masses, ledges, seams or layers and includes igneous rock of any type, conglomerate, sandstone or shale that requires breaking by hoe-ram chipping and blasting or other similar forms of breaking before excavation and removal.

(2) Rock does not include clay, sand, silt, glacial till-like soils, cobbles, boulders or soft weathered rock, or any other rock 5.0 MPa (R1) and below on the rock strength index.

(3) Rock does not include any rock that is sufficiently fragmented that it can be removed by an excavator, including large fragments that require some manipulation to remove.

(4) Rock includes boulders that are greater in volume than one (1) cubic metre and/or that protrude into the wall or bottom of the trench with a volume of at least one half (½) cubic metre.

1.4.5 Relative Compaction: Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698 or D1557, as applicable. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density in accordance with ASTM D4718, as determined by the Engineer.

1.4.6 Optimum Moisture Content: Determined in accordance with ASTMD698 or D1557, as applicable, specified to determine maximum dry density for relative compaction. Determine field moisture content on basis of fraction passing 19 mm (3/4 inch) sieve

1.4.7 Subgrade: Surface to which excavations are made for the purpose of construction as shown in the drawings. Subgrade as defined does not include additional depths of excavation that may be required or directed to obtain suitable prepared surface conditions.

1.4.8 Completed Course: A course or layer that is ready for next layer or next phase of Work.

1.4.9 Lift: Loose (uncompacted) layer of material.

1.4.10 Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

(1) 300 mm outside outermost edge at base of foundations or slabs.

(2) 300 mm outside outermost edge at surface of roadways or shoulder.

(3) 150 mm outside exterior at spring line of pipes or culverts.

1.4.11 Waste material: Excavated material unsuitable for use in Work or surplus to requirement.

1.4.12 Imported Material: Materials obtained from sources offsite, suitable for specified use.

1.4.13 Contaminated Materials: Materials excavated on site which do not meet the quality requirements for BC Contaminated Sites Regulation (CSR). Contaminated soils include those materials contaminated with chloride, sodium, hydrocarbons, and metals.

1.4.14 Contaminated Groundwater: Groundwater which includes metals, chlorides and other parameters which exceed the approved and working BC Water Quality Guidelines for the protection of Freshwater, Aquatic Life, and Metro Vancouver Sewer Use Bylaw 299.

1.4.15 Side slope: Slope in a fill area between the edge of the shoulder and the point where the slope either intersects original ground or a benching / berm.

1.4.16 Angle of Repose: Maximum angle, measured from horizontal, at which fill remains stable.

1.4.17 Travelled Roadways: Existing paved roads and road shoulders, sidewalks, paved or gravel walkways, or other gravel or paved surfaces used, or intended to be used, by vehicular or pedestrian traffic. The paved areas are to be considered to extend 300 mm beyond the edge of the road, back of curb, or sidewalk.

1.4.18 Untraveled Area: All areas not normally subjected to vehicle loading or pedestrian traffic and include open fields, easements, grassed boulevards, and landscaped areas. Topsoil: material capable of supporting good vegetative growth and suitable for use in top dressing, landscaping and seeding.

1.4.19 Unsuitable materials:

(1) Weak and compressible materials, organic soils, and peat under excavated areas.

(2) Frost susceptible materials under excavated areas.

(3) Contaminated soils

1.4.20 Unshrinkable fill or controlled density fill: very weak mixture of Portland cement, concrete aggregates and water that resists settlement when placed in utility trenches, and capable of being readily excavated. Unconfined compression strength of the unshrinkable fill or controlled density fill shall be less than 0.5 MPa (500 kPa) at 28 days.

1.5 TEMPORARY SHORING, BRACING, AND UNDERPINNING

1.5.1 Protect existing features in accordance with applicable regulations including WorkSafeBC regulations.

1.5.2 Design and supporting data to be submitted to the Engineer.

1.6 PROTECTION OF EXISTING FEATURES

1.6.1 Protect existing features in accordance with applicable regulations.

1.6.2 Existing buried utilities and structures:

(1) Size, depth and location of existing utilities and structures as indicated are for guidance only. Completeness and accuracy are not guaranteed.

(2) Prior to commencing excavation Work, notify applicable authorities having jurisdiction, establish location and state of use of buried utilities and structures. Confirm locations of buried utilities by careful test excavations.

(3) Maintain and protect from damage, water, sewer, gas, electric, telephone and other utilities and structures encountered as indicated.

(4) Where utility lines or structures exist in area of excavation, obtain direction of the Engineer and any governing authority before removing or re- routing.

(5) Record location of maintained, rerouted and abandoned underground lines.

(6) Confirm locations of recent excavations adjacent to area of excavation.

1.6.3 Existing buildings and surface features:

(1) Conduct condition survey of existing buildings, trees and other plants, lawns, fencing, service poles, wires, pavement, survey bench marks and monuments which may be affected by Work.

(2) Protect existing buildings and surface features from damage while Work is in progress. In event of damage, immediately advise the Engineer and make repair.

1.7 ADMINISTRATIVE REQUIREMENTS

1.7.1 Locate utilities and inspect the Work areas with Engineer prior to starting any excavation and trenching work at the site and confirm the limits of Work.

1.7.2 Coordinate the utilities relocation, removal, and protection work prior to starting any excavation or trenching work at the Work Site.

1.8 SUBMITTALS

1.8.1 Procedures: Section 01300

1.8.2 Equipment proposed for the fill and backfill operation, watering and compaction.

1.8.3 Permits for the transportation of material to and from Work Site. All payment necessary to obtain the permits shall be borne by the Contractor.

1.8.4 Provide Contaminated Soils Disposal Plan.

1.8.5 Provide groundwater treatment plan and drawings.

1.9 QUALITY CONTROL

1.9.1 Refer Section 01400 for general quality control requirements.

1.9.2 Provide adequate survey control to avoid unauthorized over-excavation. Any over-excavation not authorized by the Engineer shall be at Contractor expense. This shall include any backfilling to bring back to design grade.

1.9.3 Notify Engineer when:

(1) Backfilling operations begin or are resumed after a period of inactivity

(2) Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed

(3) Fill material appears to be deviating from Specifications

1.9.4 completion of the test dig. The contractor will allow for a minimum of 80 hours field investigation in his tender price.

PART 2 EXECUTION

2.1 GENERAL

2.1.1 Excavation Details:

(1) Locate existing buried services and utilities

(2) Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 50 mm, except

where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, bracing and supports, excavation shoring, dewatering systems, working space, and similar items, wherever applicable.

(3) Excavate with care adjacent to existing utilities, and pipelines. Support utilities and pipelines as required

(4) Excavate contaminated materials and dispose of materials in accordance with all BC Contaminated Sites Regulation requirements. The contractor will review previous environmental reports for the site to determine the appropriate fill disposal sites for excavated soils. The contractor will engage the services of a qualified contaminated sites professional to assist in preparation of the contaminated soil disposal plan.

2.1.2 Over / Unauthorized Excavation

(1) Do not over-excavate without written authorization of Engineer

(2) Remedy unauthorized excavation made to elevation below the specified grades at no cost to the Corporation and replace with Pit Run Gravel, Pit Run Sand, or River Sand backfill material

2.1.3 Keep prepared ground surfaces free of water, ice, snow, debris, and foreign material during placement and compaction of fill and backfill materials.

2.1.4 Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

2.1.5 Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.

2.1.6 Use equipment for backfilling and compaction that will not impose loads greater than those indicated in Contract Documents or damage the subgrade.

2.1.7 Tolerances:

(1) Final Lines and Grades: Within a tolerance of 50 mm unless dimensions or grades are shown or specified otherwise

(2) Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted

2.1.8 Remove concrete, masonry, demolished foundations and rubble and other obstructions encountered during excavation.

2.1.9 Excavation must not interfere with normal 45 degree splay of bearing from bottom of any footing.

2.1.10 Excavation and associated shoring to maintain the stability of adjacent structures throughout the period of construction.

2.1.11 For trench excavation, unless otherwise authorized by Engineer in writing, do not excavate more than 20 m of trench in advance of installation operations and do not leave open more than 10 m at end of day's operation.

2.1.12 Dispose of excess and unsuitable excavated material off site.

2.1.13 Do not obstruct flow of surface drainage or natural watercourses.

2.1.14 Earth bottoms of excavations to be undisturbed soil, level, free from loose, soft and organic matter.

2.1.15 Notify Engineer when soil at bottom of excavation appears unsuitable and proceed as directed by Engineer.

2.1.16 Remove unsuitable material from trench bottom to extent and depth as directed by Engineer.

2.1.17 Hand trim, make firm and remove loose material and debris from excavations. Where material at bottom of excavation is disturbed, compact foundation soil to density at least equal to undisturbed soil.

2.1.18 Remove and dispose of contaminated materials offsite at an approved disposal site. Provide documentation from a qualified professional to confirm material has been disposed of at an approved site.

2.2 STOCKPILING EXCAVATED MATERIAL

2.2.1 Do not stockpile excavated materials near or over existing facilities, adjacent property, completed Work and within a horizontal distance equal to the excavation depth, if weight of stockpiled material could induce excessive settlement.

2.3 BACKFILLING

2.3.1 Do not proceed with backfilling operations until Engineer has inspected and approved installations.

2.3.2 Areas to be backfilled to be free from debris, snow, ice, water and frozen ground.

2.3.3 Do not use backfill material which is frozen or contains ice, snow or debris.

2.3.4 Where clay subgrade soil is present, place the first lift of backfill 500 mm thick and compact using static rolling only.

2.3.5 Place backfill material in uniform layers not exceeding 150 mm compacted thickness up to grades shown. Compact each layer before placing succeeding layer.

2.3.6 Backfill for Yard Piping or Trenches: Place backfill above pipe surround, using fill types as shown, in uniform layers not exceeding 150 mm compacted thickness up to grades as shown on Drawings.

2.3.7 Backfill of excavations must be Pit Run Gravel, Pit Run Sand, or River Sand fill material or as specified on the Drawings.

2.3.8 Fill: Outside Influence Areas Beneath Structures, Tanks, Pavements, Curbs, Slabs, Piping, and Other Facilities: Unless otherwise shown, place Pit Run Gravel, Pit Run Sand, or River Sand fill as follows:

(1) Allow for 150 mm thickness of topsoil where required

(2) Maximum 300 mm thick lifts, except for first lift placed over clay subgrade soil (refer to 3.5.4 above)

(3) Place and compact fill across full width of embankment

2.3.9 Replacing Over-excavated Material: Replace excavation carried below subgrade lines shown or established by Engineer as follows:

(1) Beneath Fill or Backfill: Same material as specified for overlying fill or use Pit Run Gravel, Pit Run Sand, or River Sand backfill.

2.4 COMPACTION

2.4.1 Backfill in the Work Areas: Compact to 95 percent Maximum Proctor maximum dry density as determined in accordance with ASTM D1557 and D4718. If any two of the four most recent tests falls below 95 percent or any one of the four preceding tests falls below 94 percent, additional compactive effort will be required.

2.4.2 Fill (Excluding Preload and Stockpile): Compact to 95 percent Modified Proctor maximum dry density as determined in accordance with ASTM D1557 and D4718. If any two of the four most recent tests falls below 95 percent or any one of the four preceding tests falls below 94 percent, additional compactive effort will be required.

2.4.3 Trench Backfill: Compact backfill in accordance with Corporation Standard Trench Detail, included in Attachment.

2.4.4 Backfill Compaction for over excavation: Compact to a minimum dry density of 95 percent Modified Proctor corrected maximum dry density in accordance with ASTM D1557 and ASTM D4718.

2.4.5 Site Grading Material: Compact filled and disturbed areas to a density of not less than 95 percent Modified Proctor maximum dry density in accordance with ASTM D1557 and D4718.

2.5 SITE TESTING

2.5.1 Gradation:

(1) One sample from each 1,500 tonne of finished product or more often as determined by Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications

(2) If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken

(3) Remove material placed in Work that does not meet Specification requirements

2.6 SITE PREPARATION

2.6.1 Remove obstructions, ice or snow from surfaces to be excavated within limits shown.

2.6.2 Cut pavement or sidewalk neatly along limits of proposed excavation in order that surface may break evenly and cleanly.

2.7 LIMITATIONS ON EXTENT OF OPEN TRENCH

2.7.1 Following inspection of the pipe installation, bedding and backfilling is to be carried out promptly behind the pipe laying operation. At no time during the installation of a steel pipeline is there to be more than one length of pipe in the trench that has not been bedded and compacted to at least pipe springline. Similarly, for pipe of any other material, there is not to be more than two lengths in the trench that have not been bedded and compacted to at least 300 mm above the pipe crown.

2.7.2 At the end of each working day, ensure that the last pipe laid is bedded, at least to springline, and the previous pipe bedded to 300 mm above the crown.

2.7.3 All open trenches are to be barricaded, signed, and lit with warning lights at the end of each day.

2.7.4 Excavation, pipe laying, jointing, welding, and backfilling are to be properly coordinated to maintain an integral pipe installation operation.

2.8 DISPOSAL OF SPOIL

2.8.1 Dispose of excavated materials at an approved offsite disposal facility, which are unsuitable or exceed quantity needed for future fill or backfill, from the Work area excavations, road construction, staging areas, and any other excavation as part of this Contract.

2.8.2 Dispose of debris, piping, concrete, asphalt resulting from removal of underground facilities, demolition work at an approved offsite location. Dispose in accordance with appropriate regulations.

2.8.3 Transport disposal materials in tight bodied trucks (with tarp covers). Provide tire washing to prevent tracking of materials on to streets. Do not spill material on roads. Promptly clean up if such spill occurs.

2.9 FIELD QUALITY CONTROL

2.9.1 Procedures: Section 01400

2.9.2 Provide testing as required.

2.9.3 Inspection:

(1) Notify Engineer sufficiently in advance of operations, to provide field inspection

(2) On reaching specified excavation level, request an inspection of subgrade by the Engineer

(3) Provide facilities to enable proper inspection

2.10 DUST CONTROL

2.10.1 Throughout construction period, provide adequate dust control on the site and roads by watering or use of other accepted dust control materials.

2.10.2 Provide continuous control of dust from drifting or blowing.

2.10.3 Eliminate dust and dirt in areas where electrical equipment, metering instruments and similar equipment requiring interior cleanliness are being installed or assembled by providing temporary enclosures, covers for openings, or other means of protection.

2.11 RESTORATION

2.11.1 Upon completion of work, remove surplus materials and debris, trim slopes, and correct defects noted by Engineer.

2.11.2 Clean and reinstate areas affected by work as directed by Engineer.

END OF SECTION

DIVISION 3
CONCRETE

FORMWORK

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This section specifies requirements for concrete formwork, falsework and their accessories for concrete construction.

1.1.2 The Work includes design, construction, erection and removal of concrete formwork, falsework and accessories.

1.2 RELATED WORK

1.2.1 Section 01300 – Submittal Procedures

1.2.2 Section 03200 – Concrete Reinforcing

1.2.3 Section 03300 – Cast-In-Place Concrete

1.3 REFERENCE STANDARDS

1.3.1 Concrete Materials and Methods of Concrete Construction - CSA-A23.1.

1.3.2 Methods of Test for Concrete - CSA-A23.2.

1.3.3 Falsework for Construction Purposes - CSA-S269.1.

1.4 DESIGN

1.4.1 Design of concrete formwork and falsework are the responsibility of the Contractor.

1.5 SUBMITTALS

1.5.1 Submittals shall be in accordance with Section 01300 – Submittal Procedures.

1.5.2 Submit for review proposed curing procedures.

1.5.3 Submit for review proposed hoarding and heating methods for cold weather concreting.

PART 2 PRODUCTS

2.1 FORMS

2.1.1 Use material of suitable strength and quality to produce the specified surface finish.

2.1.2 Use forms which are watertight, unwarped, non-absorbent, and non-staining.

2.2 FORM TIES

2.2.1 Use only ties with ends removable to a distance of not less than 38 mm from the face of the finished concrete.

2.2.2 Form ties with a removable cone cast in the concrete shall produce a cone hole not more than 25 mm in diameter.

PART 3 EXECUTION

3.1 STRUCTURAL REVIEW

3.1.1 Notify the Engineer to permit review of formwork at least 48 hours before concreting. Review by Engineer of formwork shall be for conformance to project specifications, but not for structural strength and stability, which is the sole responsibility of the Contractor.

3.2 CONSTRUCTION AND CONTRACTION JOINT LAYOUTS

3.2.1 Construction and contraction joints shall be constructed where required as shown on the plans, as specified and/or according to CSA-A23.1. The Contractor shall prepare and submit for approval, a location diagram, and proposed details for all planned construction joints, and for layout of construction and contraction joints in slabs on grade, sidewalks and other concrete paved areas.

3.2.2 Clean all construction joint surfaces which will be inaccessible after the erection of formwork.

3.3 FORMS

3.3.1 Assemble and erect in accordance with the formwork design.

3.3.2 Allow for deflection of the formwork due to the weight of concrete.

3.3.3 Make all form joints watertight.

3.3.4 Make form surfaces smooth and flat.

3.3.5 Clean forms properly before assembling in position, and as necessary before concreting.

3.3.6 Oil or coat forms before assembly in final position.

3.3.7 Provide 20 mm chamfer at all exposed exterior corners with interior angle of 120 degrees or less.

3.3.8 Provide access for cleaning prior to concreting.

3.3.9 Do not use temporary removable spacers or blocks to support reinforcement or other items unless approved by the Engineer.

3.3.10 Finished concrete exhibiting evidence of excessive form displacement, and/or excessive deflection shall be cause for rejection of the Work and its removal and replacement at the Contractors own expense.

3.3.11 Obtain Engineer's approval before framing openings not indicated on drawings.

3.4 TOLERANCES

3.4.1 Construct formwork to maintain the tolerances of concrete work in Clause 10 of CSA-A23.1.

3.5 PLACING OF CONCRETE

3.5.1 Make a final inspection and ensure that forms are satisfactory, and no deleterious materials are present inside the area to be concreted.

3.5.2 Observe forms during concreting operations and correct any displacement of the form.

3.6 FORM REMOVAL

3.6.1 Remove forms so that no damage occurs to the concrete.

3.6.2 Consider the location, character of the structure, weather and other conditions influencing the curing of concrete, in determining the time for removal of forms. (Refer to Section 03300 – Cast-In-Place Concrete and CSA-A23.1).

3.6.3 Leave shores in place until concrete has attained sufficient strength to adequately support its own weight together with construction loads likely to be imposed.

3.6.4 Vertical Surfaces – minimum 24 hours provided curing is in accordance with Clause 21.

3.6.5 Other Surfaces - Until concrete has attained 2/3 of the specified 28-day strength, or to the Engineers approval.

3.6.6 Re-use of formwork and falsework subject to requirements of CSA-A23.1.

END OF SECTION

CONCRETE ACCESSORIES

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Include all concrete accessories required for construction of reinforced concrete elements including anchors, pins, plates, inserts, sleeves, etc. as shown on drawings.

1.1.2 Payment fabrication, procurement installation, including all material and labour, shall be considered incidental to concrete placement.

1.2 REFERENCE STANDARDS

1.2.1 Perform concrete accessories work in accordance with the following standards, except where specified otherwise. Provide one (1) copy on site of the first two (2) standards listed below:

(1) BCBC 2018, “British Columbia Building Code”.

(2) CSA-A23.1, “Concrete Materials and Methods of Concrete Construction”.

(3) CSA-A23.3, “Design of Concrete Structures”.

(4) CSA-A23.4, “Precast Concrete - Materials and Construction”.

(5) ACI 350R, “Environmental Engineering Concrete Structures”.

(6) American Society for Testing and Materials (ASTM) where noted.

(7) American Concrete Institute Detailing Manual (ACI 315) where noted.

(8) Provincial safety standards where applicable.

(9) Conform to applicable safety regulations for erection, maintenance and removal of formwork.

1.3 REGULATIONS

1.3.1 Abide by the current bylaws and regulations of the province, Town and/or Municipality in which the Work is located and abide by the current laws and regulations with regard to public safety.

1.3.2 The codes and regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers’ Compensation Board and other applicable acts administered by the authority having jurisdiction in the Province of British Columbia apply to the Work of this section.

1.4 SAFETY

1.4.1 Conform to good construction practice with regard to safety.

1.4.2 Carry out concrete accessories work in accordance with the British Columbia Building Code.

1.5 SUBMITTALS

1.5.1 Submit data on all concrete accessories specified or proposed.

1.5.2 Submit all proposed joint details, locations and construction procedures. Include waterstop, crack inducer, reglet, sealant and joint filler products as required.

1.5.3 Submit responses to all site review reports stating that all reported defects and deficiency items were corrected or stating what action was taken.

1.6 SHOP DRAWINGS

1.6.1 Submit shop drawings of all accessories where required in accordance with Section 01340 indicating where used and how accessories are to be placed.

1.6.2 Clearly indicate all pertinent dimensioning, arrangements and locations of concrete accessories.

1.7 SAMPLE PANELS

1.7.1 Provide concrete accessories for placement in a sample formwork panel for each architectural concrete surface receiving special treatment, painted finish or exposed finish as a result of formwork. Construct 2400 x 2400 in size to fully indicate special treatment or finish required, and include reglets, cone ties and tie pattern and other patterns detailed.

1.7.2 The approved sample concrete panels are to be considered a basis of quality for the accessory work. Locate where directed.

1.8 DELIVERY, STORAGE AND HANDLING

1.8.1 Deliver all materials to the site in bundles easily identified and properly marked.

1.8.2 Store and handle all material on site in a manner to prevent damage and contamination.

1.9 QUALITY CONTROL

1.9.1 The Contractor is not to assign the responsibility of coordination of concrete accessories and placing required material. Ensure a full-time qualified superintendent representing the Contractor is in attendance to inspect and check all phases of this Work.

1.10 INSPECTION AND TESTING OF DRILLED ANCHORS

1.10.1 The Contractor is to ensure drilled anchors are tested by a testing firm certified in accordance with CSA-A283.

1.10.2 An independent testing firm may be retained and paid for by the Owner and approved by the Owner's Representative in accordance with Section 01400 of this Specification.

1.10.3 The independent testing firm will only provide the minimum testing as required by the Owner and does not relieve the Contractor of his responsibilities to test all drilled anchors to ensure anchors conform to the requirements of the Contract Documents.

1.10.4 Provide casual labour to the testing firm's field personnel for the purpose of obtaining and handling sample materials. Provide free access to all portions of the Work and cooperate with the testing firm.

1.10.5 Test anchors to 150% of the greater tension working load indicated on the drawings or as specified by the Manufacturer.

1.10.6 The Contractor is to perform the following minimum testing:

(1) For 500 anchors or more, test 5% of anchors.

(2) For 100 to 499 anchors, test 7% of anchors.

(3) For 50 to 99 anchors, test 10% of anchors.

(4) For 20 to 49 anchors, test 14% of anchors.

(5) For 10 to 19 anchors, test 20% of anchors.

(6) For 1 to 9 anchors, test 33% of anchors.

1.10.7 Repair or replace anchors not meeting the specified requirements and re-test. Test up to ten (10) additional anchors where a failure occurs. Re-testing and additional testing, paid for by the Contractor.

1.10.8 The Contractor's testing firm is to submit to the Owner's Representative certified test results within two (2) days.

PART 2 PRODUCTS

2.1 CONCRETE ACCESSORIES

2.1.1 Expansion Joints: Eva-Cap.

2.1.2 Expansion Joint Compression Seals: Hydrozo Jeena Seal.

2.2 WATERSTOP

2.2.1 Waterstops: To CGSB 41-GP-35M. Purpose made polyvinyl chloride, minimum 14 MPa tensile strength, -50°C to 80°C working temperature range, 150 mm wide, center bulb, maximum possible lengths, profiled as indicated on the drawings. Use Durajoint Type 5, 5A, or Greenstreak No. 705 and 732.

2.3 BONDING AGENTS

2.3.1 Bonding agent:

(1) Two (2) or three- (3-) component modified epoxy resin. Use for construction joints in non-watertight structures and rock anchor recesses only.

(2) Use cementitious waterproofing for construction joints in liquid retaining structures such as tanks and channels and for dry areas below grade which are to be watertight.

2.4 SEALANTS

2.4.1 Joint Sealant: provide materials and sizes as shown on the Contract Drawings.

2.5 DRILLED ANCHORS

2.5.1 Drilled Anchors:

(1) Use type 316 grade B8M stainless steel Hilti HVA adhesive anchor unless otherwise noted on the drawings.

(2) Use type 316 grade B8M stainless steel anchor bolts or threaded rods, reinforcement dowels with Hilti HY150 grout or ITW Ceramic six (6) grout unless otherwise noted on the drawings. Use standard embedment depths per Hilti HY150 grouting system unless otherwise noted on the drawings.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Perform concrete accessories work in accordance with requirements of CSA-A23.1 unless indicated otherwise on the drawings.

3.2 FORMWORK ERECTION

3.2.1 Ensure that supplied accessories, hardware, and items to be cast-in will fit concrete dimensions.

3.2.2 Ensure concrete surfaces of construction joints are properly prepared for application of epoxy bonding agent or cementitious waterproofing immediately prior to placing fresh concrete. Use cementitious waterproofing in liquid retaining structures and dry areas below grade.

3.2.3 Provide continuous waterstop at all construction joints in liquid retaining structures and dry areas below grade structures with high ground water level to 600 mm above the liquid or ground water level and not less than the locations indicated on the drawings.

3.3 FORMING OF EXPOSED CONCRETE

3.3.1 The intent of this section is to ensure the accessories for formwork are of a high quality to result in concrete surfaces free of unsightly cold joints, blemishes, bugholes, honeycombing and cracking.

3.3.2 Allow Owner's Representative to inspect and approve accessories placed in formwork prior to placing concrete.

3.3.3 Ensure that reglets to be placed in formwork are acceptable for joint sealants.

3.3.4 Fill all exterior reglets in walls below grade and in liquid-retaining structures as indicated on the drawings with an approved cementitious waterproofing.

3.4 CONCRETE ACCESSORIES

3.4.1 Install all concrete accessories in accordance with drawings and Manufacturer's recommendations, straight, level and plumb. Ensure adequate support to prevent movement during concrete placement.

3.4.2 Install stair nosing centered on all concrete stairs in accordance with the Manufacturer's written recommendations.

3.4.3 Install waterstops continuous without displacing reinforcement. Do not nail through waterstops. Heat seal all joints watertight.

3.4.4 All joints except straight butt joints to be fabricated by the Manufacturer in the Manufacturer's shop.

3.4.5 Wire all waterstop to reinforcing to prevent folding during concrete placement.

3.5 PLACING CONCRETE

3.5.1 Ensure all accessories and hardware and all other items to be cast into concrete are placed securely and will not cause undue hardship in placing concrete.

3.5.2 Ensure all accessories and hardware, inserts, embedded parts, formed expansion and contraction joints and other critical items are not disturbed during concrete placement.

3.5.3 Ensure all waterstop is securely wired to reinforcing to prevent folding or movement during concrete placement. Maintaining the integrity and correct position of waterstop is critical to the performance of the structure.

3.6 CLEANING

3.6.1 Repair, remove and clean all drips and smears resulting from the Work of this section on exposed, finished surfaces or surfaces to be subsequently finished.

END OF SECTION

CONCRETE REINFORCING

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This section specifies requirements for the supply, fabrication and placing of reinforcing steel, including necessary supports, spacers, and related accessories.

1.2 RELATED WORK

1.2.1 Section 01300 – Submittal Procedures

1.2.2 Section 03150 – Concrete Accessories

1.2.3 Section 03200 – Concrete Reinforcing

1.2.4 Section 03300 – Cast-In-Place Concrete

1.3 REFERENCE STANDARDS

1.3.1 Concrete Materials and Methods of Concrete Construction CSA-A23.1.

1.3.2 Billet-Steel Bars for Concrete Reinforcement - CSA-G30.18.

1.3.3 CRSI Manual of Standard Practice.

1.4 SUBMITTALS

1.4.1 Submit certificates and mill tests for the material supplied as requested by the Engineer.

1.5 PRODUCT DELIVERY, STORAGE AND HANDILING

1.5.1 Ship bar reinforcement in standard bundles, easily identifiable and marked in accordance with the bar lists.

1.5.2 Store reinforcement to prevent deterioration or contamination by dirt, detrimental rust, loose scale, paint, oil or other foreign substances that will destroy or reduce bond.

1.5.3 Do not straighten or re-bend reinforcement in any manner.

1.5.4 Do not use bars kinked or bent by improper handling or storage.

PART 2 PRODUCTS

2.1 REINFORCING STEEL

2.1.1 Reinforcing steel to meet CSA-G30.12 as shown on drawings:

(1) All bars shall be 400 MPa grade

(2) Welded wire mesh is not permitted.

2.2 CHAIRS, BOLSTERS, BAR SUPPORTS, SPACERS

2.2.1 Provide adequate support of reinforcement (according to CRSI Manual of Standard Practice).

2.2.2 For exposed or architectural concrete surfaces use accessories which are plastic coated, stainless steel or as indicated on the drawings.

2.2.3 Precast concrete block supports must be equal in strength and quality to the concrete in the structure.

2.2.4 Chairs, bolster bar supports and spacers shall have sufficient strength to support the reinforcing under normal construction conditions. Brick shall not be used for bar supports.

2.3 FABRICATION

2.3.1 Fabricate reinforcing steel from bar sizes and grades indicated within the following tolerances:

(1) Sheared length: plus or minus 25 mm.

(2) Depth of truss bar: plus or minus 13 mm.

(3) Stirrups, ties and spirals: plus or minus 13 mm.

(4) Location of bends: plus or minus 25 mm.

2.3.2 Unless otherwise indicated, fabricate in accordance with CSA-A23.1.

PART 3 EXECUTION

3.1 STRUCTURAL REVIEW

3.1.1 Notify Engineer to permit review after placement is completed. Reinforcing for all concrete pours shall be reviewed after placing and prior to concreting.

3.1.2 Provide adequate notice of scheduled pours to facilitate review of reinforcement (minimum of 48 hours).

3.2 PLACING OF REINFORCEMENT

3.2.1 Place reinforcement as shown on the drawings and in accordance with CSA-A23.1.

3.2.2 Support reinforcement in position as follows:

(1) Laterally support reinforcement with supports in pairs on opposite faces.

(2) Do not use supports which will be forced into the supporting formwork or soil by the weight of the reinforcement or other construction loads.

(3) Separate layers of bars by precast mortar blocks, bars or equally suitable devices. Do not use pebbles, pieces of broken stone or brick, metal pipe or wooden blocks.

(4) Do not place bars on layers of fresh concrete as the Work progresses or install bars during placing of concrete.

3.2.3 Provide concrete cover as specified on drawings.

3.3 WELDING OF REINFORCMENT

3.3.1 Welding of reinforcing bars is not permitted.

3.4 SPLICING OF REINFORCEMENT

3.4.1 Splice bars only as shown on the drawings or approved by the Engineer.

3.4.2 Bar splices shall conform to CSA3-A23.3, Class B, unless noted.

3.5 DETAILS

3.5.1 Corner Bars: Install corners bars in walls, slab thickenings and beams to match the larger size of normal reinforcement unless otherwise noted on the drawings.

3.5.2 Openings in slabs or walls: Unless otherwise noted, install two (2) additional 15 M bars on all sides of every opening, one (1) near each concrete face or the number of bars intercepted, divided equally between the two (2) sides, whichever is greater. Bars to extend one (1) lap length past each side of the opening.

END OF SECTION

CAST IN PLACE CONCRETE

PART 1 GENERAL

1.1 INTENT

1.1.1 Requirements for the design and preparation of the concrete mix; handling; placing; finishing and curing of cast in place concrete.

1.2 REFERENCES

1.2.1 CSA-A23.1 - Concrete Materials and Methods of Concrete Construction.

1.2.2 CSA-A23.2 - Methods of Test for Concrete.

1.2.3 CSA-A5 - Portland Cement.

1.2.4 CSA A23.5 - Supplementary Cementing Materials.

1.2.5 CSA-A266.2 - Chemical Admixtures for Concrete.

1.2.6 CSA-A266.1 - Air-Entraining Admixtures for Concrete.

1.3 MATERIAL CERTIFICATION

1.3.1 Have available on-site one (1) copy of CSA-A23.1 and CSA-A23.2. These shall form the basis for acceptable standards of concrete practice and methods.

1.3.2 The Contractor will retain and pay for the services of an independent testing agency for on-site testing as follows:

(1) One (1) slump test and one (1) air content test per truckload of ready mix concrete.

(2) Concrete cylinder casting, curing and testing as specified below.

1.3.3 Allow for casual labour and expenses in conjunction with testing.

1.3.4 Concrete Cylinder tests:

(1) At least one (1) set of two (2) cylinders will be made for each of concrete placed, for each type of concrete mix.

(2) Cylinders shall be taken at the point of deposit of the concrete.

(3) Three (3) standard cylinders will be prepared and cured under laboratory conditions.

(4) One (1) cylinder from each test will be broken at seven (7) days and the remaining cylinders at 28 days.

(5) When there is a probability of temperatures falling below 5°C or rising above 27°C additional field cured cylinders will be prepared to verify that

adequate strength is attained. A minimum of 2 – 28 day samples must be field cured under similar temperature and humidity to the in-place concrete.

1.3.5 Test results shall be delivered directly from the test laboratory to the Engineer and to the Contractor.

1.3.6 Test reports shall include:

(1) project name

(2) date and time of sampling

(3) Supplier, truck and departure time

(4) specified strength and admixtures

(5) cement type

(6) exact location in structure

(7) slump and air content

(8) maximum aggregate size

(9) test strength and age at time of test

(10) date cylinder received by lab

(11) testing technician identification

(12) weather and temperature information

1.3.7 If any tests reveal concrete not meeting Specifications, the Engineer may enforce one (1) or more remedial procedures such as:

(1) change in mix design

(2) change in concrete Supplier

(3) additional testing by coring or impact hammer

(4) replacement of work

(5) other procedures as necessary

1.3.8 The costs of remedial work to bring concrete to meet specifications shall be borne by the Contractor.

1.3.9 The Owner may retain and pay for the services of an independent testing agency for testing for quality assurance for the Owner's purposes.

1.4 SCHEDULING OF WORK

1.4.1 Schedule work in accordance with the Owner to minimize interruptions to existing service.

1.4.2 The Owner to be notified 72 hours in advance to any interruption of service.

1.4.3 Do not interrupt water service for more than three (3) hours and confine this period between 10:00 and 16:00 local time unless otherwise authorized.

1.4.4 Notify fire department of any planned or accidental interruption of water supply to hydrants.

1.4.5 Provide "Out of Service" sign on hydrant not in use.

1.4.6 Advise local police department of anticipated interference with movement of traffic.

1.5 SUBMITTALS

1.5.1 Submit mix design and aggregate gradation curves for review at least ten (10) days in advance of concreting.

1.5.2 Submit samples of aggregates, water and cement to be used, to an approved testing agency, if required by the Engineer.

1.5.3 Submit schedule of proposed construction joints to the Engineer for review.

1.5.4 Submit mill certificates for cement and supplementary cementing materials required by Engineer.

PART 2 PRODUCTS

2.1 CEMENT

2.1.1 Conform to CSA-A5 Portland Cement.

2.2 WATER

2.2.1 Potable.

2.3 FINE AND COARSE AGGREGATES

2.3.1 Conforming to CSA-A23.1

2.4 AIR ENTRAINING MIXTURES

2.4.1 Air entrainment to CSA-A266.1.

2.4.2 No other air entraining mixture shall be used regardless of the type of cement selected, unless approved by the Engineer.

2.5 CHEMICAL ADMIXTURES

2.5.1 Conforming to CSA-A266.2.

2.5.2 Use only as approved by the Engineer.

2.6 VAPOUR BARRIER

2.6.1 0.10 mm polyethylene with 150 mm laps taped and sealed, except where noted otherwise on the drawings.

2.7 FLOOR HARDENER

2.7.1 Non-metallic floor hardener: premixed quartz aggregate coloured abrasion resistant hardener.

2.7.2 Products shall be as manufactured by Master Builders Co. Ltd. or approved equivalent alternate. Colour to be selected by the Engineer.

2.8 DOVETAIL ANCHOR SLOTS

2.8.1 Use 0.60 mm galvanized steel, insulation filled slots.

2.8.2 Use 0.65 mm thick galvanized sheet steel for reglets for flashing.

2.9 POZZOLANIC MINERAL ADMIXTURES

2.9.1 Conforming to CSA-A23.5.

2.9.2 Use only as approved by the Engineer.

2.10 FLYASH

2.10.1 Flyash may be used only on the approval of the Engineer.

2.10.2 Maximum cement replacement of 20%.

2.11 CONCRETE CURING COMPOUND

2.11.1 Chlorinated rubber type compound conforming to CSA-A23.1, Type 1.

2.11.2 On coloured floors, wax-free curing and sealing compound "Floor Coat" as manufactured by Master Builders Co. Ltd., or approved equivalent alternate.

2.11.3 Where topping or waterproofing is to be applied, ensure adequate surface preparation of the concrete for proper bonding. (Clause 21, CSA-A23.1)

2.12 EXPANDING GROUT

2.12.1 Premixed non-shrink, non-metallic aggregate, developing minimum compressive strength of 35 MPa at 28 days.

2.12.2 Use only as shown on the drawings or approved by the Engineer.

2.13 CONCRETE MIX REQUIREMENTS

2.13.1 Concrete mix requirements are indicated on the structural drawings.

2.14 MIXING

2.14.1 Ready-mixed concrete:

(1) Mix premixed or Transit-mixed concrete according to CSA-A23.1 and to ASTM-C94.

(2) Ensure that the concrete Supplier has sufficient plant capacity and transporting apparatus to provide delivery so that the interval between successive loads does not exceed 15 minutes.

2.14.2 Site-Mixed Concrete shall be in accordance with CSA-A23.1-M77.

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 The Engineer will inspect forms, foundations, reinforcing steel, construction joints, mixing, conveying and placing equipment before concreting.

3.1.2 Do not place concrete on soil that has been softened by mechanical disturbance or moisture.

3.1.3 Retighten forms at construction joints.

3.1.4 Thoroughly remove foreign matter and laitance from concrete.

3.1.5 Make suitable arrangements to prevent damage to fresh concrete by adverse weather conditions, such as rain, wind or extreme temperatures.

3.1.6 Concrete shall not be poured against frozen ground, frozen concrete or into frosted formwork.

3.1.7 Prepare all sleeves and ducts to be cast into concrete at the same time as the concrete formwork to ensure that correct assembly and fit is obtained.

3.1.8 Check civil, mechanical and electrical drawings for sleeves, inserts, etc.

3.1.9 Set sleeves, ties, anchor bolts, pipe hangers and other inserts and openings in concrete floors and walls as required.

3.1.10 Install continuous preformed vertical anchor slots to forms where masonry walls or partitions abut concrete vertical surfaces.

3.2 DELIVERY HANDLING AND STORAGE

3.2.1 Store all material in accordance with CSA-A23.1, Storage of Materials, except as otherwise noted.

3.2.2 Store each shipment of cement separately to provide access to identification and inspection of each shipment.

3.2.3 Clean stockpile areas of foreign materials.

3.2.4 Do not use stockpiled material within 150 mm of the ground surface if the stockpile is placed directly on the ground.

3.3 PLACING OF CONCRETE

3.3.1 According to CSA-A23.1, and as specified herein.

3.3.2 All formwork shall be cleaned of all debris, loose material, snow and ice immediately prior to pouring.

3.3.3 Ensure proper placement and support of reinforcement and embedded material immediately ahead of a pour.

3.3.4 Do not temporarily displace reinforcement for convenience in placing concrete.

3.3.5 Do not use wood for chairing reinforcing. No wood is allowed to be cast into concrete.

3.3.6 Do not insert reinforcement into fresh concrete.

3.3.7 Confine concrete in a suitable vertical drop pipe to within 1 m or less of the concrete in place.

3.3.8 Set screeds accurately for level surfaces or to maintain cambers as required.

3.3.9 Ensure that concrete is adequately consolidated in the forms.

3.3.10 Place concrete in such a manner that the concrete in the form is still plastic and can be integrated with fresh concrete.

3.3.11 To prevent segregation, deposit concrete in approximately horizontal layers of 300 mm to 450 mm thickness, as near as possible to its final position.

3.4 COLD WEATHER REQUIREMENTS

3.4.1 When the air temperature is at or below 5°C, or when there is a possibility of it falling to that limit within 24 hours of placing, the requirements according to CSA-A23.1 shall be met.

3.4.2 Calcium chloride to 1% may be used upon written approval of the Engineer.

3.4.3 Withdraw protection and heating gradually so that air temperature around the concrete does not drop more than 15°C per day.

3.4.4 Concrete shall be protected from alternate freezing and thawing for 14 days.

3.4.5 Provide enclosures for heating such that air circulation is maintained.

3.4.6 Frozen concrete will be rejected.

3.5 HOT WEATHER CONCRETE WORK

3.5.1 Hot weather shall be considered to be an air temperature of 27°C or greater.

3.5.2 Hot weather methods shall conform to CSA-A23.1.

3.5.3 The concrete temperature at the time of placing in hot weather shall not exceed those specified in CSA-A23.1. In the event that this limit is exceeded the concrete operations shall be suspended until the constituent materials of concrete are cooled.

3.5.4 Retarding admixtures shall be used only if approved by the Engineer prior to use in the concrete.

3.5.5 The use of ice may be required to lower the temperature of concrete for large pours.

3.6 JOINTS

3.6.1 Construction, and/or control joints shall be provided where required and as shown on the drawings or according to CSA-A23.1.

3.6.2 Carefully finish all face edges exposed to view true to line and elevation.

3.6.3 At water tight horizontal joints, apply the first layer of new concrete above the joint with an excess of mortar, obtained by omitting 20 to 50% of coarse aggregate from the normal mix.

3.6.4 Make all construction, or control joints in accordance with details shown on the drawings, layout to be submitted by Contractor for approval by Engineer.

3.6.5 See typical details for isolation joints at walls, and other locations.

3.6.6 Construction joint layouts shown on the drawings take precedence over above requirements.

3.7 GROUTING

3.7.1 Grout underside of steel columns and beam bearing plates with non-shrinking grout to Manufacturer's instructions.

3.8 VAPOUR BARRIER

3.8.1 Install vapour barrier under concrete slabs-on-grade inside building.

3.8.2 Lap vapour barrier minimum 150 mm at joints and seal with mastic cement.

3.8.3 Seal punctures in vapour barrier before placing concrete. Use vapour barrier material at least 150 mm larger than puncture and seal each patch with mastic cement.

3.9 FINISHING

3.9.1 To CSA-A23.1 and as specified herein:

(1) Ordinary surface finish.

(1) Use on concrete surfaces not exposed to view in the completed structure.

(2) Chip off fins and irregular projections.

(3) Patch honeycomb and fill tie holes with mortar containing approved bonding agent. Mix according to Manufacturer's directions.

(2) Rubbed finish.

(1) Use on formed concrete exposed to view in the completed structure.

(2) Remove fins and projections, patch honeycomb and fill tie holes as required.

(3) Saturate with water and rub with medium coarse carborundum stone using a small amount of cement-sand mortar.

(4) Continue rubbing until a uniform surface with no irregularities is obtained. Do not remove the paste produced by this rubbing.

(5) Carry out final rubbing with a fine stone and water.

(6) After the surface is dry, remove loose powder by rubbing with burlap.

(7) Leave final surface free from unsound patches, paste, powder and objectionable marks.

(3) Floated surface finish

(1) Strike off the compacted concrete to the cross section and elevation shown on the drawings. Keep a slight excess of concrete in front of the screed at all times.

(2) Obtain a uniform surface by floating as necessary. If floating is not completed before excess water appears at the surface, remove this water before continuing with floating.

(3) Add or remove concrete during floating as required to obtain a surface with no more than 3 mm deviation from the required surface in any 3 m length.

(4) Do not overwork the concrete surface. Float only enough to obtain a dense uniform surface.

(4) Broomed finish

(1) After completion of Article 3.9.1.3.4, broom to produce a non-slip surface with regular corrugations not more than 3 mm deep.

(5) Troweled finish

(1) After completion of Article 3.9.1.3.4, trowel to produce a dense smooth finish.

(6) Surface hardener

(1) Concrete floors shall be finished with floor hardener applied at a rate as recommended by the Manufacturer. Locations as shown on the drawings. Apply according to Manufacturer's instructions in conjunction with floating operations.

(2) Finish the floor to a hard dense surface free from pinholes, imperfections and trowel marks.

3.9.2 Areas which are exterior walkways, driveways or landings, shall receive a broomed non-slip surface.

3.10 CURING

3.10.1 Curing shall be according to CSA-A23.1 and as specified herein.

3.10.2 Prevent loss of moisture from concrete surfaces for at least seven (7) days after concreting.

3.10.3 Protect unformed surfaces as follows, subject to approval by the Engineer:

(1) Curing compound

(2) Waterproof covering

(3) Sprinkling or ponding

(4) Damp sand, burlap or other suitable material

3.10.4 Protect formed surfaces as follows, subject to approval by the Engineer:

(1) Leave forms in place and keep concrete wet by pouring water between concrete and forms.

3.10.5 Maintain concrete temperatures as recommended according to CSA-A23.1.

3.11 FORM REMOVAL

3.11.1 Forms shall not be removed until removal operations will cause no damage to concrete surfaces.

3.11.2 Beam soffit forms shall not be removed until sufficient strength has been attained for support of the applied dead and live loads and to minimize deflections.

3.12 PATCHING AND FINISHING OF HARDENED CONCRETE

3.12.1 Patching, if required and if allowed, shall be done immediately after stripping.

3.12.2 Methods of patching and repair shall be submitted to the Engineer and accepted before repair work is started.

3.12.3 All form ties shall be cut back a minimum of 25 mm and all tie holes shall be neatly patched and rubbed down.

3.13 DAMP PROOFING AND WATERPROOFING

3.13.1 Preparation of concrete surfaces for damp proofing and waterproofing shall conform to CSA-A23.1.

3.13.2 Application shall conform to Manufacturer's recommendations.

3.14 CONCRETE SPECIALITIES

3.14.1 Provide and install all concrete specialties as shown on the drawings and/or as necessary to complete the concrete work.

3.14.2 Included are fibreboard expansion joint covers, water stop and bond breakers.

END OF SECTION

DIVISION 5
METALS

PART 1 GENERAL

1.1 SUMMARY

1.1.1 Section includes: this section specifies supply and installation of structural steel.

1.1.2 Structural steel must be hot-dip galvanized where indicated on drawings or in other Specification Sections.

1.1.3 There are provisions in this Section that refer to fabricator design of components and connections. Where components and connections are detailed on the drawings, the components and connections must be fabricated as shown on the drawings and no fabricator design of these components and connections is required.

1.2 RELATED SECTIONS

1.2.1 Section 05500 – Metal Fabrication

1.2.2 Section 05600 – Miscellaneous Metal

1.3 REFERENCE STANDARDS

1.3.1 This Section incorporates by reference the following documents. They are part of this Section insofar as specified and modified herein. In the event of conflict between the requirements of this Section and those of a listed document, the requirements of this Section prevail.

1.3.2 BCBC 2018 – British Columbia Building Code.

1.3.3 NBC 2015 – National Building Code.

1.3.4 The Steel Construction Institute, Design Manual for Structural Stainless Steel.

1.3.5 ASTM A36, Standard Specification for Carbon Structural Steel.

1.3.6 ASTM A53, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.

1.3.7 CAN/CSA-S16.1 - Limit States Design of Steel Structures.

1.3.8 CAN/CSA-G40.20 - General Requirements for Rolled or Welded Structural Quality Steels.

1.3.9 CAN/CSA-G40.21 - Structural Quality Steels.

1.3.10 CAN/CSA-G164 - Hot Dip Galvanizing of Irregularly Shaped Articles.

1.3.11 CSA-W47.1 - Certification of Companies for Fusion Welding of Steel Structures.

1.3.12 CSA-W59 - Welded Steel Construction (Metal Arc Welding).

1.3.13 CSA-W178.1 - Certification of Welding Inspection Organizations.

1.3.14 CSA-W178.2 - Certification of Welding Inspectors.

1.3.15 CSA-W186 - Welding of Reinforcing Bars in Reinforced Concrete Construction

1.3.16 ASTM A108 - Specification for Standard Quality Cold Finished Carbon Steel Bars.

1.3.17 ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1.3.18 ASTM A193 - Specification for Alloy-Steel and Stainless Steel Bolting Material for High-Temperature Service.

1.3.19 ASTM A325 - High Strength Bolts for Structural Steel Joints Including Suitable Nuts and Plain Hardened Washers.

1.3.20 ASTM F593 - Stainless Steel Bolts, Screws and Studs.

1.3.21 ASTM A449 - Specification for Quenched and Tempered Steel Bolts and Studs.

1.3.22 ASTM A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot Dip Galvanized Coatings.

1.3.23 CGSB 1-GP-171M - Coating Inorganic Zinc.

1.3.24 SSPC SP2 - Hand Tool Cleaning.

1.3.25 SSPC SP6 - Commercial Blast Cleaning.

1.3.26 SSPC SP7 - Brush-Off Blast Cleaning.

1.4 SUBMITTALS

1.4.1 Procedures: Section 01300

1.4.2 Shop Drawings

(1) Clearly indicate sizes, spacing and locations of all structural members, connections and cambers.

(2) Indicate welded connections using standard welding symbols.

(3) Clearly indicate net weld lengths.

(4) Include the following on each shop drawing:

(a) Supplier/fabricator name

(b) project name

(c) contract number

(d) material weights and quantities

(e) material grade

(f) material coating

(g) bolt/anchor type

(5) Use welding symbols defined in CSA W59. Indicate corresponding weld procedure for each weld required for the drawings. Clearly indicate net weld lengths.

(6) On the shop drawings, clearly show method of torquing bolts.

(7) Prepare shop drawings of all connections and components designed by the fabricator under the seal and signature of Registered Professional Structural Engineer responsible for this design.

(8) Review of the shop drawings by the Engineer is intended as an assistance to the Contractor and does not relieve the Contractor of his or her responsibility for the completeness and accuracy of his or her Work and its conformance with the Contract Documents.

(9) Fabrication that commences prior to shop drawing review by the Engineer is at the risk of the Contractor.

1.4.3 Submit in writing evidence of qualification for welding under CWB. Submit calculations verifying design capacities prior to fabrication.

1.4.4 Submit evidence of ability to weld reinforcing steel in accordance with CSA-W186.

1.4.5 Contractor to collect and maintain records of Mill Test Certificates for all structural steel components, and when requested submit copies of Mill Test reports properly correlated to the materials used.

1.4.6 Prior to commencing Work, the Contractor's Registered Professional Engineer is to submit documentation showing evidence of registration in the province, plus qualifications and experience. The Contractor's Registered Professional Engineer is to further acknowledge in writing that he has reviewed the Contract Documents and is aware that he is to inspect the fabrication and installation of Work and certify the Work at completion.

1.5 QUALITY ASSURANCE

1.5.1 Qualifications

(1) The organization undertaking to weld under this section is to be fully approved by the Canadian Welding Bureau under the requirements of CSA-W47.1, Division 1 or 2.1 only. Division 3 qualification is not acceptable.

(2) Weld Inspection: The organization undertaking to perform weld inspection under this section is to be fully approved by the Canadian Welding Bureau under the requirements of CSA-W178.

Engage a Registered Professional Structural Engineer registered in the Province of British Columbia, fully qualified and experienced in the design of structural steel, connections, and welded components to be responsible for the design of specified steel components, connections, and welded components.

1.5.2 Quality Control

(1) The Contractor's Registered Professional Engineer responsible for the design of connections and other components is to inspect the fabrication and erection of these components in accordance with BCBC.

1.6 REGULATIONS

1.6.1 Abide by the current bylaws and regulations of the province and/or municipality in which the Work is located, and abide by the current laws and regulations with regard to public safety.

1.6.2 The regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers' Compensation Board and other applicable acts administered by the authority having jurisdiction of the province apply to the Work of this Section.

1.7 SAFETY

1.7.1 Carry out structural steel work in accordance with the British Columbia Building Code and current Occupational Health and Safety Act construction safety regulations.

1.8 DESIGN

1.8.1 Design components and connections in accordance with CAN/CSA-S16.1 to resist all loads and forces shown on the drawings and as noted below.

1.8.2 Design connections for wide flange beam and channel sections for a minimum force equal to one-half of the shear capacity of the web of the section with a minimum connection length of one-half the depth of the section.

1.8.3 Verification of design capacities by calculation to be made available on request.

1.8.4 Steelwork detailing and design shall be suitable for galvanizing or coating.

1.9 ACCEPTABILITY

1.9.1 Failure to comply with the requirements of this Section will result in the structure being considered potentially deficient.

1.9.2 Additional testing, inspection and evaluation may be required where evidence points to a potentially deficient structure.

1.9.3 Reinforce by additional construction or replace as directed by the Engineer at Contractor's expense all structure or material judged inadequate by structural analysis or by testing and inspection.

PART 2 PRODUCTS

2.1 MATERIALS / COMPONENTS

2.1.1 Structural steel members and plates:

(1) Wide flanges: CAN/CSA-G40.20, Grade 350W or ASTM International (ASTM) AA992 Grade 50.

(2) Tube shapes: CAN/CSA-G40.21, Grade 350W.

(3) Miscellaneous shapes: CAN/CSA-G40.21, Grade 300W.

(4) Galvanizing: CAN/CSA-G164.

(5) Minimum thickness of steel structural member is 6 mm.

2.1.2 Stainless Steel:

(1) Exterior, process areas, and submerged: American Iron and Steel Institute (AISI), Type 316/316L.

(2) Non-process interior areas: AISI, Type 304/304L.

2.1.3 Aluminum:

(1) Structural shapes, handrails, and plates: Alloy 6061-T6 or 6063-T6.

(2) Grating to be in accordance with American National Standards Institute (ANSI)/ National Association of Architectural Metal Manufacturers (NAAMM) Metal Bar Grating Manual.

(3) Checkered floor plates: Alloy 6061-T6.

2.1.4 Bolted Connections:

(1) Submerged: stainless steel Type 316.

(2) Inside enclosed tanks and channels: stainless steel Type 316.

(3) Splash zone (water level to 600 mm above the water level): stainless steel Type 316.

(4) Aluminum bolted connections are to be stainless steel Type 316 with isolation washers.

2.1.5 Anchor Bolts

(1) Anchor bolt holes in equipment support frames are not to exceed the bolt diameters by more than 25%, up to a limiting maximum oversizing of 6 mm. Minimum anchor bolt diameter is to be 12.7 mm. Anchor bolts for equipment mounting and vibration isolation systems shall be provided as specified in equipment specifications.

(2) Tapered washers are to be provided where mating surface is not square with the nut.

(3) Expansion, wedge, or adhesive anchors set in holes drilled in the concrete after the concrete is placed will not be permitted in substitution for cast-in anchor bolts, unless specifically approved by the Engineer.

(4) Upset threads are not permitted.

(5) The following materials are to be used:

Component	**Material**
Stainless Steel Anchor Bolts	ASTM A193, Grade B8M Class 1, AISI 316 or ASTM A320, Grade B8M Class 1, AISI 316
Stainless Steel Threaded Rods at Adhesive Anchors	ASTM F593 CW1 (1/4” to 5/8” Rod) ASTM F593 CW2 (3/4” to 1 ½” Rod)
Stainless Steel Nuts and Washers	ASTM A194 Grade 8M, SS316 Nuts with Type 316 SS Washers (ASTM F594 Group 2 Type 316 SS Nuts at Adhesive Anchors)
Carbon Steel Anchor Bolts	ASTM F1554 (Grade 36) – Hot Dip
High-Strength Carbon Steel Anchor Bolts	ASTM F1554 (Grade 55 Weldable per Supplementary Requirement S1) – Hot Dip Galvanized
Carbon Steel Nuts and Washers	ASTM A563 and ASTM F844
Concrete Expansion Anchors	Stainless Steel HILTI “KWIK BOLT TZ”
Concrete Adhesive Anchoring System	HILTI HIT-RE 500v3

2.2 ASSEMBLY / FABRICATION

2.2.1 Fabrication:

(1) Notify Engineer and inspection and testing firm a minimum of 48 hours prior to fabricating any steel to allow for inspection.

(2) Fabricate structural steel in accordance with CAN/CSA-S16.1, the Contract Documents, and the reviewed shop drawings.

(3) Verify dimensions of existing Work prior to commencing fabrication.

(4) Verify all drawing dimensions and conditions prior to commencing fabrication.

(5) Welding to conform to the requirements of CSA-W59. Do not splice materials without the written approval of the Engineer. Where granted, provide a complete non-destructive examination by a certified inspection and testing firm; method and firm to be approved by the Engineer. Contractor to pay for all inspection and testing. Show all approved spliced on the shop drawings.

(6) Accurately cut and mill column ends and bearing plates to assure full contact of bearing surfaces prior to welding.

(7) Seal all hollow structural sections with suitable cap plates or by welding all around to adjoining members.

(8) Provide 10 mm plate stiffeners each side of beam where continuous over supports.

(9) Provide 10 mm plate stiffener each side of beam at all bearing connections.

(10) Camber horizontal members to accommodate dead load deflection.

(11) Grind all welds smooth and grind all groove welds flush on exposed structural steel.

(12) Do not place any holes or openings in structural steel members. Where approval is granted, provide reinforcing plates around all openings to maintain design strength.

(13) Weld reinforcement where indicated. Weld in accordance with applicable requirements of CSA-W186. Do not weld reinforcing without written approval of the Engineer.

(14) Galvanize all structural steel components noted or specified to CAN/CSA-G164.

(15) Steel to be painted to have minimum edge radius of 2 mm.

2.3 MARKING

2.3.1 Mark materials to CISC Standard Code of Practice and CSA G40.20.

2.3.2 Shop mark materials for fit and match.

2.3.3 Place markings at locations not visible when erected.

2.3.4 Do not use die stamping.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL

3.1.1 Inspection and Testing

(1) Materials and workmanship are to be subject to inspection and testing by an inspection and testing firm certified in accordance with CSA-W178.1 in accordance with Section 01400.

(2) Provide access for inspection to all places where Work is being performed or stockpiled prior to shipment.

(3) Inspection and testing firm to test a minimum of one (1) in ten (10) welds. Testing of welds to include visual examination of all welding procedures at the plant and in the field, plus magnetic particle, x-ray or other means deemed necessary by the testing agency to permit certification of welds.

(4) Inspection and testing firm to inspect all bolts for fully-tightened high-strength bolted connections.

(5) Inspection and testing firm to inspect and verify one (1) coat paint, primer, zinc coat and galvanizing thickness.

(6) The Engineer may request additional testing of welds and bolts to ascertain the full amount of defects if the tests noted above indicate excessive deficiencies. Additional costs for extra testing to be borne by the Contractor.

(7) Pay for all costs for re-testing and re-inspection as a result of defective workmanship.

(8) Pay for all costs of repairs to correct defective Work.

(9) Inspection and testing firm to submit to the Engineer a final report certifying all welds and connections, including confirmation that required repairs have been completed. This report to be submitted under the seal and signature of Contractor's Registered Professional Structural Engineer registered in the Province of British Columbia and qualified to perform such Work.

(10) Notify Engineer and inspections and testing firm 48 hours prior to commencement of shop work for all testing and inspection.

3.2 CLEANING

3.2.1 Clean all structural steel surfaces to be galvanized sufficiently to accept hot dip zinc galvanizing. Use the following abrasive cleaning and/or chemical methods as required.

(1) Clean all structural steel surfaces of all material which cannot be cleaned by chemical methods. Use necessary blast methods in accordance with SSPC specifications to ensure base steel is thoroughly cleaned.

(2) Caustic cleaning: Use a hot alkali solution to remove organic contaminants such as dirt, paint markings, grease and oil from the metal surface.

(3) Pickling: Remove scale and rust from the steel surface by pickling in a dilute solution of hot sulfuric acid or ambient temperature hydrochloric acid.

(4) Fluxing: Use a fluxing method suitable for the galvanizing process to remove oxides and prevent further oxides from forming on the surface of the metal prior to galvanizing.

(5) Arrange for inspection of both cleaning and galvanizing.

3.3 ERECTION

3.3.1 Notify Engineer and inspection firm a minimum of 48 hours prior to erecting any structural steel to allow for inspection.

3.3.2 Erect structural steel as required for the drawings, CISC Standard Code of Practice and CAN/CSA-S16.1.

3.3.3 Make adequate provision for all erection loads and for sufficient temporary bracing to maintain structure safe, plumb and in true alignment until completion of erection and installation of necessary permanent bracing.

3.3.4 Do not field cut or alter structural members without the written approval of the Engineer. Report to the Engineer every failure of material to fit together properly. Corrective measures must be approved by the Engineer.

3.3.5 Set column base plates on steel wedges or shims to accurate elevations. Wooden wedges are not permitted.

3.3.6 Use the turn-of-nut method to pretension bolts used in slip critical connections and connections subject to impact or cyclic loads. Snug tighten bolts that are used in other connections.

3.3.7 Repair damaged galvanizing in accordance with ASTM A780 with zinc-rich paint such as Galvacon applied in multiple coats to a dry film thickness of 0.20 mm.

3.3.8 Remove protective coatings prior to field welding. After welding, re-coat to specified coating.

3.3.9 Columns:

(1) Roughen concrete surfaces in accordance with the grout Manufacturer’s recommendations prior to placing shims.

(2) Set column bases and base plates to the proper elevations on steel shims ready for grouting. Locate shims so they do not protrude past grouted surfaces.

(3) Clean underside of base plates before erection.

3.3.10 Clean erection marks, dirt, and debris from steel.

3.4 CERTIFICATION

3.4.1 Certify at the completion of Work, under the seal and signature of the Contractor's Registered Professional Engineer responsible for this Work, that all connections and components designed by the Contractor are capable of supporting the loads and forces indicated in the Contract Documents drawings and that all connections and components are fabricated and installed in accordance with the reviewed shop drawings.

END OF SECTION

PART 1 GENERAL

1.1 RELATED REQUIREMENTS

1.1.1 Section 03300 – Cast-In-Place Concrete

1.2 REFERENCES

1.2.1 AMERICAN SOCIETY FOR TESTING AND MATERIALS INTERNATIONAL, (ASTM):

(1) ASTM A53/A53M-18, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.

(2) ASTM A123/A123M-17, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

(3) ASTM A153/A153M-16a, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

(4) ASTM A269/A269M-15a, Standard Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

(5) ASTM A276/A276M-17, Standard Specification for Stainless Steel Bars and Shapes.

(6) ASTM A307-14e1, Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60,000 PSI Tensile Strength.

(7) ASTM A570-79, Standard Specification for Hot-Rolled Carbon Steel Sheet and Strip, Structural Quality (Withdrawn).

(8) ASTM A591/A591M-98, Standard Specification for Steel Sheet, Electrolytic Zinc-Coated, for Light Coating Weight [Mass] Applications (Withdrawn 2005).

(9) ASTM A653/A653M-17, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.

(10) ASTM A666-15, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.

(11) ASTM A780/A780M-09(2015), Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

(12) ASTM B221-14, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

(13) ASTM B221M-13, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric).

(14) ASTM B632/B632M-18, Standard Specification for Aluminum-Alloy Rolled Tread Plate.

(15) ASTM F593-17, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.

(16) ASTM F3125/F3125M-15a, Standard Specification for High Strength Structural Bolts, Steel and Ally Steel, Heat Treated, 120 ksi (830 MPa)

and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions.

1.2.2 Canadian Standards Association (CSA International):

(1) CAN/CSA G40.20-13/G40.21 13(R2018), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel. Includes Update No. 1 (2014).

(2) CAN/CSA G164 18, Hot Dip Galvanizing of Irregularly Shaped Articles.

(3) CSA G189-1966(R2003), Sprayed Metal Coatings for Atmospheric Corrosion Protection.

(4) CSA S16-14, Design of Steel Structures.

(5) CSA W47.1-09 (R2014), Certification of Companies for Fusion Welding of Steel.

(6) CSA W48 18, Filler Metals and Allied Materials for Metal Arc Welding.

(7) CSA W55.3-08(R2013), Certification of companies for resistance welding of steel and aluminum.

(8) CSA W59 18, Welded Steel Construction.

(9) CSA W178.1-18, Certification of Welding Inspection Organizations.

(10) CSA W178-02-18, Certification of Welding Inspectors.

1.2.3 National Association of Architectural Metal Manufacturers (NAAMM):

(1) NAAMM AMP 555 92, Code of Standard Practice for the Architectural Metal Industry (Including Miscellaneous Iron).

1.2.4 The Environmental Choice Program:

(1) UL 2768, Architectural Surface Coatings.

(2) UL 2760, Surface Coatings - Recycled Water Borne.

1.3 ACTION SUBMITTALS / INFORMATIONAL SUBMITTALS

1.3.1 Submit product data in accordance with Section 01300 – Submittals:

(1) Submit Manufacturer's printed product literature, Specifications and data sheets.

(2) Provide one (1) electronic copy of WHMIS MSDS (Material Safety Data Sheets) in accordance with WHMIS acceptable to Labour Canada, and Health and Welfare Canada and indicate VOC content for:

(a) Finishes, coatings, primers and paints.

1.3.2 Submit shop drawings in accordance with Section 01300 – Submittals:

(1) Indicate materials, core thicknesses, finishes, connections, joints, method of anchorage, number of anchors, supports, reinforcement, details, and accessories.

(2) For items where design is delegated to fabricator, provide shop drawings signed and sealed by the Contractor's Registered Professional Engineer registered in Province of Work, responsible for the design.

1.4 QUALITY ASSURANCE

1.4.1 Test Reports: Certified test reports showing compliance with specified performance characteristics and physical properties.

1.4.2 Certificates: Product certificates signed by Manufacturer certifying materials comply with specified performance characteristics and criteria and physical requirements.

1.4.3 Detail and fabricate metal fabrications in accordance with the NAAMM AMP 555.

1.4.4 Perform Work to the highest standard of modern shop and field practice, by personnel experienced in this Work. Accurately fit joints and intersecting members in true planes with adequate fastening. Build and erect the Work plumb, true, square, straight, level, accurate to the sizes shown, and free from distortion or defects.

1.4.5 Fabricator Qualifications: A firm experienced in producing metal fabrications similar to those indicated for this Project and with a record of successful in service performance, as well as sufficient production capacity to produce required units.

1.4.6 Welding: Qualify procedures and personnel according to the following:

(1) Welders shall be qualified by Canadian Welding Bureau for classification of Work being performed.

(2) The fabricator shall be certified to CSA W47.1, Division 1 or 2.1.

(3) Do welding inspection to CSA W178.

(4) Resistance welding: to CSA W55.3.

(5) Fusion welding: to CSA W59.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Exercise due care in storing, handling and erecting all materials and support all materials properly at all times so that no piece will be bent, twisted or otherwise damage structurally or visibly.

1.5.2 Correct damaged material and where the Consultant deems damage irreparable, replace the affected items.

1.5.3 Apply protective covering to face of all exposed finished metalwork before it leaves shop, covering to remain until item installed.

1.5.4 Fabricate large assemblies so they can be safely and easily transported and handled to their place of installation.

1.6 WASTE MANAGEMENT AND DISPOSAL

1.6.1 Separate and recycle waste materials.

1.7 SITE CONDITIONS

1.7.1 Coordinate this Work with the remainder of the Work and exercise the necessary scheduling to ensure that all Work is carried out and all items incorporated during the appropriate construction phase.

1.7.2 Provide instructions and drawings to other trades for setting bearing plates, anchors blots, and other members that are built in to work of other trades.

1.7.3 Protect other Sections of the Work from damage by this Section of the Work.

PART 2 PRODUCTS

2.1 MATERIALS

2.1.1 Steel sections and plates: to CAN/CSA G40.20/G40.21, Grade 300W.

2.1.2 Hollow Structural Sections: In accordance with CAN/CSA G40.20/G40.21, Grade 350W, Class C.

2.1.3 Steel pipe: to ASTM A53/A53M, standard weight (Schedule 40), unless another weight is indicated or required by structural loads, black finish.

2.1.4 Welding materials: to CSA W59.

2.1.5 Welding electrodes: to CSA W48 Series.

2.1.6 Fasteners: Bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws, and machine bolts.

(1) Unfinished fasteners: In areas not exposed to public, use unfinished bolts conforming to ASTM A307, Grade A, with hexagon heads and nuts. Supply bolts of lengths required to suit the thickness of the material being joined, but not projecting more than 6 mm beyond nut, without the use of washers.

(2) Finished fasteners:

(a) In areas exposed to public use, bolts, nuts, washers, rivets, lock washers, anchor bolts, machine screws and machine bolts to be hot dip galvanized in accordance with ASTM A153/A153M or CAN/CSA-G164.

(b) For joining stainless steel components use stainless steel fasteners of same type.

2.1.7 Structural bolts: to ASTM F3125.

2.1.8 Stainless steel fasteners, washers and nuts: to ASTM F593, 18-8 austenitic stainless steel (Grade 8 - B8/B8A), sized as required for purpose intended, or as otherwise indicated. Cold finished: Condition B, cold worked, per ASTM A276.

2.1.9 Aluminum Extrusions: ASTM B221/B221M, alloy 6063 T6.

2.1.10 Aluminum Alloy Rolled Tread Plate: ASTM B632/B632M, alloy 6061 T6.

2.1.11 Aluminum sheet: proprietary utility sheet, thickness as indicated, finish as directed.

2.1.12 Grout: non shrink, non metallic, flowable, 15 MPa at 24 hours.

2.2 FABRICATION

2.2.1 Fabricate work square, true, straight and accurate to required size, with joints closely fitted and properly secured.

2.2.2 Use self tapping shake proof flat, round, or oval headed screws on items requiring assembly by screws or as indicated.

2.2.3 Where possible, fit and shop assemble work, ready for erection.

2.2.4 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush. Seal exterior steel fabrications to provide corrosion protection in accordance with CAN S16.

2.2.5 Welding is to conform to CSA W59 and the fabricator certified to CSA W47.1. Include for welding inspection in the Contract.

2.2.6 File or grind all exposed welds smooth and flush. Repair or fill all pits, cracks and holes. Grind and polish all handrails to a smooth, even surface. Smooth all inside corners, returns.

2.2.7 Insulate when necessary to prevent electrolysis due to metal-to-metal contact or metal to masonry or concrete contact. Use bituminous paint or other approved method.

2.2.8 Provide fastenings, including anchor bolts, bolts, lag screws, expansion bolts, straps, brackets, etc. required for the fabrication and erection of Work of this Section.

2.3 FINISHES

2.3.1 Prior to priming steel, prepare all surfaces in conformance with SSPC SP 3 – Power Tool Cleaning for non-exposed locations and SSPC SP 5 – White metal Blast Cleaning for exposed architectural finished locations.

2.3.2 Hot dip galvanizing: galvanize steel, where indicated, to ASTM A123, minimum zinc coating of 600 g/m². (Severe, unprotected exposures).

2.3.3 Electrolytic galvanizing: galvanize steel, where indicated, to ASTM A591, minimum zinc coating of 180 g/m². (Non severe, unprotected exposures).

2.3.4 Wipe coat galvanizing: galvanize steel, where indicated to CSA G189, minimum zinc coating of 75 g/m^2. (Non severe, protected exposures).

2.3.5 Shop Primers: Provide primers that are compatible with paint systems specified.

2.3.6 Touch up galvanized surfaces with zinc rich coating, to ASTM A780: DOD P 21035 zinc rich paint, minimum DFT 8 mils.

2.3.7 Zinc Rich Paint: Conforming to DOD P 21035 zinc rich paint.

(1) Clean metal to equivalent of commercial sand blast SSPC SP6, remove sandblast in residue.

(2) Apply one (1) coat of zinc rich paint to surfaces exposed after assembly to minimum dry film thickness of 60 um (2.5 mil). Apply coating immediately after cleaning and over primer.

2.3.8 Isolation Coating: Apply an isolation coating to contact surfaces in contact with cementitious materials, wood materials and dissimilar metals except stainless steel.

2.3.9 Clear Anodized: Exposed aluminum surfaces shall be Aluminum Association (AA) Architectural Class I, AA M12C22A41.

2.3.10 Chromium plating: chrome on steel with plating sequence of 0.009 mm thickness of copper 0.010 mm thickness of nickel and 0.0025 mm thickness of chromium.

2.4 ROUGH HARDWARE

2.4.1 Furnish bent or otherwise custom fabricated bolts, plates, anchors, hangers, dowels, and other miscellaneous steel and iron shapes as required. Fabricate items to sizes, shapes, and dimensions required.

2.5 MISCELLANEOUS FABRICATIONS

2.5.1 Miscellaneous Framing and Supports: Provide steel framing and supports for applications indicated that are not a part of structural steel framework, as required to complete Work.

2.5.2 Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates, and steel bars of welded construction using mitred joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

2.5.3 Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish inserts if units must be installed after concrete is placed.

2.5.4 Miscellaneous Steel Trim: Provide shapes and sizes indicated for profiles shown. Unless otherwise indicated, fabricate units from structural steel shapes, plates, and steel bars, with continuously welded joints and smooth exposed edges. Use concealed field splices wherever possible. Provide cutouts, fittings, and anchorages as required for coordination for assembly and installation with other Work.

2.6 PIPE RAILINGS

2.6.1 Steel pipe: formed to shapes and sizes as indicated.

2.6.2 Galvanize pipe railings after fabrication.

2.7 ACCESS LADDERS

2.7.1 Construct access ladders in accordance with local OH&S safety codes.

2.7.2 Side Rails: Nominal 65 mm x 10 mm at 450 mm O/C, extend side rails to 1200 mm above upper surface, loop and return side rails for roof access ladders.

2.7.3 Rungs: Nominal 21 mm diameter rungs shouldered and welded at 300 mm O/C maximum, rungs starting at 300 mm maximum above lower entry level or roof surface, finished with acceptable non slip tread surface.

2.7.4 Ladder Mounts: Nominal 65 mm x 10 mm brackets at maximum spacing of 3050 mm with support at the top of the side rails, and centreline of rungs at 150 mm from the wall face.

2.7.5 Safety Extension: Install telescoping ladder extension to top two (2) ladder rungs in accordance with Manufacturer's written instructions for roofs penetrating roof access hatches.

2.7.6 Provide safety cage as specified.

2.7.7 Usage Classification: Service.

2.7.8 Finish: Galvanized.

2.8 CHANNEL FRAMES

2.8.1 Fabricate frames from steel, sizes of channel and opening as indicated.

2.8.2 Weld channels together to form continuous frame for jambs and head of openings, sizes as indicated.

2.8.3 Weld steel strap anchors to channel jamb frame at centres as required.

2.8.4 Finish: galvanized.

2.9 PIPE BOLLARDS

2.9.1 Fabricate pipe bollards from Schedule 40 steel pipe.

2.9.2 Concrete Fill: comply with requirements of Section 03300.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Install Work in accordance with Manufacturer's/fabricator's written instructions and Contract Documents.

3.1.2 Do welding work in accordance with CSA W59 unless specified otherwise.

3.1.3 Supply finished items to be built into those trades along with instructions for proper installation.

3.1.4 Apply architectural metal work using hidden mechanical fasteners. Installation shall be by skilled architectural metal workers experienced in highest quality work.

3.1.5 Fasteners to draw adjoining sections together in proper, true alignment, and are capable of field adjustment.

3.1.6 All fasteners, mountings to be non-loosening and installed so that they will be hidden at completion.

3.1.7 Install all Work to true, straight lines, accurate to profile, all properly aligned.

3.1.8 Isolate dissimilar metals in a manner approved by the Consultant to prevent electrolytic action or corrosion.

3.1.9 Install finish hardware supplied under other Sections required for completion of components of this Section.

3.1.10 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.

3.1.11 Provide suitable means of anchorage acceptable to Consultant such as dowels, anchor clips, bar anchors, expansion bolts and shields, and toggles.

3.1.12 Make field connections with high tensile bolts to CSA S16 and weld to prevent loosening.

3.1.13 Hand items over for casting into concrete or building into masonry to appropriate trades together with setting templates.

3.1.14 Touch up rivets, field welds, bolts and burnt or scratched surfaces after completion of erection with primer.

3.1.15 Repair galvanized areas damaged by welding, flame cutting or during handling, transport or erection in accordance with ASTM A780. Touch up with organic zinc rich paint to DOD P 21035 zinc rich paint, minimum DFT 8 mils.

3.2 PIPE RAILINGS

3.2.1 Install pipe railings to stairs.

3.2.2 Set railing standards in concrete.

3.3 ACCESS LADDERS

3.3.1 Install access ladders in locations as indicated.

3.4 CHANNEL FRAMES

3.4.1 Install steel channel frames to openings as indicated.

3.5 PIPE BOLLARDS

3.5.1 Anchor bollards in place with concrete footings. Support and brace bollards in position in footing excavations until concrete has been placed and cured.

3.5.2 Fill bollards solidly with concrete, mounding top surface.

3.6 MISCELLANEOUS ITEMS

3.6.1 Provide steel angle frame, hanging rods and bracing for supporting bulkheads and shelving.

3.6.2 Provide bracket backing supports for vanities.

3.6.3 Steel angle masonry supports as detailed.

3.6.4 Supply and install miscellaneous metal items as indicated or specified, or as otherwise required for a complete job, in accordance with the design intent of the project.

3.7 CLEANING

3.7.1 Perform cleaning after installation to remove construction and accumulated environmental dirt.

3.7.2 Upon completion of installation, remove surplus materials, rubbish, tools and equipment barriers.

END OF SECTION

MISCELLANEOUS METAL

PART 1 GENERAL

1.1 SCOPE OF WORK

1.1.1 Provide and install all miscellaneous metal shown or otherwise described on drawings including stairs, railings, frames, etc. Contractor to note that some steel may require removal and reattachment during construction.

1.2 REFERENCE STANDARDS

1.2.1 Perform miscellaneous metal work in accordance with the following standards, except where specified otherwise.

1.2.2 Provide one (1) copy on site of the first two (2) standards listed below:

(1) BCBC 2018, British Columbia Building Code.

(2) CSA-G40.20-04, General Requirements for Rolled or Welded Structural Quality Steels.

(3) CSA-G40.21-04, Structural Quality Steels.

(4) CAN/CSA-G164, Hot Dip Galvanizing of Irregularly Shaped Articles.

(5) CAN/CSA-S16.1, Limit States Design of Steel Structures.

(6) CSA-W47.1-03 (R2008), Certification of Companies for Fusion Welding of Steel Structures.

(7) CSA-W59-03 (R2008), Welded Steel Construction (Metal Arc Welding).

(8) CSA-W59.3, Resistance Welding Qualification Code for Fabricators of Structural Members Used in Buildings.

(9) CSA-W178.1-08, Certification of Welding Inspection Organizations.

(10) CSA-W178.2-08, Certification of Welding Inspectors.

(11) CSA-W48-06, Filler Metals and Allied Materials for Metal Arc Welding.

(12) CSA-W55.3-08, Certification of companies for resistance welding of steel and aluminum.

(13) CSA-W186, Welding of Reinforcing Bars in Reinforced Concrete Construction.

(14) ASTM A108-07, Specification for Standard Quality Cold Finished Carbon Steel Bars.

(15) ASTM A193, Specification for Alloy-Steel and Stainless Steel Bolting Material for High-Temperature Service.

(16) ASTM A194/A194M-08b, Standard Specification for Carbon and Alloy Steel Nuts for Bolts for High-Pressure or High-Temperature Service, or Both.

(17) ASTM A325-09, Standard Specification for Structural Bolts, Steel, Heat Treated, 830 MPa ksi Minimum Tensile Strength.

(18) ASTM A449, Standard Specification for Quenched and Tempered Steel Bolts and Studs.

(19) ASTM A563M-07, Standard Specification for Carbon and Alloy Steel Nuts [Metric].

(20) ASTM A563-07, Standard Specification for Carbon and Alloy Steel Nuts.

(21) ASTM A780-01 (R2006), Repair of Damaged Hot-Dipped Galvanized Coatings.

(22) CISC/CPMA 1-73a, Structural Steel One-Coat Paint.

(23) CISC/CPMA 2-75, Structural Steel Primer.

(24) CAN/CGSB-1.40-97, Anticorrosive Structural Steel Alkyd Primer.

(25) CAN/CGSB-1.71, Inorganic Zinc Coating.

(26) CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

(27) SSPC SP2, Hand Tool Cleaning.

(28) SSPC SP5, White Metal Blast Cleaning.

(29) SSPC SP6, Commercial Blast Cleaning.

(30) SSPC SP7, Brush-Off Blast Cleaning.

1.3 REGULATIONS

1.3.1 Abide by the current bylaws and regulations of the province and/or municipality in which the Work is located and abide by the current laws and regulations with regard to public safety.

1.3.2 The codes and regulations of the Minister of Labour, Occupational Health and Safety Act, the Workers' Compensation Board and other applicable acts

administered by the authority having jurisdiction in the Province of British Columbia apply to the Work of this Section.

1.4 SAFETY

1.4.1 Conform to good construction practice with regard to safety.

1.4.2 Carry out miscellaneous metal work in accordance with the British Columbia Building Code.

1.5 QUALIFICATIONS

1.5.1 The organization undertaking to weld under this Section is to be fully approved by the Canadian Welding Bureau under the requirements of CSA-W47.1, Certification of Companies for Fusion Welding of Steel Structures, Division 1 or 2.1 only, or CSA Standard W55.3, Resistance Welding Qualification Code for Fabricators of Structural Members, or both, as applicable.

1.5.2 Welding of steel is to be as per CSA-W59. Welding of aluminum to be as per CSA-W59.2.

1.5.3 Welding Inspection: The organization undertaking to perform weld inspection under this Section is to be fully approved by the Canadian Welding Bureau under the requirement of CSA-W178.

1.5.4 Engage a Registered Professional Structural Engineer registered in the Province of British Columbia, fully qualified and experienced in the design of structural steel, connections and welded components to be responsible for the design of specified steel components, connections and welded components.

1.6 DESIGN

1.6.1 Design components and connections in accordance with the ABC and CAN/CSA-S16.1 to resist all loads indicated on the drawing or as specified.

1.6.2 Except where members are specifically sized on the drawings, all stairs and landing sections, attachments and connections are to be designed to support a minimum live load of 4.8 kN/m^2.

1.6.3 Connections:

(1) Connection Design: to CAN/CSA-S16 to resist all loads and forces shown on the drawings and as noted below.

(2) Provide bolted or welded connections, unless shown otherwise on drawings.

(3) Use high strength bolts, except that A325 bolts may be used for connections of roof purlins, bridging, girths and trimmer beams not connecting to columns, unless otherwise noted on drawings.

(4) Use slip resistant [friction–type] connections for bolted joints designed to resist reversible forces, impact loads, seismic or wind loads, crane loads, tension loads and oversized and slotted holes not designed for movement.

1.6.4 Beam Connections

(1) Design components and connections in accordance with CAN/CSA-S16.1 to resist all loads and forces shown on the drawings and as noted below.

(2) Design connections for wide flange beams, channel sections and horizontal hollow structural steel sections for a minimum force equal to one-half ($^1/_2$) of the shear capacity of the web of the section with a minimum connection length of one-half ($^1/_2$) the depth of the section.

(3) Provide flexible beam connections for unrestrained members in accordance with CSA S16.1, unless shown otherwise on drawings.

(4) Select connections, wherever possible, from standard designs tabulated in current edition of CISC Handbook of Steel Construction, except that length of beam web angles are not to be less than half the depth of beam, and single angles are not to be used for beams deeper than 600 mm.

(5) Provide direct connections to flanges of spandrel beams for interior and exterior perimeter beams to restrain twisting but maintain flexibility in primary plane of bending.

1.6.5 Bracing and stability systems shown on structural drawings are for stability of the completed structure and are not to be assumed as adequate for various stages of construction.

1.6.6 Verification of design capacities by calculation to be made available to the Owner's Representative.

1.7 SUBMITTALS

1.7.1 Submit in writing evidence of qualification for welding under CWB.

1.7.2 Submit evidence of ability to weld reinforcing steel in accordance with CSA-W186.

1.7.3 Submit design calculations sealed and signed by a Registered Professional Structural Engineer registered in the Province of British Columbia.

1.7.4 Prior to commencing Work, the Contractor's Registered Professional Engineer is to submit documentation showing evidence of registration in the province, plus qualifications and experience. The Contractor's Registered Professional Engineer is to further acknowledge in writing that he has reviewed the specifications and drawings and is aware that he is to inspect the fabrication and installation of Work and certify the Work at completion.

1.7.5 Provide upon request copies of the following certificates:

(1) Mill certificates, signed by Manufacturer, certifying that products furnished comply with ASTM and CSA specifications in accordance with the contract requirements and with other requirements of the Contract Documents. A Certificate of Compliance will be acceptable where mill test reports are not available.

(2) Welding Certificates.

1.8 SHOP DRAWINGS

1.8.1 Submit shop drawings in accordance with Section 01340.

1.8.2 Clearly indicate materials, components, core thicknesses, finishes, dimensions, connections, joints, method of anchorage, number of anchors, supports, reinforcement, fabrication and installation details and accessories.

1.8.3 Clearly show all shop and erection details including cuts, copes, holes and threaded fasteners.

1.8.4 Clearly show all welds, both shop and field, by the currently recommended symbols of the Canadian Welding Bureau.

1.8.5 Prepare shop drawings of all connections and components designed by the fabricator under the seal and signature of the Contractor’s Registered Professional Structural Engineer responsible for this design.

1.9 QUALITY CONTROL

1.9.1 The Contractor’s Registered Professional Engineer responsible for the design of connections and other components is to inspect the fabrication and erection of these components in accordance with APEGA Responsibilities for Engineering Services for and Building Projects.

1.10 INSPECTION AND TESTING

1.10.1 The Contractor is to ensure materials and workmanship are inspected and tested by an inspection and testing firm certified in accordance with CSA

W178.1, retained and paid for by the Contractor and approved by the Owner's Representative in accordance with Section 01400 of these specifications.

1.10.2 The Contractor is responsible to inspect and test materials and workmanship to ensure miscellaneous metals work conforms to the requirements of the Contract Documents.

1.10.3 Provide casual labour and access for inspection to all places where Work is being done or stockpiled.

1.10.4 The inspection and testing firm will test one (1) in ten (10) welds. Testing of welds to include visual examination of all welding procedures at the plant and in the field, plus magnetic particle, x-ray or other means deemed necessary by the testing agency to permit certification of welds.

1.10.5 The inspection and testing firm will inspect all bolts for all snug-tightened high-strength bolted connections.

1.10.6 The inspection and testing firm will test all Nelson Studs.

1.10.7 The inspection and testing firm will inspect surface preparation and cleaning for painted and galvanized steel.

1.10.8 The inspection and testing firm will inspect and verify one coat paint, primer, zinc coat and galvanizing thickness.

1.10.9 The Contractor is to inspect and test all miscellaneous metal work to ensure compliance with the Contract Documents.

1.10.10 The Owner's Representative may request additional testing of welds and bolts to ascertain the full amount of defects if the tests noted above indicate excessive deficiencies. Additional costs for extra testing to be borne by the Contractor.

1.10.11 Contractor to pay for all costs for re-testing and re-inspection as a result of defective workmanship.

1.10.12 Contractor to pay for all costs of repairs to correct defective Work.

1.10.13 The Contractor's inspection and testing firm is to submit to the Owner's Representative final reports certifying all welds and connections, including confirmation that required repairs have been completed. These reports to be submitted under the seal and signature of a Registered Professional Structural Engineer registered in the Province of British Columbia.

1.10.14 Notify Owner's Representative and inspection and testing firm 24 hours prior to commencement of shop work for all testing and inspection.

1.11 ACCEPTABILITY

1.11.1 Failure to comply with the requirements of these specifications will result in the structure being considered potentially deficient.

1.11.2 Additional testing, inspection and evaluation may be required where evidence points to a potentially deficient structure.

1.11.3 Pay all costs for additional testing, inspection and analysis required to demonstrate the adequacy of a structure that does not meet the requirements of the Contract Documents.

1.11.4 Reinforce by additional construction or replace as directed by the Owner's Representative at Contractor's expense all structure or material judged inadequate by structural analysis or by testing and inspection.

1.11.5 The Owner's Representative may order further testing, inspection and analysis at any time. In this instance, the Owner will pay for those tests, inspections or analysis that meet the specified requirements, and the Contractor will pay for those that do not.

1.12 HANDLING

1.12.1 Use all means necessary to protect fabrications before, during and after installation.

1.12.2 In the event of damage, immediately make all repairs and replacements necessary to the approval of the Owner's Representative at no additional cost to the Owner.

1.13 PRODUCT DELIVERY AND STORAGE

1.13.1 Schedule delivery of components to site to coincide with installation of Work.

1.13.2 Store components to prevent damage and distortion.

1.13.3 Protect finishes from scratches and soiling.

1.13.4 Store materials in a safe, dry, above ground location.

1.13.5 Prevent contact with material that may cause corrosion, discolouration or staining.

1.14 COORDINATION WITH OTHER TRADES

1.14.1 Supply necessary instructions, templates and drawings to other trades for setting anchor bolts and directions for installing anchorages, including sleeves,

concrete inserts, anchor bolts and items with integral anchors that are embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.14.2 Coordinate primer requirements with paint system specifications in Section 09900. Failure to apply the referenced primer will result in this Section removing the applied primer and re-coating with specified material at no additional cost to the Owner.

PART 2 PRODUCTS

2.1 MATERIALS/COMPONENTS

2.1.1 Supply new materials, free from defects impairing strength, durability or appearance, of the best commercial quality for purposes specified.

2.1.2 Where metal fabrications are exposed to view in the completed Work must have smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, Manufacturer's stamps or roughness.

2.1.3 Structural steel members and plates: To CSA-G40.21 of Type W weldable steel. Minimum yield strength 350 MPa for hollow structural steel members, wide flange sections, channel sections and angles with legs 80 mm or greater; 300 MPa for plates.

2.1.4 Structural steel angles with 80 mm legs or less: To CSA-G40.21 of Type W weldable steel. Minimum yield strength 300 MPa.

2.1.5 Shear stud connections: Headed concrete anchors conforming to ASTM A108.

2.1.6 Bolts and required nuts and washers: High strength type recommended for structural steel joints to ASTM A325, medium-carbon steel. Nuts for galvanized bolts to be A563 Grade DH or A194 Grade 2H.

2.1.7 Anchor bolts as noted on the drawings to ASTM A193 and A449.

2.1.8 Welding materials as per CSA-W59.

2.1.9 Stainless steel: To ASTM A167 and ASTM A276, Type 316L as indicated on the drawings.

2.1.10 Structural Aluminum: 6061-T6.

2.1.11 Nut dimensions as per ASA B182 for heavy semi-finished hexagon nuts.

2.1.12 For fastenings in stainless steel use stainless steel Type 316 ELC ASTM A167.

2.1.13 All fasteners submerged in water or sewage: Stainless steel Type 316 ELC ASTM A167.

2.1.14 Drilled adhesive anchors refer to Section 03150.

2.1.15 One-coat paint where no further painting is specified: Conform to CISC/CPMA 1.73a, Structural Steel One-Coat Paint.

2.1.16 Primer where further painting is specified: Conform to CISC/CPMA 2-75, Structural Steel Primer.

2.1.17 Primer: to CAN/CGSB-1.40 for interior locations, to CAN/CGSB-1.181 (zinc-rich) to exterior locations.

2.1.18 Shop and field studs to be Nelson headed type anchors with fluxed ends or approved equivalent. Sizes as detailed on drawings.

2.1.19 Shop galvanizing: Hot dipped galvanizing with a minimum coating of 900 g/m^2 to CAN/CSA-G164.

2.2 CORROSION PROTECTION

2.2.1 Use stainless steel, aluminum or galvanized steel where indicated on drawings.

2.3 SAFETY CHAINS

2.3.1 Removable 5 mm proof chain 13 mm x 29 mm c/c oval shaped type 316 SS stainless steel links, snaphooks and eye unless noted otherwise.

2.4 STEEL LEDGE ANGLE AND LINTELS

2.4.1 Fabricate and install steel ledger angles and lintels as detailed on the drawings and reviewed shop drawings, complete with anchors or bolts, as indicated.

2.4.2 Fabricate and install steel ledger angles and lintels to withstand all superimposed loading.

2.4.3 Install level and true to line.

2.5 STEEL FRAMING AROUND OPENINGS

2.5.1 Fabricate steel plate and bent plate framing around openings, including around windows, doors louvers and the like, as detailed on the drawings and reviewed shop drawings.

2.5.2 Coordinate installation of steel framing with doors, windows, louvres and the like, to ensure openings are correctly sized.

2.5.3 Install steel plate and bent plate framing to support doors, windows, louvers and the like, and to withstand all superimposed loading.

2.6 BENT SHEET METAL FRAMING

2.6.1 Fabricate and install 0.762 mm base metal thickness, Z275 galvanized sheet metal, continuous C channel framing to parapets on roof, and to ends of hollow core slabs as detailed on the drawings and reviewed shop drawings.

2.6.2 Fabricate in minimum 2440 mm lengths. Butt joints together so that sections are flush and even with each other to provide a smooth flat surface to accept membranes, plywood and finishes.

2.6.3 Mechanically fasten channels to hollow core slabs with drilled anchors, of type to suit installation, with two (2) anchors (one (1) at each side of bottom leg of channel) at maximum 400 mm o.c., and to withstand all superimposed loading.

2.6.4 Mechanically fasten C channel to face of hollow core slab ends and edges, to provide a smooth flat surface, ready to receive membrane and finishes.

2.7 ANCHOR BOLTS, LAG SCREWS, ETC.

2.7.1 Provide anchor bolts, bolts, bolt washers and nuts, lag screws, expansion shields, toggles, straps, sleeves, brackets, etc., where required and where indicated.

2.8 MISCELLANEOUS FRAMING

2.8.1 Refer to drawings for miscellaneous metal items and embedded plates which are to be fabricated, supplied and installed under this Section.

2.8.2 Fabricate all other metal fabrication items or miscellaneous metal items required to complete the project.

2.9 HATCH COVERS

2.9.1 Locate hatch covers where indicated on the drawings. Hatch sizes are identified on the drawings to match the existing arrangement. Coordinate size, materials, dimensions, etc. via shop drawing submissions.

2.9.2 Pre-Engineered Hatch Cover: Designed by Supplier for loads indicated on the drawings. Maximum deflection not to exceed 1/300 of the span or 6 mm.

2.9.3 Hatches to open 90º and lock automatically in that position.

2.10 LOOSE BEARING PLATES AND LEVELING PLATES

2.10.1 Fabricate loose bearing and leveling plates for steel items bearing on masonry concrete construction. Drill plates to receive anchor bolts for grouting.

2.11 STEEL LADDER/RUNGS

2.11.1 Fabricate and install all ladders as detailed on the drawings and reviewed shop drawings and to meet all British Columbia Building Code requirements and to meet all current Occupational Health and Safety Act requirements, including all appendices and to ANSI 14.3. Ladders include, but are not limited to the following:

(1) Fabricate and install exterior roof ladders as detailed.

2.12 FABRICATION

2.12.1 Notify the Owner's Representative and inspection and testing firm a minimum of 24 hours prior to fabrication to allow for inspection.

2.12.2 Fabricate miscellaneous metals in accordance with CAN/CSA-S16.1, the drawings, specifications and the reviewed shop drawings.

2.12.3 Verify dimensions of existing Work, site conditions, and drawing dimensions prior to commencing fabrication.

2.12.4 Welding to conform to the requirements of CSA-W59. Do not splice materials without the written approval of the Owner's Representative. Where granted, provide a complete non-destructive examination by a certified inspection and testing firm; method and firm to be approved by the Owner's Representative. Contractor to pay for all inspection and testing. Show all approved splices on the shop drawings

2.12.5 No cutting or provision for holes except as on approved drawings.

2.12.6 Bolted connections to be friction type connections.

2.12.7 Shop installed shear studs to be installed in strict conformance with requirements of CSA-W59.

2.12.8 Tolerances of all miscellaneous metal to be maintained strictly in accordance with CAN/CSA-S16.1.

2.12.9 Grind all welds smooth and grind all groove welds flush on exposed structural steel.

2.12.10 Do not place any holes or openings in structural steel members without the approval of the Owner's Representative. Where approval is granted, provide reinforcing plates around all openings to maintain design strength.

2.12.11 Weld reinforcement where indicated. Weld in accordance with applicable requirements of CSA-W186. Do not weld reinforcing at any location without written approval of the Owner's Representative.

2.12.12 Weld all anchors required to restrain concrete masonry walls.

2.12.13 Weld shear stud connectors in strict accordance with Manufacturer's instructions by electrical resistance only.

2.12.14 Galvanize all structural steel components noted or specified to CAN/CSA-G164.

2.12.15 Apply one (1) coat of paint or primer where required.

2.12.16 Provide two (2) coats of alkali resistant bituminous paint to all aluminium in contact with or imbedded in concrete mortar or grout.

2.13 SURFACE PREPARATION

2.13.1 Thoroughly clean and suitably pretreat steel prior to finishing.

2.13.2 Remove loose mill scale, rust, oil, grease, dirt and other foreign matter using SSPC-SP No. 6, Commercial Blast Cleaning, followed by SSPC – SP No. 1, solvent cleaning. Shop prime all commercial blast cleaned surfaces immediately after cleaning operations.

2.13.3 Grind and sand all sharp projections smooth.

2.14 FINISHES

2.14.1 Shop paint items, all miscellaneous metal items with the exception of those which are to be galvanized or special coating.

2.14.2 Do prime painting to CSA-S16-01. Ensure shop primers are compatible with paint finishes and special coatings.

2.14.3 Use primer as prepared by Manufacturer without thinning or adding admixtures. Paint on dry surfaces, free from rust, scale of grease. Do not paint when temperature is lower than 7^{o}C.

2.14.4 After fabrication, clean, remove rust, mill scale, grease or extraneous material. Unless specified otherwise, apply to all items, in shop, a full smooth coat of primer (see materials). Work paint into corners and open spaces.

2.14.5 Apply two (2) coats of primer to parts inaccessible after assembly.

2.14.6 Apply one (1) coat of primer to steel surfaces except where encased in concrete. Leave these surfaces clean and uncoated.

2.14.7 Touch-up burnt or scratched surfaces. Touch-up bare or worn areas on site after installation, and apply field painting also to field-installed bolts, welds, screws, etc.

2.14.8 Make good corrosive protection after welding where burnt by welding operations and where removed to facilitate welding operations, using two (2) coats of zinc-rich touch-up primer conforming to CAN/CGSB-1.181.

2.14.9 Back prime with bituminous paint all aluminum surfaces in contact with concrete or masonry.

2.14.10 Provide hot dipped galvanized finish at all exterior metal fabrications and elsewhere indicated.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

3.1.1 Prior to installation of the Work of this Section, carefully inspect the installed Work of all other trades and verify that all such Work is complete to the point where this installation may properly commence.

3.1.2 Verify that metal may be fabricated and erected in strict accordance with the original design, the approved shop drawings and the referenced standards.

3.1.3 In the event of a discrepancy, immediately notify the Owner’s Representative.

3.1.4 Do not proceed with fabrication or installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 ERECTION

3.2.1 Erect in accordance with approved drawings. Erect true and plumb. Use temporary bracing where necessary to take care of all loads to which the structure may be subject, including erection equipment and operation of same. Leave such bracing in place as long as required for safety.

3.2.2 Use bolts for field connections except where welded field connections called for on drawings.

3.2.3 Tolerance of all structural steel to be maintained strictly in accordance with CAN/CSA-S16.1.

3.2.4 Obtain acceptance of Owner's Representative prior to site cutting or making adjustments to other Work.

3.3 CERTIFICATION

3.3.1 Certify at the completion of Work, under the seal and signature of the Contractor's Registered Professional Engineer responsible for this Work, that all connections and components designed by the Contractor are capable of supporting the loads and forces indicated in the Contract Specifications and on the drawings and that all connections and components are fabricated and installed in accordance with the reviewed shop drawings.

END OF SECTION

DIVISION 11
EQUIPMENT

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This Section specifies the general requirements for supply and installation of all process mechanical piping systems and is supplemented by other specific details shown or specified in the respective piping system section.

1.1.2 All materials and component in contact with water destined to be potable conform to ANSI/NSF 60 and 61.

1.1.3 Provide piping with thickness specify in this Section or greater.

1.1.4 Piping connections to be welded, flanged or coupled. Connect piping to pumps, valves, or other equipment with flanges.

1.1.5 Beveled pipe ends for welding or suit connections as shown on drawings.

1.1.6 Provide long radius bends unless otherwise shown or specified. Provide smooth flow Stainless Steel bends 600 mm and less, to ASME B16.9.

1.1.7 Pipe hanger, expansion joint, guide, anchor, support and seismic restraint system are generically shown on the drawings. Provide and make submissions in accordance with requirements of this Section.

1.1.8 The Specifications and drawings only provided the minimum requirements of piping system. Piping details including pipe supports and hangers, coupling, guide, anchor, expansion joints and seismic restraints are shown on the drawings generically but not completely. Provide design, supply and installation of all components of a complete piping system suitable for its intended use and in compliance with this Section and applicable standards and regulations.

1.1.9 Refer to Section 11205 for Process Piping Welding.

1.1.10 Refer to Section 11206 for Hangers and Supports for Process Piping.

1.2 REFERENCES

1.2.1 American Water Works Association (AWWA)

(1) C220, Stainless-Steel Pipe, ½ In. (13 mm) and Larger.

(2) C226, Stainless-Steel Fittings for Waterworks Service, Sizes ½ In. Through 72 In. (13 mm Through 1800 mm).

(3) C228, Stainless-Steel Pipe Flange Joints for Water Service—Sizes 2 In. Through 72 In. (50 mm Through 1800 mm).

(4) C229, Fusion-Bonded Polyethylene Coatings for Steel Water Pipe and Fittings.

(5) C500, Metal-Seated Gate Valves for Water Supply Service.

(6) C509, Resilient-Seated Gate Valves for Water.

(7) C510, Air Valve and Vent Inflow Preventer Assemblies for Potable Water Distribution System and Storage Facilities.

(8) C651, Disinfection Water Mains.

(9) M6, Water Meters: Selection, Installation, Testing & Maintenance.

(10) M14, Backflow Prevention and Cross-Connection Control: Recommended Practices.

(11) M17, Fire Hydrants: Installation, Field Testing, and Maintenance of Fire Hydrants.

(12) M23, PVC Pipe - Design and Installation.

(13) M44, Distribution Valves: Selection, Installation, Field Testing, and Maintenance.

(14) M51, Air Valves: Air Release, Air/Vacuum, and Combination.

(15) M58, Internal Corrosion Control in Water Distribution Systems.

(16) Disinfection of Pipelines and Storage Facilities Field Guide.

(17) Water Distribution Handbook.

1.2.2 American Society of Testing and Materials (ASTM)

(1) A312, Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipe.

(2) A380/A380M, Standard Practice for Cleaning, Descaling and Passivation of Stainless Steel Parts, Equipment and Systems.

(3) A403, Wrought Austenitic Stainless Steel Pipe Fittings.

(4) A778, Welded Unannealed Stainless Steel Tubular Products.

(5) A563, Specification for Carbon and Alloy Steel Nuts.

(6) A967/A967M, Standard Specification for Chemical Passivation Treatments for Stainless Steel Parts.

(7) A999, General Requirements for Alloy and Stainless Steel Pipe.

(8) B88, Specification for Seamless Copper Water Tube.

(9) D1784, Specification for Rigid PVC Compounds and CPVC Components.

(10) D1785, Specification for PVC Plastic Pipe, Schedules 40, 80 and 120.

(11) D2464, Specification for Threaded PVC Plastic Pipe Fittings, Schedule 80.

(12) D2466, Specification for PVC Plastic Pipe Fittings, Schedule 40.

(13) D2467, Specification for PVC Plastic pipe Fittings, Schedule 80.

(14) D2855, Standard Practice for Making Solvent-Cemented Joints with PVC Pipe and Fittings.

(15) D3139, Specification for Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals.

(16) F477, Specification for Elastomeric Seals for Joining Plastic Pipe.

1.2.3 The American Society of Mechanical Engineers (ASME)

(1) A13.1, Scheme for the Identification of Piping Systems.

(2) B1.20.1, Pipe Threads, General Purpose.

(3) B16.5, Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard.

(4) B16.11, Forged Fittings, Socket-Welding and Threaded.

(5) B16.15, Cast Copper Alloy Threaded Fittings: Classes 125 and 250.

(6) B16.18, Cast Copper Alloy Solder Joint Pressure Fittings.

(7) B16.21, Non-metallic Flat Gaskets for Pipe Flanges.

(8) B16.22, Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

(9) B16.24, Cast Copper Alloy Pipe Flanges and Flanged Fittings. Class 150, 300, 400, 600, 900, 1500 and 2500.

(10) B16.25, Butt Welding Ends.

(11) B16.26, Cast Copper Alloy Fittings for Flared Copper Tubes.

(12) B31.3, Process Piping.

(13) B32, Solder Metal.

(14) B36.10M, Welded and Seamless Wrought Steel Pipe.

(15) B36.19M, Stainless Steel Pipe.

1.2.4 National Sanitation Foundation (NSF)

(1) 60, Drinking Water Treatment Chemicals.

(2) 61, Drinking Water System Components.

1.3 SUBMITTALS

1.3.1 Submit in accordance with Section 01300.

1.3.2 Shop drawings and Product Data:

(1) Submit with Bid a copy of this Section with each paragraph check marked to indicate spec compliance or provide explanations for any proposed deviation.

(2) Material specification data for pipe, fittings, and accessories.

(3) Installation instructions.

(4) Fabrication (weldment) shop drawings of all prefabricated spool pieces prior to commencement of shop fabrication.

(5) Provide hanger, expansion joint, guide, anchor, support and seismic restraint system design details including locations, load information, design calculations and illustrative drawings, stamped and signed by the Contractor's competent Registered Professional Engineer registered in the Province of British Columbia.

(6) For expansion joints submit Manufacturer's catalog data, shop drawings and assembly drawings confirming general arrangement, dimensions, tolerances, materials of construction, weights and installation details. Submit calculations to substantiate expansion joint selection and amount of pre-compression, stamped and signed by the Contractor's competent Registered Professional Engineer registered in the Province of British Columbia.

(7) Seismic design. All components of the piping system shall be designed to resist and be connected to the structure for seismic loads as specified in the 2018 British Columbia Building Code (BCBC), provide piping system with lateral and longitudinal seismic restraint. Submit calculations and layout of seismic restraints stamped and signed by the Contractor's competent Registered Professional Engineer registered in the Province of British Columbia.

1.3.3 Test Reports: Reports of all factory and field tests.

1.4 PRODUCT DELIVERY, STORAGE, AND HANDLING

1.4.1 Fit piping connections with pipe caps.

1.4.2 During loading, transporting, and unloading, exercise care to prevent damage to material. Exclude dirt, dust or deleterious material and to avoid the possibility of contamination or physical damage to the particles.

1.4.3 Use slings, hooks, pipe tongs, or skids.

1.4.4 Do not roll or skid against pipe already on ground.

1.4.5 Repair any damage done to coating or lining.

1.4.6 Handle per Manufacturer's recommendations.

1.4.7 Store rubber gaskets in cool dark location.

1.4.8 Adequately tag or otherwise mark all piping and fittings as to size.

1.5 WARRANTY

1.5.1 For plastic piping system, provide written warranty against defects and premature failure for a period of at least five (5) years from the overall Project Acceptance date, anticipated in 2025.

1.5.2 For other piping system, provide written warranty against defects and premature failure for a period of at least two (2) years from the overall Project Acceptance date, anticipated in 2025.

PART 2 PRODUCTS

2.1 PIPING DATA

2.1.1 Stainless Steel Piping.

(1) Design Pressure: 100 psi, Vacuum rating: 14.5 psi.

(2) Hydrostatic Testing, 150 psig for 2 hours, no pressure drop or leakage allowed.

(3) Stainless Steel Pipe and fitting design and fabrication comply with AWWA C220 and C226, and the standards listed in following clauses. In any case of confliction, the requirements of this Section prevail.

(4) Comply with ASTM A380/A380M and ASTM A967 for Cleaning, Descaling and Passivation.

(5) Pipe: ASTM-A312 or ASTM-A778 Type 316L, surface finish to AWWA C220, dimensions and detailed specifications as following:

(a) 8 mm to 50 mm, ASME B 36.19 M, Schedule 40S.

(b) 65 mm to 750 mm, ASME B 36.19 M, Schedule 10S.

(c) 800 mm to 1200 mm, ASME B 36.19 M, Min. wall thickness 10 mm.

(6) Fittings:

(a) ASTM A182, Type 316L, surface finish to AWWA C220.

(b) Physical properties to match or exceed pipe.

2.1.2 PVC Piping.

(1) Design Pressure: 100 psi, Vacuum rating: 14.5 psi.

(2) Solvent welded glued joints.

(3) Pipe: Sch. 80 polyvinyl chloride (PVC), gray, ASTM D 1785. Pipe carrying fluid destined to be potable shall bear the National Sanitation Foundation (NSF) label.

(4) Fitting, Sch. 80 to ASTM D2467, same material and color as pipe.

(5) Joints: Solvent weld, except flanged or threaded permitted where required at equipment connections and where required on the drawings. Use primer and solvent cement suitable for the fluid service and in accordance with ASTM D2564.

(6) Pipe Cleaner: As recommended by the pipe manufacturer for the schedule and size to be joined.

2.2 FLANGES

2.2.1 Raise faced for piping connections, flat faced for mating flanges connecting to cast flanges of equipment and valves.

2.2.2 Slip-on and blind flanges to ANSI 16.5 Class 150, unless otherwise specified.

2.3 FLANGE GASKETS

2.3.1 Flange gaskets shall be NSF 61 Approved, or with NSF 61 material for potable water application.

2.3.2 Use full faced gaskets with flat face flanges, use flat ring gaskets with raised face flanges.

2.3.3 Use minimum 3 mm thick EPDM gasket, Garlock Style 98206 or approved alternate.

2.3.4 Provide insulated flanges and insulation kits to isolate contact of dissimilar metals. The bolt holes in the insulated flanges shall be enlarged as required to accept bolt insulating sleeves. Insulation kits shall be as manufactured by Central Plastics, PSI Industries, or reviewed equivalent.

2.4 BOLTS AND NUTS

2.4.1 For dry installations, made of carbon steel to ASTM A307, Grade B, galvanized, hexagonal heads, or made of stainless steel 316L to ASTM A563.

2.4.2 For wet, buried and submerged installations and installation of Stainless Steel piping system, made of Stainless Steel 316L to ASTM A563, grade A.

2.4.3 Use insulation shoulder washer to isolate contact of dissimilar metals.

2.5 COUPLINGS

2.5.1 Couplings may be used for jointing standard steel pipe, thin walled steel pipe, stainless steel pipe, ductile iron pipe, HDPE high density polyethylene pipe and PVC pipe.

2.5.2 Fabricate grooved joint couplings of ductile iron to ASTM A536, and in accordance with AWWA C606. Provide cut grooves in pipe and fittings in accordance with AWWA C606. Rolled grooves and roll-groove type joints are not acceptable.

2.5.3 Victaulic Style 77 flexible couplings.

2.5.4 Victaulic W-07 Advanced Groove System rigid couplings, where specified.

2.5.5 Coupling gaskets – Grade E-EDPM.

2.5.6 Coupling Materials:

(1) Ductile Iron to ASTM A536 for indoor installations.

2.6 GROOVES

2.6.1 For system using Victaulic products:

(1) Standard Steel Pipe – Advanced Roll Groove to Victaulic specifications.

(2) Light Wall Steel Pipe – Roll grooves to Victaulic specifications.

(3) Stainless Steel Pipe – Roll grooves to Victaulic specifications using “RX” rolls.

2.7 PIPE SLEEVES

2.7.1 Provide pipe sleeves as shown on drawings, made of carbon steel material for dry installation, made of Stainless Steel 316 for wet, buried and submerged installations.

2.7.2 Unless detailed otherwise, pipe sleeve to be one (1) size larger than the penetrating pipe for 100 mm and larger pipe, and two (2) sizes larger for pipe 75 mm and smaller.

2.7.3 Pipe sleeves shall have a minimum 50 mm by 8 mm thick steel ring continuously welded all around the middle of the pipe length.

2.8 EXPANSION JOINTS

2.8.1 Design and provide expansion joints to compensate for thermal expansion and contraction in the piping system, to isolate equipment from stresses and vibration transmitted from the piping system, on the location of piping passing structural expansion joint and where piping system are exposed damaging due to differential settlement.

2.8.2 Unless otherwise specified, provide spool, resilient arch type expansion joint.

(1) Construct of multiple plies of woven fabric impregnated with elastomer and reinforced with steel rings or wire embedded in the body.

(2) Provide backup or retaining rings of galvanized steel construction. Make retaining rings a nominal 10 mm thick, split type.

(3) Use filled arch type expansion joints on all piping systems conveying fluids containing solids.

2.9 SHOP COATING AND LINNING

2.9.1 Provide Carbon Steel pipe and fitting with Fusion Bonded Coating to AWWA C213.

2.10 WELDING SHOP INSPECTION AND EXAMINATION

2.10.1 Shop inspection examination according to ASME B31.3, for Category D Fluid Service. Submit inspection and examination report. Where applicable, different welds shall be examined by different methods.

PART 3 EXECUTION

3.1 EXAMINATION

3.1.1 Vendor to examine areas for:

(1) Defects such as weak structural components that adversely affect execution and quality of Work.

(2) Deviations beyond allowable tolerances for piping clearances.

3.1.2 Start installation only when conditions are satisfactory

3.1.3 Pipe:

(1) Carefully examine pipe and fittings for cracks, damage to linings, and other defects prior to installation.

(2) Remove all defective pipe from site and replace.

3.2 NUTS AND BOLTS

3.2.1 Install nuts and bolts so that bolts have a minimum of two (2) exposed threads projecting after tightening; with a maximum of eight (8) threads projecting.

3.2.2 Apply Denso paste to exposed threads, flanges and coupling bolts.

3.3 INSTALLATION OF PIPE AND FITTINGS

3.3.1 Prior to commencing piping work, examine route for conflicts and notify the Engineer of any conflicts. Obtain approval of the Engineer for any relocations.

3.3.2 Install to piping lines and elevations shown on the drawings.

3.3.3 Install all piping parallel to building walls.

3.3.4 Determine exact location of each pipe in the field with respect to adjacent and interconnecting piping and equipment.

3.3.5 Install all piping systems in accordance with the applicable standards for pressure piping.

3.3.6 Provide unions intermittently in all screwed piping systems to facilitate removal of valves and every section of the piping system without cutting any pipe or joint.

3.3.7 Provide temporary bracing and supports to adequately support pipes and fittings during installation.

3.3.8 Where the required piping is not shown on drawings or is shown diagrammatically, the pipes shall be installed in such a way as to conserve head room and interfere as little as possible with the spaces through which they pass.

3.3.9 Maintain grade on all draining pipes. Horizontal water piping shall be run with a grade of 2% to drain.

3.3.10 Where piping is to connect to equipment, dimensions shown on the drawings are based on catalogue information of first named Supplier.

3.3.11 Modify Work to suit final dimensions shown on shop drawings for equipment.

3.3.12 Ascertain the correct equipment dimensions before ordering piping closure lengths and fittings. Review of drawings by the Engineer will not relieve the Contractor of his/her obligation in this respect.

3.4 JOINTING PIPES - GENERAL

3.4.1 Clean pipes inside and outside before assembly. Remove welding slag.

3.4.2 Ream pipes and tubes.

3.4.3 Make screwed joints using approved compound or Teflon tape applied to male threads. Use thread tape on PVC pipe.

3.4.4 Connect pipes to equipment as shown or specified, without springing the pipes.

3.4.5 Provide complete isolation of dissimilar metals. Do not connect copper to any ferrous metal.

3.4.6 Use standard fittings for direction changes.

3.4.7 Follow the recommendations of the manufacturer for jointing pipes and installing couplings and fittings.

3.5 FLANGED JOINTS

3.5.1 Fit flanged joints so that gaskets are bearing uniformly and joints are even. Apply an anti-seize compound to bolt threads and tighten bolts evenly.

3.6 EXPANSION PIECES

3.6.1 Install piping to permit free movement of piping caused by thermal expansion and contraction except where it is anchored.

3.6.2 Install Victaulic couplings on flexible radius grooved cast iron pipe wherever pipe crosses structural expansion joints and install flexible Victaulic couplings wherever steel pipe crosses structural expansion joints.

3.6.3 Provide for expansion and contraction by installing suitable expansion joints as is necessary or where indicated.

3.6.4 Provide expansion joints having ratings equivalent to the test pressures specified for the particular piping system and wetted surfaces of material similar to that of the piping system.

3.6.5 Provide anchors and guides where necessary to direct expansion into expansion pieces.

3.7 PIPES THROUGH FLOORS AND WALLS

3.7.1 Standard steel or stainless steel pipe sleeves where pipes pass through floors and walls at dry installations.

3.7.2 Install sleeves flush at walls and projecting at floors as detailed or 50 mm above floor surfaces and flush with bottom.

3.7.3 Provide continuously welded rings on pipes passing through walls below grade or where walls are watertight.

3.7.4 Where thrust restraint is required design according to AWWA Manual M11 or as detailed.

3.7.5 For stainless steel pipe passing through concrete use stainless steel sleeves.

3.7.6 There shall be no direct contact between structural steel with pipe sleeve or piping.

3.7.7 Seal space between sleeves and pipes with non-hardening mastic Daraseal A or approved alternative.

3.8 FIELD PAINTING, COATING AND LINING

3.8.1 Provide un-painted or un-lined area of Carbon Steel pipe and fitting with 100% solids epoxy to AWWA C210.

3.9 CLEANING, HYSTROSTATIC TEST AND DISINFECTION

3.9.1 Perform piping cleaning, hydrostatic test and disinfection in accordance with Section 01565.

3.9.2 Test all piping at pressure of 150 psig for a duration of 2 hours, no leakage or pressure drop is allowed.

END OF SECTION

PROCESS PIPING AND WELDING

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This Section specifies the general requirements for welding.

1.1.2 Do all Work associated with the welding process, such as procedure qualification, welder qualification, line-up, welding, and weld inspection, examination and testing, in accordance with standards listed in this Section, except otherwise specified.

1.1.3 Butt welding for pipe and fitting connections, fillet welding for socket weld type pipe fittings.

1.2 REFERENCES

1.2.1 ASME B31.3, Process Piping Code (ASME B31.3). For Category D fluid service.

1.2.2 ASME Boiler and Pressure Vessel Code (ASME BPVC):

(1) Section V, Nondestructive Examination.

(2) Section IX, Welding and Brazing Qualifications.

1.2.3 ASME B16.25, Buttwelding Ends.

1.2.4 AWWA C206, Field Welding of Steel Water Pipe.

1.2.5 ASTM A380/A380M, Standard Practice for Cleaning, Descaling, and Passivation of Stainless Steel Parts, Equipment, and Systems.

1.2.6 CSA W48, Electrode and filler metals certification.

1.3 SUBMITTALS

1.3.1 Submit with Bid a copy of this Section with each paragraph check marked to indicate spec compliance or provide explanations for any proposed deviation.

1.3.2 Submit in accordance with Section 01300.

1.3.3 Certifications, work procedures, testing report specified in this Section.

1.3.4 All regulatory submissions as required by the British Columbia Power Engineers and Boiler Pressure Vessel Safety Act and Regulations.

1.4 QUALITY ASSURANCE

1.4.1 Welder.

(1) All welders are certified under the BC Boilers Branch Safety Act and Regulations including Technical Safety BC, and qualitied under ASME

BPVC IX. As a minimum, welders will hold a Level B Journeyman Welder's Certificate. Welder are certificated to be for the shielded metal arc method of welding.

(2) Welder perform piping welding are certified for pipeline welding in the flat, vertical, and overhead positions.

(3) Each welder is certified for the material on which he/she works. Welders working on stainless steel piping must not work on welding of any other material.

(4) Record all tests given to each welder and the detailed results of each test. Maintain the record and a list of qualified welders. Welders may be required to requalify if there is a question about their ability.

(5) Submit copies of welder certificates and welder testing report.

1.4.2 Equipment and Tools.

(1) Equipment and tools used for welding must be, made and marked for work on specific material. These tools must not be used for any other material. Equipment and tools used for welding Stainless Steel piping must not be made of materials that could contaminate the Stainless Steel.

1.4.3 WELDING PROCEDURE

(1) Submit in written, notice of when and where the welding of the test joints will take place, and work procedures. Perform testing under witness of Engineer.

PART 2 PRODUCTS

2.1 FILLER MATERIAL

2.1.1 Shielded metal arch electrodes (manual welding) to conform to CSA W48. Grade to be of tensile strength equivalent to or greater than the ultimate tensile strength of the parent metal, and to be suitable for the electric current characteristics, position of welding, and other conditions of intended use.

2.2 END BEVELS

2.2.1 For Steel Piping, provide pipe ends with mill bevels to ASME 16.25. Bevels to be 37.5° with a vertical lip of 1.60 mm and maximum root gap of 1.6 mm. Field bevels to be smooth and uniform.

2.2.2 For Stainless Steel Piping, provide pipe ends with mill bevels to ASME 16.25. Bevels to be 37.5° for full penetration welding.

2.3 EQUIPMENT

2.3.1 Welding equipment to be 200 A or larger DC machines, for welding of ferrous metal material.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Submit work plan and procedure before Work.

3.1.2 Partial penetration welding for Steel piping, full penetration welding for Stainless Steel piping, without shrinkage or porosity. Welds shall be smooth and shall not have undue protrusions on the pipe interior.

3.1.3 No two (2) weld beads shall be started or stopped in the same location. Each weld pass shall be visually examined and any defects (i.e., pin holes, slag inclusions, gas pockets, and undercutting, etc.) shall be repaired prior to welding the next pass.

3.1.4 Striking the arc on the pipe at any point other than the welding groove shall not be allowed. Any section of pipe which has been arc burned may, at the Engineer's discretion, be cut out and replaced at the Contractor's expense.

3.1.5 No weld to be subjected to sudden variations in temperature and no welded sections to be subjected to stresses, due to movement of pipe, loading on pipe, etc., until the welds have cooled below 38°C. Damage caused by the welded pipe being subjected to stresses before complete cooling of welds to be corrected at the Contractor's expense.

3.1.6 All temperatures to be measured by pyrometric crayons or other suitable devices approved by the Engineer.

3.1.7 All passes to have no more than 5 minutes elapse between the previous pass termination and the commencement of the next pass.

3.1.8 Use inert gas backing for stainless steel welding. Solar flux prohibited for liquid commodity piping.

3.1.9 For stainless steel piping, pickle all joints and heat affected zones to ASTM A380/380M.

3.1.10 Backwelding is not allowed without qualification of the welding procedure used.

3.2 WEATHER CONDITIONS (FIELD WELDING)

3.2.1 Welding shall not be done when the quality of the completed weld would be impaired by prevailing weather conditions, including but not limited to moisture, blowing sands, high winds, or low temperatures. Windshields may make conditions for welding satisfactory.

3.2.2 If, in the opinion of the Engineer, protection from prevailing weather conditions is necessary, then welding shall cease until this protection has been placed correctly. The Contractor will not be compensated for "downtime" delays of this nature.

3.2.3 Metal surfaces in and adjacent to the welding groove to be dry before welding commences and while welding is in progress.

3.2.4 When ambient temperature is below 0°C, welding operations to cease, unless an appropriate welding procedure has been qualified.

3.3 LINEUP CLAMPS

3.3.1 Internal lineup clamps to be used whenever practicable and when used shall not be removed until root bead is complete. External lineup clamps may be used only when use of internal lineup clamps is not practicable. Root bead segments used in connection with external lineup clamps to be uniformly spaced around the circumference of the pipe, and to have an accumulative length of not less than 50% of the pipe circumference before the clamp may be removed. Pipe to remain supported and stationary until root bead is completed.

3.4 CLEARANCE

3.4.1 When the pipe is welded in a trench, bell hole to be of sufficient size to provide the welder or welders ready access to the joint so that their skill is not impaired. When pipe is welded above ground, the working clearance around the pipe at the weld shall be not less than 400 mm.

3.5 STEEL PIPING WELDING

3.5.1 In accordance with AWWA C206 - Field Welding of Steel Water Pipe.

3.5.2 Perform welding by the shielded metal arc welding process. Three (3) beads or more shall be required, and the size and type of rods used shall be suitable for the pipe being welded.

3.5.3 Prevent interior pipelining from damage during welding. Longitudinal weld seams shall be on opposite sides of the pipe at the joint.

3.5.4 The minimum distance between two (2) adjacent circumferential welds is 50 mm. If this requirement cannot be satisfied, stress relieving of the welds must be undertaken.

3.6 STAINLESS STEEL PIPING WELDING

3.6.1 Clean piping end by using stainless steel brushes and acetone.

3.6.2 Select filler rods and electrodes to conform with the pipe composition and submit lists for review.

3.6.3 Make tack welds employing gas tungsten arc methods and remove while making the root pass.

3.6.4 Use gas tungsten arc welding for materials to 3 mm thick or less, use Gas Metal Arc Welding or Shielded Metal Arc Welding for thickness material.

3.6.5 Use argon as arc shielding gas.

3.7 REPAIR OR REMOVAL OF WELD DEFECTS

3.7.1 Repair and remove weld defects in accordance with ASME B31.3 and Section IX of ASME BPVC.

3.8 INSPECTION, EXAMINATION AND TESTING

3.8.1 After completion of welding, welding joints to be left uncoated for a period sufficient to permit inspector perform the inspection.

3.8.2 Provide inspector with reasonable facilities and space for inspection and obtaining any information the Inspector required to complete a full inspection and analysis.

3.8.3 Perform inspection, examination and testing in accordance with ASME B31.3, and applicable standards listed in this Section. Where applicable, different welds shall be examined by different methods.

3.8.4 Test (Visual and Radiography) on all sizes and types of pipe welds.

3.8.5 Visually examine not less than 100% of all welds.

3.8.6 Radiographic examine not less than 10% of circumferential butt welds for each welder.

3.8.7 Perform one (1) full circumference radiographic inspection for every 20 welded pipe-to-pipe and pipe-to-fitting joints for each welder.

3.8.8 Upon failure of any radiographic exam, the Inspector shall perform three (3) additional radiographic testing as directed by the Engineer plus one (1) after repair.

3.8.9 Submit inspection, examination and testing report.

3.9 PIPING PROTECTION, FIELD COATING AND LINNING

3.9.1 Protect and prepare for field welding all carbon steel pipe which has been previously coated.

3.9.2 Repair damage to coating or linings in compliance with AWWA standards of respective coating, lining and piping material.

3.9.3 After field welding, coating and lining welding joints in compliance with AWWA standards of respective coating, lining and piping material.

3.10 DEFECTS CAUSING REJECTION

3.10.1 Acceptance criteria for welds shall follow ASME B31.3, for Category D Fluid Service.

3.10.2 Any rejected welds shall be repaired or replaced.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 Design, select, locate, supply and install hangers, supports, thrust block and seismic restraints for piping in accordance with the requirements of this section.

1.2 REFERENCES

1.2.1 British Columbia Building Code (BCBC).

1.2.2 British Columbia Plumbing Code (BCPC).

1.2.3 American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME):

(1) ANSI/ASME B31.3, Process Piping. For Category D fluid.

1.2.4 Manufacturer's Standardization Society of the Valves and Fittings Industry (MSS):

(1) MSS SP 58, Pipe Hangers and Supports Materials, Design and Manufacture.

(2) MSS SP 69, Pipe Hangers and Supports – Erection and Application.

(3) MSS SP-89, Pipe Hangers and Supports – Fabrication and Installation Practices.

1.2.5 American Water Works Association (AWWA):

(1) M11, Steel Pipe: A Guide for Design and Installation.

(2) M23, PVC Pipe - Design and Installation.

(3) M55, PE Pipe Design and Installation.

1.2.6 American Society of Testing and Materials (ASTM):

(1) ASTM A240 / A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.

1.2.7 American Society of Civil Engineers (ASCE):

(1) 7, Minimum Design Loads for Buildings and Other Structures.

1.2.8 American Institute of Steel Construction (AISC):

(1) M011, Specification for Structural Steel Buildings.

1.2.9 Metal Framing Manufactures Association (MFMA):

(1) Standards Publication No.4.

1.2.10 Sheet Metal & Air Conditioning Contractors' National Association:

(1) Seismic Restraint Manual Guidelines for Mechanical Systems.

1.2.11 Canadian Standard Association (CSA-S832):

(1) S832, Seismic Risk Reduction of Operational and Functional Components (OFC) of Buildings.

1.3 DESIGN REQUIREMENTS

1.3.1 Design and Stamp piping hanger, support, thrust block and seismic restraint system by the Contractor's competent Registered Professional Engineer registered in British Columbia.

1.3.2 Criteria for Design:

(1) In accordance with requirements and standards listed in this Section, and manufacture's instructions.

(2) Ensure that support systems do not transmit excessive quantities of heat to building structure.

(3) All components of the system shall be designed to resist and be connected to the structure for seismic loads as specified in the British Columbia Building Code (BCBC). For calculating the seismic load the following shall be used:

(a) Site Class: D

(b) Importance factor, IE = 1.5 (post disaster structures)

(c) Site specific acceleration values: Sa (0.2) = 0.723, Sa (0.5) = 0.706, Sa (1.0) = 0.482, Sa (2.0) = 0.311, PGA = 0.335

(4) Resist all static and dynamic loads, which includes but are not limited to:

(a) Weights of pipes, valves, fittings, insulating materials, suspended hanger components, and normal fluid contents.

(5) Calculate static loads as all piping filled with water.

(6) Refer to drawings and Specifications for the designed pressure and hydrostatic testing pressure of piping system.

1.3.3 Maximum load the constraint system take must not exceed those listed in MSS SP-58.

1.3.4 Framing Support System:

(1) Beams: Size such that beam stress does not exceed 172000 Kpa and maximum deflection does not exceed 1/360 of span.

(2) Column Members: Size in accordance with the Manufacturer's recommended method.

1.3.5 Reduce noise and vibration transmission.

1.3.6 Maximum hanger spacing and minimum rod size shall be in accordance with the following:

Pipe Size	Maximum Spacing Steel and SS	Maximum Spacing PVC and PE
25 mm or below	1.2 m	1.2 m
32 mm to 50 mm	1.8 m	1.8 m
65 mm to 75 mm	2.4 m	2.1 m
100 mm to 125 mm	2.4 m	2.1 m
150 mm	3.6 m	2.4 m
200 mm to 300 mm	5.4 m	2.4 m
350 mm and greater	6.4 m	3.4 m

1.4 SUBMITTALS

1.4.1 Submit with Bid a copy of this Section with each paragraph check marked to indicate spec compliance or provide explanations for any proposed deviation.

1.4.2 Submit in accordance with Section 01300.

1.4.3 Shop Drawings Submittal:

(1) Submit shop drawings including calculation, plan and section signed and stamped by the Contractor’s competent Registered Professional Engineer registered in British Columbia, along with product data sheets.

(2) Plans and sections showing pipe hanger, support and seismic restraints types, locations and material.

(3) Identify hanger, support and seismic restraint type by catalogue number and shop drawing detail number.

(4) Indicate on shop drawings gravity and lateral forces considered in design.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

2.1.1 Grinnell.

2.1.2 Anvil International.

2.1.3 B Line.

2.1.4 Unistrut.

2.1.5 Approved equivalent.

2.2 MATERIALS

2.2.1 Use pipe hangers and supports listed in this Section and on Contractual drawings.

2.2.2 Fabricated pipe hangers, supports and seismic restraints with hot-dipped galvanized or epoxy coated steel for dry installation.

2.2.3 Fabricated pipe hangers, supports and seismic restraints with 316 Stainless Steel to ASTM A240 for wetted or submerged installation.

2.2.4 Use 0.5 mm thick nylon coated hanger and support for plastic piping system.

2.2.5 Provide cadmium plated steel nuts, bolts, washers and threaded rods in non-corrosive, controlled environment areas. Provide 316 stainless steel nuts, bolts, washers and threaded rods, for wetted or submerged installation.

2.2.6 Where dissimilar metals contact with the piping systems, provide neoprene barrier strips.

2.3 PIPE SUPPORTS

2.3.1 Wall supports use Grinnell Fig. 194, Fig. 195, or Fig. 199 welded steel brackets.

2.3.2 Pipe saddle supports, Grinnell Fig. 264 adjustable pipe saddle support complete with riser pipe and floor flange.

2.3.3 Strap supports, Grinnell Fig. 262 for four (4) 100 mm and smaller pipe. Provide straps for larger pipe as detailed on drawings.

2.4 PIPE HANGERS

2.4.1 For pipe of 75 mm and smaller, Grinnell Figure CT97C coated adjustable pipe ring complete with hanger rod and expansion case or insert for mounting on concrete surface.

2.4.2 For pipe of 300 mm and smaller, Grinnell Fig. 260 adjustable clevis.

2.4.3 For all sizes, trapeze style hanger.

2.4.4 For concrete inserts use Grinnell Fig. 152, Fig. 117 and Fig. 285 to suit service conditions and pipe size.

2.4.5 For ceiling flanges, use Grinnell Fig. 153.

2.4.6 Hanger rods shall be machine threaded both ends and shall be hot dipped galvanized after fabrication.

2.4.7 Spring hangers shall be Grinnell Fig. 80 V or 81 H constant support spring hangers.

2.5 SEISMIC TRANSVERSE AND LONGITUDINAL BRACE

2.5.1 Single pipe bracing Figures 1, 2, 3, 4, 5, 6, 7, and 8.

2.6 TRAPEZE SUPPORTS

2.6.1 Use strut, angle or channel welded frames for trapeze hangers. Unless otherwise specified, provide steel trapeze and pipe rack components having a minimum thickness of 2.7 mm with a maximum deflection 1/240 of the span.

2.6.2 Type 20 - Trapeze Pipe Support:

(1) All piping: Unistrut P2471.

2.7 STRUCTURAL ATTACHMENTS

2.7.1 Provide supports where shown on the Contract Drawing.

2.7.2 Type A - Side Beam Bracket: equal to Anvil Fig 202.

2.7.3 Type B - Steel Beam Clamp: equal to Anvil Fig 292.

2.7.4 Type C - Welded Beam Attachment: equal to Anvil Fig 6.

2.8 FRAMING CHANNEL.

2.8.1 41 mm square. Acceptable product: B-Line B-22 or Unistrut P1000.

2.8.2 41 mm x 83 mm. Acceptable product: B-Line B11 or Unistrut P5000.

2.9 ACCESSORIES

2.9.1 Hanger Rods: provide hanger rods threaded on both ends or continuous threaded and sized as required by Manufacturer.

2.9.2 Insulation: 6.4 mm by 75 mm neoprene rubber wrap between metal pipe and pipe hanger of dissimilar metals. Provide minimum 3 mm neoprene barrier between dissimilar metals for other installations.

2.9.3 Vibration Isolation Pad: Install under base flange of pedestal type pipe supports adjacent to equipment, and where required to isolate vibration.

2.10 THERMAL PIPE HANGER SHIELD

2.10.1 Provide thermal shields at seismic restraint locations on pipe requiring insulation.

2.10.2 Provide stainless steel band clamps on thermal shields at longitudinal pipe restraint locations.

PART 3 EXECUTION

3.1 GENERAL

3.1.1 Install support systems in accordance with requirements and standards listed in this Section, and Manufacture's instructions.

3.1.2 Locate hangers and supports as near as possible to concentrated loads such as valve, flanges, etc. Locate hangers, supports and accessories within appropriate span lengths to support continuous pipeline runs unaffected by concentrated loads.

3.1.3 Support pipes to run along floors at least 150 mm clear of the floors to allow cleaning, excepting drain lines that can be run flush with floors.

3.1.4 Arrange supports to allow the removal of valves without dismantling adjacent piping.

3.1.5 For piping 600 mm or greater, use stainless steel 304 fabricated supports or concrete supports that contact at least 30% of the pipe circumference, grout support bases 50 to 100 mm above the finished floor level.

3.1.6 Install lateral supports for seismic loads at all change in direction and change in elevations.

3.1.7 Support large or heavy valves, fittings and appurtenances independently of connected pipes.

3.1.8 Provide hanger or support within 1 m of each change in direction or size at each piping branch leg, on one (1) side of each valve, and on the first spool piece or fitting extending from a piece of equipment.

3.1.9 Provide supports on one (1) side of flexible joints and couplings within one (1) pipe diameter to the face of the joint or coupling.

3.1.10 Locate hangers and supports proximity to equipment and tank to ensure that connections to equipment, tanks, etc. are substantially free from loads transmitted by the piping.

3.1.11 Support piping so that temporary pipe supports will not be required when removing parts of the piping system for equipment maintenance.

3.1.12 Support piping so that no pockets will be formed in the span due to sagging of the pipe between supports caused by the weight of the pipe, medium in the pipe, insulation, valves and fittings.

3.1.13 Provide all necessary sway braces, dampeners, flexible hoses and restraints to eliminate all movements of piping due to vibration. Install additional braces and anchors as necessary to eliminate vibrations.

3.2 INSTALLATION

3.2.1 Support all piping after alignment and before tightening joints.

3.2.2 Do not move pipe after tightening joints.

3.2.3 Where several pipes can be installed in parallel and at the same elevation, provide trapeze hangers.

3.2.4 Do not drill or burn holes in the building structural steel.

3.2.5 Do not use hanger components for purposes other than for which they were designed. Do not use hanger components for rigging and erection purpose.

3.2.6 Do not install pipe supports and hangers in equipment access areas or bridge crane runs.

3.2.7 Install items to be embedded before concrete is poured. Fasten embedded items securely to prevent movement when concrete is poured.

3.2.8 Use embedded anchor bolts instead of concrete inserts for support installations in wet area.

3.2.9 Provide reinforcing bars in concrete for inserts carrying pipe over 100 mm in diameter.

3.2.10 Support vertical piping at every floor level. Spacing of vertical supports to confirm with spacing of horizontal supports.

3.2.11 Hanger and support components in contact with plastic pipe to be free of burrs and sharp edges.

3.2.12 Rollers to roll freely without binding.

3.2.13 Recoat ends of framing channels cut to length with zinc dust-zinc oxide coating.

3.2.14 Provide plastic or rubber end caps at the exposed ends of all framing channels.

3.2.15 Cut and drill baseplates to specified dimensions prior to welding stanchions or other attachments and prior to setting anchor bolts.

3.2.16 Grout between base plate and floor to be free of voids and foreign material.

3.2.17 Include any piping support modifications on the shop drawings submitted prior to fabrication or installation.

3.2.18 Review the drawings prior to installation of piping, conduit, and fixtures by this or any other Division. Identify any conflicts and confirm the routing of each section of pipework prior to commencement of installation. Advise of any conflicts with existing services. Where necessary, amend the routing of pipework to avoid conflict and provide shop drawings showing proposed routing.

3.2.19 Prior to installation, inspect and field measure to ensure that previous Work is not prejudicial to the proper installation of piping.

3.2.20 All major modifications to accommodate installed equipment and structural components are subject to review. Do not commence Work on related piping until Engineer's review is complete.

3.3 ADJUSTMENTS

3.3.1 Adjust hangers and supports to obtain required pipe slope and elevation. Use shims made of material that is compatible with the piping or pipe support material. Adjust stanchions prior to grouting of baseplates.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This Section specifies the general requirements for supply, delivery, installation supervision, testing and commissioning of a UV disinfection system to treat filtered water. The UV system will treat the combined effluent from all four (4) filters.

1.2 RELATED WORK

1.2.1 Read in conjunction with all Division and contract drawings.

1.3 SCOPE

1.3.1 The Manufacturer shall design, fabricate, supply, assembly, test, and deliver to the site an ultraviolet (UV) disinfection system, consisting of two (2) UV reactors and associated components and parts for installation by a Contractor. The Manufacturer shall coordinate the details of the delivery with the Contractor.

1.3.2 The UV reactors shall be a closed type vessel with UV lamps, suitable for pressurized flow applications. Each unit shall be furnished with a power supply assembly, controls and instrumentation such that a complete and operable system is provided.

1.3.3 The UV system shall include, but not limited to, UV intensity sensors, UV transmittance monitors, lamps, ballasts, automatic wiping systems, integral cleaning systems, cooling system with solenoid valve for cooling water inlet and drain, instrumentation and control components. All safety equipment for the UV system including face shields and warning signs shall also be provided.

1.3.4 The Manufacturer shall be responsible for provision of shop drawings and design information, supervision and verification of the equipment installation, start up, validation testing, on site performance guarantee testing, operation during testing and training.

1.3.5 Validation reports shall be submitted prior to delivery for evaluation by the Engineer. The validation of UV systems shall comply with the latest US EPA UV Disinfection Guidance Manual, and shall meet the inactivation criteria outlined in 2.2 of this Section (11260).

1.3.6 Third Party Validations performed with MS2-Phage or T-1 will be accepted. The UV reactor validation shall be pre-approved by Health Authority as required.

1.3.7 The UV disinfection system shall be the product of a company regularly engaged in the manufacture and supply of this type of equipment and whose equipment is of a design, which has been in satisfactory service under similar conditions for not less than ten (10) years.

1.3.8 Acceptable Manufacturers: Trojan Technologies, Calgon, or Approved equivalent.

1.4 DEFINITIONS

1.4.1 Validated Reactor – A validated reactor shall be a reactor that has been validated prior to delivery under the following conditions.

(1) Validated flow range shall contain the design flow range as stated in this Section.

(2) Validated UVT is less than or equal to the design UVT as stated in this Section.

1.4.2 Validated dose is greater than or equal to the minimum design Reduction Equivalent Dose (RED) as stated in this Section.

1.4.3 Equivalent Dose – Equivalent dose shall indicate the maximum dose necessary with a full-scale UV system to provide a level of inactivation of a specific organism equivalent to the level of inactivation for the same organism achieved in a laboratory using a collimated beam apparatus with a low pressure lamp producing UV energy at a wavelength of 254 nm to test a water sample collected at the same time.

1.4.4 Medium Pressure (MP) Lamps – MP lamps shall be defined as lamps with the input power converted to UV light at 200 – 400 nm with a pressure of approximately 20 psi.

1.4.5 Guaranteed Life – Guaranteed life shall be defined as the Manufacturer's warranted life of the lamp, sleeve, ballast, and sensor.

1.4.6 Expected Lamp Life – Expected lamp life shall be defined as the Manufacturer's estimated life of the lamp based on the operating conditions presented in this Section.

1.4.7 Prorated Start Time – Prorated start time shall begin after a minimum of 20% of the guaranteed life has lapsed.

1.4.8 Guaranteed Maximum Head Loss – The guaranteed maximum head loss shall be head loss measured in mm of water column allowed through the UV reactor at peak production flow rate between the inlet flange and the outlet flange.

1.5 STANDARDS

1.5.1 Without limiting the generality of other requirements of the specifications, all Work specified herein shall conform to or exceed the requirements of the applicable portions of the following documents to the extent that provisions of such documents are not in conflict with the requirements of this Section.

(1) US EPA:

(a) 40CFR Parts 9, 141, and 142 – National Primary Drinking Water Regulations: Long Term 2 Enhanced Surface Water Treatment Rule; Final Rule.

(b) UV Disinfection Guidance Manual 815/R-06/007.

(2) National Sanitation Foundation (NSF):

(a) NSF61 – Drinking Water System Components Health Effects.

(3) American Water Works Association Standard:

(a) F110 Ultraviolet Disinfection Systems For Drinking Water.

(4) National Water Research Institute (NWRI):

(a) Ultraviolet Disinfection Guidelines for Drinking Water and Water Reuse, 2nd Edition.

(5) International Standard Organization:

(a) ISO 9001: Management System of the Quality Assurance.

(6) International Conference of Building Officials (ICBO):

(a) International Building Code (IBC) 2006.

(7) Institute for Electrical and Electronics Engineers (IEEE):

(a) IEEE 519-1992: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.

1.5.2 All electrical equipment including control panels custom manufactured for this project shall bear the label of CSA or Canadian Underwriter's Laboratories, Inc. (cUL) confirming the products meet UL safety requirements.

1.5.3 Installation of electrical equipment and materials shall comply with WorkSafe BC and OSHA Safety and Health Standards (29 CFR 1910 and 29C FR 1926, as applicable), National Electrical Code, state building standards, and applicable local codes and regulations.

1.6 SEISMIC DESIGN AND ANCHORAGE

1.6.1 All components of the system shall be designed to resist and be connected to the structure for seismic loads as specified in the 2018 British Columbia Building Code (BCBC). Use following parameters as Minimum for seismic loading calculating.

(1) Site Class: D

(2) Importance factor, IE = 1.5 (post disaster structures)

(3) Site specific acceleration values: Sa (0.2) = 0.723, Sa (0.5) = 0.706, Sa (1.0) = 0.482, Sa (2.0) = 0.311, PGA = 0.335

1.7 SUBMITTALS

1.7.1 Submit with Bid a copy of this Section with each paragraph check marked to indicate spec compliance or provide explanations for any proposed deviation.

1.7.2 Submit shop drawings and product data in accordance with Section 01300 – Submittals.

1.7.3 Submittals during proposal:

(1) Type, Manufacturer, and general description of the products with descriptions and specifications of the major component, including electrical equipment ratings and data sheets for all devices.

(2) General outline drawings showing clearly all general and essential dimensions. Scaled drawings of cabinet assembly and layout shall include interior and exterior views.

(3) Detailed bill of materials for all components, including Manufacturer's name, description, and catalog number. Provide a list of service depots for all equipment.

(4) Third Party Engineer Letter confirming off-site validation testing including name of third party testing lab and testing protocols.

(5) A list identifying any water treatment chemicals that may have any detrimental effects on the UV equipment and/or its disinfection capabilities.

(6) A typical UV lamp decay curve from new to replacement condition. Hydraulic calculations demonstrating compliance with the required hydraulic characteristics.

(7) Total headloss curves for minimum flow, maximum flow, and at least three (3) intermediate points.

(8) The power per lamp (including ballast loss) and the system peak power consumption (including ballast loss) for new lamps, burn-in (100 hours) and end of lamp life.

(9) Lamp output certification. Complete UV lamp and ballast output report prepared by an independent testing laboratory within the past 12 months. This report shall verify the output of the lamp and ballast at various operating conditions.

(10) Electrical and control schematics and dimensioned layouts, which shall demonstrate UV system control system interface signals to the plant control system, including point-to-point interconnection diagrams. Terminal numbers, wire numbers and/or colour coding shall be furnished.

(11) Certification that the cost of replacement lamps is guaranteed for a minimum of ten (10) years from the date of acceptance after performance guarantee testing. During these ten (10) years, the price shall be adjusted

annually by the Canadian Consumer Price Index with start of adjustment period commencing with the acceptance of equipment and commissioning.

(12) Documentation on the integrity of the lamp sleeves, and monitoring practice.

(13) Installation requirements.

(14) Pricing for the UV equipment PLC & HMI software licences (Rockwell) to be provided as a separate line item from the rest of the UV equipment in the pricing submission.

1.7.4 Shop Drawing - Submittals Prior to fabrication

(1) All requirement in Item 1.7.2.

(2) Validation report from off-site testing containing performances curves for the UV reactor/system, showing its performance over a range of flow rates, UV transmittance values, and doses. This report will be used to confirm the Manufacturer's UV dose delivery claims.

(3) Calculations showing the maximum allowable pressure for the lamp sleeves and the maximum bending stress experienced by the lamp sleeves under the maximum flow conditions specified herein.

(4) A computational fluid dynamic (CFD) model showing the performance of the UV reactor in the proposed piping configuration.

(5) Detailed narrative information on how the actual UV control system will operate.

(6) Control panel front elevation drawings showing all face-mounted instruments; control panel interior layout drawing showing locations of major components, motor controls, control power transformers, fuses, and circuit breakers; and point-to-point wiring drawings; complete external electrical interconnection diagrams for control panels and field junction boxes, including number, sizes, and type of cables or wire required between panel, junction boxes, and equipment components. Include documentation required for each panel.

(7) Installation instructions, operation, and maintenance manuals.

1.8 TOOLS AND SPARE PARTS

1.8.1 The Manufacturer shall provide a list of recommended spare parts, special tools, and maintenance materials.

1.8.2 The following list of spare parts is the minimum requirement:

(1) 5% of total installed UV lamps

(2) 5% percent of total installed quartz sleeves

(3) 5% of total installed ballasts

(4) 5% of total installed sleeve holder seals

(5) 5% of wiper rings

(6) Two (2) wiper drive mechanisms

1.8.3 Selected spare parts shall be suitably packaged with labels indicating the contents of the package.

1.9 EQUIPMENT WARRANTY

1.9.1 The Manufacturer shall be responsible for equipment warranty, as specified herein and elsewhere in this Contract.

1.9.2 Equipment Warranty:

(1) The Manufacturer shall warrant all equipment, for a period of 24 months from the overall Project Acceptance date, anticipated in 2025.

(2) The Manufacturer shall replace or repair non-consumable parts of the UV system proved to be defective in material or workmanship upon written notice, provided that the equipment is installed in accordance with the Manufacturer's instructions and operated and maintained in accordance with the instructions contained in the Manufacturer's Operation and Maintenance Manual delivered with the UV system.

(3) The Manufacturer shall be liable for the direct labour and material cost of such repair or replacement by the Contractor.

1.9.3 Lamp Warranty:

(1) The Manufacturer shall warrant that useful lamp output is maintained for a minimum 5000 hours of operation or as specified in the accepted Proposal.

(2) Should lamp performance not be in accordance with above, cost of replacement lamps shall be as follows:

Lamp Hours	Lamp Cost
1 - 5000 hours	Lamps replaced at no charge
5001 - guaranteed hours	Lamp price prorated proportional to actual hours

(3) Performance Warranty:

The Manufacturer warrant that the UV system be capable of providing the design at the service conditions as described in this Section.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 The UV disinfection system will be installed in the filter effluent pipe headers in the Pipe Gallery as shown in the drawings. The UV system shall be designed to provide continuous disinfection operation of the filtered water stream to achieve the treatment targets as specified herein. The Manufacturer shall assume complete responsibility for performance requirement and conformance with these Specifications.

2.1.2 The UV reactors shall be suitable for installation in 600 mm dia. pipelines for disinfection of filtered water.

2.2 DESIGN CRITERIA

2.2.1 The UV system shall be designed to inactivate pathogenic protozoa, *Cryptosporidium and Giardia,* by exposing the water stream to high intensity UV light with the following design conditions:

Description	Design
Number of Treatment Trains (UV Rectors)	2 (1 duty 1 standby)
Design Process Flow for Each UV Reactor, MLD	28
Maximum Capacity for Each UV Reactor, MLD	Vendor to Provide
Minimum Flow for Each UV Reactor, MLD	5.3
UV Technology	Medium Pressure
Minimum RED (Reduction Equivalent Dose, MS-2), mJ/cm^2	40
Design UV Transmittance (at 254 nm)	91%
Maximum allowable headloss, mm	52
Minimum End of Lamp Life (EOLL) factor	0.9
Minimum Lamp Fouling factor	0.8
Treatment Specification	Minimum 3-log inactivation of *Cryptosporidium parvum* and 3-log inactivation of *Giardia. lamblia*
pH	7 – 8
Influent Temperature, ^oC	2 – 25
Turbidity, NTU	1
Total Organic Carbon, mg/L	0.31 - 2.5
True Color, TCU	< 5
Reactor Design Pressure, kPa	200

2.2.2 Water quality data shown above are for information only. These data are anticipated filtered water quality based on the pilot plant study and may deviate from the actual operation data.

2.2.3 The minimum RED shall be validated by third party validation testing.

2.2.4 The specified minimum RED shall be provided at the design UVT, maximum flow and minimum temperature, at end of lamp life. Manufacturers shall indicate what safety factor has been allowed to account for fouling or aging of the quartz sleeve.

2.3 UV DISINFECTION SYSTEM

2.3.1 The UV system shall include, but shall not be limited to, the following equipment:

(1) Two (2) UV reactors.

(2) MP lamps and ballasts.

(3) UV intensity sensors (one (1) per lamp for MP), plus two (2) reference sensors.

(4) Two (2) online transmittance monitors (duty/standby) that shall measure transmittance at 254 nm with a 1-cm path length.

(5) Cleaning system capable of either mechanical and/or chemical cleaning, per reactor.

(6) Pressure differential gage (one for each reactor, provided and controlled by others).

(7) All controls and control panels as specified herein and as recommended by the equipment manufacturers to ensure a complete operating UV system.

2.3.2 The operator shall either remotely or locally select the desired UV dose for each individual reactor. The calculated UV dose for each reactor shall take into account the flow to the reactor, the status of the UV lamps, actual irradiance levels measured by the UV sensors, and transmittance of the filtered water. The calculation model shall take into account hydrodynamics of the UV reactor at the flow level being used and shall be verified with validation test results.

2.3.3 The minimum RED and associated power usage values shall be guaranteed for the intended installation.

2.3.4 Each UV reactor shall be capable of completely independent operation.

2.3.5 The UV system shall meet NSF 61 standards for potable service.

2.4 UV REACTORS

2.4.1 The UV reactor shall be a closed vessel, which can be connected to water piping using flanged end connections. Flanges shall conform to ANSI/AWWA C207 Class B.

2.4.2 The reactors shall consist of UV lamps, quartz lamp sleeves, UV intensity sensors, lamp sleeve wipers, lamp timers, and temperature sensors.

2.4.3 The reactors shall be designed for a minimum operating pressure of 200 kPa.

2.4.4 The reactors shall be designed for turbulent plug flow behavior to ensure axial mixing for optimum photon absorption and at the same time eliminating short circuiting.

2.4.5 Flow distribution baffles shall be provided to ensure equal flow and velocity distribution to each lamp if required and if used during validation testing. The baffle shall be integral to the vessel, shall be designed to prevent any dead zones in the vessel, and shall require no maintenance.

2.4.6 Reactor body, flanges and accessories (including but not limited to: baffles, cleaning valves, solenoid valves, sample valves) shall be manufactured of 316L stainless steel. All stainless steel pipe, fittings, or specials shall be shop cleaned and passivated prior to being shipped. All cleaning and passivating shall be performed in accordance with ASTM A380. After cleaning, the stainless steel shall be covered or otherwise adequately protected from surface contamination.

2.4.7 Sealing rings shall be Viton or approved alternative.

2.4.8 The UV reactor shall be designed such that the operating personnel can change the lamps without draining the reactor.

2.4.9 The UV reactor shall be provided with access ports for easy maintenance of the quartz sleeves and cleaning system.

2.4.10 The UV reactors shall be capable of delivering the specified RED at maximum design flow rates at the end of the useful lamp life.

2.4.11 Provide a level or flow switch to detect a leak.

2.4.12 Each UV reactor shall be equipped with a temperature sensor and a temperature switch, to protect against heat buildup and potentially damaging the UV lamps. The temperature sensor shall be wired to the control panel and shall shut down the UV reactor and initiate a critical alarm condition when activated.

2.4.13 Provide a cooling water system for the UV Reactor(s) with cooling water inlet and outlet solenoid and isolation valves.

2.5 UV LAMPS

2.5.1 The Manufacturer shall provide certification by an independent laboratory that the lamps emit 90% of their total UVC output between the wavelengths of 230 and 275 nanometers after 100 hours burn-in, at the expected operating temperature of the UV lamp.

2.5.2 The filament shall be significantly rugged to withstand shock and vibration.

2.5.3 Operated by contactor switched ballasts. The ballasts shall be of high power factor type. Ballast ventilation shall have air filters.

2.5.4 The system shall provide for manual lamp selection on operator interface.

2.5.5 The lamp bases shall be resistant to UV, ozone, and chlorine.

2.5.6 Provide lamp timers to measures the lamp run time.

2.5.7 The lamp output shall not fluctuate by more than 3% as a result of variations in water temperature between 2°C and 38°C

2.6 UV LAMP SLEEVES

2.6.1 A lamp sleeve shall be provided around each UV lamp to prevent the lamps and electrical connections from contact with water. The minimum UV 254 transmittance of the quartz sleeve shall be rated for 88% at the start of its life.

2.6.2 The UV lamp sleeves shall be manufactured from Type 214, fully annealed clear fused quartz tubing.

2.6.3 The quartz sleeves shall be readily disassembled and assembled.

2.6.4 Each quartz sleeve shall be independently sealed within the reactor. The open end of the lamp sleeves shall be sealed by means of an O-ring and Type 316 stainless steel compression plate.

2.7 UV INTENSITY SENSORS

2.7.1 Each UV lamp shall be provided with a UV intensity monitor, mounted in the center of a representative UV reactor and connected to a central control panel. The peak response for the UV monitor shall be between 255 and 280 nm; and less than 10% of the sensor response shall be above 300 nm. The sensor shall not degrade after prolonged exposure to UV light. Sensor readings shall be displayed on the control screen and shall be accurately calibrated to produce a current that is proportional to the UV light intensity.

2.7.2 A portable hand-held reference sensor meeting the same requirements as the permanent sensors shall be provided for routing checking.

2.7.3 The wet portion of the sensor shall have a stainless steel housing, Viton or equal O-ring, and a high purity quartz probe over the sensor site hole.

2.7.4 The sensor shall be unaffected by static, electromagnetic fields, or short wave radio emissions.

2.7.5 The sensor shall produce a 4-20 mA signal, which shall be sent to the system PLC.

2.7.6 The sensors shall be interfaced with control system to provide feedback regarding UV dose requirement.

2.7.7 Sensors provided shall be approved by DVGW or equivalent.

2.8 CLEANING SYSTEM

2.8.1 Each UV reactor shall be designed to accommodate an automatic lamp quartz sleeve cleaning system.

2.8.2 The cleaning system shall be an on-line mechanical cleaning (OMC) system consisting of wipers that are driven by either screws attached to electric motors or pneumatic pistons and complete with an automatically initiated and controlled cleaning cycle.

2.8.3 The wipers shall be either mechanical wipers or physical-chemical wipers. Mechanical wipers shall consist of 316L stainless steel brush collars or Teflon rings that move along the lamp sleeve, while the physical-chemical wipers shall have a collar filled with cleaning solution that moves along the lamp sleeve.

2.8.4 Cleaning equipment to be powered and controlled from system control panel.

2.8.5 The cleaning system shall operate automatically with an adjustable cycle frequency via operator interface. Manual cleaning system control option shall be available through the operator interface.

2.8.6 Operation of the cleaning mechanism shall not reduce the effectiveness of disinfection.

2.9 UV TRANSMITTANCE MONITORS

2.9.1 Provide two (2) on-line UV transmittance (UVT) monitors. The monitors will be installed on the filter effluent pipe headers.

2.9.2 The UVT monitors shall be capable of measuring the transmittance of water in the range of 75 to 100% at a wavelength of 254 nm. The 4-20 mA output of measurement shall be adjusted to a percentage transmittance output corresponding to a layer of 1 cm path length. Accuracy shall be +/- 1.5% FSD.

2.9.3 The device shall accept a water turbidity range of 0 to 5 NTU and an operating pressure of 1 to 200 kPa.

2.9.4 Lockable NEMA 4X enclosures shall be fabricated from 316 stainless steel.

2.9.5 Power supply shall be 120V/1 ph/60 Hz.

2.10 DOSE PACING SYSTEM

2.10.1 A dose-pacing system shall be supplied to modulate the lamp power levels and the number of lamps in operation in relationship to the signal from the filter flow meter, UV intensity sensor signal(s) in conjunction with UV transmittance values. The flow signal will be digitally communicated via plant SCADA.

2.10.2 The UV system shall be dose-paced such that as the flow, water quality, and lamp conditions change, the UV dose delivered is optimized while conserving power.

2.10.3 The flow pacing system shall allow the operator to vary the flow rate setting.

2.11 ELECTRICAL AND CONTROL SYSTEMS

2.11.1 UV reactor electrical and control systems shall be housed in cabinets consisting of a main power supply section, ballast cabinet and control cabinets. The electrical system components for each reactor shall include a Lamp Drive Power Distribution Panel, and a Lamp Drive Enclosure.

2.11.2 The cabinet doors shall open beyond 90 degrees to allow for maximum accessibility. Lamp Drive Power Distribution Panel:

(1) Housed in a lockable NEMA 3R enclosure with front access design.

(2) Main Breaker, 480 VAC with front of panel disconnect switch.

(3) Distribution Breakers, 480 VAC, one for each lamp power supply.

(4) Continuous angle or channel for seismic restraint anchoring.

2.11.3 Lamp Drive Enclosure (High Voltage System):

(1) Housed in a lockable NEMA 3R enclosure.

(2) 480 VAC for Lamp Power Supply.

(3) 480 VAC magnetic contactors.

(4) 120 VAC control transformer.

(5) Power factor better than 0.9 at full power.

(6) Primary and secondary ballast CT’s.

(7) Enclosure cooling fans.

(8) Enclosure over temperature alarm switches.

(9) Enclosure door power interlock switches.

(10) Continuous angle or channel for seismic restraint anchoring.

(11) Forced air ventilation system with air filters.

2.11.4 Local Control Panel (LCP) (Low Voltage System):

(1) The UV control Enclosure.

(2) 120 VAC for powering control circuit.

(3) 120 VAC for control system I/O, field devices.

(4) UPS system (minimum 10 minutes) for controls and instrumentation, integral to UV panel.

2.11.5 Programmable Logic Controller (PLC):

(1) Local Control Panel shall be provided with Allen Bradley PLC with Ethernet connections.

(2) The PLC IO modules shall accommodate all new instrumentation signals with spares for future expansion.

(3) All information collected by the UV Supplier through the PLC is to be made available to the SCADA system. As a minimum, all information displayed on the HMI and all set points/adjustable parameters at the HMI are to be equally accessible to the plant SCADA system.

(4) Owner will program the SCADA system to read information from the UV PLC or Controller for display on plant SCADA system.

(5) Connection of Ethernet communication cabling to the SCADA system will be by the Contractor. Provide an approved fibre management and termination within each control enclosure for installation and termination of plant-wide Ethernet network. Clearly identify termination points on all drawings and inside of control enclosure.

(6) Provide a complete, as commissioned, hard and soft copy of the UV control and HMI runtime programs for use by the Owner.

2.11.6 Operator Interface Panel (HMI):

(1) One (1) HMI shall be provided per control cabinet. The HMI shall function to provide operator interface for displaying process status and changing process set points and testing components during servicing.

(2) HMI shall be mounted on NEMA 3R panel located in the filter pipe gallery.

(3) Touch screen minimum 14 inch diagonal ultra bright TFT panel mount, 800 x 600 VGA colour display suitable for exterior installation and weatherproof. Liquid crystal displays are not acceptable. Provide a hinged clear weatherproof cover over the HMI.

(4) One (1) copy of Development Software Microsoft Windows based.

(5) Runtime software for each HMI.

(6) No logic required for control shall be programmed or executed in the HMI.

(7) Digital communication cable and conduit between the local control panel of the Manufacturer and the HMI will be provided by the Contractor.

2.11.7 Power supply to equipment shall be 120 V, 60 Hz, 1 phase. Power supply for all control circuits and equipment shall be separate from the 600 Volt supply.

2.12 PROCESS MONITORING AND CONTROL

2.12.1 The UV system shall operate under the control of a Programmable Logic Controller (PLC) that shall be programmed by the Manufacturer. The main functions of the control software are to control the process and monitor the system status, and to alert the operator to any fault conditions. The UV Control System shall deliver specified dose determined by SCADA adjustable setpoint. The system shall be fail-safe for the operator's safety and equipment protection. Alarm and status messages shall be displayed on the operator interface station on the control panel and communicated by SCADA.

2.12.2 Fail-safe Interlocks:

(1) Lamp:

(a) Alarm on lamp failure and identification of failed lamp(s).

(b) Power interlock on HV cabinet door.

(2) Level:

(a) Alarm and shutdown on low level.

(3) Temperature:

(a) Alarm and shutdown on high water temperature.

(b) Alarm and shutdown on power supply over-temperature.

(4) Leak Detection:

(a) Alarm and shutdown if reactor leak detected.

(b) Closing of isolation valves.

(5) UV Intensity:

(a) Alarm on UV intensity out of range.

2.12.3 Process Monitoring and Controls:

(1) The Manufacturer shall take full responsibility for the fabrication, programming, testing and commissioning of the local control panel.

(2) All filter related instrumentation and final control elements will connect directly with the main plant SCADA system which will support full monitoring and control functionality. The required variables will be made available to the UV PLC or Controller via the plant SCADA system.

(3) The main plant SCADA system provides the means for the operators to monitor and control all plant functions. Alarm and status conditions of the UV system will be transmitted to the plant SCADA system.

(4) The control philosophy and operation will vary between UV lamp technologies and equipment suppliers. All information collected by the equipment manufacturers programmed PLC or Controller will be brought to the plant SCADA system via Ethernet. The UV Manufacturer shall program the PLC and provide assistance to the Owner in the interface to the plant SCADA system which shall be programmed by others.

(5) Each filter effluent flow meter signal will be routed via the plant SCADA system and data network to facilitate automatic dose paced UV control of the associated UV reactor system. The UV control system and HMI shall be independent of the plant SCADA system but will provide an operator interface to the UV system for local control purposes and visualization of status and alarms.

(6) The following list is an indication of the parameters to be made available to the UV - Control and SCADA Systems.

(a) Reactor On

(b) UV Intensity

(c) Water Temperature

(d) UV Transmittance

(e) Lamp Power / Hours Run

(f) Lamp Status

(g) Total Run Time

(h) Lamp Age

(i) Unit Power Meter

(j) Alarm / Faults

2.12.4 Other features included in the system:

(1) The UV intensity sensor relays the information back to a processor that adjusts the power input as necessary to increase or decrease the delivered UV dosage. The UV intensity sensor operates in conjunction with the on-line UVT monitor, to monitor and adjust the applied UV dosage.

(2) Capability to vary UV intensity in accordance with dose set point, flow, and UV transmittance. Flow and UV transmittance signals are provided via SCADA.

(3) The temperature sensor triggers an alarm that engages the UV lamps in a shutdown sequence if the temperature exceeds a prescribed value.

(4) The UVT monitor relays information back to a processor (via SCADA) that adjusts the power input as necessary to increase or decrease the delivered UV dose.

(5) A power control module operates in conjunction with a PLC, UV intensity sensor and UVT monitors to adjust the applied UV dosage.

2.13 VALIDATION TESTING

2.13.1 The Manufacturer shall provide third-party, independent, off-site validation of the UV reactors as described below.

2.13.2 Demonstrate reactor validation by providing documentation that the UV System design and construction has undergone specific testing and validation protocols by an independent party not associated with the Manufacturer. Validation protocols need to address:

(1) Performance standards, equipment, documentation, personnel qualifications at the UV test facilities.

(2) Preparation of the bioassay organism and how it was used for reactor validation.

(3) Testing and performance evaluation of the UV reactors

(4) Procedure used to analyze and organize data from the testing.

2.13.3 The procedures used for specific testing and validation protocols shall be from the latest version of USEPA UV Guidance Manual.

2.13.4 Validation testing shall be carried out before delivery to confirm the performance of the UV system. The validation protocol will be reviewed by the Engineer. The Manufacturer shall prepare a complete validation report to document results of validation testing including all test details, apparatus used, test data, dates performed, location, and information on testing party.

PART 3 EXECUTION

3.1 ON-SITE SERVICES

3.1.1 The Manufacturer shall allow a minimum of five (5) person-days in two (2) trips for on-site services including but not limited to:

(1) Provide instructions, and assistance to the Contractor during installation.

(2) Inspect, test, commission and adjust the equipment after installation to verify mechanical, structural and electrical integrity and conformance to the equipment Specifications.

(3) Load, check, test, adjust and confirm that the PLC programming operates as intended by the design.

3.1.2 After 30 days provide one-day on-site visit to inspect and test equipment operation and provide follow-up training.

3.1.3 At time required for first lamp change, provide one-day on-site visit to instruct personnel in correct lamp changing procedures.

3.1.4 Provide additional services at no cost to correct any problems due to the design and/or fabrication of the ultraviolet disinfection equipment.

3.1.5 Submit name, qualifications, and experience of Field Technician.

3.1.6 Lamp Disposal

(1) The Manufacturer shall provide shipping containers for non-functional lamps, produce shipping manifests, pay for all shipping, customs, duties, and taxes, and manage all requirements related to hazardous waste handling and disposal of lamps.

(2) Manufacturer shall disclose the manner and method of disposal or recycle of the lamps in the form of a submittal for review. This submittal shall be submitted prior to delivery of the Goods to the site.

3.2 TESTING

3.2.1 System Functional Testing:

(1) Prior to startup, the Manufacturer shall inspect the installed UV disinfection system for proper alignment, correct operation, proper connection, and satisfactory function of all components. The Manufacturer's representative shall approve the installation and provide certification that the system components have been installed correctly and are ready for operation.

(2) Functional testing shall be witnessed by the Engineer, and shall demonstrate that the system and related control system operate in accordance with the Specifications, including all operating, monitoring, and shutdown functions.

3.2.2 PLC Testing:

(1) The Manufacturer's representative shall be fully trained in the operation and programming of the UV control system PLC and the operator interface programs and program development. The representative shall be capable of and equipped to make changes or modifications to the control program and to instruct the Owner's Representatives in program backup, loading,

troubleshooting of PLC logic and I/O modules and updating of program hard copies.

(2) The Manufacturer's representative will be required to provide the assistance as necessary to facilitate the programming of the plant SCADA System with respect to alarms and data for the UV System controls/PLC.

(3) The Manufacturer shall provide software copy and hard copy of the PLC Program to the Owner.

3.2.3 Performance Guarantee Testing

(1) Performance Guarantee Testing shall include power consumption testing, as well as head loss testing and effluent quality testing at two (2) different times (events) during the Commissioning. The proposed Performance Guarantee Testing procedure shall have been developed by the Manufacturer and submitted to and reviewed by the Engineer before scheduling and performing the Performance Guarantee Test.

3.3 TRAINING

3.3.1 The Manufacturer shall provide two (2) day on-site training session to the operators. Coordinate training with the Contractor, Engineer and the Owner's Representative.

3.3.2 The Manufacturer shall provide detailed daily, weekly, monthly and yearly maintenance, lamp replacing and troubleshooting instructions during training.

3.4 CLOSE OUT DOCUMENTATION

3.4.1 The Manufacturer shall provide updated Operation and Maintenance manuals as defined in item 1.7.4 (7) of this specification.

3.4.2 The Manufacture shall also update all power and control systems drawings to reflect the as constructed status of the installed UV systems.

END OF SECTION

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 This Section specifies the design, supply, manufacture, testing, delivery and site services of process valves.

1.1.2 Complete valves with Actuators, deliver as fully assembled, ready for installation on site.

1.1.3 Mark valves in accordance with MSS SP-25.

1.1.4 Read in conjunction with construction drawings for connections details, submit shop drawing for approval before manufacture.

1.1.5 Read in conjunction with Section 11290A valve schedule & 16994 / 16994a Instrument Specification Sheets.

1.1.6 All materials shall be compatible with the liquids in contact.

1.1.7 All valves in contact with water or chemicals shall be NSF 61 listed. All material in contact with water and chemicals shall be NSF 61 certified or food grade, except for stainless steel.

1.1.8 Provide electric on/off valve shown on drawings.

1.1.9 All bolts, nuts, washers and installation hardware to be SS316L.

1.2 REFERENCES

1.2.1 The American Society of Mechanical Engineers (ASME):

(1) B16.1, Cast Iron Pipe Flanges and Flanged Fittings, Class 25, 125, 250, and 800.

1.2.2 American Society for Testing and Materials (ASTM):

(1) A126, Standard Specification for Gray Iron Castings for Valves, Flanges, and Pipe Fittings.

(2) A313/A313M, Standard Specification for Stainless Steel Spring Wire.

(3) A351/A351M, Standard Specification for Castings, Austenitic, for Pressure-Containing Parts.

(4) B148, Standard Specification for Aluminum-Bronze Sand Castings.

(5) B584, Standard Specification for Copper Alloy Sand Castings for General Applications.

1.2.3 American Water Works Association (AWWA):

(1) C500, Metal-Seated Gate Valves for Water Supply Service.

(2) C504, Rubber-Seated Butterfly Valves, 3 In. (75 mm) Through 72 In. (1,800 mm).

(3) C507, Ball Valves, 6 In. Through 60 In. (150 mm Through 1,500 mm).

(4) C508, Swing Check Valves for Waterworks Service, 2-In. Through 24-In. (50-mm Through 600-mm) NPS.

(5) C509, Resilient-Seated Gate Valves for Water Supply Service.

(6) C514, Air Valve and Vent Inflow Preventer Assemblies for Potable Water Distribution System and Storage Facilities.

(7) C515, Reduced-Wall, Resilient-Seated Gate Valves for Water Supply Service.

(8) C517, Resilient-Seated Cast-Iron Eccentric Plug Valves.

(9) C520, Knife Gate Valves, Sizes 2 In. (50 mm) Through 96 In. (2,400 mm).

(10) C530, Pilot-Operated Control Valves.

(11) C540, Standard for Power-Actuating Devices for Valves and Sluice Gates.

(12) C550, Protective Interior Coatings for Valves and Hydrants.

1.2.4 Manufacture's Standardization Society (MSS):

(1) SP25, Standard Marking System for Valves, Fittings, Flanges, and Unions.

(2) SP139, Copper Alloy Gate, Globe, Angle, and Check Valves for Low Pressure/Low Temperature Plumbing Applications.

1.2.5 National Sanitation Foundation (NSF):

(1) NSF 61, Drinking Water System Components – Health Effects.

1.3 SUBMITTALS

1.3.1 Submit with Bid a copy of this Section with each paragraph check marked to indicate spec compliance or provide explanations for any proposed deviation.

1.3.2 In accordance with Section 01300.

1.3.3 A copy of this specification and all other relevant specification and addenda updates, with each paragraphs check marked to show specification compliance or marked to show deviations with explanations.

1.3.4 NSF/ANSI/CAN 61 certification of valves, material and coating. Manufacturer's literature and cut-sheets, include information of head loss characteristics through

the valve, operating torque and valve end configuration, I/O and power requirements of electrical actuators.

1.3.5 PDF format and Excel spread calculation with formulas for sizing air, vacuum and combination release valves. The calculation shall be performed, signed and stamped by a competent professional engineer.

1.3.6 Material specification.

1.3.7 Installation Instruction, Operation and Maintenance Manual (O&M).

1.4 QUALITY ASSURANCE

1.4.1 Manufacture shall regularly design, manufacture and supply valves of this section in the recent ten years and have a minimum 20 success project references.

1.4.2 All valves shall be provided by a single manufacture to the maximum extend.

1.4.3 Perform shop testing and get approval before shipment.

1.5 DELIVERY, STORAGE, AND HANDLING

1.5.1 Package the valves suitable for outdoor storage. Protect equipment from damage, construction activities, dust, damp, adverse weather and temperature.

1.5.2 Tag the package with the name of the installation location and the valve tag numbers.

1.6 WARRANTY

1.6.1 Provide compliance and performance guarantee.

1.6.2 Provide written warranty against faulty design, construction and excessive wear and tear of equipment for a period of at least two (2) years from the overall Project Acceptance date, anticipated in 2025.

1.6.3 In case of rejection of any valve, allow the unit to remain in service and under the control of the end user, without charging, for such time as may be required to provide and deliver a replacement.

PART 2 PRODUCTS

2.1 ACCEPTABLE VALVE MANUFACTURERS

Valve Type	Accepted Manufacturers
Ball Valves (100 mm and smaller)	Velan, M.A. Stewart & Sons Ltd, NVC,
Butterfly Valves (80 mm and larger)	Bray, Keystone, Pratt, DeZurik, Clow, Victaulic
Air Valves	Pratt, Apco, Valmatic, ARI

Valve Type	Accepted Manufacturers
Solenoid Valves	ASCO, Burkett
PVC Valves	Chemline, Hayward, Georg Fischer

2.2 ACCEPTABLE ELETRIC OPERATOR MANUFACTURERS

2.2.1 Rotork, EIM, Limitorque, Auma.

2.3 VALVES

2.3.1 Coat Iron or Steel valve with fusion bonded epoxy in accordance with AWWA C550, interiorly and exteriorly.

2.3.2 Valves to open counter-clockwise.

2.3.3 Ball Valve:

(1) Smaller than 100 mm, stainless steel ball valves:

(a) Full port, with 3-piece body, quarter turn lever handle and FNPT threaded end connections.

(b) Body and cap manufactured of stainless steel.

(c) Pressure rating of Class 250.

(d) The ball shall be replaceable and manufactured of solid stainless steel.

(e) Teflon seat.

2.3.4 Butterfly Valve:

(1) 80 mm and larger:

(a) Conform to AWWA C504.

(b) Flange style body ANSI B16.1 Class 125, or approved alternative. The use of a stop lug cast integrally with or mechanically secured to the body for the purposes of limiting disc travel by mean of direct contact or interference with the valve disk will not be acceptable;

(c) Gray iron, ductile iron or stainless steel bodies with synthetic rubber seat.

(d) ANSI Type 304 or 316 stainless steel valve shafts.

2.3.5 Air, Vacuum and Combination Release Valve:

(1) Double flange connections to ASME B16.1 Class 125 or ASME B16.5 Class 150, or NPT threaded ends.

(2) Conform to AWWA C512 and C514.

(3) Complete with isolating ball or gate valve.

(4) The valve body, cover, baffle shall be constructed of ASTM A126 Class B cast iron for working pressures up to 300 psig.

(5) The orifice, float, bushing and linkage mechanism shall be constructed of Type 316 stainless steel. Non-metallic floats or linkage mechanisms are not acceptable. The orifice button shall be Viton for simple lever valves and Buna-N for compound lever designs.

2.3.6 Solenoid valve:

(1) All solenoid valves will operate on 120VAC single phase 60 Hz power supply, be constructed from stainless steel.

(2) Specially constructed with a dampening device to prevent water hammer. Valves will be diaphragm type. The diaphragm will be supported by a metal backing plate to protect the diaphragm. Valve body and trim material will be brass or stainless

Steel.

(3) Coil replacement must be possible without shutting off water supply to the valve.

2.3.7 PVC Ball Valve:

(1) Type 1 PVC ball valve 80 mm or smaller.

(2) True union connection for valve 50 mm or smaller, double flange connection for valve 65 mm or 80 mm.

(3) Full port design.

2.3.8 PVC Butterfly Valve:

(1) PVC Type 1 of wafer type design, 100 mm and above.

2.3.9 PVC Check Valve:

(1) Wafer style for valve 50 mm or above.

(2) True Union style for valve 40 mm and smaller.

(3) EPDM seat/seals with free floating ball designed for either vertical or horizontal installation and rated for 150 psi.

2.4 ACTUATORS

2.4.1 Provide manual actuators, unless otherwise specified in Section 16994 / 16994a or as shown on Construction Drawings.

2.4.2 Ensure that all pneumatic or electrical actuators will stay in position on loss of instrument air or control signal.

2.4.3 Design and install valve actuators to facilitate adjustment of valve packing without removal of the actuator.

2.4.4 Ensure that all handwheel actuators are enclosed and sealed for protection against corrosion and other damage;

2.4.5 Ensure that all valve actuators are removable without taking the associated valve out of service.

2.4.6 Ensure that all torque and limit switches will be adjustable.

2.4.7 Equip electric actuated with a manual override.

2.4.8 Provide manual actuators in accordance with the following:

(1) For valves 150 mm and smaller, provide direct acting lever or handwheel actuators of the manufacturer's best standard design.

(2) For valves 150 mm and larger valves and gates, provide gear-assisted manual actuators, with an operating pull of maximum 226 Newton (60 lbs) of the rim of the handwheel.

(3) Provide T wrench operator to butterfly valve HV3-1-03.

(4) Where valves cannot be reasonably located within 2.0 m above the floor or operating level, provide chain drives consisting of sprocket-rim chain wheels, chain guides, and operating chains. The wheel and guide will be ductile-iro cast iron or steel, and the chain will be stainless steel, extending to 1200 mm above the operating floor level. The valve stem of chain-actuated valves will be designed for the additional load from the weight and chain pull. Provide hooks for chain storage where chains interfere with pedestrian traffic.

2.4.9 Electric Actuators:

(1) Provide Electric Actuator as specified in Section 16994 / 16994a or as shown on Construction drawings, comply with AWWA C540.

(2) The motor operated valve actuator will include the motor, operator unit gearing, limit switch gearing, limit switches, torque switches, indication, local control, bored and key wayed drive sleeve for non-rising stem valves, declutched lever and auxiliary handwheel as a self-contained unit.

(3) The motor will be specifically designed for valve operator service requiring electric power.

(4) The motor will be sized per AWWA Standards for electric motor operators and will be totally enclosed, non-ventilated type.

(5) Include a handwheel for “Manual” operation which will display an embossed or engraved arrow, together with “Open” and / or “Close” legend; A clutch will prevent operation of the motor when the handwheel is engaged and disconnect the drive to the handwheel when the motor is energized. The force to be exerted on the rim of the handwheel will not exceed 180 N when opening or closing.

(6) Rated for use on a 120 Volt, single phase, 60 Hz power.

(7) Be designed for at least 12 full cycles (opening/closing) per hour, including two in immediate succession at the end of the hour.

(8) Be equipped for remote operation. A “Test / Off / Auto” selector switch will be provided as an integral part of the actuator. When “Auto” is selected the local “Stop” button will still be operative.

(9) Have a local mechanical position indicator fitted in the actuator to clearly indicate when the valve is fully open, fully closed, or in any intermediate position.

(10) Have waterproof enclosures forming part of each actuator. The motor enclosure will be at least.

(11) NEMA 4X and the actuator terminal box at least NEMA 4X. Terminals on the actuator terminal block will be clearly labelled and will correspond with the identification shown on the manufacturer’s diagram of connections.

(12) Have a torque rating approximately 50% in excess of that required to operate the valve under the specified operating conditions. The torque limit switches will be set to protect the valve, gearbox, and actuator under all operating conditions specified; and have an anti-condensation heater.

(13) Include anti-condensation heater.

2.5 SPARE PARTS

2.5.1 For each type of the valve, provide standard spare parts package for one year operation.

PART 3 PRODUCTS

3.1 INSTALLATION

3.1.1 Install by Contractor in accordance with contract drawings and manufacturer’s installation instructions.

3.1.2 When installed butterfly valves near elbows or tees, shaft shall be positioned parallel to plane of curve such that flow will not create either opening or closing forces upon the valve disc.

3.1.3 Install valves with seat away from direction of pressure, where applicable.

Section 11290A – Valves Schedule

Tag	Quantity	Type	Description
MV3-1-0X	1	600mm, Motorized Butterfly Valve	UV1 Effluent Control Valve
MV3-1-0X	1	600mm, Motorized Butterfly Valve	UV2 Effluent Control Valve
HV3-1-0X	1	600mm, Hand-operated Butterfly Valve	UV1 Inlet Isolation Valve
HV3-1-0X	1	600mm, Hand-operated Butterfly Valve	UV2 Inlet Isolation Valve
HV3-1-0X	1	600mm, Hand-operated Butterfly Valve	UV Effluent Main Isolation Valve
SV3-1-0X	1	40 mm, Solenoid Valve	UV1 Cooling Water Inlet Isolation
SV3-1-0X	1	40 mm, Solenoid Valve	UV1 Cooling Water Outlet Isolation
SV3-1-0X	1	40 mm, Solenoid Valve	UV2 Cooling Water Inlet Isolation
SV3-1-0X	1	40 mm, Solenoid Valve	UV2 Cooling Water Outlet Isolation
ARV3-1-0X	1	25 mm, Air Release Valve	UV2 Effluent Header Air Release
ARV3-1-0X	1	25 mm, Air Release Valve	UV Effluent Main Air Release

END OF SECTION

DIVISION 16
ELECTRICAL

PART 1 GENERAL

1.1 RELATED WORK

1.1.1 Refer to Division 1 for General Requirements related to the Contract Documents.

1.1.2 Refer to Division 3, 4 & 5 (Structural), Division 11 (Process Mechanical), and Division 16 (Electrical & Instrumentation).

1.1.3 The following Sections of Division 16 are included for Electrical & Instrumentation installation:

1.2 GENERAL

1.2.1 The Electrical General Requirements and the specifications bound herewith shall be subject to all the requirements of the General Conditions and the Supplemental General Conditions of Division 1, except that these Electrical General Requirements shall take precedence over and modify any pages or statement of the Supplemental General Conditions and shall be used in conjunction with them as a part of the Contract Documents.

1.2.2 It is the intention of these specifications and drawings, to provide for a complete and fully operating electrical system, with facilities and services to meet the requirements described herein, and in complete accord with applicable codes and ordinances.

1.2.3 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 drawings, required for the installation testing and placing into service the complete electrical system, except when it is specifically mentioned that certain materials and/or labour are not part of the Contract Documents.

1.2.4 All electrical work must be coordinated with Division 11 - Process Mechanical, Division 15 - Mechanical. It is the Contractor's responsibility to co-ordinate the Work of all sub-trades on this project and to ensure that the Work covered under related Divisions is completed by qualified personnel.

1.2.5 A copy of Division 16 should be provided to the various instrumentation and process mechanical system suppliers to ensure their equipment meets the intent of the specifications

1.3 EQUIPMENT MANUFACTURERS

1.3.1 All equipment shall be manufactured by experienced manufacturers who can demonstrate in-use records for all equipment offered.

1.3.2 Requests for approval of alternative suppliers shall be submitted to the Engineer prior to tender closing. Refer to Section 01300 - Submittals.

1.3.3 The majority of equipment shall be supplied by a single manufacturer, particularly where aesthetics is of concern, such as in panels, and luminaires.

1.3.4 All control panels shall be CSA certified.

1.4 CODES AND STANDARDS

1.4.1 Do complete installation in accordance with CSA C22.1:21, BC Building Code, BC Electrical Safety Branch amendments except where specified otherwise.

1.4.2 Do underground systems in accordance with CSA C22.3 No.7-M86 except where specified otherwise.

1.4.3 All Work shall be executed in accordance with the current codes, standards, statutes or recommendations of the following technical societies, trade organizations, and governing agencies, and shall be subject to the inspection of those departments having jurisdiction:

(1) Sunshine Coast Regional District Ordinances.

(2) Canadian Electrical Code (CEC) C22.1 latest edition as amended by local inspection authority.

(3) BC Hydro Standards and Requirements.

(4) BC Tel Standards and Requirements.

(5) BC Building Code and WCB.

(6) Institute of Electrical & Electronics Engineers (IEEE).

(7) National Fire Protection Association (NFPA).

(8) National Electrical Manufacturers Association (NEMA).

(9) International Organization for Standardization (ISO).

(10) International Electro technical Commission (IEC).

(11) Canadian Standards Association. (CSA).

(12) Insulated Cable Engineers Association (ICEA).

(13) Illuminating Engineering Society of North America (IES).

1.4.4 Where Work required by the drawings and specifications is above the standards required by these organizations or agencies, it shall be done as shown or specified.

1.4.5 All fees, permits, licenses, etc., necessary in order to complete the Work of this section shall be obtained and paid by the Contractor.

1.5 COMPLIANCE

1.5.1 Failure to comply to the drawings and specifications shall be cause for rejection and the Contractor shall be required to make good at no additional cost to the Owner or their agents.

1.6 INSTALLATION OF EQUIPMENT

1.6.1 Install all equipment in accordance with the Manufacturer's recommendations and in a manner that will ensure satisfactory operation upon completion.

1.6.2 Provide all labour and all necessary equipment including timbers, scaffolding, tools and rigging materials for installation of the equipment.

1.6.3 The Contractor shall be responsible for coordinating all mechanical, instrumentation and other works for the equipment being installed.

1.6.4 The installation of certain mechanical items specified to be supplied in this section may or may not be specified to be installed in Division 11. The Contractor shall coordinate this activity.

1.6.5 The installation of certain instrumentation and control items specified to be supplied in this section may or may not be specified to be installed in Division 16. The Contractor shall coordinate this activity.

1.7 MANUALS

1.7.1 Refer to Division 1, General Requirements, Section 01700 Contract Closeout, for requirements for Operation and Maintenance Manuals.

1.7.2 Provide operating and maintenance brochures for all equipment and arrange for their insertion into the Operation and Maintenance Manuals. The brochures shall include all applicable, descriptive, and technical data, maintenance and operating procedures, wiring diagrams, spare parts lists, service representatives, and suppliers for replacement parts. The brochures shall be neatly and orderly assembled in binders.

1.7.3 Requirements for operation and maintenance of process control and instrumentation equipment shall be as specified in various sections of Division 16 and Section 01700 – Contract Closeout.

1.8 SHOP DRAWINGS

1.8.1 Refer to Section 01340 – Shop Drawings.

1.8.2 Shop drawings shall be submitted for all major equipment as designated in the “GENERAL” paragraph of each section of these specifications.

1.8.3 Shop drawings shall be first checked by the Contractor for space, dimension, performance characteristics and general conformance to the drawings and specifications and shall be so stamped. Shop drawings not stamped as specified

will be returned to Contractor without action. Contractor's stamp shall include name and address of Contractor, the date checked, the initials of the checker, and the status of the checking.

1.8.4 Shop drawing submittals shall be grouped according to specification section or categories and shall be labeled with the proper name of the project and specification section. Partial submittals of a group or category will not be reviewed (e.g., submit all panels, all lighting fixtures, etc.).

1.8.5 Shop drawings shall include Manufacturer's name and address, equipment or material descriptive names, and catalog number. Shop drawings shall indicate dimensions, voltage and current characteristics, wire sizes, test or conformance data, construction, and rough-in data of all material to be used.

1.8.6 Submit shop drawings and/or product literature for system components as called below, but not limited to:

(1) Cables & Accessories.

(2) Electrical Protection and Metering Products.

(3) Molded Case Circuit Breakers. (MCCB).

(4) Safety Disconnect Switches. (DS).

(5) Distribution Transformers.

(6) Panelboards and Accessories.

(7) Switches, Wall Boxes, Pull Boxes & Raceways.

(8) Terminal Relays.

(9) Terminal and Wire Marking System.

(10) Lightning and Surge Protectors.

1.8.7 Shop drawings shall be clear and legible. Fax copies are not acceptable.

1.8.8 Shop drawings shall be dimensioned.

1.8.9 The Engineer's review includes for a general overview of shop drawings for conformity to project requirements in accordance with the Contract Documents and does not relieve the Contractor of errors or discrepancies.

1.8.10 Allow ten (10) working days for the review and processing of shop drawings.

1.9 SHOP DRAWINGS – REGISTER AND REVIEW PROCEDURE

1.9.1 Contractor sends shop drawings to Engineer. Shop drawings will be registered there in a master registry to summarize the status of all the shop drawings that are received.

1.9.2 The number of sets of shop drawings to be submitted will be one (1) digital copy. Engineer will retain one (1) copy for file and distribute either through the Engineer or directly to the applicable reviewer.

1.9.3 Shop drawings will be date-stamped, numbered, and registered as they are received by the Engineer. A standard review stamp will be used for all drawings.

1.9.4 Shop drawings will be numbered in accordance with the specification sections from which they are derived, e.g., cable tray shop drawings would be numbered as follows:

(1) 16114-01 and after re-issue.

(2) 16440-02 etc.

1.9.5 A submission does not have to be only one item but can consist of a package of items that can be reviewed as a whole.

1.9.6 For example, a pump submission may consist of:

(1) General Arrangement.

(2) Pump Curve.

(3) Motor Sheet.

(4) Control Panel.

1.9.7 These should all be grouped under one (1) number.

1.9.8 On each shop drawing register sheet, enough room will be left to provide room for resubmitted shop drawings. Each resubmission will be given the same number along with the revision number (Rev. 1, Rev. 2, etc.) and will be documented immediately below the submission.

1.9.9 Shop drawings that have been reviewed shall be distributed to the Owner and Contractor.

1.9.10 The shop drawings review procedure is as follows:

(1) The file copy will be reviewed as follows:
- All acceptable elements are checked with yellow pencil.
- All corrections are noted in red pencil.
- All notes or other instructions are made in red pencil.

(2) If elements of the shop drawing are not being checked, then no mark is made on the file copy.

(3) All red notes from the file copy are then transferred to the distribution copies.

(4) All drawings are then stamped and marked as required (i.e., Review, Reviewed as Modified, Revise and Resubmit, Not Reviewed). The date and signature are also entered on all copies in red ink.

(5) All shop drawings to be reviewed and returned in two (2) weeks.

1.10 DRAWINGS OF RECORD

1.10.1 One (1) complete set of construction drawings shall be kept on site. Records during construction will be maintained as per Section 01390 – Drawings of Record.

1.11 COORDINATION OF WORK

1.11.1 Cooperate and coordinate with other trades on the project.

1.11.2 Make suitable arrangements with other trades to make provision for the electrical work and be responsible for the assurance that such provisions are satisfactory for the electrical work.

1.11.3 Check drawings and specifications of other trades for conflict and coordination with the electrical trade. If any conflicts are found, obtain a ruling from the Engineer before proceeding.

1.12 POWER SUPPLIES

1.12.1 Provide all necessary power supplies for other trades.

1.12.2 Power wiring to field devices shall be not less than #12AWG.

1.13 WORK INCLUDED

1.13.1 The Work included is the provision and commissioning of a complete and fully functional UV disinfection system c/w link to the existing plant SCADA system. The Work shall include any equipment, material and labour not specifically noted or detailed in the specifications and drawings, but which is evidently required to furnish a complete system. The Work shall include but not be limited to:

(1) Install Vendor supplied UV Disinfection systems (one (1) duty and one (1) standby) including the Control Power Panels (CPP), UV transmittance monitoring systems, and instruments provided with the UV system.

(2) Provide two (2) 600V-480V transformers for the UV system control panels (one for each system).

(3) Distribution upgrades to the MCC section with new 60A breakers for the CPP feeders:

- Install three (3) new 120VAC 15A breakers in the P2A panel for the following new equipment:

  (i) Magnetic Flow Meter

(ii) 20” Actuated Butterfly Valve

(iii) OptiView UVT Monitor Panel

Provide circuit breakers that match the other existing circuit breaker manufacturers in panel P2A.

(4) Provide TECK 90 cables, in the existing cable trays, from the existing MCC located in the electrical room to the new transformers, and from the UV system CPPs to the new UV reactors. Additionally provide TECK 90 cables, from panel P2A to the new 120VAC equipment mentioned in the above Section 1.13.1.

(5) Remove the existing UV system and the afferent cables, transformer, and panel after the installation and commissioning of the two (2) new UV reactors.

(6) UV system grounding, connection to existing grounding loop.

(7) A high level of coordination will be required with process mechanical installer (Division 11). Responsibility shall include receiving, uncrating, examining for shortages or damage, assembling, field fitting, installing, mounting, wiring, and testing of Vendor supplied subsystems.

(8) All required seismic restraints for all EI&C equipment and installations.

(9) Allow in the Tender Price sufficient time to test, adjust, demonstrate, and troubleshoot the complete control system including all devices and wiring. The Contractor shall have a fully qualified and available control technician(s) to work totally independent or with the installed equipment representative until a complete control system is commissioned and works reliable and trouble free.

(10) Start-up and commissioning of the complete control system.

1.13.2 The associated instrumentation, as detailed on the drawings and datasheets. The Work shall include but not be limited to:

(1) Field commissioning, adjustments, and certified manufacturers acceptance reports.

(2) Provide power and controls cable to associated instrumentation.

(3) Program the instrumentation & valves with the UV system.

1.13.3 Field commissioning, adjustments, and certified manufacturers acceptance reports.

1.14 WORK NOT INCLUDED

1.14.1 Not used.

1.15 WORKMANSHIP

1.15.1 Workmanship shall be the best quality, executed by workers qualified to do electrical work as defined under Part 4 of the Electrical Safety Act.

1.15.2 The Engineer reserves the right to require the dismissal from the site of workers deemed incompetent.

1.15.3 In cases of dispute, decisions as to the quality, fitness, or workmanship rest solely with the Engineer, whose decision is final.

1.15.4 If any of the work is such as to make it impractical to produce required results, immediately notify the Engineer.

1.15.5 All exposed parts of the electrical wiring systems such as exposed conduits, flush plates, cabinet trim, fixtures, etc., shall be square and true with the building construction.

1.16 DRAWINGS AND SPECIFICATIONS

1.16.1 The drawings and specifications shall be used together, and all materials and labor mentioned in one but omitted from the other shall be considered as sufficiently specified and shall therefore be supplied and installed.

1.16.2 The location of various items on the drawings is approximate, unless specified otherwise, and is subject to slight revisions as the Work is installed in order to accommodate construction conditions.

1.16.3 Where equipment and material dimensions are dependent upon building dimensions take field measurements, do not scale the drawings.

1.16.4 The drawings are not intended to be scaled for roughing-in measurements nor to serve as shop drawings.

1.16.5 The Contractor shall consult the architectural, structural, mechanical, or equipment drawings for dimensions, obstructions, and location of equipment of other trades. Any discrepancies between architectural, structural, mechanical, or equipment drawings and the Work shown on the electrical drawings shall be reported to the Engineer for adjustment.

1.16.6 The installation details, instructions, and recommendations of the manufacturer of the product used, or modified to obtain the best end result, shall be the basis of attaining installation of the products for usage on this project except where definite and specific instructions are set forth herein or details are shown on the drawings.

1.16.7 Outlet devices, switches, panels, cabinets, fixtures, and special equipment are shown on the drawings only in a schematic manner and not necessarily in their specific location. The Contractor shall be responsible for exact locations of the outlets to form a functional and aesthetic installation either by careful review of all architectural elevations, tile patterns, surface finishes, and equipment arrangements or by consultation with the Engineer and other trades involved.

1.17 ERRORS AND OMISSIONS

1.17.1 In the event of errors or discrepancies between the drawings and specifications, the Contractor shall obtain a ruling before Tenders are submitted.

1.17.2 If a ruling has not been requested, it shall be assumed that in event of a discrepancy, the Contractor has allowed for the more expensive alternative.

1.18 ALTERNATIVE EQUIPMENT

1.18.1 The Contractor is required to submit a base Tender for the specified equipment and show a separate price increase or reduction complete with detailed descriptions for alternative equipment.

1.18.2 The Engineer shall review alternate equipment after Tender submissions and be the sole judge of the acceptability of alternatives. Alternate proposals shall include comprehensive details and any perceived benefits to the Owner.

1.18.3 After the award of the Contract Documents, any request for a substitution must be made in writing by the Contractor (not Material Supplier or Subcontractor). Such request shall state the name of the product specified, the name of the product proposed for substitution, the reason for requesting the substitution, and any change in Contract Amount resulting from the substitution. No such substitution shall be made until an appropriate contract modification has been issued and approved.

1.19 AS-BUILT DRAWINGS

1.19.1 The Contractor is required to keep current a marked-up set of drawings recording all modifications to the electrical equipment on site and upon request provide to the Engineer for review.

1.19.2 After commissioning the Contractor shall transfer all changes to a single set of drawings.

1.19.3 At the time of Substantial Performance, the Contractor shall amend the CAD files. Obtain the services of an approved CAD draftsperson to transfer all changes to amend the CAD files in AutoCAD 2005. Include all revisions and change orders. Submit the “Record Drawing” CAD files and one (1) set of plots to the Engineer prior to Total Performance of the Contract Documents.

1.19.4 No Substantial Performance shall be issued until final “Record Drawing” CAD files and one (1) set of prints have been received and accepted by the Engineer.

1.20 GUARANTEE / WARRANTY

1.20.1 The Contractor shall guarantee/warrant all equipment supplied by the Contractor and replace at the Contractor’s expense any part which may fail or prove defective within a period of 12 months after final acceptance.

1.20.2 Lamps are the only exception to this guarantee period.

1.21 VOLTAGE RATINGS

1.21.1 Operating voltages: Site voltage is 600V, 3 phase, 60 Hertz. UV System is 480V 3 phase.

1.22 MATERIALS AND EQUIPMENT

1.22.1 Provide materials and equipment in accordance with this Division and other related Divisions.

1.22.2 Equipment and materials to be CSA certified or have equivalent electrical certification as accepted in the Province of BC.

1.22.3 Where there is no alternative to supplying equipment which is not certified, as specified, obtain special approval from Electrical Inspection Authority.

1.23 PAINTING AND FINISHES

1.23.1 Thoroughly clean and degrease metal surfaces before priming and painting with two (2) air-dried coats of finish paint to provide an average thickness of 5 mils.

1.23.2 Paint indoor SES, MCC Sections and Control Panel enclosures ASA Gray to match existing.

(1) All steel parts (except plated parts) shall be provided with UL Listed and CSA certified acrylic/alkyd baked enamel paint finish. All painted parts shall undergo a multi-stage treatment process, followed by the finishing paint coat.

(2) Pre-treatment shall include:

(a) Hot alkaline cleaner to remove grease and oil.

(b) Iron phosphate treatment to improve adhesion and corrosion resistance.

(3) The paint shall be applied using an electro-deposition process to ensure a uniform paint coat with high adhesion.

(4) The standard paint finish shall be tested to UL 50 per ASTM B117 (5% ASTM salt spray) with no greater than 0.125 in (3 mm) loss of paint from a scribed line.

(5) Paint color shall be #49 medium light gray per ANSI standard Z55.1-967 (60-70 gloss) on all surfaces, unless otherwise specified. Control station plates and escutcheon plates shall be painted a contrasting gray. All unit component mounting pans for combination starters shall be painted white for better visibility inside the unit.

1.23.3 Where touch-up or repainting is required use paint obtained from the equipment manufacturer.

1.24 CONTRACTOR'S RESPONSIBILITY

1.24.1 The Contractor shall be responsible for the equipment and work until its completion and final acceptance.

1.24.2 The Contractor shall replace any item which may be damaged, lost or stolen without additional cost to the Owner.

1.24.3 Install all the Work promptly and in advance of concrete pouring or similar construction.

1.24.4 Co-ordinate with other Divisions the placement of in-slab conduits and sleeves prior to pouring.

1.24.5 Co-ordinate the Work with other Divisions such that all equipment, conduits, and wiring will be installed in the best arrangement.

1.24.6 Protect finished and unfinished work from damage. Any equipment or material damaged by weather, mishandling or other incident shall be replaced with new equipment and material at the direction of the Engineer and at no additional cost.

1.24.7 Before acceptance clean all exposed surfaces of lighting luminaries, lamps, Starters, Motor Control Panels and other electrical equipment of dust and plaster. Restore any damaged paint surfaces to factory-quality finish.

1.24.8 Furnish all work and materials in accordance with CSA codes, provincial and local inspection department, and BC Hydro regulation requirements.

1.25 LOCATION OF EQUIPMENT

1.25.1 Examine and study the Architectural, Structural and Mechanical drawings for items affecting the installation of the Work under this specification and locate conduit runs, pull and junction boxes, disconnects, controlled equipment and panels accordingly and such that working clearances and maximum ceiling heights can be maintained, and to avoid conflict with other installations.

1.25.2 Any device, panel or equipment which is miss-located as a result of failure to observe the foregoing instructions shall be relocated without extra cost.

1.25.3 If a specific equipment location is in question, request directions from the Engineer.

1.26 ALIGNMENT OF ELECTRICAL COMPONENTS

1.26.1 Where there are two (2) or more equipment items (switches, outlets, panels, or related equipment) are installed together, they shall be aligned vertically and/or horizontally to present a neat orderly appearance.

1.26.2 They shall also be aligned and symmetrical with architectural elements.

1.27 ACCESSIBILITY

1.27.1 Install all Work so as to be readily accessible for adjustment, operation, and maintenance.

1.28 EQUIPMENT IDENTIFICATION

1.28.1 Identify electrical equipment with name plates and labels as follows:

Nameplates:

Lamicoid 3 mm thick plastic engraving sheet, white face, black core, mechanically attached with self tapping screws unless noted otherwise.

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

1.28.2 Wording on nameplates to be approved by Engineer prior to manufacture.

1.28.3 Allow for average of 25 letters per nameplate.

1.28.4 Identification to be English.

1.28.5 Disconnects and contactors: indicate equipment being controlled and voltage.

1.28.6 Terminal cabinets and pull boxes: indicate system and voltage.

1.28.7 Transformers: indicate capacity, primary and secondary voltages.

1.29 WIRING IDENTIFICATION

1.29.1 Identify wiring with permanent indelible markings, either numbered or colored plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.

1.29.2 Maintain phase sequence and color coding throughout.

1.29.3 Color-coding to C22.1:21.

1.29.4 Phase terminations shall be red, black, blue, and wiring changes to obtain proper rotation shall be made at end devices, i.e., motors.

1.30 CONDUIT AND CABLE IDENTIFICATION

1.30.1 Colour code conduits, boxes, and metallic sheathed cables.

1.30.2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or flooring, and at 15 m intervals.

1.30.3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

1.30.4 Colour code conduits, boxes, and metallic sheathed cables.

	Prime	Auxiliary
up to 250 V	yellow	
up to 600 V	yellow	grey
up to 5 kV	yellow	blue
up to 15 kV	yellow	red
up to 25 kV	yellow	black
Telephone	green	
Other communication syst	green	blue
Fire alarm	red	
Emergency voice	red	blue

1.30.5 Provide cable identifications and follows:

(1) All cables shall be tagged with markers showing the complete cable numbers at locations as follows:

(a) Cables entering starters, panels one (1) marker immediately above (or below) glanding plate or cabinet bottom.

(b) In addition to the above one (1) marker at point where cables enter starters.

(c) All control conductors of all cables shall be marked with the complete wire number at both ends.

(d) All wire shall be identified by thermoplastic PVC sleeve type wire markers.

(e) Wire markers shall be the individual interlocking type assembled to compose the wire number or a continuous tubular sleeve type custom hot stamped with the wire number.

1.31 WIRING TERMINATION

1.31.1 All wires are to be terminated on approved lugs or terminal blocks suitable for copper conductors.

1.32 SEISMIC RESTRAINS

1.32.1 Provide seismic restraint and anchorage for all equipment and services in accordance with current Canadian Building Code, and all applicable Building Bylaws. Submit shop drawings certified by a Registered Professional Structural Engineer registered in the Province of British Columbia, indicating seismic anchoring points and methods. See requirements as stated in Section 16195 – Seismic Restrains.

1.32.2 The completed installation is to be certified by a Registered Professional Engineer to demonstrate that the equipment meets the requirements of all Codes and Bylaws in terms of “withstanding” all forces in any direction to be expected in the project seismic zone. “Withstanding” shall generally mean remaining in one (1) piece and not breaking away from moorings.

1.33 MOTORS

1.33.1 Not Applicable.

1.34 POWER FACTOR CORRECTION

1.34.1 Not Applicable.

1.35 PROTECTIVE DEVICES

1.35.1 The Contractor shall ensure circuit protective devices such as circuit breakers, overload relays and fuses are installed and set to required values.

1.36 OVERTIME

1.36.1 The Contractor shall include all overtime costs (if required) in the Contract Price.

1.37 FIELD QUALITY CONTROL

1.37.1 The Contractor shall conduct and pay for following tests:

(1) Power distribution system including phasing, voltage, grounding, and load balancing.

1.37.2 Provide a manufacturer's certificate or letter confirming that the entire installation as it pertains to each system had been installed in accordance with the Manufacturers' instructions.

1.37.3 Insulation Resistance Testing:

(1) Megger circuits, feeders, and equipment up to 350 V with a 500 V instrument.

(2) Megger 350-600 V circuits, feeders, and equipment with a 1000 V instrument.

(3) Check resistance to ground before energizing.

1.37.4 Carry out tests in presence of the Engineer.

1.37.5 Provide instruments, meters, equipment, and personnel required to conduct.

1.37.6 Ground fault detectors shall be dynamically tested by injecting current flow into the zero-sequence current sensor.

1.37.7 Submit test results for Engineer's review.

1.38 CONSTRUCTION PERIOD TESTS

1.38.1 All the Work which is required to be placed within the construction or concealed shall be carefully tested and inspected before being permanently covered up.

1.38.2 All tests shall be made in the presence of the Engineer or the Owner and shall meet with their approval.

1.39 START-UP, TESTING, AND COMMISSIONING

1.39.1 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. Refer to Section 16991 – Distribution Equipment, Startup & Testing.

1.39.2 Results of tests are to be logged by the Contractor and submitted to the Engineer. Any apparent defects shall be reported and corrected.

1.39.3 When preliminary checks have been completed and equipment is operating or ready to operate, individual systems shall be setup in accordance with the specifications and/or Manufacturer's recommendations. After setup, the system shall be placed in operation in conjunction with the Engineer and/or the Owner's designated operating personnel.

1.39.4 In general, the start-up and commissioning shall be in accordance with Section 01650.

1.40 SUBSTANTIAL COMPLETION INSPECTION

1.40.1 Prior to substantial completion inspection, submit written confirmation that:

(1) The installation as specified is completely assembled and wired.

(2) All wiring devices, plates, lighting fixtures and other equipment are operational, clean, and correctly labeled.

(3) All systems have been tested as required and are in proper working order.

(4) Panel-board directories have been completed and all lamicoid nameplates have been installed.

(5) Factory finished equipment has been cleaned, touched up or refinished to present a new appearance.

(6) Protection relays and/or instrumentation (circuit breakers, overload relays, ground fault detectors, metering equipment) has been set up and tested.

(7) Maintenance manuals have been submitted.

1.41 CARE, OPERATION AND START-UP

1.41.1 Instruct the Owner’s Representatives in the operation, care, and maintenance of equipment.

END OF SECTION

PART 1 GENERAL

1.1 GENERAL

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

1.1.2 Conduct and pay for all required tests.

1.1.3 Provide all required instruments, meters, equipment, and personnel required to conduct tests during and at the end of this project.

1.1.4 Prior to the final demonstration and instructional seminars required by the specifications and drawings, test and check all portions of the electrical system for satisfactory operation. All tests to be done in the presence of the Engineer and/or his representative, suitably logged, tabulated, signed and incorporated in project documentation.

1.2 SCOPE OF WORK

1.2.1 In addition to the requirements detailed in this Section, refer to Section 16010 – General Electrical Requirements, Section 16994 - Instrumentation, Section 01670 – Commissioning and Handover.

1.2.2 The Contractor shall carry out all tests necessary to ensure that the entire electrical installation and its equipment, materials, and components are in a satisfactory physical condition electrically and shall perform the intended functions and operations. Tests shall be conducted by personnel having a minimum of five (5) years' experience in the type of equipment and testing required.

1.2.3 The Contractor shall complete his Quality Control plan and testing plan with the General Requirements and the requirement listed by ANSI/NETA ATS-2009 standard.

1.2.4 The Contractor shall provide all instruments and equipment necessary for the required tests. All instruments shall be recently calibrated and shall have calibration certificates submitted to the Engineer for review. Part of shop drawing approval process, the Contractor shall submit a detailed test procedure including all test acceptance values and a proposed schedule for review by the Engineer prior to commencing test work at the site.

1.2.5 Final tests and checks shall be made in the presence of the Engineer. At the discretion of the Engineer, some of the tests listed separately below may be run concurrently.

1.2.6 The Contractor shall correct all errors, omissions, and deficiencies, which are found by the tests without additional cost.

1.2.7 Results of all tests shall be recorded and one (1) set of test records, comprising a complete checklist for each item tested and all measured values recorded, shall be furnished to the Engineer.

1.2.8 DC test voltages shall be used for hi-pot tests.

1.2.9 Meggers shall not be used on instrument signal wiring, semi-conductor devices, pulse generators, and similar equipment.

1.2.10 Pre-Testing, and verification to include, but not be limited to the following, and all other tests as recommended by the equipment manufacturer:

Test	Performance checked by
Normal visual	Electrical trade
Mechanical inspections	Low voltage systems installers
Megger tests	Electrical trade
Load balance tests	Electrical trade
Distribution voltage checks	Electrical trade
Power factor readings	Electrical trade
Witness testing	Engineer's representative, Electrical trade representative,
Grounding	Electrical trade
Ground Resistance	Electrical trade
Low Voltage systems	Low voltage systems, installer and electrical trade

PART 2 PRODUCTS

2.1 CHECK TAGS

2.1.1 On commencement of each portion of the electrical/instrumentation testing, the "Electrical" or "Instrumentation" checkout tag shall be attached to each piece of electrical and instrumentation equipment and completed. Refer to sample tags in Section 16030. Contractor to supply check-out/testing tags.

PART 3 EXECUTION

3.1 READINESS FOR TESTING

3.1.1 Prior to energization of any equipment and commencement of tests, the Contractor shall visually check and verify that the following has been completed:

(1) The entire assembly is clean inside and outside. The cables are not lying loosely or hanging free. Spare conductors are neatly identified, bundled together and secured.

(2) The equipment is adequately bonded and grounded with the ground wires installed clear of bus work.

(3) The phasing of all bus work and primary circuits is identified.

(4) All equipment is correctly identified (front and back, if applicable).

(5) All cables leaving electrical equipment have proper cable connectors, and are properly identified as per cable schedule and wiring diagrams.

(6) All unused holes are adequately plugged.

(7) All unused wall and floor openings are sealed.

(8) Relay and sections of equipment enclosures are properly identified.

(9) Motors and connected units have been properly fastened down to the base, and aligned. (Signatures affixed by other Contractors to the alignment stage of mechanical checkout tag.)

(10) The installation is in a safe condition, there are not unguarded live parts. Conduit seals are in place if a hazardous condition could occur during the testing phase.

(11) Arc Flash labels in place for all distribution and motor control equipment.

3.1.2 Prefunctional Checkout:

(1) Conduct functional testing in accordance with requirements of Section 16010 and 16994. Prior to functional testing, adjust and make functional all protective devices. Prior to equipment energization, perform a functional checkout of the control circuits. Verify all interlocks and alarms to check that specified actions occur.

3.2 CHECK-OUT TAGS

3.2.1 Upon receipt of equipment attach a “Check-Out Tag” to each piece of equipment that has a designated Tag or equipment number assigned.

3.2.2 On completion of each phase of the installation, enter the appropriate information on the tag, including the test results or make cross-reference to appropriate test forms.

3.2.3 Tag – as shown on the Form 16030-Y; 90 mm x 215 mm size, yellow coloured tag stock with reinforced eye.

3.3 MINIMUM TESTS REQUIRED FOR VARIOUS TYPES OF EQUIPMENT

3.3.1 It shall be understood that the tests stipulated below represent minimum requirements and shall be augmented by any additional tests recommended by manufacturers of particular equipment item or by such tests as are deemed desirable by the Contractor or the Engineer. The minimum tests are:

(1) Power transformers:

(a) Visual inspection, including core and coil, bus, tap link board, terminals, enclosure and grounding.

(b) Insulation resistance test core steel to ground.

(c) Insulation resistance by megger - primary and secondary – phase to phase, phase to ground.

(d) Ratio test at each tap setting.

(e) Indication and annunciation of temperature.

(f) Protective relay test.

3.3.2 Medium Voltage switchgear and circuit breakers:

(1) Main bus has proper phasing.

(2) Megger test for bus.

(3) Functional tests (close/trip/manual/auto/racking).

(4) Megger test each circuit breaker pole.

3.3.3 Potential transformers (all voltages):

(1) Verification of winding ratio (nameplate rating).

(2) Verification of terminal polarity.

(3) Check of insulation resistance.

(4) Verification of grounding connections.

3.3.4 Protective devices (Power Breakers):

(1) Adjustment to specified settings with subsequent check of correct operation and annunciation at this setting by current or voltage injection, as applicable.

(2) Primary and secondary current injection at three (3) points on operation curve to confirm operation.

3.3.5 Power supply and distribution circuits:

(1) Phasing of all primary circuits prior to energizing.

3.3.6 PT circuits:

(1) Circuit insulation (with grounds lifted).

3.3.7 Motor control circuits and 60 Hz process control circuits:

(1) Verification of continuity of wiring.

(2) Verification of correctness of operation by operation of all operator's controls, interlocks, automatic devices, and local hand switch stations.

(3) In the case of motor starters, these tests shall be made with starter racked out and with control fuse removed, using a temporary "foreign" control supply.

(4) End-to-end loop checks of all digital input/output wiring and analog wiring.

3.3.8 Cables (when terminations are completed).

(1) 600VAC & Below power cables:

(a) 3-conductor cable – generally covered by MCC tests.

(b) 1-conductor multiple cables – applicable to drive switchboards, incoming feeders.

(c) Check for a "cross" between multiple conductors as follows:

(i) With cables installed and terminated at both ends, mark each cable and its terminal with phase or armature loop polarity designation, so that connections can be lifted and remade without transposing conductors.

(ii) Lift the lugs from the terminals at both ends and tie at each end all like-phase or like-polarity conductors together with bare copper conductors.

(iii) Megger between phase groups and between positive and negative polarity sets. Zero resistance will indicate that one (1) or more cables are crossed.

(d) Correct any crossed connection, retest, and reconnect.

3.3.9 Phase rotation:

(1) Check for proper phase rotation.

3.3.10 AC motors:

(1) Insulation - covered by MCC tests.

(2) Check for proper lubrication.

(3) Check for direction of rotation.

(4) Check for excessive noise and vibration.

3.3.11 AC drives - wiring check:

(1) Check for correctness and continuity of all external control wiring, including PLC to drive connections, PLC to Vendor package equipment connections, field connections and motor heater connections.

(2) Check for continuity of RTD circuits inside motor by measuring at the motor terminal box the resistance of each RTD. Resistance should be approximately 100 ohms.

(3) Coordinate with the equipment supplier to check the requirements of the drives/motors.

3.3.12 Low voltage switchgear and circuit breakers:

(1) Main bus has proper phasing.

(2) Megger test phase-to-phase and phase-to-ground.

(3) Functional tests.

3.3.13 Grounding system:

(1) Test of ohm value of ground system using fall-of-potential test method.

(2) Visual inspection of all points of system grounding, i.e., transformer neutrals and grounding resistors.

(3) Calculation of step and touch potentials per CEC Section 36.

3.3.14 Instrumentation and controls:

(1) Test in accordance with Section 01670 – Commissioning and Handover.

3.3.15 AC drives/motors operation check:

(1) Set AC drives to approved program settings.

(2) Operate the AC drive and motor (not coupled) in manual mode. Confirm satisfactory operation in accordance with the Manufacturer's instructions.

(3) Operate the AC drive and motor (coupled) in automatic mode via PLC. Confirm satisfactory operation and control.

(4) Coordinate with the equipment supplier’s representative to test and commission the equipment.

END OF SECTION

PART 1 GENERAL

1.1 RELATED WORK

1.1.1 Refer to Division 1 for General Requirements related to the Contract Documents.

1.1.2 Refer to Division 5 (Structural), Division 11 (Process Mechanical), and Division 16 (Electrical & Instrumentation).

1.2 DESCRIPTION OF WORK

1.2.1 The Contractor shall furnish and install as shown or specified herein the following basic materials and shall complete the Work in compliance with the following methods. The section shall include but not be limited to:

(1) Electrical Equipment Mounting and Provisions

(2) Outlet Boxes, Pull Boxes and Junction Boxes

(3) Conduit Seals

(4) Wire and Cable

(5) Disconnect Switches

(6) General Installation

(7) Special Requirements

(8) Equipment Identification

(9) Equipment Cleanup

(10) Cutting and Patching

(11) Remodeling

1.3 QUALITY ASSURANCE

1.3.1 All materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established Manufacturers.

1.3.2 Where such listing is available, all electrical materials used in the Work shall be listed by the Canadian Standards Association and shall bear the “CSA" label.

1.4 1.4 Codes and Standards

1.4.1 Do complete installation in accordance with CSA C22.1:21, BC Building Code, BC Electrical Safety Branch amendments except where specified otherwise.

1.4.2 Do underground systems in accordance with CSA C22.3 No.7-M86 except where specified otherwise.

1.4.3 In general all Work shall be executed in accordance with the current codes, standards, statutes or recommendations of the following technical societies, trade organizations, and governing agencies, and shall be subject to the inspection of those departments having jurisdiction:

(1) Sunshine Coast Regional District Electrical Installation Ordinances.

(2) Canadian Electrical Code (CEC).

(3) BC Building Code and WCB.

(4) Institute of Electrical & Electronics Engineers (IEEE).

(5) National Fire Protection Association (NFPA).

(6) National Electrical Manufacturers Association (NEMA).

(7) International Organization for Standardization (ISO).

(8) International Electro technical Commission (IEC).

(9) Canadian Standards Association. (CSA).

(10) Insulated Cable Engineers Association (ICEA).

(11) Illuminating Engineering Society of North America (IES).

1.4.4 Where Work required by the drawings and specifications is above the standards required by these organizations or agencies, it shall be done as shown or specified.

1.4.5 All fees, permits, licenses, etc., necessary in order to complete the Work of this Section shall be obtained and paid by the Contractor.

1.5 QUALITY ASSURANCE

1.5.1 All materials and equipment shall be new and of best quality, of the type best suited for the purpose intended, and be made by nationally recognized and substantially established manufacturers. The type and weight of material used for each purpose shall be as herein specified, and all material shall conform with the requirements of the latest standard specifications of the "ASTM" for that particular material.

1.5.2 All electrical materials used in the Work shall be listed by the Canadian Standards Association and shall bear a "CSA" label.

1.6 SHOP DRAWINGS

1.6.1 Provide shop drawings as specified in Section 16010 – General Electrical Requirements.

1.7 COORDINATION OF WORK

1.7.1 Cooperate and coordinate with other trades on the project.

1.7.2 Make suitable arrangements with other trades to make provision for the electrical work and be responsible for the assurance that such provisions are satisfactory for the electrical work.

1.7.3 Check drawings and specifications of other trades for conflict and coordination with the electrical trade. If any conflicts are found, obtain a ruling from the Engineer before proceeding.

PART 2 PRODUCTS

2.1 CONCRETE PLATFORMS, FOUNDATIONS

2.1.1 Unless otherwise specified or indicated, all floor mounted equipment (such as Control Panels, transformers, etc.) shall be anchored to two (2) 100 mm by 50 mm minimum channel iron sills, by tack welding or bolting. Sills shall be furnished by the Contractor to suit the equipment and shall be installed so that equipment is 100 mm above floor.

2.1.2 Where a membrane waterproofed floor or pressure slab is under the equipment, there shall be provided a 100 mm high concrete platform poured separately on top of finished floor slab. This platform shall not extend more than 50 mm in all directions beyond the maximum dimensions of the equipment. The 100 mm channel sills specified above shall be furnished and installed in this platform.

2.1.3 In addition to the above, the Contractor shall provide all foundations and pits required for installation of the Work specified herein.

2.1.4 The above specified concrete work shall be constructed of dense concrete composed of one (1) part Portland cement, two (2) parts clean, sharp sand, and four (4) parts crushed stone or gravel. All exposed surfaces shall be finished with 1:2 mix cement mortar troweled smooth with beveled edges. All necessary anchor bolts, washers, templates, etc., shall be furnished complete and bolts shall be built into foundations with proper size sleeves.

2.1.5 Concrete Inspections:

(1) Advise the Engineer so that the Engineer may inspect installation and be present during placement of concrete and clean-out.

2.2 ELECTRICAL EQUIPMENT MOUNTING AND PROVISIONS

2.2.1 Wherever electrical troughs, panel boards, etc., are indicated mounted on indoor wall surfaces, the Contractor shall first install a 19 mm (¾") Type BD plywood panel of sufficient size for mounting all equipment. Plywood panels shall be cleanly cut, without burrs or splinters, square, and painted two (2) coats of gray fire-retardant preservative on both sides.

2.2.2 Plywood shall be anchored to walls by means of toggle or expansion anchors. Equipment shall be attached to plywood by means of wood screws.

2.2.3 Wherever indicated by the drawings or by other sections of this specification, furnish and install wiring troughs to facilitate connections to electrical equipment. Troughs shall be constructed of code gauge metal, prime coated inside and out and with a gray enamel finish coat. Covers shall be screw attachment type. Troughs shall be installed wherever two (2) or more safety switches or motor starters occur at one (1) location, fed from a common set of conductors, to allow tap connections to be made outside of the switch or starter cover.

2.2.4 Panelboards and Control Panels mounted to walls outdoors or indoors in process area shall be offset from the wall by 25 mm with stainless steel hardware.

2.3 RACEWAYS

2.3.1 Galvanized Rigid Conduit (GRC): The galvanized rigid steel conduit shall not be used for this project.

2.3.2 Intermediate Metal Conduit (IMC): IMC conduit shall not be used.

2.3.3 Electrical metallic tubing (EMT): EMT shall not be used.

2.3.4 Aluminum conduit. In general, heavy wall aluminum alloy conduit shall be used throughout except as specified hereinafter. Heavy wall conduit aluminum alloy with smooth interior and carefully reamed ends and shall bear the CSA label. Elbows and couplings shall contain the same alloying chemistry as the conduit. Heavy wall, aluminum conduit shall be used in all runs where required for mechanical protection. Heavy wall conduit only shall be used in all exposed runs. All aluminum couplings and fittings shall be of the threaded type.

2.3.5 Rigid non-metallic conduit shall be made of virgin polyvinyl chloride resin, extruded, Schedule 40 PVC rigid conduit, light grey in color, supplied in 3 m (10 foot) lengths each with a coupling. It shall be U.L. listed and bear the label for use above ground, underground direct burial and concrete encased. It shall be cut square with all rough edges removed from ends to protect the wires from abrasion. All connections shall be made by solvent welding. All fittings shall be installed in accordance with the Manufacturer's recommended procedures. Expansion joints shall be provided wherever conduit crosses building expansion joints or where a wide temperature differential exists.

2.3.6 Flexible metal conduit shall be used for connections to motors, fixed appliances and recessed luminaires where required. Maximum lengths of flexible conduit used to install motors, appliances or transformers shall be 750 mm. Metal conduits shall be jumpered by use of grounding bushing with pressure type wire terminal. A green grounding conductor shall be installed in all flexible metal conduit over 2 m in length, or 300 mm diameter or larger; conductor size shall be as indicated or as required by the Canadian Electrical Code.

2.3.7 Liquid-tight conduit with liquid-tight fittings shall be used in washrooms, kitchens, wells, sump pits, transformer connections, where exposed to the weather, and areas of high moisture content.

2.3.8 Flexible metallic tubing shall not be used except where provided for pig-tail connections by lighting luminaire manufacturers. Tubing shall not be over 2 m in length and shall be in accordance with the Canadian Electrical Code.

2.3.9 All empty conduits shall include a polypropylene fish cord between pull boxes.

2.3.10 Conduits shall be fastened using two-hole steel straps for conduits larger than 50 mm. Beam clamps shall be used to secure conduits to exposed steel work.

2.4 BOXES AND FITTINGS

2.4.1 Process area outlet boxes shall be aluminum standard electrical type with knockout openings as required and shall be manufactured by Appleton, Crouse-Hinds or equal and approved.

2.4.2 Outlet boxes shall be at least 37 mm (1½ inches) deep, 100 mm (4 inches) square or octagonal stamped steel type with 100 mm (4 inches) square device covers of size to accommodate devices noted. Outlet boxes in masonry walls may be special masonry type. Outlet boxes on exposed conduit runs in unfinished areas and equipment rooms shall be 100 mm (4 inches) square or multi-gang boxes with matching covers. Outlet boxes on exposed conduit runs in finished areas or where indicated shall be cast FS type with covers as specified elsewhere. Floor outlet boxes shall be special types as specified elsewhere. Outlet boxes for receptacle devices shall be provided with grounding lead lug or screw.

2.4.3 Exterior outlet boxes noted as WP (weatherproof) shall be a flush FS type box with at least four (4) machine screw connections for a gasketed device and cover.

2.4.4 Pull boxes and junction boxes are generally not indicated on drawings except for special requirements. The Contractor shall install pull boxes or junction boxes as required to facilitate wire pulling. Pull boxes and junction boxes shall be galvanized code gauge steel with removable or hinged covers and shall be sized as required. Pull boxes and junction boxes shall be installed in accessible locations and shall not be installed in finished spaces without approval of the Engineer.

2.4.5 Provide insulation barriers in gang type switch boxes containing more than one (1) switch when connected to different voltage systems or to two (2) different phases of a 347-volt system.

2.4.6 Explosion-proof outlets shall be as specified elsewhere.

2.4.7 On all conduit systems the connector fitting shall be of the insulated throat type. Where rigid conduit is connected to a threadless box, NEMA 4X aluminum Meyers Hubs shall be used.

2.4.8 All conduit fittings shall be of steel as manufactured by The Thomas and Betts Co., Steel City Company, RACO, Crouse-Hinds, or equal. Malleable iron fittings shall not be used on any conduits.

2.5 CONDUIT SEALS

2.5.1 The Contractor shall furnish and install where shown on the drawings or specified herein type "EYS" conduit seals. Seals shall be installed on conduits that pass-through walls or ceilings of coolers and from a non-hazardous area to a hazardous area according to the CEC. Seals to be installed on the conduit passing through a cooler shall be put on the warm side of the wall or ceiling as close to the cooler as possible. After conductors have been installed, EYS fittings shall be filled with sealing compound according to Manufacturer's recommended method.

2.5.2 The Contractor shall furnish and install where shown on the drawings or specified herein O-Z/Gedney type "FSK" thru wall and floor seals. Seals shall be installed in all concrete walls below grade, which have waterproofing membrane. Seals shall be installed with pressure clamp on the inside of the wall. After conductors have been installed conduit shall be filled with a water-tight sealant similar to Dow Corning 3-6548 RTV silicone foam.

2.6 WIRE AND CABLE – 600 VOLT RATED

2.6.1 All wire and cable for feeder and branch of circuits shall conform to the requirements of the current edition of the CEC and shall meet all relevant Specifications. Conductors shall be 1000 volt rated as noted or 600V rated unless noted, coated soft-drawn copper or annealed copper, and unless otherwise noted on the plans and in these specifications, shall have type THWN insulation. Wire and cable shall not be older than 12 months.

2.6.2 Wire and cable shall comply with the latest editions of ICEA standard WC5 (5-61-402) for thermoplastic insulated wire.

2.6.3 Conductor sizes shall be standard American Wire Gauge (AWG) sizes and shall be as noted on the drawings. All conductors shall be stranded. Minimum size shall be No. 12, unless otherwise noted. Wire size on 120-volt, 20 ampere branch circuit runs over 25 m shall be increased to No. 10 (minimum) to limit excessive voltage drop. All 3 phase, four (4) wire (20 ampere) branch circuit home runs for ballasted lighting shall be minimum No. 10 wire. Wire size requirements larger than No. 12 shall be as noted on the Drawings or as required for the load.

2.6.4 All wire and cable shall be delivered to the job in standard coils and reels with approved tag noting length, wire size, insulation type, and manufacturer's name; and shall be suitably protected from weather and damage during storage and handling.

2.6.5 Splices shall be made with solderless - tapeless, mechanical wire connectors with spring action to maintain constant pressure on the conductors. Connectors shall be U.L. listed and equal to 3M Scotchblok Brand, Type Y, R, G, and B, or Ideal Model 45I, 452, 455, and 453.

2.6.6 Splices and taps in wireways shall be made using 3M Scotchblok Brand #562 and 567 self-stripping tap connectors for copper conductor size No. 12 and No. 10. For conductors size No. 8 and larger use approved gutter taps similar to OZ/Gedney type PMX combination parallel gutter taps and covers.

2.6.7 Where taping of conductors is required, use minimum of two (2) layers wrapped half-lapped. Tape shall be U.L. listed 3M Scotch Branch 33+, or equal. Splices in areas of high ambient temperatures (boiler control panels, electric heating element controls and junction boxes, etc.) shall be made with crimp type, zinc plated steel, connectors with wrap-cap insulators equal to Ideal crimp connector.

2.6.8 Branch circuit wire and cable shall be factory color-coded by integral pigmentation, and feeder cables shall be color-coded at all terminations with plastic colored tape, with a separate color for each phase and neutral conductor. The color code indicated in the accompanying chart shall be used consistently throughout the electrical installation.

CONDUCTOR	SYSTEM VOLTAGE	
	600V/1000V	120V/240V
PHASE A	BROWN	BLACK
PHASE B	YELLOW	RED
PHASE C	ORANGE	BLUE
NEUTRAL	WHITE	
EQUIP. GND.	GREEN	

2.7 DISCONNECT SWITCHES

2.7.1 All switches shall have switch blades which are visible when the switch is OFF and the cover is open.

2.7.2 Lugs shall be front removable and listed for 75°C conductors (30-100 ampere) or 75 °C conductors (200-1200 ampere), copper conductors only.

2.7.3 Switches shall have all copper current carrying parts.

2.7.4 All current carrying parts shall be plated to resist corrosion.

2.7.5 Switches shall have removable arc suppressors to facilitate easy access to line side lugs.

2.7.6 Switches shall have provisions for a field installable electrical interlock.

2.7.7 Switch operating mechanism shall be quick-make, quick-break such that, during normal operation of the switch, the operation of the contacts shall not be capable of being restrained by the operating handle after the closing or opening action of the contacts has started.

2.7.8 The operating handle shall be an integral part of the box, not the cover.

2.7.9 Provisions for padlocking the switch in the OFF position with at least three (3) padlocks shall be provided.

2.7.10 The handle position shall travel at least 90 degrees between OFF and ON positions to clearly distinguish and indicate handle position.

2.7.11 All switches shall have a dual cover interlock mechanism to prevent unintentional opening of the switch cover when the switch is ON and prevent turning the switch ON when the cover is open. The cover interlock mechanism shall have an externally operated override, but the override shall not permanently disable the interlock mechanism. The tool used to override the cover interlock mechanism shall not be required to enter the enclosure in order to override the interlock.

2.7.12 Switch covers shall be attached with welded pin-type hinges.

2.7.13 The enclosure shall be finished grey baked enamel paint, which is electrodeposited on cleaned, phosphate pre-treated galvannealed steel (Type 3R, 12, 12K).

2.7.14 The enclosure shall have ON and OFF markings.

2.7.15 The operating handle shall be provided with a dual coloured, red/black position indication,

2.7.16 All switches shall have provisions to accept up to three (3) 9 mm (3/8 inch) hasp padlocks to lock the operating handle in the OFF position.

2.7.17 Tangential knockouts shall be provided to facilitate ease of conduit entry for switches rated 30-200A.

2.7.18 Type 4X Stainless Steel enclosures.

2.7.19 Switches shall be horsepower rated for AC and/or DC as indicated on the plans.

2.8 FASTENING AND SUPPORTS

2.8.1 Secure equipment to tile and plaster surfaces with lead anchors.

2.8.2 Secure equipment to poured concrete with stainless steel expandable inserts.

2.8.3 Secure equipment to hollow masonry walls or suspended ceilings with toggle bolts.

2.8.4 Fasten exposed conduit or cables to building construction or support system using straps.

(1) One-hole malleable iron straps to secure surface conduits and cables 50 mm and smaller.

(2) Two-hole steel straps for conduits and cables larger than 50 mm.

(3) Beam clamps to secure conduit to exposed steel work.

2.8.5 Provide metal brackets, frame hangers, clamps, and related types of support structures where indicated or as required to support conduit and cable runs.

2.8.6 Ensure adequate support for raceways and cables dropped vertically to equipment where there is no wall support.

2.8.7 Do not use wire lashing or perforated strap to support or secure raceways or cables.

2.8.8 Do not use supports or equipment installed for other trades for conduit or cable support except with permission of other trade and approval of Engineer.

2.8.9 Install fastenings and supports as required for each type of equipment, cable, and conduit, and in accordance with Manufacturer's installation recommendations.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

3.1.1 Conduits shall be sized as noted or as required by CEC for number and size of conductors installed except that 21 mm shall be minimum size for all conduit runs. Maximum size shall be as allowed by the CEC and within the limits of commonly manufactured sizes.

3.1.2 All conduit joints shall be cut square, threaded, reamed smooth and drawn up tight. Bends or offsets shall be made with standard conduit ells or field bends made with an approved bender or hickey.

3.1.3 All metal conduit and metal raceways except as noted below and unless the building construction forms an approved means of support, shall be securely positioned by aluminum straps, clamps, and hangers with suitable fastenings. Concealed conduits shall be run in a direct line with long sweep bends and offsets. Exposed conduits shall be run parallel to and at right angles to building lines and neatly grouped and supported with approved conduit hangers or channel supports. Wooden plugs shall not be used.

3.1.4 All conduit, fittings and boxes shall be concealed where building construction will permit except drops from ceilings, risers from floor to island motors or appliances in equipment areas.

3.1.5 All conduits 25 mm diameter and larger shall be provided with expansion fittings where the conduits cross building joints. Conduit with continuous horizontal runs over 30 m, without a minimum of two (2) 90º bends, shall be provided with expansion fittings. Expansion fittings in poured concrete shall be OZ/Gedney Type "AX" with Type "BJ" bonding jumper. For Electrical Metallic Conduit (EMT) use Type "TX" expansion fittings.

3.1.6 Conduits shall be continuous from outlet to outlet, from outlets to cabinets, pull or junction boxes and shall be secured to all boxes with locknuts and bushings in such manner that each system shall be electrically continuous throughout. Conduit

ends shall be capped to prevent entrance of foreign materials during construction. Conduit size changes shall occur only at outlet or pull boxes.

3.1.7 Rigid non-metallic conduit shall be used only where noted on the drawings. Even where use is indicated, rigid non-metallic conduit shall not be used above grade or where exposed, even partially. No non-metallic elbows shall be used anywhere. All elbows shall be PVC coated galvanized rigid steel, with a minimum radius of 12 times the conduit diameter.

3.1.8 The Contractor shall provide and install all conduits and wiring for power, controls, and communications, noted on drawings for Division 11. Coordinate with Division 11 for devices to be connected by conduits, and the number and size of control conduits to be installed by Division 16.

3.1.9 The Contractor shall provide and install all conduits for power, controls, and communications, plus wiring for any 120-volt power supply requirements noted on drawings for Division 11. Control and signal conductors shall be provided and installed by Division 11. Coordinate with Division 11 for devices to be connected by conduits, and the number and size of control conduits to be installed by Division 16.

3.1.10 This Contractor shall provide and install all conduits and wiring for power, controls, and communications, noted on drawings for Division 15. Coordinate with Division 15 for devices to be connected by conduits, and the number and size of control conduits to be installed by Division 16.

3.2 MOUNTING HEIGHTS

3.2.1 Verify locations and dimensions of electrical equipment, particularly in the case of door swings, heights of cabinets and counters, shelves and location of equipment installed by Owner or other trades.

3.2.2 Mounting height of equipment is shown to centerline of equipment unless otherwise specified or indicated.

3.2.3 If mounting height of equipment is not specified or indicated, verify before proceeding with installation.

3.2.4 Provide hardware required for various mounting configurations as detailed in drawings for rail mount, post mount and wall mount, as required and appropriate for each application.

3.3 SPECIAL REQUIREMENTS

3.3.1 Conduit shall not be installed outside of building walls or exterior court areas except where specifically noted.

3.3.2 All conduit systems must be installed complete before conductors are pulled in. Wire shall not be drawn into conduit until after the conduit system is complete and has been thoroughly swabbed out. Wire shall not be drawn into conduit in such a manner as to injure the insulation.

3.4 EQUIPMENT IDENTIFICATION

3.4.1 All electrical equipment furnished by the Contractor shall be provided with identification indicating its use or function. Equipment to be identified shall include, but not be limited to switchboards, panelboards, distribution panels, automatic transfer switches, special system control panels, motors, and motor starters, push-button stations, pilot light, special lighting or control switches, emergency receptacles, special receptacles, communication system pull boxes and junction boxes, and empty conduits provided for future use. Normal use lighting switches, receptacles and conduit will not require identification unless specifically noted otherwise.

3.4.2 Identification labels shall be white laminated plastic plates with black engraved letters. Letters shall be minimum of 6 mm (1/4 inch) high and centered on the plates. Attach plates with self tapping screws or pop rivets. Flush panelboards occurring in corridors shall have identification plate on interior, attached with adhesive. Labels for the emergency distribution equipment shall be red laminated plastic plates with white letters.

3.4.3 For communication systems pull or junction boxes and blank outlet boxes, plastic laminated engraved, adhesive backed labels, black color, shall be used for identification (attach to inside of cover plate in finished areas).

3.4.4 Distribution sections, motor control center, etc., shall have individually identified breakers or switches with identification directly adjacent to the device and not in a typed directory.

3.4.5 Panelboards shall be provided with a neatly typed directory with plastic protector of circuits describing loads and areas served. Room names or Owner's room numbers shall be used; do not use plan room numbers. Spare positions shall be left blank on directory.

3.4.6 Hand lettering of identification will not be acceptable. Temporary labels used during construction shall be completely removed and surface repainted if required.

3.4.7 Devices using standard wall plates and requiring identification shall be provided with engraved plates. Plates shall be machine engraved and the letters filled in with white enamel, with minimum 6 mm (1/4 inch) high letters.

3.4.8 Identify electrical equipment with name plates and labels as indicated in Section 16010 and 16994, following the requirements:

(1) Wording on nameplates to be approved by Engineer prior to manufacture.

(2) Allow for average of 25 letters per nameplate.

(3) Identification to be English.

(4) Disconnects and Contactors: indicate equipment being controlled and voltage.

(5) Terminal Cabinets and Pull Boxes: indicate system and voltage.

(6) Local Control Panel: indicate equipment being controlled and voltage.

(7) Transformers: indicate capacity, primary and secondary voltages.

3.5 EQUIPMENT CLEANUP

3.5.1 Special care must be taken for protection of panels, switches, starters, etc. All must be kept completely protected from weather elements, painting, etc., until the building is substantially completed. Damage from rust, paint, scratches, etc., shall be corrected as directed by the Engineer.

3.5.2 Clean all switchgear, motor controls, etc., and take special care to remove dirt, mortar, wire scraps, etc., from junction boxes and switchgear interiors.

3.5.3 Accessible elements of disconnecting and protective devices of equipment, coils of dry type transformers and the like shall be cleaned with compressed air (less than 15 PSI) and the enclosures vacuum cleaned prior to being energized.

3.6 CUTTING AND PATCHING

3.6.1 In existing construction this Contractor shall perform all cutting required and all necessary patching after completion to restore the surface to its original condition, unless otherwise indicated.

3.6.2 In new construction the Contractor will be required under the Contract Documents to leave all chases and openings in walls, floors, ceilings, partitions, etc., where shown on the drawings or otherwise necessary to receive electrical work, but the Contractor shall furnish full information as to locations, dimensions, etc., of such chases and openings, including provision and proper setting of sleeves and other equipment in such time as to cause no delay to the Work.

3.6.3 Should any cutting of walls, floors, ceilings, partitions, etc., be required for proper installation of the Work or apparatus of the Contractor or be made necessary on account of the Contractor’s failure to give proper information at the time required, such cutting shall be done at the Contractor’s own expense, restoring the Work to its original condition.

3.6.4 All cutting and patching done by this Contractor shall be subject to the direction and approval of the Engineer. This Contractor shall not endanger the stability of the structure by cutting, digging, or otherwise, and shall not be at any time cut or alter work of any other Contractor without Engineer's consent.

3.7 REMODELING WORK

3.7.1 Contractor shall visit existing building before submitting bid and become familiar with existing conditions.

3.7.2 In general, wiring in existing buildings shall remain as is except as noted on drawings or specified elsewhere.

3.7.3 When existing walls, ceilings, floors, electrical panels, light fixtures, switches, or other outlets are removed, the Contractor shall extend existing circuiting, if required; install junction boxes in walls, ceilings, or floors, if required, to continue circuiting; remove all unused wire; remove all unused conduit where accessible; and install new plates with blank gangs as required on existing outlet boxes.

3.7.4 Added loads to existing circuiting shall be balanced between phases. On existing panelboard where circuitry is changed, the Contractor shall furnish a revised, typed panel directory.

3.7.5 Where new conduit is surface mounted in existing finished areas, the Contractor shall be responsible for painting the new conduit and boxes to match the existing surface finish.

3.7.6 Existing equipment removed and not reused shall become the Contractor's property and be removed from the site, unless otherwise specified or shown.

3.7.7 The Contractor shall coordinate all removal work to maintain services to all equipment and areas until such time as these items are removed or demolished.

3.7.8 The Contractor shall work closely with the Owner to coordinate removal or relocation of all telephone conduit and outlets. Provide the Owner a minimum of 48 hours notice of any demolition affecting telephone services or equipment.

3.7.9 The facility must remain in operation during construction. Contractor shall provide any temporary connections necessary to maintain services to the existing service. Provide advance notice of minimum 72 hours to the Owner of any temporary service outages. Advance notice shall be in writing with copies to the Engineer. Provide temporary generator power when outages are anticipated to exceed one (1) hour in duration.

3.7.10 In general, the Contractor shall assume that all Work which involves a service outage shall be performed on an overtime basis. Work shall continue until service is restored.

3.8 CHECK LISTS

The following check lists are provided as a guide only. All Work shall be strictly to specifications and the latest Canadian Electrical Code.

3.8.1 Raceways, Cables, And Conductors:

(1) Conduits are free of kinks.

(2) The conduits are new (salvaged raceways permitted only with special permission).

(3) Approved raceways are used for the application and environment in which they are placed.

(4) Conduits do not have more than the equivalent of three (3) 90° bends.

(5) Conduits are properly and adequately supported.

(6) Conduits are installed neatly, attractively and grouped wherever and whenever possible.

(7) Conduits that are supported on hanger racks must have the spacing of the support based on the size of the smallest raceway in the group.

(8) Conduits are mechanically free of undue stress and strain.

(9) Insulating bushings are installed on all raceways that contain conductors #8 AWG or larger.

(10) Radii of conduit bends to conform to code standards.

(11) Conduits are sloped to prevent accumulation of moisture in electrical distribution equipment or in boxes.

(12) Conduits terminate with approved connectors or couplings.

(13) Unused conduits or empty conduits are properly capped to prevent debris, dirt, etc. from entering.

(14) Rigid metal conduit is properly reamed and threaded.

(15) Rigid metal conduit has two (2) locknuts and a bushing wherever it terminates.

(16) EMT may is used only in the Administration building.

(17) EMT may not be mounted in wet locations (e.g., EMT may not be installed on the surface of a roof).

(18) Expansion fittings or similar methods are used whenever the expansion and contraction of the conduit is a factor.

(19) Field bends on PVC are free of deformations, kinks, and thermal scarring.

(20) Pull strings and or pull boxes are present for conduit lengths in excess of 30 m.

(21) Conduit fill meets code standard.

(22) Conduits penetrating a firewall, outside wall or routed through a hazardous location are properly sealed.

(23) Conduits requiring bonding conductors must have the bonding conductor routed inside of the raceway.

(24) Conduits must never contain spliced conductors.

(25) Mechanical protection is required for conduits that are subject to injury (e.g., Conduit riser on a power pole located in a lane or driveway).

(26) Pulling compound has been removed and cleaned from the exterior of the conduit.

(27) Conduits that emerge from concrete structures that are subject to frost heaveal must be sleeved to prevent the conduit from being strained.

(28) Condulets such as LB, LL, LR, T, C do not contain spliced conductors (special permission may be granted).

(29) Condulets are accessible for maintenance purposes.

(30) Seal tight flexible conduit is kept as short as necessary to provide a flexible connection.

(31) 10 mm flexible conduit is kept to 750 mm or less in length.

(32) Only plenum rated (FT4) cables are to be placed in plenum spaces.

(33) Termination bushing or sleeve is present for AC90 cables (BX).

(34) Cables are properly and adequately supported.

(35) Conductors are color coded.

(36) Conductors and cables are clearly and legibly identified as required by the specifications.

(37) Vertically oriented cables are properly supported with no undue strain being experienced by the connector.

(38) Cables and conductors are installed only when ambient temperatures are acceptable for the conductor’s insulation rating.

(39) Cables and conductors are terminated with approved connectors.

(40) Distribution cables and conductors are within the maximum allowable 3% voltage drop.

(41) Cables and conductors routed through areas with an ambient temperature above 30° C are derated.

(42) Cables and conductors contained within a raceway with more than three (3) current carrying conductors are derated.

(43) Insulation rating of conductors is correct for the application (e.g., RW90 required for conductors connecting luminaires).

(44) High voltage cables are shielded and must be terminated or spliced using approved stress relief connectors.

(45) Single conductor armored cables with significant sheath currents must be derated or isolated from ground.

(46) Paralleled conductors must be same size, type, length, insulation and terminated in an identical manner.

(47) Paralleled conductors are placed in approved configurations.

(48) Cables placed in cable trays are properly spaced or the cables are derated.

(49) Cable tray loading capacity is within acceptable limits.

(50) Cables in cable trays passing through a firewall are fire stopped with an approved sealing agent

(51) Cable trays are clearly identified with tags.

(52) A bonding conductor accompanies metallic cable trays.

(53) Busways are located in a dry and non-corrosive environment.

3.8.2 Boxes, Cabinets and Wireways:

(1) Splitter boxes are mounted to allow the hinged door to fall open (hinges are located along the lower edge).

(2) Covers for splitter boxes and wire-ways are secured without any strain being imposed on the cover from conductors contained within.

(3) Enclosures are rated for the environment in which they are placed.

(4) Boxes are sufficiently large to accommodate all the conductors they contain and for all the devices that may either be mounted on them or within them.

(5) Junction boxes, termination boxes, cabinets and wire racks are tagged, labeled and or color coded.

(6) Junction boxes, termination boxes, cabinets and wire racks are adequately supported.

(7) Junction boxes, termination boxes, cabinets and wire racks are free of damage, scratches, and dents.

(8) A minimum of 225 mm of conductor length is present at each outlet box.

(9) Cover plates are on the boxes and are adequately secured (all screws or bolts are on).

(10) Unused openings in boxes, cabinets and fittings are closed.

(11) Conductors of different power systems contained within the same enclosure are suitably barriered.

(12) Pull boxes or junction boxes are large enough to accommodate the required bending radius of the conductors.

(13) Junction boxes, termination boxes, cabinets and wire racks are fully accessible.

(14) Junction boxes, termination boxes, cabinets and wire racks are color coded where required.

END OF SECTION

CONDUITS, FASTENINGS, AND FITTINGS

PART 1 GENERAL

1.1 GENERAL

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

1.2 LOCATION OF CONDUIT

1.2.1 Drawings and tables do not indicate all conduit runs.

1.2.2 Those indicated are in diagrammatic form only.

1.2.3 Provide all conduits required for a complete installation. All conductors are to be in conduit unless otherwise specifically indicated.

PART 2 PRODUCTS

2.1 CONDUITS

Provide conduits and cables as mentioned on the drawings and as required for a complete and operational installation. Schedules on drawings are provided for general information only and do not list all required conduits and conductors.

Division 16 is also responsible to provide conduit, cables, and terminations for other Divisions. Division 16 to coordinate this activity with Division 11 – Process Mechanical, Division 5 – Structural. It is the Contractor's responsibility to co-ordinate the Work of all Subcontractors on this project and to ensure that the Work covered under related Divisions is completed. Termination of Division 16 cables and wire may or may not be completed by Division 16.

Power and signal conduits and cables between the equipment and the existing MCC and Control Panels as detailed on the drawings.

Power to devices from associated circuit breakers and/or disconnect switches.

2.1.1 Rigid aluminum threaded conduit in all process areas.

2.1.2 Rigid PVC (RPVC) Type.

2.1.3 Electrical metallic tubing (EMT) in administrative buildings.

2.1.4 Minimum size 19 mm.

2.2 CONDUIT FASTENINGS

2.2.1 Two (2) hole steel straps for conduits larger than 50 mm.

2.2.2 Beam clamps to secure conduits to exposed steel work.

2.3 CONDUIT FITTINGS

2.3.1 Fittings: manufactured for use with conduit specified. Coating: same as conduit.

2.3.2 Factory “ells” where 90° bends are required 25 mm and larger conduits.

2.4 CONDUIT SEALS

2.4.1 Type EYS seals with factory sealing compound where required, and for all conduits entering or leaving a hazardous location as defined in the electrical code.

2.5 FISH CORD

2.5.1 Polypropylene.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Install conduits to conserve headroom in exposed locations and cause interference in spaces through which they pass.

3.1.2 Replace conduit if kinked or flattened more than 1/10th of its original diameter.

3.1.3 Mechanically bend metal conduit over 19 mm diameter.

3.1.4 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.

3.1.5 Install fish cord in empty conduits.

3.1.6 Where conduits become blocked, remove and replace blocked section.

3.1.7 Do not use liquids to clean out conduits.

3.1.8 Dry conduits out before installing wire.

3.2 SURFACE CONDUITS

3.2.1 Run parallel or perpendicular to building lines.

3.2.2 Group conduits wherever possible on surface channels.

3.2.3 Do not pass conduits through structural members except as indicated.

3.2.4 Do not locate conduits less than 75 mm parallel to hot water lines with minimum of 25 mm at crossovers.

3.3 WIRING METHOD

3.3.1 In building: concealed above ceiling and in walls in finished areas, on surface or in slab in open plant area and mechanical room, unless other wise specified.

END OF SECTION

GROUNDING

PART 1 GENERAL

1.1 RELATED WORK

1.1.1 Section 16010 – Electrical General Requirements.

1.1.2 Section 16050 – Basic Materials and Methods.

1.2 SUMMARY

1.2.1 Install complete grounding system as indicated and in accordance with Canadian Electrical Code and local inspection authority.

PART 2 PRODUCTS

2.1 EQUIPMENT

2.1.1 Clamps for grounding of conductor, size as indicated, to electrically conductive underground water pipe.

2.1.2 System and circuit, equipment, grounding conductors, bare stranded copper, soft annealed, size as indicated.

2.1.3 Non-corroding accessories necessary for grounding system, type, size material as indicated, including but not necessarily limited to:

(1) Grounding and bonding bushings.

(2) Protective type clamps.

(3) Bolted type conductor connectors.

(4) Thermit welded type conductor connectors.

(5) Bonding jumpers, straps.

(6) Pressure wire connectors.

PART 3 EXECUTION

3.1 INSTALLATION GENERAL

3.1.1 Install complete permanent, continuous, system and circuit, equipment, systems including, electrodes, conductors, connectors, accessories, as indicated, to conform to requirements of the Engineer, and local authority having jurisdiction over installation.

3.1.2 Where rigid metallic conduit or / and PVC is used, run ground wire in conduit.

3.1.3 Install connectors in accordance with Manufacturer's instruction.

3.1.4 Protect exposed grounding conductors form mechanical injury.

3.1.5 Make buried connections, and connections to conductive water main, electrodes, using copper welding by Thermit process.

3.1.6 Use mechanical connectors for grounding connections to equipment provided with lugs.

3.1.7 Soldered joints are not permitted.

3.1.8 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw.

3.1.9 Make grounding connections in radial configuration only, with connections terminating at single grounding point. Avoid loop connections.

3.1.10 All grounding electrode conductors (conductors from ground bars to ground rods) shall be installed in PVC conduit.

3.2 ELECTRODES

3.2.1 Not Used.

3.3 EQUIPMENT GROUNDING

3.3.1 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: service equipment, transformers, duct systems, control panels, building steel work, distribution.

3.4 FIELD QUALITY CONTROL

3.4.1 Perform tests in accordance with Section 16010 – Electrical General Requirements.

3.4.2 Perform ground continuity and resistance tests using method appropriate to site conditions and approval of the Engineer and local authority having jurisdiction over installation.

3.4.3 Perform tests before energizing electrical system.

3.5 FIELD CHECK LIST

3.5.1 Soil tests have been conducted to determine low resistance connection to earth is available. Grounding system is tested and verified as adequate.

3.5.2 Grounding conductors are adequately protected from mechanical damage and if buried are deep enough to meet or exceed minimum code depths.

3.5.3 Ground rods are placed in locations shown on the drawings and are properly installed.

3.5.4 Ground wells are properly constructed and are accessible.

3.5.5 Grounding conductors are mechanically and electrically secure. Grounding conductors are free of damage.

3.5.6 Thermally welded grounding conductors are examined to determine if weld is both electrically and mechanically acceptable.

3.5.7 Check that only copper conductors are used for grounding system.

3.5.8 Confirm size of grounding conductors meets code standards.

3.5.9 Connections to artificial or natural electrodes are electrically and mechanically secure.

3.5.10 Connections to system distribution equipment is adequate and secure.

3.5.11 Bonding of all metallic electrical equipment (motors, luminaires, welders, etc.) has been accomplished.

3.5.12 Bonding of all metallic raceways (conduits, cabletrays, wireways, etc.).

3.5.13 Bonding of metal gas lines, water lines, sewer lines, telecom systems and CCTV systems has been done.

3.5.14 Isolated grounds have been connected to the bonding bus of the distribution system.

3.5.15 Structural steel and steel supports have been bonded.

3.5.16 The bonding screw of the identified conductor terminal (neutral) has been removed from all distribution panelboards.

3.5.17 Service neutral conductor is grounded.

3.5.18 Neutral conductors on the secondary of transformers are grounded.

3.5.19 Transformer cores and cases are bonded.

3.5.20 All flexible raceways have a separate bonding conductor placed within the flexible raceway.

3.5.21 High Voltage Substations are grounded to ensure that step, touch, and transfer potentials are limited as per the CEC.

3.5.22 A bonding jumper is present between the metal outlet box and the receptacle. A bonding conductor is present for the receptacle.

3.5.23 Mounting straps of receptacles and switches must be bonded. Spacers used on mounting screws must not impede bonding of mounting strap.

3.5.24 High or low resistance system grounding resistors are appropriately located for the kW heating that may occur under ground fault conditions.

3.5.25 Continuity of the entire grounding and bonding system.

3.5.26 Ground detection equipment to detect a ground fault in ungrounded systems.

3.5.27 Adequately sized and located bonding conductors for the dissipation of electrostatic charges in areas where hazardous substances are or may be present.

3.5.28 Lightning arrestors are grounded to earth.

3.5.29 Lightning protection systems are adequately bonded and grounded. Conductors are kept as short as possible and involve the least amount of bends. Conductors are free of nicks and cuts.

3.5.30 Alternate power supplies (standby generators, UPS, etc.) are adequately grounded and or bonded.

3.5.31 Secondary of instrument transformers are grounded.

3.5.32 Cables supplying motors and welders have adequately sized bonding conductors.

3.5.33 Nonmetallic raceways contain a bonding conductor.

3.5.34 Metallic raceways placed in the ground or in the concrete contain a bonding conductor.

END OF SECTION

SEISMIC RESTRAINT

PART 1 GENERAL

1.1 WORK INCLUDED

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

1.1.2 Provide seismic restraint and anchorage for all equipment and services in accordance with the current edition of the British Columbia Building Code, except that the seismic loads shall be determined in accordance with the National Building Code of Canada 2010 edition.

1.1.3 Restraints shall meet the requirements of the latest edition of the British Columbia Building Code and amendments.

1.1.4 The total electrical seismic restraint design and field review and inspection will be by an APEGS (British Columbia 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 Contractor's Seismic Restraint Engineer. The Contractor's Registered Professional Structural Engineer, herein referred to as the Contractor's Seismic Consultant, will provide normal engineering functions as they pertain to seismic restraint of electrical installations.

1.1.5 The Contractor shall be aware of, and comply with, all current seismic restraining requirements and make provision for those that may come into effect during construction of the project. Make proper allowance for such conditions in the tender.

1.1.6 The Contractor's Seismic Consultant shall submit original signed British Columbia Building Code "Letters of Assurance" "Schedules B1, B2, and C-B" to the Prime Contractor or Electrical Consultant.

1.2 REFERENCE STANDARDS

1.2.1 Conform to the following reference standards (editions as enforced in the Province of British Columbia at time of facility construction):

(1) British Columbia Building Code.

(2) National Building Code of Canada.

1.3 SUBMITTALS

1.3.1 Shop Drawings: Submit with the related items of equipment in accordance with Section 01340 and Section 16010.

1.3.2 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.

1.3.3 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.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 All seismic restraints systems shall conform to local authority having jurisdiction and all applicable code requirements.

2.1.2 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.

2.1.3 The Contractor's 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.

2.1.4 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.

PART 3 EXECUTION

3.1 FLOOR MOUNTED EQUIPMENT

3.1.1 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 Contractor's Seismic Consultant.

3.2 CONDUITS AND CABLE TRAY

3.2.1 Provide restraint installation information and details on conduit and equipment as indicated below.

3.2.2 Vertical Conduit:

(1) Attachment - Secure vertical conduit at sufficiently close intervals to keep the conduit in alignment and carry the weight of the conduits and wiring.

Stacks shall be supported at their bases and, if over two (2) stories in height, at each floor by approved metal floor clamps.

(2) At vertical conduit risers, wherever possible, support the weight of the riser, at a point or points above the center of gravity of the riser. Provide lateral guides at the top and bottom of the riser, and at intermediate points not to exceed 9.2 m.

(3) Riser joints shall be braced or stabilized between floors.

3.2.3 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.

3.2.4 Provide transverse bracing for cable trays and conduit racks at 12.2 m o.c. maximum unless otherwise noted. Provide bracing at all 90o bend assemblies and pull box locations.

3.2.5 Provide longitudinal bracing for cable tray and conduit racks at 24.4 m o.c. maximum unless otherwise noted.

3.2.6 Do not brace cable trays stacks or conduit rack runs against each other. Use separate support and restraint system.

3.2.7 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 Contractor's Seismic Consultant.

3.2.8 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.

3.2.9 A tray system (tray stack) or conduit system shall not be braced to dissimilar parts of a building or two (2) 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.

3.2.10 Provide large enough conduit sleeves through walls or floors to allow for anticipated differential movements with fire-stopping where required.

3.2.11 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 the Contractor's Seismic Consultant and submit shop drawings to consultants for their reference.

END OF SECTION

PART 1 GENERAL

1.1 PRODUCT DATA

1.1.1 Submit product data in accordance with Section 01300 – Submittal Procedures.

1.1.2 Include time-current characteristic curves for breakers with ampacity of 60 A and over or with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.2 CLOSEOUT SUBMITTALS

1.2.1 Provide operation and maintenance data for dry type transformers for incorporation into manual specified in Section 01700 – Contract Closeout.

1.2.2 Operation and maintenance instructions to include:

(1) Instruction book for each type of breaker.

(2) Time-current characteristic curves for each type of breaker.

PART 2 PRODUCTS

2.1 BREAKERS GENERAL

2.1.1 Bolt-on moulded case circuit breaker: quick- make, quick-break type, for manual and automatic operation for panel boards.

2.1.2 Common-trip breakers: with single handle for multi-pole applications.

2.1.3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips to range from three (3) to eight (8) times current rating.

2.1.4 Circuit breakers with interchangeable trips as indicated.

2.1.5 Circuit breakers to have minimum of 10,000 A symmetrical (rms) interrupting capacity rating.

2.2 THERMAL MAGNETIC BREAKERS [DESIGN A]

2.2.1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 MAGNETIC BREAKERS [DESIGN B]

2.3.1 Moulded case circuit breaker to operate automatically by means of magnetic tripping devices to provide instantaneous tripping for short circuit protection.

2.4 SOLID STATE TRIP BREAKERS [DESIGN D]

2.4.1 Moulded case circuit breaker to operate by means of a solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time (L), short time (S), instantaneous (I) and ground (G) tripping for phase and ground fault short circuit protection.

2.5 OPTIONAL FEATURES

2.5.1 Include:

(1) On-off locking device where indicated.
The MCCB breaker for the UV system should be provided with a lockout device in open position, to keep the breaker open during the maintenance of the UV system unit. The lockout device shall be:

(a) ELO-29370/VE

(b) Brady ELO-65396

(c) Master Lock 491B

(d) Approved equivalent

(2) Handle mechanism on outside of MCC.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Install thermal magnetic circuit breakers into MCC as indicated for both the UV1 & UV 2 CPP (Control Power Panel).

END OF SECTION

DISTRIBUTION TRANSFORMERS UP TO 600V - PRIMARY

PART 1 GENERAL

1.1 WORK INCLUDED

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

1.1.2 Use transformers of one Manufacturer throughout the project.

1.2 REFERENCE STANDARDS

1.2.1 Conform to the following reference standards:

(1) Canadian Electrical Code as adopted by the Province of British Columbia.

(2) Transformers to be built in accordance with CSA standard C9 M1981 (R2002) and shall be energy efficient type that meet or exceed CSA-C802.2 for dry-type transformers and tested in accordance with this standard.

1.3 SUBMITTALS

1.3.1 Shop drawings: Submit with the related items of equipment in accordance with Contract Documents.

1.4 CLOSEOUT SUBMITTALS

1.4.1 Operating and Maintenance Data: Provide with the related item of process equipment for incorporation in Operation and Maintenance Manual.

PART 2 PRODUCTS

2.1 TRANSFORMERS

2.1.1 Type ANN, 3Ø, 60 Hz, size (50 kVA) as shown on the drawings, 600 V input delta, 480 V output wye, for use in electrical rooms, or controlled environments.

2.1.2 Voltage taps: 2 FCAN and 2 FCBN 2.5% taps.

2.1.3 Windings shall be copper.

2.1.4 Insulation: Class H with Class B temperature rise.

2.1.5 Basic impulse level: 10 kV.

2.1.6 Transformers to be of same manufacture as MCC. Acceptable manufacturers are Eaton Cutler Hammer, Schneider, or Allen Bradley.

2.1.7 Transformers will be three (3) phase, maximum 150°C rise, copper windings, delta grounded wye, rated 600V - 480V.

PART 3 EXECUTION

3.1 INSTALLATION

3.1.1 Ensure the equipment is properly installed to provide satisfactory service.

3.1.2 Ensure adequate clearance around transformer for ventilation.

3.1.3 Make primary and secondary connections in accordance with wiring diagram.

3.1.4 Energize transformers after installation is complete and insulation tests performed.

3.2 TESTING AND COMMISSIONING

3.2.1 Perform tests and document results in accordance with Contract Documents requirements.

3.2.2 For each item of equipment, attach test documentation.

END OF SECTION

DISTRIBUTION EQUIPMENT STARTUP & TESTING

PART 1 GENERAL

1.1 INTENT

1.1.1 This Section specifies general requirements common to all starting and testing of electrical components and systems. Read this Section in conjunction with related sections which specify specific portions of electrical starting and testing work.

1.1.2 Except where otherwise specified, arrange and pay for the testing and related requirements specified in this and related Sections.

1.1.3 If test results do not conform with applicable requirements, repair, replace or adjust or balance components and systems. Repeat testing as necessary until results acceptable to the Engineer are achieved.

1.2 RELATED WORK IN OTHER SECTIONS

1.2.1 Division 1 testing requirements.

1.2.2 Electrical component and systems specified in Division 11 and 16.

1.3 DOCUMENTATION

1.3.1 Manufacturer's Reports:

(1) Arrange for Manufacturer to submit copies of all production test records required by the Specifications prior to shipping.

(2) Arrange for Manufacturer to submit brief step-by-step description of entire starting procedure to allow the Engineer to repeat starting at any time.

1.3.2 Provide complete copies of testing reports for all distribution equipment. Report forms to be accepted industry documentation as provided by testing firms regularly engaged in distribution testing.

1.4 STARTING AND TESTING - GENERAL

1.4.1 Prior to testing ensure all electrical components are cleaned and free of dust.

1.4.2 After testing, protect components subject to dust from construction activities.

1.4.3 Notify the Engineer when starting and testing of all components has been completed.

1.4.4 Do not conceal or cover components until inspected, tested and approved by the Engineer.

1.4.5 Assume all liabilities associated with starting, testing and balancing procedures.

1.4.6 Assume all cost associated with starting, testing, adjusting and balancing including the supply of testing equipment.

1.5 WITNESSING OF STARTING AND TESTING

1.5.1 Prior to starting and testing of electrical equipment or systems, prepare a schedule for the required testing. Review schedule with the Engineer.

1.5.2 Provide sufficient notice (minimum seven (7) days) prior to commencing tests.

1.5.3 The Engineer may witness all or any portion of testing and starting procedures performed by Division 16.

1.5.4 Division 16 to be present for all tests.

1.6 QUALITY ASSURANCE

1.6.1 All starting, testing procedure shall be in accordance with:

(1) The Contract Documents.

(2) Requirements of authorities having jurisdiction.

(3) Manufacturer's published instructions.

(4) Applicable CSA, IEEE, IPCEA, EEMAC, NEMA and ASTM Standards.

1.6.2 Personnel involved in starting, testing, adjusting and balancing procedures shall have experience in electrical components and systems starting and testing and shall be able to interpret results of readings and tests and report state of systems in a clear and concise manner.

1.6.3 If requirements of any of the foregoing conflict, notify the Engineer before proceeding with tests and obtain written clarification.

1.7 MANUFACTURER'S STARTING RECOMMENDATIONS

1.7.1 Prior to starting components or systems, obtain and review Manufacturer's installation, operation and starting instructions.

1.7.2 Use Manufacturer's and Supplier's starting personnel where required to maintain validity of manufacturer's warranty. Confirm with Manufacturer that all testing specified in the Specifications will not void any warranties.

1.7.3 Compare installation to Manufacturer's published data and record discrepancies. Modify procedures detrimental to component performance prior to starting component.

1.8 MANUFACTURER'S SERVICE ON SITE

1.8.1 Arrange and pay for qualified Manufacturer's Representatives to supervise starting and testing of the following electrical components and systems:

(1) Ultra Violet Disinfection System.

1.8.2 Manufacturer's Representative shall be experienced in the design and operation of components and systems being started, have the ability to interpret results of readings and tests and report results in a logical fashion.

1.9 PRESIDING AUTHORITIES

1.9.1 Starting procedures defined in this section may duplicate verification conducted by presiding authorities. To facilitate expedient turnover of building, arrange for authorities to witness procedures in a manner that avoids unnecessary duplication of tests.

1.9.2 Obtain certificates of approval, acceptance and comply with rules and regulation of authorities having jurisdiction. Provide copies of all certificates to the Engineer.

1.10 CORRECTION OF DEFICIENCIES

1.10.1 Correct all contract deficiencies found during electrical component and system starting and testing and Engineer’s performance verification.

1.11 COMPLIANCE WITH DEFINED PROCEDURES

1.11.1 Failure to follow the specific instructions defined herein pertaining to correct starting procedures may result in re-evaluation of component by independent testing agency selected by the Engineer at the Contractor’s expense. Should results reveal component has not been started in accordance with specified requirements, component may be rejected. If rejected, remove component from site and replace. Replacement component shall also be subject to full starting procedures, using same procedures specified on the originally installed component.

1.12 COORDINATION

1.12.1 Coordinate with all sub-trades, other divisions, Manufacturers, Suppliers and other specialists as required to ensure all phases of the Work shall be properly organized prior to commencement of each particular testing procedure. Establish all necessary manpower requirements.

1.12.2 Coordinate the activities of this Section with the starting and testing of:

(1) Process Mechanical components and systems specified in Division 11.

(2) Instrumentation and Control components and systems specified in Division 16.

(3) Mechanical components and systems specified in Division 11.

(4) Other components and systems specified in all other Divisions.

(5) Division 1.

1.12.3 Where any component or systems require testing prior to starting, ensure that such work has been completed and approved prior to starting of the electrical components and systems.

1.13 IMPLEMENTATION

1.13.1 Unless otherwise specified in writing by the Engineer all testing and related requirements specified herein will be performed prior to the issue of the interim certificate of completion.

PART 2 PRODUCTS

2.1.1 Not Applicable.

PART 3 EXECUTION

3.1 GENERAL COMPONENT STARTING & TESTING

3.1.1 Energizing Electrical Components:

(1) Prior to energizing components provided under other sections and components provided by the Owner:

(a) Confirm components nameplate data with characteristics of power supply.

(b) Verify supply authority voltage and phase rotation.

(c) Ensure all independent testing as specified in related sections has been completed and deficiencies have been corrected.

(d) Close and open all devices to ensure proper mechanical operation.

(e) Megger all feeders and record results on approved verification forms.

(2) Load Balancing:

(a) Measure load balance on all feeders at distribution centres, motor control centres and panel boards with normal loads (lighting included) operating at time of acceptance. Adjust branch circuit connections as required to obtain best balance of current between phases and record changes.

(b) Measure phase voltages at loads and adjust transformer taps to within 2% of rated voltage of components.

(c) If load unbalance exceeds 15%, reconnect circuits to balance loads. Revise panel board directories and wiring identification accordingly.

(d) Submit, at completion of the Work, a report listing phase and neutral currents on panel boards, dry core transformers and motor control centres, operating under normal loads. State hour and date on which each load was measured and voltage at time of test.

(3) Insulation Resistance Testing (Megger Test):

(a) Megger circuits, feeders and components up to 350V with a 500V instrument.

(b) Megger 350-600V circuits, feeders and components with a 1000V instrument.

(c) Check resistance to ground before energizing.

(d) Carry out tests in presence of the Engineer.

(e) Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

(f) Submit test results for the Engineer's review.

(4) Ground Resistance Testing:

(a) Measure ground resistance of ground grids with earth test megger to verify compliance with CSA C22.2 No. 0.4-1982 and Canadian Electrical Code.

(5) Coordination of Protective Devices:

(a) Ensure circuit protective devices such as overcurrent trip relays, fuses are installed to design values and settings.

(6) Voltage Testing and Adjusting:

(a) Test voltage at service entry point, and secondary of transformers above 45 kVA. Record voltages at interim acceptance and three (3) months after practical completion for a period of four hours during a normal workday.

(b) Adjust transformer tap settings to compensate for under-voltage or over-voltage conditions, if directed to do so by the Engineer.

3.2 HIGH VOLTAGE POWER DISTRIBUTION (ABOVE 750 V)

3.2.1 Not Applicable.

3.3 LOW VOLTAGE POWER DISTRIBUTION (BELOW 750 V)

3.3.1 Circuit Breaker:

(1) Breakers - Moulded case breakers to 150 Amp:

(a) Visual inspection.

(b) Mechanical function test.

(c) Set all units with adjustable magnetic trip units.

(2) Breakers - Moulded case breakers 150 Amp frame and larger:

(a) Visual inspection.

(b) Ductor test.

(c) Megger test.

(d) Mechanical function test.

(e) Set all units with adjustable magnetic trip units.

(f) Where solid state protection is provided with large breakers, test units as follows:

(i) Inspect and test in accordance with Manufacturer's most recent installation and maintenance brochure.

(ii) Perform tests using Manufacturer's relay test unit as applicable, with corresponding test instruction.

(iii) If the Manufacturer's tester is not available, use an approved relay tester unit with the proper test data and test accessories.

(iv) Proof test each relay in its control circuit by simulated trip tests to ensure total and proper operation of breaker and relay trip circuit by injection of the relay circuit to test the trip operation.

(v) Check C/T and P/T ratios and compare to coordination data.

3.3.2 Protective Relaying:

(1) Installation and testing per High Voltage Power Distribution defined in this section.

3.3.3 Dry Type Transformer:

(1) General:

(a) Complete verification form for each transformer.

(i) Visual inspection of enclosures and all accessories.

(ii) Torque test all bus connections and cable terminations and seal with red lacquer.

(iii) Conduct megger test.

(iv) Dielectric power factor test.

(v) Core ground test.

(vi) Ratio test in all tap positions.

(vii) Test operation of temperature and operation of all associated alarm contacts.

(viii) Test and calibrate ground fault relays and function test to trip associated breakers.

3.3.4 Wiring & Cables:

(1) General:

(b) Test conductors at distribution centres and panel boards for insulation resistance to ground (Megger Test).

(c) Test service grounding conductors for ground resistance.

(d) Provide the Engineer with list of test results on approved verification form showing location at which each test was made, circuit tested and results of each test.

(e) Remove and replace entire length of cable if cable fails to meet any of the test criteria.

(f) Automatic Power Factor Correction Components:

3.3.5 Grounding:

(1) Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.

(2) Perform tests before energizing electrical distribution.

(3) Disconnect ground fault indicator during tests.

(4) Provide test report documenting successful test results.

END OF SECTION

ELECTRICAL EQUIPMENT AND SYSTEMS DEMONSTRATION

PART 1 GENERAL

1.1 WORK INCLUDED

1.1.1 Provide demonstration and instruction sessions to familiarize plant operation and maintenance personnel with electrical systems and their operation and maintenance.

1.1.2 Submit system sign off sheets for each system listed prior to substantial completion.

1.1.3 All sign off and survey sheets shall be typewritten.

1.1.4 The training sessions shall be established by system vendor based on system complexity and experience with similar installations. The proposed training sessions shall be submitted by Contractor with the final submittal (shop drawings approval) of the listed equipment.

1.1.5 Demonstration and training sessions shall take place at site with both audio-visual training sessions and a hands-on training on equipment installed. The training session shall not be less than six (6) hours for the equipment listed in the present specification.

1.2 MANUFACTURER'S SITE SERVICES

1.2.1 Arrange and pay for appropriately qualified Manufacturers Representatives to provide or assist in providing electrical equipment and system demonstration and instruction as specified herein.

1.3 CONTRACTOR COORDINATION

1.3.1 The Engineer will chair demonstration and instruction sessions.

1.3.2 Establish agendas for demonstration and instruction sessions in conjunction with plant personnel. Coordinate scheduling of sessions with plant personnel, prior to final commissioning of the listed equipment.

PART 2 PRODUCT

2.1 NOT USED.

PART 3 EXECUTION

3.1 SYSTEMS DEMONSTRATION

3.1.1 Demonstrate operation of following systems:

(1) Panel boards and Transformers.

(2) 480V, 3Ph UV Disinfection system.

(3) 120 Volt System.

(4) Mechanical Equipment Connections, valves and associated controls.

(5) Process Control Panels.

(6) Local Control Panels.

(7) Assist with SCADA System Functional testing.

(8) Local Control Panels and Keypads and Touch Screens on Local Control Panels.

(9) Leak Alarms and other Equipment Protection Devices.

(10) Emergency Stop buttons, pull lines and other safety interlocks.

3.2 SYSTEMS TRAINING

3.2.1 Provide training sessions to operational and maintenance personnel for the following systems:

(1) All new equipment and associated system interfaces.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

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

1.1.2 Setup parameters & test electrical powered actuators and supply, setup & test accessories for controlled devices.

1.1.3 All powered actuators shall be supplied together with the mechanical equipment (e.g. valves, gates, etc.) by the mechanical equipment supplier under Division 11. Coordinate actuator requirements with Division 11.

1.1.4 Sizing and matching of powered actuators to controlled devices shall be undertaken by the mechanical equipment supplier under Division 11 and coordinated with the Work specified herein.

1.2 SUBMITTALS FOR REVIEW

1.2.1 Submittals in accordance with section 01300 – Submittals and Section 16010 – General Electrical Requirements.

1.2.2 Furnish shop drawings for complete actuator assemblies and accessories prior to delivery.

1.2.3 Division 11 responsible for the calculations for sizing, noise, cavitation and actuator torque calculations.

1.3 SERVICE CONDITIONS

1.3.1 The valve suppliers shall provide verification that the control actuators are compatible with their valves and are correctly sized.

1.3.2 The actuator manufacturer is responsible for supplying and mating the actuator to the valve. Valve manufacturer is responsible for providing actuator mounting flange. Actuator supplier to supply the actuator mounting bolts and machine the actuator stem and nut to meet the valve stem requirements. Refer to Section 11290 – Process Valves.

1.4 SHIPMENT, PROTECTION AND STORAGE

1.4.1 Ship and store equipment in accordance with Division 1 and Section 16010 – General Electrical Requirements.

1.5 DELIVERY AND STORAGE

1.5.1 Deliver by Division 11.

1.5.2 Clearly tag all control valves and actuators, stating size, type, coatings and mating parts.

1.5.3 When stored on site use storage methods recommended by the Manufacturer to prevent damage, undue stresses, or weatherproofing.

1.6 PROCESS VALVE AND ACTUATOR SCHEDULES

1.6.1 Refer to the drawings for valve and actuator identification. Power actuated devices, which require automation, as shown on the P&ID's and in Divisions 11 and 16 specifications.

1.6.2 Devices and actuators shall be provided from the device manufacturer and shipped pre-assembled with all accessories.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 Provide new material only.

2.1.2 Provide all actuator mounting hardware and accessories mounted on the device prior to shipment.

2.1.3 Provide device and actuator as a matched set from the same Manufacturer wherever possible.

2.1.4 All motorized valves actuators shall have reverse starting control transformer and local controls integral with valve actuator, suitably housed to prevent breathing and condensation.

2.1.5 All actuators and positioners shall have LCD position indicator and provide non-intrusive setting and commissioning.

2.1.6 Tag the control devices, accessories and actuators to indicate operating characteristics. Tag the actuator inlet and outlet ports for electric or pneumatic services. Electric actuators must be CSA approved.

2.1.7 Each electric actuator shall have a hand switch with three (3) position functionality 'O/C/A' where; 'A' position (Remote Mode) allows the PLC control over the valve position, 'O' position (Manual Open) drives the valve to the Open position and 'C' position (Manual Close) drives the valve to the Closed position.

2.2 ACTUATOR TYPES

2.2.1 Electro-Mechanical Actuators, General:

(1) Provide electric actuators of type shown on the P&IDs.

(2) Unless noted otherwise, the actuator will fail to the last position when the control function or power fails.

(3) Unless otherwise specified, electric actuators to be 129VAC, 1Ø, 60 Hz for service. Provide each actuator with a high torque, reversible motor which is capable of continuous duty over the full operating range.

2.2.2 Electric Linear Actuators, Open/Close Type (EMLO) and Modulating Type (EMLM):

(1) The drive train to be rated for heavy duty, continuous service. Connect the actuator drive shaft to gear box shaft(s) through a removable flexible mechanical coupling. Where the actuator is fitted to two (2) stems, ensure that the gearing in each gearbox allows both stems to move identically.

(2) House the internal components of actuators and related gear boxes in weather proof, corrosion proof metal enclosures. Electrical components shall be contained in EEMAC 4X enclosure. All electrical and mechanical components shall be capable of continuous operation in an ambient temperature range of -40°C to plus 40°C.

(3) Provide a space heater for each actuator.

(4) Fit actuators with a capstan hand wheel operator. Fit hand wheel assemblies with a clutching mechanism which prevents hand wheel operation during normal motor operation. Provide a 1:1 gearing ratio with respect to the main drive shaft for the hand wheel.

(5) Fit removable safety guards over all moving drive train components between the actuator and each gear box.

(6) Provide adjustable limit switches on each actuator to define the upper and lower limit of the stroke.

(7) Provide a controller enclosure to contain a motor contactor complete with overload protection. Provide line, load, and external control terminal strips.

(8) Provide a local operating station with a Local-Off-Remote switch and an Open-Close-Auto switch.

2.3 POSITION SWITCHES AND INDICATORS

2.3.1 When specified, actuator position switches include two (2) form C 2 amp contacts in an EEMAC 4 (minimum) rated enclosure.

2.3.2 Cams to be fastened to a splined shaft and adjustable without set screws.

2.3.3 Provide a visual indicator with beacon type display showing red when the controlled device is closed position and green in open.

2.3.4 Supply all required hardware for mounting of position monitor in accordance with the specified valve/actuator orientation.

2.3.5 Valves to have external position indication.

2.3.6 Enclosures to be suitable for environment to which they are exposed.

2.4 MANUAL LOADING STATION

2.4.1 Manual loading station shall consist of a manually adjustable loading regulator, changeover valve (manual/automatic), a gauge for manual signal pressure indication, a gauge for automatic signal pressure indication, an air set, and air supply isolating valve.

2.4.2 Mount loading station on a galvanized plate attached to a floor stand. Locate station within 2 m of the controlled device.

2.5 COMMUNICATIONS REQUIREMENTS

2.5.1 All actuators shall communicate over hardwired signals, per drawings and minimum monitoring requirements below.

2.6 MINIMUM MONITORING AND CONTROL SIGNAL REQUIREMENTS

2.6.1 Open Close Electric actuators:

(1) Valve Opened

(2) Valve Closed

(3) General Fault

(4) Open/Close Command(s)

PART 3 EXECUTION

3.1 PREPARATION

3.1.1 Prior to installation of the valve actuators, field measure and check all equipment locations, pipe alignments, and structural installations. Ensure that sufficient space and accessibility is available for pneumatic and electric actuators.

3.1.2 Where conflicts are identified, inform the Engineer and initiate the necessary modifications at no cost to the Owner.

3.2 INSTALLATION

3.2.1 Install actuators, related panels, wiring as shown in the drawings, and as recommended by the Manufacturer.

3.2.2 Install valves as described in Division 11 & 16.

3.3 FIELD TESTING AND COMMISSIONING

3.3.1 Provide testing and commissioning in accordance with Division 16.

3.3.2 Factory test each actuator assembly prior to shipment.

3.3.3 The manufacturer's representative will be required to commission the electric and actuators to verify the installation and make final travel limits and torque adjustments.

3.4 TRAINING

3.4.1 Provide training in accordance with Sections 01664 – Training and Division 16.

END OF SECTION

INSTRUMENT SPECIFICATION SHEETS

PART 1 GENERAL

1.1 DESCRIPTION

1.1.1 Conform to the requirements Division 11 & 16.

1.1.2 The Instrument Specification Sheets detail relevant data for the supply of the Magnetic flow meter & valves (located as an Appendix to this section). Additional valve info can be found in Section 11290 Process Valves.

1.1.3 Provide instruments complete with mounting hardware, floor stands, wall brackets or instrument racks as required by the Manufacturer and specified herein.

1.2 SUBMITTALS FOR REVIEW

1.2.1 Make submittals in accordance with the requirements specified in Division 1, 3, 5, 11, & 16.

(1) Record Drawings

1.2.2 Update the Instrument Specification Sheets to reflect the latest data and vendor information.

1.2.3 Provide Instrument Specification Sheets which contain actual data provided as part of a packaged equipment submittal. Any additional instruments must be included in the Instrument Index and be properly cross referenced.

1.3 STANDARDS OF CONFORMANCE

1.3.1 Instrument Systems and Automation Society, ISA-S50.1, current edition, Compatibility of Analog Signals for Electronic Industrial Process Instruments.

1.3.2 ISA Standard S20: Specification Forms for Process Measurement and Control Instruments, Primary Elements and Control Valves.

1.3.3 Underwriter Laboratories, UL508, Standards for Industrial Control Equipment.

1.3.4 National Electrical Manufacturers Association (NEMA), Pub. No. ICS-6, enclosures for industrial controls and systems.

1.3.5 Canadian Standards Association (CSA).

1.3.6 Approvals:

(1) Factory Mutual (FM) approval for explosion proof and intrinsic safety IS.

(2) Canadian Standards Association (CSA) approval for explosion proof and intrinsic safety C6.

PART 2 PRODUCTS

2.1 GENERAL

2.1.1 The attached Instrument Specifications Sheets specify instrumentation devices and detail application requirements.

2.2 TYPICAL MANUFACTURERS

2.2.1 The Instrument Specification Sheets define approved and typical Manufacturers.

2.2.2 Refer to at bottom section of data sheet for instrument "Supply Code" information.

PART 3 EXECUTION

3.1 SETUP, TEST & COMMISSIONING

3.1.1 Setup, test, startup, and commission all instruments as required by Division 11 & 16.

3.1.2 The Contractor shall allow for services of a qualified equipment representative to carry out setup and testing of all instruments.

3.2 INSTRUMENT SPECIFICATION SHEETS

3.2.1 Attached.

END OF SECTION

ISS Sheet

ISS Spec Code: **FM3-1-04**

Project: Chapman Creek WTP UV Upgrade
Project #: 111700729
Client: Chapman Creek WTP
Specification Section: 16994

FULL BORE MAGNETIC ELEMENT
DEVICE SPECIFICATION

1.0 Performance Characteristics		**3.0 Transmitter Con't**	
1.1 Accuracy rating:	+/- 0.2%	**3.9 Output signal type:**	Analog
1.2 Conductivity (uS/m):	Drinking Water	**3.10 Supply voltage:**	120 VAC
1.3 Min/Max fluid temp (°C):	5 / 40	**3.11 Type:**	Remote
1.4 Min/Max press. @design temp (kPa):	0 / 1034	**4.0 Special Requirements**	
1.5 Min/Max velocity span (m/s):	0.3 / 2.5	**4.1 Cert/Approval**	NSF-61 or equivalent General Purpose CSA
1.6 Min/Max working temp (°C):	0 / 40	**4.3 Reference specification:**	16994
2.0 Sensing Element		**5.0 Accessories**	
2.1 Body type:	MAG 5100W or Approved Alt.	**5.1 Calibrator/Configurator:**	N/A
2.2 Cable length:	10 m	**5.2 Empty tube detector:**	Yes
2.3 Connection to transmitter:	Mfr. std. cable		
2.4 Electrode type:	Hastelloy C276 or 316 SS		
2.5 Enclosure rating:	IP 67		
2.6 Flow tube diameter (mm)	500 DN (20") Class 150 RF		
2.7 Flow tube material:	Carbon steel ASTM A 105		
2.8 Flow tube style:	Full bore magnetic		
2.9 GND/Protective ring material:	Carbon steel ASTM A 105 (QTY 2)		
2.10 Lining material:	EPDM / Ebonite or drinking water approved (NSF-61)		
2.11 Material:			
2.12 Process connection:	Class 150 ANSI RF		
2.13 Mounting Location:	Remote		
3.0 Transmitter			
3.1 Calibration:	3-point calibration, 0.2%		
3.2 Connection:	Screw terminal block, ½" NPT cable glands		
3.3 Analog Comm std.:	4 - 20 mA w/ HART		
3.4 Enclosure material:	Fibre glass reinforced polyamide		
3.5 Enclosure rating:	IP67/NEMA 4X		
3.6 Grounding:	Internal ground lug		
3.7 Integral indicator style:	3 x 20 characters, background illuminated display		
3.8 Mounting (Wall/Pipe):	Wall		

Manufacturer:	Siemens
Model:	MAG 6000/5100W
Approved Alternate(s):	N/A

Notes:

- Unclassified Zone
- Wall mount kit required
- Vendor supplied cable kit including standard coil cable and special electrode cable to allow for empty pipe detection.
- Zero upstream pipe ID option required to maintain accuracy

Revision:	**Date:**	**Comments:**	**By:**
	July 2024	Issued for Tender	MJL

ISS Sheet

ISS Spec Code: **HV3-1-0X (QTY 3)**

Project: Chapman Creek WTP UV Upgrade
Project #: 111700729
Client: Chapman Creek WTP
Specification Section: 11290

ISOLATION BUTTERYFLY VALVE, HAND OPERATED
DEVICE SPECIFICATION

1.0 Performance Characteristics		**5.0 Transmitter**	
1.1 Deadband:	NA	**5.1 Connection:**	NA
1.2 Min/Max fluid temp (°C):	5 / 40	**5.2 Control power:**	
1.3 Min/Max press. @design temp (kPa):	0 / 350	**5.3 Communication std.:**	
1.4 Min/Max velocity span (m/s):	0.3 / 2	**5.4 Grounding:**	
1.5 Min/Max working temp (°C):	0 / 30	**5.5 Integral indicator:**	
2.0 Design		**5.6 Local controls:**	
2.1 Nom. Size (mm):	600	**5.7 Remote controls:**	
2.2 Body Style:	Flanged ANSI B16.1 Class 125/Lugged/Approved Alt.	**5.8 Mounting:**	
2.3 Body Material:	Gray Iron/Ductile Iron/Stainless Steel	**5.7 Output Signal Type:**	
2.4 Shaft Material:	ANSI Type 304 or 316 SS	**6.0 Positioner or Controller**	
2.5 Seat Material:	NSF EPDM	**6.1 Duty cycle:**	NA
3.0 Actuator		**6.2 Failsafe:**	
3.1 Diaphragm/Oring matl.:	NA	**7.0 Special Requirements**	
3.2 Enclosure finish:	NA	**7.1 Cert/Approval:**	NSF-61 AWWA C504
3.3 Enclosure material:	NA	**7.2 Reference specification:**	11290
3.4 Enclosure rating:	NA	**7.3 Actuated equipment:**	Refer to Division 11
3.5 Fitting type:	NA	**8.0 Accessories**	
3.6 Manual operation:	Handwheel (gear-assisted)/Chain drives. See Spec 11290	**8.1 Nameplate:**	Dataplate attached to housing
3.7 Supply voltage (V AC/Ph/Hz):	NA		
3.8 Valve Type:	Butterfly		
4.0 Motor			
4.1 Insulation:	NA		
4.2 Protection:			
4.3 Running torque:			
4.4 Seating torque:			
4.5 starts/hour:			
4.6 Thrust:			

Manufacturer:	Bray, Keystone, Pratt, DeZurik, Clow, Vitaulic	**Notes:**
Model:		- Mark valves in accordance with MSS SP-25
Approved Alternate(s):		- 4 typical isolation Valve for UV1 and UV2

Revision:	**Date:**	**Comments:**	**By:**
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ISS Sheet

ISS Spec Code: **MV3-1-0X (QTY 2)**

Project: Chapman Creek WTP UV Upgrade
Project #: 111700729
Client: Chapman Creek WTP
Specification Section: 11290 & 16993/16994

EFFLUENT BUTTERYFLY VALVE, MOTORIZED
DEVICE SPECIFICATION

1.0 Performance Characteristics		**5.0 Transmitter**	
1.1 Deadband:	NA	**5.1 Connection:**	Screw terminal block
1.2 Min/Max fluid temp (°C):	Min. 5, Max. 40	**5.2 Control power:**	120 VAC
1.3 Min/Max press. @design temp (kPa):	0 /1034	**5.3 Communication std.:**	Hardwired signals
1.4 Min/Max velocity span (m/s):	0.3 / 2.5	**5.4 Grounding:**	Integral ground lug
1.5 Min/Max working temp (°C):	5 /40	**5.5 Integral indicator:**	Mfr. Std. large format LCD c/w pos. indication and status alarms
2.0 Design		**5.6 Local controls:**	Local - Off - Remote, Close - Stop - Open
2.1 Nom. Size (mm):	600	**5.7 Remote controls:**	Open/Closed
2.2 Body Style:	Flanged ANSI B16.1 Class 125/Flanged/Approved Alt.	**5.8 Mounting:**	Integral to actuator
2.3 Body Material:	Gray Iron/Ductile Iron/Stainless Steel	**5.7 Output Signal Type:**	Discrete
2.4 Shaft Material:	ANSI Type 316 SS	**6.0 Positioner or Controller**	
2.5 Seat Material:	NSF61 EPDM	**6.1 Duty cycle:**	On/Off
3.0 Actuator		**6.2 Failsafe:**	Fail last position
3.1 Diaphragm/Oring matl.:	Mfr. Std.	**7.0 Special Requirements**	
3.2 Enclosure finish:	Epoxy coated	**7.1 Cert/Approval:**	NSF-61 AWWA C504
3.3 Enclosure material:	Mfr. Std.	**7.2 Reference specification:**	11290
3.4 Enclosure rating:	CSA Type 4X (EX)	**7.3 Actuated equipment:**	Refer to Division 11 & 16
3.5 Fitting type:	Direct mount, gear box	**8.0 Accessories**	
3.6 Manual operation:	Integral handwheel c/w clutch	**8.1 Nameplate:**	Dataplate attached to housing
3.7 Supply voltage (V AC/Ph/Hz):	120VAC		
3.8 Valve Type:	Butterfly		
4.0 Motor			
4.1 Insulation:	Mfr. Std.		
4.2 Protection:	Stall, over temp, single phasing, phase rotation		
4.3 Running torque:	By vendor		
4.4 Seating torque:	By vendor		
4.5 starts/hour:	<100		
4.6 Thrust:	By vendor		

Manufacturer:	Rotork Actuator & Bray, Keystone, Pratt, DeZurik, Clow, Vitaulic, Challenger or approved alternate valves	**Notes:**
Model:		- Mark valves in accordance with MSS SP-25
Approved Alternate(s):		

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ISS Sheet

ISS Spec Code: **SV3-1-0X (QTY 4)**

Project: Chapman Creek WTP UV Upgrade
Project #: 111700729
Client: Chapman Creek WTP
Specification Section: 11290 & 16994

N/O, 2-WAY GENERAL SERVICE SOLENOID VALVE FOR WATER
DEVICE SPECIFICATION

1.0 Performance Characteristics		**6.0 Special Requirements**	
1.1 Commodity pressure (kPa):	1034	**6.1 Cert/Approval:**	NSF-61 or equivalent General Purpose CSA
1.2 Max. press. @design temp (kPA):	1034	**6.2 Reference specification:**	11290
1.3 Min/Max working temp (°C):	Min. 5, Max. 40	**7.0 Accessories**	
1.4 Service:	Flushing water (Cooling)	**7.1 Nameplate:**	SS Name Plate
2.0 ACTUATOR			
2.1 Coil rating (A):	5		
2.2 Fall positon:	Open		
2.3 Operation:	NO (Normally Open)		
2.4 Port configuration:	2-way		
2.5 Type:	Pilot operated solenoid valve		
2.6 Voltage rating:	120 VAC		
3.0 Connection Head			
3.1 Electrical comm.:	As Needed		
3.2 Enclosure rating:	CSA Type 4X		
3.3 Manual override:	Required		
4.0 Valve Body			
4.1 Core and plugnut:	430F SS		
4.2 Core tube:	305 SS		
4.3 Diaphragm seal:	PTFE		
4.4 Disc. holder:	PA		
4.5 Enclosure material:	304 SS (min.)		
4.6 Enclosure rating:	CSA Type 4X		
4.7 Shading coil:	Silver		
4.8 Springs:	302 SS		
5.0 Process Connection			
5.1 Line material:	As required by process line		
5.2 Mounting:	Wall		
5.3 Size:	As required by process line		
5.4 Style:	NPT		

Manufacturer:	ASCO	**Notes:**
Model:		- Unclassified Zone
Approved Alternate(s):	Burkert or approved alternate	- NSF-61 drinking water approval required

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