

PART 1 - GENERAL

1.1 Owner Supplied Equipment

The City is proposing to upgrade the Kitsilano Sewage Pump Station as described in the Contract Documents. Time is of the essence for the project and the City (Owner) has pre purchased specified equipment to expedite the work with the intent of allowing the Contractor to commence work as soon as possible. Equipment supplied by the Owner is detailed in the Contract Documents.

Estimated delivery dates are provided and shall be used for scheduling purposes. Actual equipment delivery dates will differ from the dates provided and the Contractor shall adjust his schedule accordingly. Claims for delays or extra costs for late equipment deliveries will not be considered provided the Contractor has other contract work to complete.

1.2 MCC/PDC Assembly - Owner Supplied

- .1 The MCC/PDC includes a complete motor control assembly with power and metering sections, power distribution sections, VFD sections and control cabinet as shown on the MCC reference drawings.
- .2 The MCC/PDC assembly will be delivered to the site in sections. The sections will be offloaded by the Contractor and placed in the pump station. The sections will be jointed and bolted together as required for a complete MCC assembly along with internal section to section wiring. The MCC fabricator will be responsible for assisting the Contractor in joining the sections together and for rewiring the section to section wiring.
- .3 On completion of jointing and section to section wiring the MCC supplier shall inspect the assembly and provide written confirmation that the MCC assembly has been properly placed in the pump station and is acceptable for field wiring.
- .4 Tender drawings used for the fabrication of the MCC assembly will be provided on award of contract.

1.3 Pumps - Owner Supplied

- .1 Smart Turner Pumps will be providing the equipment shown in the attached purchase order and described generally as follows:
 - .1 Two Complete New Pumps including:
 - .1 Pump stool and suction elbow;
 - .2 Pump volute, impeller, mechanical seal, bearing frame;
 - .3 75 hp vertical motor.
 - .2 Two Existing Rebuilt Pumps including:
 - .1 New pump volute, impeller, mechanical seal, bearing frame;
 - .2 75 hp vertical motor.

- .3 The new and rebuilt pumping units will be supplied in two separate pieces (pump assembly and motor) and will be assembled by the Contractor according to the supplier's instructions and recommendations. The Contractor shall use qualified personnel to assemble the pump components.
- .4 Assembled pumping units will not be commissioned until inspected by the pump supplier who will inspect the installed pumps. The Contractor will carry out any modifications to the pump installations as instructed or recommended by the pump supplier and as necessary for the pumps to be covered under the manufacturer's warranty.
- .5 Pump components requiring assembly includes but is not necessarily limited to the following:
 - .1 Pumps stools, suction elbow, pump volute, impeller, bearing frame, mechanical seal to be one assembly;
 - .2 Motor to be one assembly;
 - .3 Motor to pump (Faulk) mechanical coupling.
- .2 New pumps will be delivered to the Kitsilano pump station for offloading and installation by the Contractor.
- .3 Pumps to be rebuilt include the following removal work:
 - .1 Remove the complete pump assembly except the pump stool and suction elbow. Disassemble the pump motor and ship to Smart Tuner in Ontario for rebuilding. **Shipment costs to Ontario will be borne by the contractor;**
 - .2 Rebuilt pumps will be delivered (at Pump Rebuilders cost) to the Kitsilano pump station for offloading and installation by the Contractor.
 - .3 New and rebuilt pumps will be delivered on different dates.

1.4 Pump Discharge Valves - Owner Supplied

- .1 Pump check valves:
 - .1 New Valmatic surgebuster valves as indicated;
 - .2 New Valmatic plug valves as indicated;
- .2 Pump valves will be supplied and delivered to the site by Flotech for offloading and storage and installation in the pump station by the Contractor. Bolting and related items are not included.

1.5 Flow Meter Transmitters

- .1 Flow meter transmitters will be supplied to the Contractor directly by the City or by the forcemain contractor who will install flow tubes in manholes outside the pump station including electrical ducts and signal wiring. The signal wiring will extend back to the station and through the pump room wall.
- .2 The Contractor will install the flow meter transmitters in the pump station and connect all field wiring to the MCC and shall also be responsible for startup and

commissioning of the flowmeter assembly (tube, transmitter and wiring in the pump station).

1.6 Contractor Responsible for Coordination and Acceptance of Owner Supplied Equipment

- .1 The Contractor will be provided contact information for all City supplied equipment.
- .2 The Contractor will be responsible for all coordination and scheduling with all suppliers of City supplied equipment and will accept, unload and inspect all Owner supplied equipment and shall then be responsible for safekeeping and installation. Any Owner supplied equipment damaged after offloading and inspection and determine to have been damaged by the Contractor shall be replaced or repaired by the Contractor as directed and solely determined by the Engineer.
- .3 The Contractor shall submit a signed acceptance form for all Owner supplied equipment received on site indicating the equipment has been received, offloaded and is in satisfactory condition.

2.0 PRODUCTS

2.1 Pump Purchase Order

QTY	PART NUMBER	DESCRIPTION	NET PRICE EA	DELIVERY
2	8WOFS	Smart Turner Vertical Non-Clog Pump 10HH Frame Assembly Pump Stool & Suction Elbow Included Impeller Trimmed to 15-1/4" As per Specification provided All Cast Iron Construction Flowserve Cartridge ISC2PX Seal Hardened Wear Rings Falk 1080T Coupling Weight 2,275 lbs.		8-10 Weeks ARO
4	Motor / Custom	75HP 1200 Rpm 3/60/575-Volt TEFC Vertical 405TC Baldor / Reliance IEE841 Severe Duty Motor Nema Premium Efficiency to Specification provided		" " "
4	Performance	Non-Witnessed Performance Test @ 5 points as per HI. Plotted curve to be provided.		1-2 Weeks

City of Vancouver
 Kitsilano Sewage Pump Station Upgrade
 Tender PS10134

Section 01105
 Owner Supplied Equipment
 Page 5 of 6

2	8WOFS Rebuilds	Smart Turner Vertical Non-Clog Pump Less Pump Stool & Suction Elbow Rebuild Existing pumps and convert to 10HH Frame Assembly. Full Inspection of Complete Pump New Impeller Trimmed to 15-1/4" New 10HH Frame Assembly Flowserve Cartridge ISC2PX Seal New Stuffing Box New Hardened Wear Rings Falk 1080T Coupling All Gaskets Misc Hardware 1 Year Parts & labour Warranty *re-use existing casing, Suction Cover and misc parts for remainder.		*1 Week Approx. *Parts pre-ordered with new pumps.
1	On-Site Supervision for commissioning	Flight \$ 1,000.00 (Toronto to Vancouver) Hotel & Meals \$ 1,000.00 (Best Western) On-Site \$ 1,600.00 (8 Hours x 2 days Weekdays) Car Rental \$ 250.00 (4 Days) Travel Time Weekday \$400.00 (2 days x 200) *At least one weeks' notice will be required These prices are estimated and will be billed as per actual costs. Receipts will be provided to support costs. Any additional time will be charged as per Smart Turner's standard rates see "On-site supervision" form.		TBA

2.2 Valves

- .1 See specifications.

**INVITATION TO TENDER NO. PS10134
KITSILANO PUMP STATION UPGRADE CONSTRUCTION
APPENDIX A - MATERIALS AND EQUIPMENT**

1 GENERAL

1.1 Documents

- .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 Description

- .1 This section contains the general requirements of Materials, equipment and workmanship. This section supplements but does not supersede specific requirements found elsewhere in the Specifications.

1.3 Products and Materials Supplied By Contractor

.1 Quality

- .1 Products, equipment and articles (referred to as Materials throughout the Specifications) incorporated in the Work shall be new, not damaged or defective, and of the best quality (compatible with Specifications) for the purpose intended.
- .2 Defective products, whenever identified will be rejected, regardless of previous inspections. Remove and replace defective products at the Contractor's own expense and be responsible for delays and expenses caused by rejection.
- .3 Should any dispute arise as to the quality or fitness of Materials, the decision rests solely with the Owner based upon the requirements of the Contract Documents.
- .4 Unless otherwise indicated in the Specifications, maintain uniformity of manufacture for any particular or like item throughout the Work.
- .5 Preliminary acceptance of Materials, equipment or products listed by supplier names will not in any way constitute a waiver of the Specifications covering such equipment. Final acceptance will be based on full conformity with the Contract Documents.

.2 Availability

- .1 Review Materials delivery requirements and anticipate foreseeable supply delays for any items. If delays in supply of Materials are foreseeable, notify the Consultant of such, in order that substitutions or other remedial action may be authorized in ample time to prevent delay in performance of the Work.
- .3 Comply with Part B - Instructions to Tenderers, paragraph 15.0 Product Approval.

1.4 Equipment Supplied By Owner

- .1 The following equipment has been or will be purchased by the City of Vancouver, and will be furnished to the Contractor FOB jobsite:
 - .1 Motor Control Centre (MCC/PDC) complete with VFD's and control panel;
 - .2 Pumping equipment;

**INVITATION TO TENDER NO. PS10134
KITSILANO PUMP STATION UPGRADE CONSTRUCTION
APPENDIX A - MATERIALS AND EQUIPMENT**

- .3 Check valves and isolation valves for the new pump discharge piping;
- .4 Flow meter converters for installation in the pump station. Flow tubes, electrical ducting and wiring supplied and installed by forcemain contractor. See drawings for details; and
- .4 Existing RTU Cabinet.

1.5 Manufacturer's Instructions

- .1 Unless otherwise indicated in the Specifications, install or erect Materials in accordance with manufacturer's instructions.
- .2 Notify the Consultant, in writing, of conflicts between the Specifications and manufacturer's instructions.
- .3 Improper installation or erection of Materials, due to failure in complying with these requirements, to be removed and reinstalled at no increase in Contract Price.
- .4 The construction drawings provided in this ITT package have been produced using the best information available to date. The vendor drawings have only recently been made available for some of the Owner supplied equipment, and at that, have been preliminary at best. Therefore, the primary source of equipment information for both Owner and Contractor supplied equipment has been catalogue cuts and typical arrangements. Unless significantly different requirements result between the certified vendor documentation and the drawings used to create the construction drawings, the Contractor is responsible to adjust the design to suit at no increase in Contract Price.
- .5 Notify the Consultant, in writing, of significant differences between the certified vendor documentation and the drawings used to create the construction drawings

1.6 Workmanship

- .1 General
 - .1 Execute the Work using workers experienced and skilled in the respective duties for which they are employed to obtain workmanship of the best quality.
- .2 Coordination
 - .1 Ensure cooperation of workers in laying out Work. Maintain efficient and continuous supervision.
 - .2 Coordinate all the Work of all Subcontractors.
 - .3 Ensure that all Subcontractors examine the Drawings and Specifications for other parts of the Work, which may affect the performance of their Work.
- .3 Protection of Work in Progress
 - .1 Adequately protect Work completed or in progress. Work damaged or defaced due to failure in providing such protection is to be removed and replaced, or repaired, as directed by the Owner or the Consultant, at no increase in Contract Price.

**INVITATION TO TENDER NO. PS10134
KITSILANO PUMP STATION UPGRADE CONSTRUCTION
APPENDIX A - MATERIALS AND EQUIPMENT**

.2 Prevent overloading of any structure.

.4 Remedial Work

.1 Perform remedial Work required to repair or replace the parts or portions of the Work identified as defective or unacceptable at no increase in Contract Price. Coordinate adjacent affected Work as required.

.2 Perform remedial Work by specialists familiar with the Materials affected. Perform in a manner to neither damage nor endanger any portion of the Work.

1.7 Quantities

.1 Materials or products indicating quantity and dimension, which are shown on the Drawings or in the Specifications, are not guaranteed to be accurate and are to be checked by the Contractor.

.2 Claims for additional payment resulting from variations between quantities shown on the schedules and those actually installed will not be accepted.

1.8 Metric Project

.1 Unless otherwise noted, this Project has been designed and is to be constructed in the S.I. metric system of measurements.

2 PRODUCTS

Please see Section 01105 - Owner Supplied Equipment, 2.0 Products.

3 EXECUTION

Not Applicable

END OF SECTION

1.0 GENERAL

1.1 Form of Tender Payment Items

- .1 Incorporate all costs including Contractor's overhead and profit associated with finding and supplying all material and performing all work specified in the Contract Documents in the Payment Items set out on the Form of Tender.
- .2 **All work of the project must be included under the payment items included.** The Owner will not consider claims by the Contractor for extra payment on grounds that work performed or labour and/or materials supplied in accordance with the requirements of the Contract Documents could not be properly charged to Payment Items listed in the Form of Tender.
- .3 The items in the Form of Tender shall cover all that is necessary to construct and complete the work. Include costs of a general nature for work not directly listed on the Form of Tender but included in the Contract Drawings by either direct mention or implication, in those Payment Items to which they pertain most closely.
- .4 All work items shall be paid for only once. If a work item is incorrectly included in two or more separate Payment Items, the Engineer shall determine the Payment Item which most reasonably applies.

2.0 DESCRIPTION OF PAYMENT ITEMS

The following description of items is for payment purposes only and does not describe or define the Scope of Work.

FORM OF TENDER APPENDIX I - SCHEDULE OF QUANTITIES AND PRICES

SECTION 1 - GENERAL

ITEM 1.1 Mobilization and Demobilization

This item includes all costs associated with mobilization and demobilization associated with the Contractors equipment, safety equipment, site facilities and services necessary to carry out and complete the work.

This item shall include costs associated with carrying out the work.

The total amount of this item shall not exceed five percent of the total tendered price. Mobilization will be processed under the first progress claim certificate and demobilization will be processed after completion of the work.

Two payments will be made each at fifty (50) percent of the lump sum price tendered for this item (one for mobilization and one for demobilization) in the schedule of Quantities and Prices.

ITEM 1.2 Bonding, Security and Permits

This item includes all costs associated with the costs of bonding, insurance, permits, fees, security and other related necessary to carry out and complete the work.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

SECTION 2 - SITE WORK

ITEM 2.1 Site work for Installation of New BC Hydro Primary Ducts

This Item includes all costs associated with the supply and installation of all new BC Hydro primary high voltage ducts including trenching, excavating, backfilling, ducts, concrete encasement, pull cords, tie ins at BC Hydro vault and PMT. Also included is all liaison and coordination with BC Hydro for the installation.

Included is the cost for all surface restoration required for the duct work and the offsite disposal of all excavated materials. Inspection costs and BC Hydro approval of the work is included.

Payment will be made at the unit rate per lineal meter tendered for this item in the Schedule of Quantities and Prices. The installed length shall be measured along the ground surface from start point at BC Hydro vault (or as specified) to PMT.

ITEM 2.2 Site work for BC Hydro Service for PMT and Secondary Ducts and Wiring

This Item includes all costs associated with the supply and installation of all items required for installing the new BC Hydro Electrical Service including excavating, trenching backfilling and surface restoration for secondary ducts, transformer pad, building entry for underground service ducts, wires, cables and connections. Also included is all liaison and coordination with BC Hydro for the installation.

Included is the cost for all excavation and surface restoration required for the construction and the offsite disposal of all excavated materials. Inspection costs and BC Hydro approval of the work is included.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 2.3 Door Access Slabs, Landscaping, Park Walkway, Site Restoration and Site Cleanup

This item includes all costs associated with the provision of outside stairs, ramps, access slabs, concrete park walkway to tennis courts and other related items associated with providing access to the new external doors to be installed at the pump station (as well as access to the Parks Board tennis courts) including clearing of shrubs, vegetation, excavation, placing of bedding and backfill material and concrete access works as required for construction activities to proceed and includes the disposal of all excavated materials offsite in a manner which meets all applicable environmental regulations and requirements.

This Item includes all costs associated with final site grading, surface restoration and

landscaping and cleanup of the site as indicated on the drawings and specifications including grading for slope and drainage, new pavement and pavement and or sidewalk restoration, new crushed rock and restoration of crushed rock surface areas, walkways, parking areas, topsoil, grass, shrubs and related items.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

SECTION 3 - BUILDING WORK

ITEM 3.1 New Exterior Metal Doors

This item includes all costs associated with the installation of external doors, door frames, door hardware, locksets, door louvers, sawcutting for door openings, grouting, dowelling and setting of door frames, sealing and all other work and finishing required to complete the installation of exterior doors.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 3.2 Washroom Modifications

This Item includes all labour, material, equipment and costs required for completing all modifications to the existing washroom in the pump station wet well room. Payment for this item includes reinforced masonry block work, co-ordination with the new external door installation, sealing blocks, to floors, ceilings and walls as well as providing a gas tight seal at the floor and ceiling levels. Electrical work required in the washroom will be paid for under a separate payment item.

This item also includes removal of the existing wet well to electrical room metal door and replacement with masonry block.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 3.3 MCC Concrete Pad and Miscellaneous Concrete

This item includes all costs associated with saw cutting and removing the existing MCC housekeeping pad and installing a new reinforced concrete housekeeping pad for the new MCC as well as other concrete work. Also included is covering the floor cutout south of the existing MCC with metal plate and angles as indicated on the drawings.

Also included in this item is the filling and grouting of all holes and openings and the patching of damaged floor areas in the electrical room, pump room and wet well room resulting from the removal of equipment.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 3.4 Metal Work

This item includes all costs associated with supplying installing and fabricating all metal work required for the pump station including pipe supports, brackets, fasteners, gratings, plates fasteners and all other related items required for the work.

Metal items shall be painted or hot dip galvanized or as specified in the contract documents.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 3.5 Ventilation

This item includes all costs associated with the supply, installation, testing and commissioning of mechanical ventilation systems for the pump station building, including the electrical room and wet well room.

This item includes all fans, ducts, duct accessories, hangers, seismic supports, louvers, dampers, intakes, grilles, outlets, thermostats, sealants, fasteners, connectors, sheet metal work and all related accessories and items required and or indicated in the contract documents.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 3.6 Air Compressor and Associated Air Piping/Electrical Removals

This item shall include all costs associated with removing the existing air compressor, air compressor concrete pedestal and electrical connections in the electrical room and all associated air piping not required. The air compressor and piping cannot be removed until the new pumps and discharge piping is removed. This item includes all costs of temporarily relocating the air compressor if required to provide adequate working room until the unit can be permanently removed.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 3.7 Painting of Electrical and Wet Well Rooms

This item includes painting all items except those covered under piping and includes doors, masonry block, designated floors, walls and ceilings in the electrical and wet well rooms. The item also includes all cleaning and surface preparation required prior to painting to ensure proper bonding and adherence of new paint.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

SECTION 4 - PUMPS AND PIPING

ITEM 4.1 Remove Two (2) Existing Pumping Units and Replace with Two (2) New Owner Supplied Pumping Units

This Item includes all costs associated with:

- .1 Removing and salvaging two complete pumping units including motor, pump, pump stool and pump suction elbow;
- .2 Pumps to be removed in accordance with approved project schedule and as directed by the Engineer;
- .3 Salvaged pumps to be delivered in good condition to the City's works yard or other designated location;
- .4 Offloading, checking, safekeeping and storing of the two new Owner supplied pumps in the station;
- .5 Installing the two new pumping units and motors including placement, alignment, setting and bolting on the existing foundation and connecting to existing suction piping and new discharge piping. Also included is any remedial work required to repair the pump concrete foundation pad including grouting, levelling and alignment.
- .6 Installing new Owner Supplied Falk type flexible couplings between motor shaft and pump/gear box and setting and checking alignment in accordance with pump installation manuals.
- .7 Pump supplier to inspect and approve installation prior to pump start up;
- .8 Correct any pump installation deficiencies as determined by the pump supplier or Engineer;
- .9 Co-ordination with electrical for motor connections and rotation;
- .10 Start up and commissioning;
- .12 All other mechanical items required to provide a complete working system.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 4.2 Remove Two (2) Existing Pumping Units and Replace with Two (2) Owner Supplied Rebuilt Pumping Units

This Item includes all costs associated with:

- .1 Removing two complete pumping units including motor, pump, pump stool and pump suction elbow;
- .2 Pumps to be removed in accordance with approved project schedule and as directed by the Engineer;
- .3 Removed pumps (less motors) to be shipped in one piece at Contractor's expense to Smart Turner Pumps in Burlington Toronto for rebuilding (pump rebuild costs and new motors paid for by the Owner);
- .4 Co-ordinating with Smart Turner for scheduling of the shipping and return of the rebuilt pumps.
- .5 Offloading, checking, safekeeping and storing of the two Owner supplied

- rebuilt pumps in the station;
 - .6 Installing two new Owner Supplied pumping units and motors including setting, placement, alignment on the existing foundation and connecting to existing suction piping and new discharge piping. Also included is any remedial work required to repair the pump concrete foundation pad including grouting , levelling and alignment.
 - .7 Installing new Owner Supplied Falk type flexible couplings between motor shaft and pump/gear box and setting and checking pump to motor alignment in accordance with pump installation manuals.
 - .8 Pump supplier to inspect and approve installation prior to pump start up;
 - .9 Correct any pump installation deficiencies as determined by the pump supplier or Engineer;
 - .10 Co-ordination with electrical for motor connections and rotation;
 - .11 Start up and commissioning;
 - .12 All other mechanical items required to provide a complete working system.
- Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 4.3 Remove Existing Pump Discharge Piping and Valves (Four Sets) & Replace with New Piping & Owner Supplied Valves and Accessories

This Item includes all costs associated with:

- .1 Coordination with project schedule for pump station operation and forcemain work outside the station;
- .2 Staged removal of pump discharge piping and valves while maintaining pump station in operation. Includes four pump sets.
- .3 Salvage all pneumatic operated pump control valves to City works yard;
- .4 Supply and install new discharge piping and valves (Owner supplied valves), Includes four pump sets;
- .5 Offloading, checking, safekeeping and storing of Owner supplied valves in the station;
- .6 Installation of pipe supports, fasteners, pipe coatings and linings, pipe alignment, pipe fitting to match existing discharge piping arrangement;
- .7 Supply and installation of pressure gauges and pressure transmitters and associated connecting valves and piping;
- .8 Coordination with trades, City personnel and other forcemain contractor to maintain pump station in operation;
- .9 Testing and commissioning.

SECTION 5 - ELECTRICAL

ITEM 5.1 Co-ordination with BC Hydro and Power Service

This item covers all costs associated with the co-ordination and scheduling with B.C. Hydro and others for the provision of a B.C. Hydro power service for the Kitsilano pump station as indicated in the contract documents. This item includes:

- Coordination with BC Hydro for all service aspects;
- Any items not covered under other payment items related to the provision of a new BC Hydro power service.

Payment for this item will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 5.2 Temporary Power Supply and Temporary VFDs

This item covers all costs associated with the provision of three phase 600VAC temporary power to the site to operate the pump station during the period when the BC Hydro power supply is out of service.

Temporary power shall be provided by a generator set adequate for all four existing pumps and house loads as detailed in the Contract Documents. The genset must be able to provide high quality 480VAC three phase power and connect to the existing MCC via the existing Manual Transfer Switch.

This item also includes all costs associated with using 480/600 VAC Step Up Transformers to operate 600VAC motors from the existing 480 VAC MCC and the supply and installation of the temporary "VFD panels" as described in the Special Provisions to operate the new and rebuilt pumps.

Payment for this item will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 5.3 Removal of Existing Unit Substation and Installation of New Owner Supplied Motor Control (MCC), Power Distribution Center (PDC) Including VFD's and Control Panel

This Item includes all costs associated with the installation, testing and commissioning of a new Owner Supplied Motor Control Centre (MCC) and Power Distribution Centre (PDC) in the pump station as specified in the contract documents. This item includes offloading MCC sections (delivery to site by MCC fabricator) placement, connection of individual sections (assisted by MCC fabricator who will reconnect section to section internal wiring) and installation of the MCC and related units using the door opening provided into the building.

This item also includes removal of the existing electrical switch gear and transformer

in the pump station and salvage to the City's works yard or other designated location.

This item includes all seismic bracing, brackets, welding of MCC bottom to metal insert embedded in the MCC housekeeping pad, bolts, fasteners and all else required to install the MCC and PDC.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 5.4 Supply and Install Electrical Systems and all Field Wiring (Power, Control, Instrumentation)

This item includes all costs associated with the provision of all electrical work required inside and outside the Kitsilano pump station as required in the contract documents and as required to provide complete working electrical systems at the site and not included in other payment items. Electrical work includes power, distribution, control, communications and instrumentation systems.

This item includes but is not limited to the supply and installation of all labour, equipment and materials for electrical items including switches, above and below ground conduits and ducts, concrete embedded ducts and conduits and surface mounted conduits and ducts, cable sleeves, buried cables, wires, cables, wiring, nameplates, pull boxes, junction boxes, explosion proof junction boxes, receptacles, enclosures, wires, cables and all else required to complete the electrical installation as shown or indicated in the contract documents.

This item also includes instrumentation items including ultrasonic level sensor assemblies, pressure transmitters, submersible pressure transmitter, flow meter convertors and related items.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 5.5 Heating and Lighting Systems

This item includes all costs associated with the supply and installation of all heating and lighting systems and all related accessories for the pump station as specified in the contract documents.

Payment for this item will be made at the lump sum price tendered in the Schedule of Quantities and Prices.

ITEM 5.6 Supply and Installation of Smoke Detector and Security Alarm Systems

This item includes all costs associated with the supply and installation of all smoke

detectors and door intrusion alarms and all related accessories for the pump station as specified in the contract documents. Costs for wiring and connecting the smoke detector to the PLC/SCADA system and local audible alarm are included in this item.

Payment for this item will be made at the lump sum price tendered in the Schedule of Quantities and Prices.

ITEM 5.7 Grounding System

This item includes all costs associated with the supply and installation of the new station grounding system and interconnection of the new system to the existing grounding system.

Payment for this item will be made at the lump sum price tendered in the Schedule of Quantities and Prices.

SECTION 6 - TESTING AND COMMISSIONING

ITEM 6.1 Testing and Commissioning Pumping Systems, VFD'S and Electrical Equipment

This item includes all costs associated with the onsite testing and commissioning of all pumping and electrical equipment to confirm correct operation of all equipment including but not limited to:

- Sewage pumps and motors;
- Variable Frequency Drives;
- PLC and I/O modules;
- Ultrasonic and pressure transmitter level sensing systems in the wet wells;
- Pressure transmitters on the discharge forcemains;
- MCC and PDC and all sections;
- Transfer switch;
- Control panel and instrumentation systems;
- UPS;
- Alarm systems;
- Heating, ventilation and lighting systems;
- Other related equipment.

Specific testing and commissioning requirements are specified in the governing technical specifications and shall be used for specified procedures and tests and test reports to be carried out and provided by the Contractor.

This item includes the cost for the onsite attendance of all equipment suppliers required for testing and commissioning work (except for Owner Supplied items where indicated). This item includes co-ordinating with the suppliers of Owner Supplied equipment to schedule technical suppliers' representatives on site for testing. The costs for onsite attendance of representatives for Owner Supplied Equipment is paid for by the Owner but any additional costs incurred by the Owner for site representatives caused by delays, equipment installation or other causes attributable to the Contractor and which require the representative to return to site will be charged to the Contractor.

Incorrect operation and or deficiencies found during the testing and commissioning will be corrected by the Contractor as required by the contract documents.

Payment will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices.

ITEM 6.2 Test and Commission all other items

This item includes the onsite testing of all other equipment not included in other items. If the Contractor includes an amount in this item, he must attach a complete

and detailed list of items included.

If the list of items to be tested by the Contractor is acceptable to the Engineer, payment for this item will be made at the lump sum price tendered for this item in the Schedule of Quantities and Prices. If this item is not used it will be assume that the other Section 6 Payment Items include for the testing and commissioning of all equipment, systems and items supplied by the Contractor.

ITEM 6.3 Operation and Maintenance Manuals

This Item includes all costs associated with supplying operation and maintenance manuals for the project as specified in the contract documents.

Separate manuals are required for electrical equipment, pumps and the standby generator system.

Payment for this item will be made at the lump sum price tendered in the Schedule of Quantities and Prices.

END OF SECTION

1.0 GENERAL

1.1 Categories of Submittals

- .1 General requirements and detailed Specifications require various submissions to demonstrate that materials, equipment, methods, and work comply with the provisions and intent of the Contract Documents. Submittals fall into two general categories:
 - a) Submittals for Review.
 - b) Submittals for Information Only.
- .2 Provide submittals in accordance with this section and as specified in the various technical sections contained throughout the Specifications.
- .3 The Engineer may require additional submittals from the Contractor when, in the opinion of the Engineer, such additional submittals are warranted.

1.2 Administrative

- .1 Submittals covered by these requirements include manufacturers' information and data sheets, descriptive data, certificates, product data, shop drawings, test procedures, test results, samples, requests for substitutions, all mechanical, electrical and electronic equipment and systems, fabricated items, piping and miscellaneous work-related submittals.
- .2 Adjustments made on shop drawings or other submittals by the Engineer are not intended to change the Contract Price. If adjustments affect the value of work, state such in writing to the Engineer prior to proceeding with the work.
- .3 Provide the submittals specified to Engineer for review. Submit all information promptly and in an orderly sequence so as to not cause delay in the Work. Failure to submit in ample time is not considered sufficient reason for an extension of Contract time and no claim for extension by reason of such default will be allowed.
- .4 Include the projected dates for Submissions of Submittals for Review in the Construction Schedule as specified in Specification Section 01100
- .5 Do not proceed with work affected by any submittal until review is complete. Normally, submittals for review and comment will be returned to the Contractor within 10 days, 30 days for substitution, exclusive of any time awaiting clarification or further information; however, the time for returns will necessarily vary and may exceed 10 days depending upon the complexity of the submittal, the number of submittals, and the express needs of the Contractor.

- .6 Review submittals prior to submission to the Engineer. This review represents that necessary requirements have been determined and verified, or will be, and that each submittal has been checked and coordinated with the requirements of the Work and the Contract Documents. Submittals not stamped, signed, dated and identified by the Contractor will be returned without being examined and will be considered rejected.
- .7 Clearly edit submittal documents to indicate only those items, models, or series of equipment, which are being submitted for review. Cross out or otherwise obliterate all extraneous materials.
- .8 Ensure that there is no conflict with other submittals.
- .9 Coordinate submittals among subcontractors and suppliers.
- .10 Coordinate submittals with the Work so that work will not be delayed and schedule different categories of submittals, so that one will not be delayed for lack of coordination with another.
- .11 The Contractor is responsible for the accuracy and completeness of information submitted. Notify Engineer in writing of materials, equipment or methods of work which deviate from the Contract Documents. Notification in writing, to accompany submittal transmittal and noted under deviations.
- .12 The Contractor's responsibility for errors, omissions and deviations in submission is not relieved by the Engineer's review of submittals.
- .13 Keep one reviewed copy of each submission on site.
- .14 Detail all shop drawings and data sheets using the metric system. Prepare to a drafting standard equivalent to the Contract Drawings.
- .15 Shop drawings and data sheets indicating modified design requirements or design requirements not included in the Contract Documents require the seal of a qualified Professional Engineer, registered in the Province of British Columbia.

1.3 Transmittal Procedure

- .1 Accompany all submittals with transmittal form 01330-A attached.
- .2 Use a separate form for each specific item, class of material, equipment, and items specified in separate, discrete sections, for which the submittal is required. Identify Contract Document, equipment numbers, equipment descriptors, drawing

numbers, and Specification Sections for each submittal and item in each submittal.

- .3 Identify submittal documents common to more than one piece of equipment with all the appropriate equipment numbers.
- .4 Use a single form for submittals for various items when the items taken together constitute a manufacturer's package or are so functionally related that expediency indicates checking or review of the group or package as a whole.
- .5 Note a unique number, sequentially assigned, on the transmittal form accompanying each item submitted. Submittals will be classified according to categories agreed to by the Contractor and Engineer. Use the following format by category for submittal numbers: "XXX", where "XXX" is the sequential number assigned by the Contractor. Resubmittals will have the following format: "XXX-Y", where "XXX" is the originally assigned submittal number and "Y" is a sequential letter assigned for resubmittals, i.e., A, B, or C being the 1st, 2nd, and 3rd resubmittals, respectively. Submittal 25-B, for example, is the second resubmittal of submittal 25.
- .6 All submittals (Contractor and sub contractor) to be stamped as reviewed by General Contractor. Submittals not stamped as reviewed will be returned to the General Contractor.

1.4 Submittals for Review

- .1 All submittals, except where specified to be submitted for information only, to be submitted by the Contractor to the Engineer for review. Provide submittals for review for all equipment and material substitutions, alternatives or deviations from that specified.
- .2 Submittals which do not have all the information required to be submitted, including notation of all deviations from the Contract requirements, are not acceptable and will be returned without review.
- .3 Review by the Engineer is for the sole purpose of ascertaining conformance with the general design concept in accordance with the Specifications. This review does not mean that the Engineer approves the detail design inherent in the submittals, shop drawings and data sheets, responsibility for which remains with the Contractor, and such review does not relieve the Contractor of responsibility for errors or omissions in the shop drawings and data sheets or of 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 and installation and for coordination of the work of all sub-trades.

- .4 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of the section under which the adjacent items will be supplied and installed. Indicate cross references to Contract Drawings and Specifications.
- .5 Submit 4 copies of submittals, except where other quantities are specified, including shop drawings for each requirement requested in Specification sections and as the Engineer may reasonably request. PDF copies of shop drawings are recommended for most submissions provided all stamps are included. Where submittal contains detailed factory information original copies must be submitted.
- .6 Submittals for review will be returned to the Contractor with one of the four following notations:
 - a) If the review indicates that the material or equipment complies with the Contract Documents, submittal copies will be marked "Reviewed". In this event, the Contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.
 - b) If the review indicates limited modifications are required, copies will be marked "Reviewed as Modified". The Contractor may begin implementing the work method or incorporating the material and equipment covered by the submittal in accordance with the noted corrections. Where submittal information will be incorporated in operation and maintenance data, provide a corrected copy.
 - c) If the review reveals that the submittal is insufficient or contains incorrect data, copies will be marked "Revise and Resubmit". Do not undertake work covered by this submittal until it has been revised, resubmitted and returned marked either "Reviewed" or "Reviewed as Modified".
 - d) If the review indicates that the material, equipment, or work method does not comply with the Contract Documents, copies of the submittal will be marked "Rejected - See Remarks". Submittals with deviations which have not been identified clearly may be rejected. Do not undertake the work covered by such submittals until a new submittal is made and returned marked either "Reviewed" or "Reviewed as Modified".
- .7 After submittals are stamped "Reviewed" or "Reviewed as Modified", no further revisions are permitted unless re-submitted to the Engineer for further review.
- .8 If upon review by the Engineer, no errors or omissions are discovered or if only minor corrections are made, 1 copy will be returned and fabrication and installation of work may proceed. If shop drawings and data sheets are rejected, noted copy and 2 unmarked copies will be returned and resubmission of corrected shop drawings and data sheets, through the same procedure indicated above, to

be performed before fabrication and installation of work may proceed. Where four copies have been submitted one copy will be returned.

- .9 The City may deduct, from payments due to Contractor, costs of additional Engineering reviews incurred if shop drawings and data sheets are not corrected after one (1) review by Engineer.

1.5 Submittals for Information Only

- .1 Where specified, furnish submittals to the Engineer for information only at least 30 days prior to commencement of the work covered by the submittal. Submittals for information only will be used by the Engineer for general information and filed without comment. The Engineer retains the right to return submittals for information only if the submittal does not comply with the Contract Documents and general design criteria.
- .2 Submittals for information only are not subject to review procedures. They are to be provided as part of the Work under the Contract and their acceptability determined under normal inspection procedures.
- .3 Submit 2 copies of information only submittals including product data, manufacturer's standard data sheets or brochures for requirements requested in Specification Sections and as the Engineer may reasonably request where shop drawings will not be prepared due to standardized manufacture of product.
- .4 Submit operation and maintenance information in accordance with Section 01831. Obtain from each manufacturer specific equipment record data, performance data and maintenance requirements.
- .5 Where specified submit engineering calculations sealed by a qualified Professional Engineer, for information only.

1.6 Request for Substitution

- .1 Make requests for substitution by written application accompanied with sufficient information as specified under Section 01630 to permit the Engineer to identify the nature and scope of the request.
- .2 Follow submittal procedures and submit 4 copies of all information for each substitution request.
- .3 Upon receipt of written application for substitution from the Contractor, including the specific information specified, the Engineer will estimate the cost and time requirement of evaluating the request and present the estimates to the

Contractor. The Contractor is advised that the estimates are based upon the best information available to the Engineer at the time; however, the actual cost, based on time and expense, will be documented and applied in the final analysis of the substitution request.

- .4 If the Contractor wishes the Engineer to continue the review of the request, advise the Engineer in writing and submit sufficient additional information as may be requested by the Engineer. No evaluation will take place until such time as the Contractor has agreed to the estimate in writing and has authorized the Engineer to deduct the cost of the evaluation from monthly progress payments due the Contractor.

2.0 PRODUCTS

- .1 Not Used

3.0 EXECUTION

- .1 Not Used

END OF SECTION 01330

01330-A SUBMITTAL TRANSMITTAL FORM:

Submittal Description: _____

Submittal No:¹ _____

Specification Section: _____

TO: ATTN:	Routing	Sent	Received
OWNER:	Contractor/CM		
PROJECT:	CM/DECS		
	DECS/CM		
CONTRACTOR:	CM/Contractor		

We are sending you Attached
 Under separate cover
 via _____

- Submittals for Review (RVU)
- Submittals for information only (INF)
- Substitution (SUB)
- Operation & Maintenance

Information (O&M)

Remarks: _____

Item	Copies	Date	Section No.	Description	Review action ^a	Reviewer initials	Review comments attached

^a Attach additional sheets if necessary. REV= Reviewed; RAM= Reviewed as Modified; RAR= Revise and Resubmit; REJ= Rejected

Contractor: Certify either A or B:

- A. We have verified that the material or equipment contained in this submittal meets all the requirements, including coordination with all related work, specified (no exceptions).
- B. We have verified that the material or equipment contained in this submittal meets all the requirements specified except for the attached deviations.

No.

Deviation

Certified by:

 Contractor's Signature

01831-A EQUIPMENT INSTRUMENTATION DATA RECORD FORM

GENERAL DATA

Equipment Number:		Equipment Location:	
Equipment Description:		Serial Number:	
Model Number:		Style Number:	
MANUFACTURER:			
Street Address:			
City:		State/Province:	Zip/Postal Code:
Phone #:		Fax #:	
MANUFACTURER's Contact		Phone #:	
VENDOR			
Street Address:			
City:		State/Province	Zip/Postal Code:
Phone #:		FAX #:	
VENDOR's Contact:		Phone #:	
Date I/S:	Date of Warr:	P.O. #:	Purchase Cost:

TECHNICAL DATA (Complete all areas where applicable)

<input type="checkbox"/>	Alternate to Specifications - Check () if Applicable	CSA Approved Classification
Mounting:		Accuracy
Power Requirements:		
Materials of Construction:		
Wetted Parts Material		

ADDITIONAL SPECIFICATIONS/NOTES

01831-B EQUIPMENT MECHANICAL DATA RECORD FORM

GENERAL DATA

Equipment Number:		Equipment Location:	
Equipment Description:		Serial Number:	
Model Number:		Style Number:	
MANUFACTURER:			
Street Address:			
City:		State/Province:	Zip/Postal Code:
Phone #:		Fax #:	
MANUFACTURER's Contact		Phone #:	
VENDOR			
Street Address:			
City:		State/Province	Zip/Postal Code:
Phone #:		FAX #:	
VENDOR's Contact:		Phone #:	
Date I/S:	Date of Warr:	P.O. #:	Purchase Cost:

TECHNICAL DATA (Complete all areas where applicable)

Size:		Weight	
R.P.M.	Design BHP:	Impeller Diameter:	
Rotation/Discharge:	Bearing Lubrication:		
Bearing Numbers and Quantity:			
Applicable Tolerances:			
Oil/Air Filters			

PACKING/SEAL DATA

Style:		Make:	
Size:		Cooling:	
Lubrication:		Lip Seals:	
Seal Type/Numbers:			

ADDITIONAL VALVE DATA

Valve Seat Material:	Valve Seat Number:
DRIVE DATA: COUPLING	
Make:	Size:
Type:	
DRIVE DATA: V-BELT	
Make:	Belts:
Driver:	Driven:

01831-C EQUIPMENT ELECTRICAL DATA RECORD FORM

GENERAL DATA

Equipment Number:		Equipment Location:	
Equipment Description:		Serial Number:	
Model Number:		Style Number:	
MANUFACTURER:			
Street Address:			
City:		State/Province:	Zip/Postal Code:
Phone #:		Fax #:	
MANUFACTURER's Contact		Phone #:	
VENDOR			
Street Address:			
City:		State/Province:	Zip/Postal Code:
Phone #:		FAX #:	
VENDOR's Contact:		Phone #:	
Date I/S:	Date of Warr:	P.O. #:	Purchase Cost:

TECHNICAL DATA (Complete all areas where applicable)

GENERAL				
Nominal Voltage	Phase:	Frequency:	kW:	kVA(r):
P.F.:	Amps:	Ambient Temperature:	Temperature Rise:	
Nominal Efficiency:	Insulation Class:	Insulation Type:	BIL:	
Weight:	Enclosure Type:	Enclosure Dimensions (H x W x D):		
CSA Approved Hazard Classification Group:		Class:	Division:	
ADDITIONAL MOTOR DATA				
Synch RPM:	HP:	Frame:	LRA:	Service Factor:
Design Letter:	KVA Code:	Duty:	Guaranteed Minimum Efficiency @ Full Load:	
Winding Heater Volts:		Winding Heater Watts:		
Over Temp. Sensor Type:	DE Bearing:	ODE Bearing:		

01831-D EQUIPMENT MAINTENANCE REQUIREMENT DATA RECORD FORM

GENERAL DATA

Equipment Number:		Equipment Location:	
Equipment Description:		Serial Number:	
Model Number:		Style Number:	
MANUFACTURER:			
Street Address:			
City:		State/Province:	Zip/Postal Code:
Phone #:		Fax #:	
MANUFACTURER's Contact		Phone #:	
VENDOR			
Street Address:			
City:		State/Province	Zip/Postal Code:
Phone #:		FAX #:	
VENDOR's Contact:		Phone #:	
Date I/S:	Date of Warr:	P.O. #:	Purchase Cost:

GENERAL AND PREVENTATIVE MAINTENANCE REQUIREMENTS

MAINTENANCE REQUIREMENTS							

LUBRICANTS

Recommended:							
Alternative:							

ADDITIONAL SPECIFICATIONS/NOTES

01832-A Spare Parts and Special Tools List (Form 1 of 2)

Specification Section	Equipment Description	Equipment Name	Manufacturer	Model #	Quantity	Spare Parts Required	Box Tag Number

Note: Although presented on two 215 mm x 280 mm pages, Form 01750-A should be completed on a 280 mm x 432 mm page.

1.0 GENERAL

1.1 Requirements

- .1 This section specifies general requirements and procedures for the Contractor's submissions of shop drawings and product data to Engineer for review. Additional specific requirements for submissions are specified in individual sections of Divisions 2 to 16. **Note shop drawings and product data are required for all equipment whether specified in the technical specifications or referenced on the drawings.**
- .2 Until submission is reviewed, work involving relevant product may not proceed.
- .3 Present shop drawings in metric units unless specified otherwise.
- .4 Contractor's responsibility for errors and omissions in submission is not relieved by Engineer's review of submissions.
- .5 Notify Engineer, in writing at time of submission, identifying deviations from requirements of Contract Documents stating reasons for deviations.
- .6 Contractor's responsibility for deviations in submission from requirements of Contract Documents is not relieved by Engineer's review of submission, unless Engineer gives written acceptance of specific deviations.
- .7 Make any changes in submissions which Engineer may require consistent with Contract Documents and resubmit as directed by Engineer.
- .8 Notify Engineer, in writing, when resubmitting, of any revisions other than those requested by Engineer.

1.2 Submission Requirements

- .1 Coordinate each submission with requirements of work and Contract Documents. Individual submissions will not be reviewed until all related information is available.
- .2 Allow 7 days for Engineers review of each submission.
- .3 Accompany submissions with transmittal letter, in duplicate, containing:
 - .1 Date
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing.

- .5 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
- .6 Other pertinent data.

- .4 After Engineer's review, distribute copies.

1.3 Shop Drawings

- .1 Shop drawings: original drawings, or modified standard drawings provided by Contractor, to illustrate details of portions of work, which are specific to project requirements.
- .2 Maximum sheet size 1000 x 707 mm.
- .3 Submit 3 copies of shop drawings.

1.4 Product Data

- .1 Product data: manufacturer's catalogue sheets, brochures, literature, performance charts and manufactured products.
- .2 Submit 2 copies of product data.

END OF SECTION 01340

1.0 GENERAL

- .1 The CONTRACTOR is totally responsible for the quality of MATERIAL and PRODUCT which he provides and for THE WORK.
- .2 The CONTRACTOR is responsible for quality control and shall perform such inspections and tests as are necessary to ensure and demonstrate that THE WORK conforms to the requirements of the CONTRACT DOCUMENTS.
- .3 During the progress of THE WORK, a sufficient number of tests shall be performed by the CONTRACTOR to determine and demonstrate that MATERIAL, PRODUCT and installation meet the specified requirements.
- .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 and demonstrate that THE WORK conforms to the requirements of the CONTRACT DOCUMENTS.
- .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).
- .6 Product testing, mill tests and laboratory reports shall demonstrate that PRODUCTS and MATERIALS supplied by the CONTRACTOR meet the specifications under various sections of the CONTRACT DOCUMENTS.

1.1 Quality Control Testing by the Contractor

- .1 Work Under this Contract
- .2 The CONTRACTOR shall retain the services of an independent testing agency under supervision of the ENGINEER, and pay the cost of testing services for quality control including, but not limited to, the following:
 - .3 Sieve analysis of sands and aggregates to be supplied for THE WORK.
 - .4 Aggregates and mix design for Portland Cement concrete.
 - .5 Standard Proctor Density curves for backfill and embankment materials and roadway and walkway granular base and sub-base materials.
 - .6 Compaction control tests for backfill and embankment material and roadway and walkway granular base and sub-base materials.
 - .7 Any product testing that is required and is specified under various sections of the specifications.
 - .8 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 and demonstrate that all necessary retesting and replacement of construction can proceed without delay.

- .9 The CONTRACTOR shall promptly provide the ENGINEER with copies of all test results

1.2 Quality Assurance Testing by the Owner

- .1 Work Under this Contract
- .2 The OWNER may retain and pay for the services of an independent testing agency for testing for quality assurance, for the OWNER'S purposes.
- .3 The OWNER'S testing agency and the ENGINEER 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.
- .4 Inspections and tests by the OWNER'S testing agency and by the ENGINEER 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.
- .5 The ENGINEER, at his discretion, may order or perform any additional inspections and tests for purposes of his own or for purposes of the OWNER.
- .6 The CONTRACTOR shall coordinate with the ENGINEER the scheduling of testing and inspection by the OWNER'S testing agencies or by the ENGINEER, to enable testing to be done as necessary, without delay, and the CONTRACTOR shall notify the ENGINEER 48 hours in advance of operations to allow for such inspection and tests by the ENGINEER or the OWNER'S testing agency.

1.3 Code Compliance Testing

- .1 Work Under this Contract
- .2 Inspections and tests required by codes or ordinances, or by a plan approval authority, shall be the responsibility of and shall be paid for by the CONTRACTOR.
- .3 Copies of reports resulting from such inspections shall be submitted in a timely manner by the CONTRACTOR to the OWNER.

1.4 Retesting

- .1 Work Under this Contract
- .2 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. Retesting, including retesting by the OWNER'S testing agency, shall be at the CONTRACTOR'S expense.

- .3 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.
- .4 If the CONTRACTOR fails or refuses to do remedial work or replace unacceptable MATERIAL or PRODUCT, the ENGINEER may refuse to certify payment and the OWNER may refuse to make payment, in addition to any other remedies the OWNER may have.

END OF SECTION 01400

1.0 GENERAL

1.1 Requirements

- .1 Observe and enforce all safety measures required by Labour Relations Code, Workers' Compensation Board, and all applicable statutes. In the event of discrepancy between such provisions, the most stringent provision will apply.
- .2 Appoint a suitably qualified employee who has sole responsibility on site on behalf of the Contractor, for compliance with the safety measures and to advise the City in writing with copy to the CONTRACT ADMINISTRATOR.

1.2 Safety and Health Regulations

- .1 Adopt and comply with the WCB Industrial Health & Safety Regulations and the regulations of other regulatory bodies.
- .2 Be responsible for occupational safety and health on the Work Site, and ensure that all workers comply with the Corporation's safety regulations.
- .3 Develop and be responsible for OSH Program which is to include, but not be limited to the following:
 - a) Section 1, Policy and Administration
 - b) Section 2, OSH Education and Training
 - c) Section 3, Supplementary Instructions
 - c) Section 4, Supervision of Workers
 - d) Section 5, OSH Inspections
 - e) Section 6, Monitoring of Plant and Hazardous Conditions
 - f) Section 7, Accident Investigation and Follow-Up
 - g) Section 8, First Aid Services and Equipment
 - h) Section 9, Joint Occupational Health and Safety Committee
 - i) Section 10, Emergency Preparedness & Evacuation
 - j) Section 11, Records and Statistics
 - l) Section 12, Additional Systems and Programs
 - m) Section 13, OSH Program Regular Review
- .4 Ensure that workers are instructed and trained in safe and healthy working practices; take immediate action to correct any unsafe conditions and hold regular weekly safety meetings (toolbox meetings) with all workers.
- .5 Additional Responsibilities
 - a) Present Clearance Letter from WCB to show WCB coverage.
 - b) Provide safety orientation for the Owner's representatives and all Contractor and subcontractor employees. Provide records of orientation to the City.
 - c) Cooperate with City's personnel.

- d) Establish Job Safety Procedures.
 - e) Work cooperatively and safely with Subcontractors.
 - f) Ensure that the following essentials of the Workplace Hazardous Materials Information System (WHMIS) are provided:
 - a. Worker education on controlled products.
 - b. Workplace labeling and identification.
 - c. A Material Safety Data Sheet where the employer produces a controlled product.
- .6 Arrange and supply transportation for injured workers both on and off site.
- .7 Ensure the City is advised of all injuries, which are or may be considered to be lost time accidents.

1.3 General Site Rules

- 1 Follow all posted traffic control signs. The maximum speed on Site for all vehicles is 15 km/h except as otherwise posted.
- .2 Ensure that all workers comply with "NO SMOKING" regulations in effect in areas of the plant site.
- .3 Wear hard hats and safety footwear on the Work Site at all times. Wear reflective vests as required by site policy.
- .4 Wear eye protection where there is a risk of eye injury; this includes chipping, grinding, welding, drilling, sawing, etc.
- .5 Wear hearing protection in accordance with WCB Regulations and ensure all workers have a valid hearing test.
- .6 Report all injuries to the supervisor on the day of injury.
- .7 Report categories of injuries immediately, in accordance with WCB Regulations.
- .8 Wear full body harnesses when working above 3 metres and where fall protection is required by WCB regulations. Certify all devices used to suspend workers. Use scaffolding that complies with WCB Regulations.
- .9 Obtain a valid certificate of inspection for all cranes and boom trucks before coming on Work Site.
- .10 Immediately remove any worker found to be impaired.
- .11 Immediately report all hazardous situations including those involving the Work to the OSH Coordinator.

- .12 Obtain and display at the site Material Safety Data Sheets (MSDS) for all controlled products before the product is allowed on Work Site.
- .13 Follow hot work permit requirements where conditions exist in the plant or where as a result of testing or commissioning the need is indicated.

1.4 Work in Vicinity of Overhead Power Lines

- .1 Request BC Hydro to relocate, de-energize or guard any energized conductor where construction equipment may operate within 3 m of conductor, 75 kV or less, 4.6 m for 75 kV to 259 kV or 6.1 m for 250 kV or larger.
- .2 Obtain BC Hydro approval prior to operating any equipment within the limits of energized conductors stated in 1.4.1 above.
- .3 Where practical, avoid storage under high voltage overhead power lines.
- .4 If metallic materials must be stored under power lines, protect personnel from effects of induced currents by grounding at two (2) locations with AWG #2 copper ground conductors and grounding rods.
- .5 Complete and submit WCB Form 30M33 prior to commencement of work.

1.5 Submittals for Information Only

- .1 Submit, to the City in written format, the safety orientation program for all direct and subcontract employees. Confirm in writing that the safety program has been presented to all direct and subcontract employees prior to work commencing on site.
- .2 Submit to the City one copy of all Material Safety Data Sheets as required by WHMIS. These sheets must be submitted before the controlled product is used on site.
- .3 Submit to the City minutes of safety meetings, accident investigations, safety inspections, OSH program, safety orientation records, hearing test records, copies of safe work procedures and copies of training records.

1.6 Confined Space Entry

- .1 Address all WCB requirements of areas of new construction which may be deemed to be confined spaces by WCB requirements.

2.0 PRODUCTS

Not Used

3.0 EXECUTION

Not Used

END OF SECTION 01412

1.0 GENERAL

1.1 General

- .1 The Contract Price is based upon those materials and equipment models identified and named in the detailed Specifications. Substitutions or variations to those specified will not be allowed without formal submittal, review and acceptance in accordance with this section.
- .2 The Specification sections contain pertinent performance criteria, quality, function and requirements for materials and methods to achieve work described.
- .3 Coordinate pertinent related work and modify surrounding work as required to complete project under each substitute designated.
- .4 Normally substitutions will not be permitted unless:
 - a) The specified product is not available.
 - b) The specified product does not meet critical delivery.
 - c) The substitute has a greater or equal value to the City for a lower cost.

1.2 Requests for Substitution

- .1 Whenever materials or equipment are specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular supplier or manufacturer the naming of the item is regarded as the standard to establish the type, function and quality required.
- .2 Material or equipment of equal or better performance and quality may be offered in substitution for those specified. Requests for review of substitute items of material and equipment will not be accepted by Engineer from anyone other than the Contractor.
- .3 Requests for substitution include any request for changes from the Contractor which require significant design changes, redesign or significant design reviews.
- .4 Request for substitution to be made by written application to Engineer and to include sufficient data to enable the Engineer to assess the acceptability of requirements, including the following:
 - a) All submittal information required for the specified equipment, including all deviations from the specified requirements and/or necessitated by the requested substitution.
 - b) Materials of construction, including material Specifications and references.
 - c) Dimensional drawings, showing required access and clearances, including any changes to the Work required to accommodate the proposed substitution.

- d) Drawings and details showing changes if the offered substitution necessitates changes to or coordination with other portions of the Work. Perform these changes as part of the substitution of material or equipment at no additional cost.
- e) Certification that the proposed substitute will adequately perform the functions and achieve the results called for by the general design, be similar and of equal substance to that specified and be suited to the same use as that specified.
- f) Information and performance characteristics for all system components and ancillary devices to be furnished as part of the proposed substitution.
- g) Reproducible Contract Drawings, marked up to illustrate all alterations to all structural, architectural, mechanical, electrical and HVAC systems required to accommodate the proposed substitution.
- h) Certification that acceptance of the proposed substitute will not prejudice achievement of Substantial Performance.
- i) Itemization of all costs including any licenses fee or royalty that will result directly or indirectly from the acceptance of the proposed substitution. Include redesign and cost of claims of any other contract affected by the resulting change.
- j) Guaranteed credit or cost reduction offered if the proposed substitution is accepted.
- k) Recommended maintenance requirements and availability of spare parts and service.

1.3 Engineer's Review

- .1 Engineer will evaluate each proposed substitution. Engineer will be the sole judge of acceptability, and no substitute will be ordered, installed or utilized without Engineer's prior written acceptance by either a Change Order or a reviewed shop drawing.
- .2 Pay the Engineer's cost, above and beyond the time required to review shop drawings for specified product, for evaluating the requested substitution even though the request may be denied. Costs will be charged on a time-and-expense basis and will be deducted from progress payments due the Contractor. Procedures for processing substitutions to be as specified in Section 01330.

2.0 PRODUCTS

- .1 Not Used

3.0 EXECUTION

.1 Not Used

END OF SECTION 01630

1.0 GENERAL

1.1 Description

- .1 The work of this section comprises the recording of all site measurements, dimensions, details and all other information necessary for the preparation of accurate project record drawings.
- .2 The compilation of project record information shall be an ongoing activity during construction and the Contractor shall maintain up to-date red mark-ups of prints at the site at all times.

1.2 Record Drawings

- .1 Engineer will provide two sets of white prints for record drawing purposes.
- .2 Maintain project record drawings and record accurately significant deviations from Contract documents caused by site conditions and changes ordered by Engineer.
- .3 Mark changes in red.
- .4 Record following information:
 - .1 Depths of various elements of foundation in relation to pump station floor and roof elevation.
 - .2 Horizontal and vertical location of all underground and all pump chamber equipment and utilities and appurtenances referenced to floor and walls and other permanent surface improvements.
 - .3 Horizontal and vertical location of all underground piping systems referenced to geodetic elevations and also to offsets from pump station and reservoir and other permanent surface features.
 - .4 Location of all existing utilities uncovered below ground during execution of the work referred to permanent surface features.
 - .5 Field changes of dimension and detail.
 - .6 Changes made by Change Order or Field Order.
- .5 At completion of project and prior to final inspection, neatly transfer notations to second set and submit both sets to Engineer.

END OF SECTION 01720

1.0 GENERAL

1.1 Manuals

- .1 Provide an organized compilation and description of operational and maintenance data including detailed technical information, documents and records describing operation and maintenance of individual products or systems.
- .2 Manuals shall contain the following sections entitled:
 - .1 Section 1: Civil components;
 - .2 Section 2: Mechanical Components;
 - .3 Section 3: Pumping Components
 - .2 Section 4: Electrical Power components;
 - .3 Section 5: Electrical Control and Instrumentation components
- .3 Separate stand alone manuals shall be provided where specified.
- .4 For all equipment and items, the operating and maintenance manuals shall include:
 - .1 Specification data;
 - .2 Vendor drawings;
 - .3 Manufacturers recommended operating, maintenance and service data including:
 - nameplate information including make, size, capacity, model number and serial number;
 - spare parts lists as recommended by manufacturer;
 - operating instructions;
 - maintenance instructions;
 - maintenance and service materials or special tools;
 - trouble shooting procedures;
 - .4 Name, address and telephone number of local or closest supplier c/w contact person;
 - .5 Warranty & guarantee information;
 - .6 Test data obtained during commissioning.
 - .7 Results of testing and commissioning.

1.2 General Requirements

- .1 Assemble, coordinate, bind and index required data into Operation and Maintenance Manual and organize data into required sections.
- .2 Label each section with tabs protected with celluloid covers fastened to hard paper dividing sheets.

- .3 Type descriptions, lists and notes.
- .4 Drawings, diagrams and manufacturers literature must be legible.

1.3 Submissions

- .1 Provide one set of completed operating and maintenance manuals to Engineer for **review four weeks prior to scheduled date for start of pump station commissioning**. Revise manuals as directed by Engineer.
- .2 When manuals are approved provide **four identical sets** of approved operating and maintenance manual binders to the Owner.
- .3 **Commissioning may not proceed until manuals are approved by the Engineer.**

1.4 Binders

- .1 Binders: Black vinyl 3-ring hard cover with clear vinyl overlay on front, open at top to accept full page identification insert. Suitable for 8 1/2 inch wide by 11 inch high documents.

1.5 Contents

- .1 Binders:
 - .1 Cover sheet containing:
 - .1 Date submitted.
 - .2 Project title, location and project number.
 - .3 Names and addresses of Contractor, and all Sub-contractors.
 - .4 Table of Contents.
 - .2 Technical sections as specified.
 - .3 Identify each major section with individual title page (ie CIVIL, MECHANICAL, ELECTRICAL)

1.6 Equipment

Unless specified otherwise all equipment and components supplied and installed under this contract shall be included in the manuals. The following equipment includes but is not limited to the equipment to be included in the manuals:

- .1 Civil Items
 - Piping;
 - Pipe coatings;

- Couplings;
 - Fittings;
 - Concrete and mortar mix;
 - Granular Bedding and Backfill materials;
 - Asphalt restoration materials;
- .2 Building Items (where applicable)
- Masonry block;
 - Cast In Place Concrete;
 - Doors and hardware;
 - Louvres;
 - Interior finishes;
 - Sealants and building paint;
- .3 Mechanical Items (where applicable)
- Fans;
 - Heaters;
 - Finishes (paints)
- .4 Pumping Items (Owner Supplied)
- Sewage pumps and motors;
 - Pump performance curves;
 - Pump service and maintenance data;
- .5 Electrical Equipment
- Power Service;
 - Motor control centre (MCC) - Owner Supplied;
 - Power Distribution Centre (PDC) - Owner Supplied;
 - Control panel - Owner Supplied;
 - Transfer switch - Owner Supplied;
 - Breakers - Owner Supplied ;
 - Switches;
 - Fuses;
 - Variable Frequency Drives - Owner Supplied ;
 - Harmonic filters - Owner Supplied ;
 - RFI filters- Owner Supplied ;

- Conduits, cables, wires, connectors, terminal blocks, fastening devices;
- Wire markers;
- Power supplies;
- UPS;
- Lights;

.6 Instrumentation Equipment

- PLC and modules- Owner Supplied;
- Operator Interface (HMI) - Owner Supplied;
- Control Panel Equipment- Owner Supplied;
- Field instruments.

END OF SECTION 01740

1.0 GENERAL

- .1 This section specifies requirements for excavating, trenching and backfilling of underground utility installations and structures and will apply to the installation of the BC Hydro transformer, electrical ducts and other site related items.

1.1 Definitions

- .1 Common Excavation: excavation of materials of whatever nature, which are not included under definitions of rock excavation and include hardpan, partially cemented materials, clay or other materials which, in the opinion of the Engineer, can be ripped and excavated with heavy construction equipment.
- .2 Over-excavation: excavation below bottom of bedding, and includes backfilling of over-excavation with specified material, as authorized by Engineer.
- .3 Removals: removal and disposal off-site of concrete/metal structures including walks, curbs, gutters, manholes, catchbasins, pipes, culverts and any other structures on surface or underground shown on Contract Drawings for removal. Removal includes backfilling of excavation with specified material.
- .4 Travelled Surfaces: roadways, lanes, driveways, parking areas, road shoulders, walkways, or other surfaces over which vehicular or pedestrian traffic will routinely travel following completion of the Contract.
- .5 Untraveled Surfaces: surfaces other than Travelled Surfaces.

1.2 Safety Requirements

- .1 Design and install trench shoring in accordance with the regulations of WorkSafe BC and other local or Provincial governing regulations.

1.3 Disposal

- .1 Disposal of all excavated material offsite in compliance with the Contract Documents

1.4 Open Trench Limitations

- .1 For trench excavation, unless otherwise authorized by Engineer, do not excavate more than 30 m in advance of installation operations and, except where absolutely necessary, do not leave open trench at end of day's

operation.

1.5 Inspection and Testing

- .1 Refer to General Conditions.

2.0 PRODUCTS

2.1 Materials

- .1 Approved Native Material: Reuse of excavated material will not be allowed and all excavated material will be disposed offsite.
- .2 Imported Material: Well graded Granular material as specified.
- .3 Granular Road Sub-base Course: Well graded Select Granular Sub-base.
- .4 Crushed Granular Road Base Course and Surfacing Gravel: Crushed gravel Granular Base as specified.
- .5 Bedding: Crushed or graded gravels conforming to Granular Pipe Bedding and Surround Material. Type 1 material as specified.
- .6 Drain Rock: Conforming to Drain Rock as specified.

2.2 Granular Bedding and Pipe/Duct Surround Material

- .1 Crushed or graded gravel to conform to following gradations:

Type 1 (Standard Gradation)

Sieve Designation	Percent Passing
19 mm	90- 100
12.5 mm	65 - 85
9.5 mm	50 - 75
4.75 mm	25 - 50
2.36 mm	27 - 55
1.18 mm	10 - 35

0.600 mm	6 - 26
0.300 mm	
0.075 mm	0 - 5

2.2 Granular Subbase

- .1 Granular subbase and backfill to be well graded granular material, free from organic matter, conforming to following gradation:

Type 2 (Standard Gradation)

Sieve Designation	Percent Passing
75 mm	100
25 mm	50 - 85
0.150 mm	0 - 15
0.075 mm	0 - 8

2.3 Granular Base

- .1 Granular Base to be clean 19 mm crushed gravel conforming to following gradation:

Type 3 (Standard Gradation)

Sieve Designation	Percent Passing
19 mm	100
12.5 mm	75 - 100
9.5 mm	60 - 90
4.75 mm	40 - 70
2.36 mm	27 - 55
1.18 mm	16 - 42
0.600 mm	8 - 30
0.300 mm	5 - 20

0.075 mm	2 - 8
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3.0 EXECUTION

3.1 Clearing

- .1 Prior to clearing, ascertain the exact limits of the areas on which clearing may take place and restrictions on removal of existing trees, structures or other items.
- .2 Lift and set aside for replacement, existing shrubs, trees, rockeries, fences, ornaments, signs, and all other items which impede the work.
- .3 All stumps located within 1.5 metres for trench centre-line shall be removed.

3.2 Layout of Works

- .1 Contractor to be responsible for detailed layout of work to locations, elevations and grades shown on the Contract Drawings. Engineer will supply reference benchmark and control work points as shown on the Contract Drawings.

3.3 Sawcutting Pavements

- .1 Prior to excavation, existing asphalt or concrete pavements and sidewalks shall be sawcut in straight lines parallel to the trench centerline. The total cut width shall not be greater than the limits of excavation shown on the Contract Drawings.
- .2 Alternatively the existing pavement or sidewalk may be removed by approved milling machinery.
- .3 Where Engineer determines that existing pavement or sidewalk is in poor condition and sawcutting is not warranted, cutting of pavement may be done by trenching equipment.

3.4 Grassed Areas

- .1 Where trench passes through lawn, neatly cut and remove sod before excavation. Save sod for replacement upon backfilling trench.
- .2 Strip topsoil after area has been cleared and stockpile in locations approved by Engineer. Avoid mixing topsoil with subsoil.

3.5 Trench Excavation

- .1 Excavate trenches to allow pipe to be laid to alignment and grade required with allowance for specified pipe bedding. Excavate by hand where necessary to locate existing underground utilities or to preserve existing trees, shrubs or other items.
- .2 Trench width to conform to dimensions shown on Contract Drawings. Where trench width exceeds that specified, Engineer may require Contractor to demonstrate that excess width does not adversely affect pipe. All remedial measures including higher class of pipe strength or bedding will be to Contractor's cost.
- .3 If bottom of excavated trench is, in the opinion of the Engineer, unstable and cannot adequately support pipe, install concrete bedding as shown on Contract Drawings or over-excavate trench to suitable sub-grade as directed by the Engineer. Backfill over-excavation with granular base in maximum 0.3 metre lifts and compact to minimum 95% Modified Proctor density in compliance with ASTM D1557. Bedding material may be employed to a maximum depth of 0.3 meters. Use drain rock backfill only if authorized by Engineer.

3.6 Trench Bracing & Sheeting

- .1 Trenches shall be sheeted and braced in accordance with the regulations of Workers Compensation Board and as, in the opinion of the Engineer, may be necessary to protect property and structures adjacent to the work, the work itself or to maintain trench widths within the specified limits.
- .2 Trench bracing and sheeting shall be located no closer than 150 mm to the widest section of any installed pipe. Whenever possible, vertical trench timber or sheeting shall not extend below the springline of the pipe being installed. When it is necessary to place sheeting or timber below the springline of the pipe e.g. for over-excavation, the sheeting shall be raised in 0.6 metre lifts and all backfill placed below the level of the pipe springline shall be thoroughly compacted on each lift to fill the void left by the raised sheeting.
- .3 Trench sheeting and bracing shall be removed where removal will not result in damage to adjacent structures. Otherwise it shall be left in place.
- .4 When sheeting or bracing is removed from a trench in which backfill is to be compacted, it shall be removed in a manner which permits compaction of the backfill in accordance with the specifications. Otherwise it shall be left in place.
- .5 When sheeting and bracing left in place, it shall be cut so that no sheeting remains closer than 1 metre below ground surface.

3.7 Handling Excavated Material

- .1 Excavated material must be disposed of offsite at approved locations.

- .2 Stockpiles of excavated material shall not hinder access to any commercial property. Vehicle access to private driveways shall not be impeded for more than twenty-four (24) hours. Pedestrian access to individual properties shall be maintained at all times.
- .3 Stockpiles of surplus excavated material shall be removed within 2 working days of excavation or as approved by the Engineer.

3.8 Dewatering

- .1 Keep trench and structure excavations free of water at all times.
- .2 Prevent trench water from entering pipe. During jointing operation, keep pipe ends dry.
- .3 Discharge of dewatering must comply with City of Vancouver Environmental Requirements.

3.9 Trench Bottoms

- .1 Before installation of bedding material remove soft or non-compactable material from trench bottom and keep trench free from water during entire pipe laying and backfilling operation to ensure proper compaction of granular materials.

3.10 Bedding and Pipe Installation

- .1 Related Work: Pipe/conduit installation, including bedding, pipe/conduit laying, and granular surround to be in accordance with following sections.
 - .1 Division 16 Underground ducts and cables

In general, pipe bedding and surround extends to 300 mm above installed pipe.

3.11 Backfill - General

- .1 Backfilling and compaction shall proceed as close to pipe laying operation as practical. Backfill operation shall be planned to minimize exposure of backfill material to wet weather.
- .2 Place backfill carefully to avoid damage to installed pipe. Dump first lift of backfill material to side of trench or roll down slope. Vertical dumping of first lift material onto trench centreline not permitted.
- .3 Structure backfill shall take place in even layers around the pump station as

concrete slabs and walls are poured and cured and such that no unbalanced forces are developed on the structure.

3.12 Backfill

- .1 Unless shown otherwise on the Contract Drawings, all trench and structure backfill shall be Type 3 Imported Granular Material as specified.
- .2 Place granular backfill in maximum 300 mm thick lifts and compact to achieve minimum of 95% Modified Proctor Densities (to ASTM D1557). Adjust moisture content of backfill as may be necessary to achieve specified density.
- .3 Engineer may approve thicker backfill lifts, up to maximum of 600 mm, if Contractor can demonstrate, at his expense, that his compaction equipment and procedures can achieve specified density throughout a thicker lift.

3.13 Travelled Surfaces - Surface Restoration

- .1 **Gravelled Surfaces:** Unless shown otherwise on the Contract Drawings, all gravelled travelled surfaces shall be restored with a minimum of 150 mm thick Crushed Granular Road Base and Surfacing Gravel compacted to 95% Modified Proctor Density.
- .2 **Gravel Road Shoulders:** as above. Unless indicated otherwise on the Contract Drawings, road shoulders shall be restored to original width or 1 metre, whichever is greater.
- .3 **Asphalt Paved Surfaces:** Areas to be restored with asphalt surfaces are as indicated on the drawings and shall include:
 - .1 Granular Road Sub-base: compacted to 95% Modified Proctor Density
 - .2 Crushed Granular Road Base Course; compacted to 95% Modified Proctor Density
 - .3 Hot Mix Asphaltic Concrete; to City of Vancouver requirements. Thickness of HMAC to be as specified on Contract Drawings, to match existing or 100 mm whichever is greater to a maximum of 150 mm.

END OF SECTION 02315

PART 1 - GENERAL

1.1 Reference Standards

The current edition of the following standards shall apply to the Work:

- .1
 - .a CSA-A5, Portland Cement
 - .b CSA-A23.1, Concrete Materials and Methods of Concrete Construction
 - .c CSA-A23.2, Methods of Test for Concrete
 - .d CSA—A23.5, Supplementary Cementing Materials.
 - .e CAN-CSA-S269.-M, Concrete Formwork

- .2
 - .a ASTM C360, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .b ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .c ASTM C494/C494M, Standard Specification for Chemical Admixtures for Concrete.
 - .d ASTM C1017, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

1.2 Certificates

- .1 A minimum of 4 weeks prior to starting concrete work, the Contractor shall submit to the Engineer, manufacturer's test data and certification by a qualified independent inspection and testing laboratory that the following materials will meet specified requirements:
 - .a Portland cement
 - .b Supplementary cementing materials
 - .c Grout
 - .d Admixtures
 - .e Aggregates
 - .f Water
 - .g Joint Filler
 - .h Bonding Agents
 - .i Curing Compounds

- .2 The Contractor shall provide certification that plant, equipment and materials to be used in concrete comply with requirements of CSA A23.1 and that materials and mix design are adjusted to prevent excessive expansion due to alkali aggregate reactivity.

- .3 The Contractor shall provide certification that mix proportions selected will produce concrete of specified quality and strength and will comply with CSA A23.1. Submit test results from at least five separate sets of tests for each design mix proposed. Provide test certificates for strength, air content, and slump of the proposed concrete mixes. Submit the proposed concrete mix design to the Engineer indicating

material contents in weight per cubic meter of concrete.

- .4 The Engineer's review of the mix designs is for general conformity with specified requirements and shall not mitigate the Contractor's obligation to provide concrete suitable for placing in the locations specified and meeting all specified requirements.

1.3 Quality Assurance

- .1 A minimum of 4 weeks prior to beginning concrete work, the Contractor shall submit proposed quality control procedures for Engineer's approval for the following items:
 - .a Hot weather concrete
 - .b Cold weather concrete
 - .c Curing
 - .d Finishes
 - .e Placement
 - .f Construction Joints

1.4 Submittals

- .1 Submittals shall be in accordance with Section 01340.
- .2 Submit pour schedule with proposed locations of construction for review by Engineer.

1.5 Schedule of Work

- .1 Schedule all concrete work with the Work described in other sections of these specifications to ensure that all block outs, reinforcing and embedded items are properly incorporated into the formwork before placing concrete.

PART 2 - PRODUCTS

2.1 Materials

- .1 Cement: Type GU, conforming to CSA A5. Use the same brand of cement throughout the Work.
- .2 Supplementary cementing materials: conforming to CSA-A12.5, Type F.
- .3 Water: conforming to CSA A23.1.
- .4 Aggregates: conforming to CSA A23.1, Use normal density aggregates.
- .5 Air-entraining admixture: conforming to ASTM C260.
- .6 Chemical admixtures and water reducing admixtures: conforming to ASTM C494 or ASTM C1017
- .7 Curing compounds: conforming to ASTM C309.
- .8 Joint material: resilient, pre-moulded bituminous saturant, conforming to ASTM D 1751 and resistant to heat, oil and ozone.
- .9 Joint sealant: synthetic rubber-based two component compound, Sternson Duoflex or approved equal. Use Sternson Talychem Talyflex or approved equal where chemical resistance is required.
- .10 Form tie plugs: precast high-strength cement compound plugs. SnaPlugs by Burke or equal.
- .11 Do not use admixtures containing calcium chloride. Engineer to approve accelerating or set retarding admixtures during cold and hot weather placing.

2.2 Mix Proportions

- .1 Design and proportion concrete mix to meet design strength requirements. Include consideration of weather, temperature, curing shrinkage and methods of concrete placement.
- .2 Proportion normal density concrete to CSA-A23.1, Clause 14 to give the following:

Mix Type and Location	Specified Strength [Mpa]	Class of Exposure	Nominal Size Coarse Aggregate	Slump At Point of Discharge [mm]	Air Content [%]	Density of Air-Dry Concrete [kg/cu. m]
Structural Concrete for foundations, slabs, walls, curbs, gutters	30	F-1	20	80±20	5 to 8	2300 ± 50

- .3 Obtain the approval of the Engineer before using chemical admixtures other than those specified.

PART 3 - EXECUTION

3.1 Workmanship

- .1 Provide 48 hours notice to the Engineer and obtain his approval before placing concrete.
- .2 Place concrete in accordance with CSA-A23.1, and CSA S269.3.
- .3 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .4 Before placing or curing concrete during adverse weather, obtain Engineer's approval of the proposed method of protection.
- .5 Maintain accurate records of poured concrete to indicate date, location of pour, quality, air temperature and test samples taken.

Plant and Mixing Requirements

- .6 Maintain plant and delivery equipment in good working condition.
- .7 For truck mixers, mixing to be in accordance with CSA-A23.1.

3.2 Transport and Delivery of Mix

- .1 Time from initial mixing to final placing to be not more than 90 minutes if mix is transported by agitating equipment. Addition of water after mixing not permitted.

3.3 Embedded Metal and Openings

- .1 Provide and install sleeves, ties, anchor bolts, conduit, other inserts and openings as shown on the drawings. Get approval from the Engineer for sleeves, openings etc., with maximum dimension greater than 100 mm not indicated on structural drawings.
- .2 Do not pass sleeves, ducts, pipes, or other openings through joints, except where expressly detailed on structural drawings or approved by the Engineer.
- .3 Do not eliminate or displace reinforcement to accommodate hardware. If inserts cannot be located as specified, get approval for all modifications from the Engineer before placing concrete.
- .4 Check locations and sizes of sleeves, openings, etc., shown on structural drawings with mechanical and electrical drawings.
- .5 Set embedded metal true to positions shown within ± 3 mm.

3.5 Chamfer and Fillets

- .1 Provide 20mm chamfer along all external exposed edges and 20 mm fillets along all internal edges, unless otherwise noted.

3.6 Construction and Control Joints

- .1 Locate joints as indicated on the Structural Drawings and Standards or as approved by the Engineer.
- .2 If additional joints are required to suit construction, locate and design the joints to ensure that the strength and appearance of the structure are not impaired.
- .3 If construction joints are required, conform to DCA-A23.1
- .4 Provide control joints conforming to CSA-A23.1
- .5 Fill control joints as shown on the Structural Drawings or described in the specifications.
- .6 Waterproof construction joints with spray on waterproofer.

3.7 Curing and Protection

- .1 Cure and protect in accordance with CSA A23.1, and the special requirements for hot weather concreting and cold weather protection
- .2 Do not use curing compounds on surfaces that will subsequently receive permanent protective coatings.

3.8 Finishing of Surfaces - General

- .1 Finish all surfaces in accordance with CSA A23.1 with final finish as required by the specifications or noted on the Structural Drawings.
- .2 Cure and finish the concrete to suit the intended use of the surface.
- .3 Grind exposed sharp edges of concrete.
- .4 On exposed walls or slabs, plug the core holes created by the form ties with precast plugs fixed in place with adhesive. Unless otherwise noted, use a plug size chosen to leave a small reveal after the plug is inserted.

3.9 Finishing Interior Floors

- .1 Floors shall be finished to the provisions of CSA A23.1. Floor surfaces shall be screeded and bull floated to a smooth level surface without high spots, ridges, or depressions.

- .2 As soon as surface bleed water has dissipated and the concrete has hardened sufficiently, the surface shall be floated and steel trowelled to a final dense, hard, and smooth finish, with at least two passes of the trowel.
- .3 Final surface flatness shall conform to Table 15, Class A."
- .4 Provide a light broom finish to exterior slab areas.

3.10 Defective Concrete

- .1 Concrete is defective when:
 - a. It contains honeycombing, embedded debris, uncontrolled shrinkage cracking, or other surface defects.
 - b. It is damage by freezing.
 - c. It is placed at too high a temperature.
 - d. Edges are spalled.
 - e. It is damaged due to construction operations.
 - f. It does not meet the specified strength requirements

3.11 Repair and Restoration

- .1 Repair defective concrete work:
 - a. Repair defective areas while concrete is still plastic, otherwise wait until curing is completed. On defective concrete use only repair methods reviewed and pre-approved by the Engineer.
- .2 Remove and replace defective concrete where directed by Engineer:
 - a. Remove concrete containing defective work.
 - b. Replace with new concrete in accordance with this Section.

3.12 Inspection and Testing

- .1 Inspection and testing of concrete and concrete materials will be carried out by an independent testing laboratory retained by the Contractor.
- .2 Concrete testing frequency and methods shall be in accordance with CSA A23.1 and CSA A23.2 except as otherwise specified:
 - a. Take three (3) test cylinders for each 100 cubic meters of concrete or portions of each mix type of concrete or each separate type of structural element in on day's pour.
 - b. Test one cylinder at the age of 7 days. Test a second and third cylinder at the age of 28 days.
 - c. When the frequency of testing stipulated above provides less than three tests for a given mix type of concrete, make tests from at least three randomly selected batches.

- .3 Ensure concrete conforms to the compressive test requirements contained in CSA a23.1. If unsatisfactory trends become evident in test results, immediately correct the deficiency by adjusting the mix design. If improvement is not achieved, the Contractor may be required to carry out one or more of the following at his expense:
 - a. Non-destructive testing (Appendix 'A' CSA A23.2).
 - b. Accelerated curing of Test Cylinders.
 - c. Drill cores from portions of the structure in question and test in accordance with CSA A23.2.
 - d. Such other tests as the Engineer may specify.
 - e. Removal and replacement of all defective concrete.

- .4 Engineer may, at his discretion retain and pay for the services of an independent Testing Agency to monitor the mixing and handling of concrete, take additional strength and slump tests, and check all matters affecting quality control of the concrete. Extend full co-operation and assistance to the Testing Agency, including provision of access and samples for testing.

3.13 Clean-Up

- .1 Remove all concrete spill or splash from finished surfaces before concrete hardens or sets.

- .2 When work is finished, remove all surplus material, equipment and debris from the site. Leave the site broom clean.

END OF SECTION 03300

PART 1 - GENERAL

1.1 Work Included

- .1 Furnish all materials, labour, equipment and services for all concrete unit masonry work as indicated on the contract drawings and specified herein.
- .2 Smooth face masonry block (as shown on the drawings) to be used for the electrical building.

1.2 Related Work

Read this Section in conjunction with the other Sections of the Specifications and the General Requirements.

- .1 Section 03300 - Cast-in-Place Concrete
- .2 Section 09900 - Painting

1.3 Reference Standards

- .1 Carry out masonry work in accordance with the most current edition of the following standards except where specified otherwise:
 - a) CSA-CAN3-S304-M Masonry Design for Buildings
 - b) CSA-CAN3-A371-M Masonry Construction for Buildings
 - c) CSA-A165.1-M Concrete Masonry Units
 - d) CSA-A179-M Mortar and Grout for Unit Masonry
 - e) CSA-A82.56-M Aggregate for Masonry Mortar
 - f) ASTM A 82 Steel Wire, Plain for Concrete Reinforcement

1.4 Submittals

- .1 Submit laboratory test reports certifying compliance of masonry units and mortar ingredients with the specification requirements.
- .2 Submit upon request samples of masonry block, concrete fill, mortar and reinforcing.

1.5 Delivery and Storage

- .1 Ensure that materials are delivered to job site in dry condition.
- .2 Store materials under waterproof cover on pallets or plank platforms held off ground by means of plank or timber skids.

1.6 Cold Weather Requirements

- .1 Take adequate precautions to prevent freezing of mortar and mortar materials when air temperature is below 5 degrees C.
- .2 When air temperature is below -4 degrees C protect and heat masonry to maintain air temperature above 0 degrees C on both sides of walls during operations and for a period of 24 hours after placing block and mortar.

1.7 Hot Weather Requirements

- .1 Protect freshly laid masonry from drying too rapidly by means of waterproof non-staining coverings.

1.8 Protection

- .1 Protect masonry and other work from marking, mortar droppings, and other damage.
- .2 Provide temporary bracing of masonry work as required during and after erection until permanent lateral support is in place.

1.9 Scheduling the Work

- .1 Schedule all masonry work with the work described in the other Sections of these Specifications to ensure that all openings, embedded items, and built-in items are properly incorporated into the masonry work prior to grouting including doors, pipes, louvers, ducts, air ducts, conduits, and related items.

PART 2 - PRODUCTS

2.1 Materials

- .1 Standard concrete masonry units: Type 1 - Smooth Face Block as shown on the contract drawings to CSA A165.1-M.
 - a) Classification: H/15/B/M
 - b) Strength: 20 MPa on net area
 - c) Nominal Size: 200 mm x 200 mm x 400 mm, as indicated
 - d) Special shapes: provide bond beams, lintel blocks, etc. as required and as indicated on the contract drawings.

- .2 Mortar: Cement / Sand Mortar Type S to CSA A179M.
 - a) Strength: 20 MPa at 28 days
 - b) Masonry hydrated lime Type "A" to CSA A179
 - c) Aggregate conforming to CSA A82.56-M.

- .3 Reinforcing:
 - a) Provide ladder-type horizontal reinforcement and vertical and horizontal deformed steel reinforcement as shown on the drawings.
 - b) Steel to be free of any coating which in opinion of The Engineer would impair the bond; place reinforcement accurately, and tie so that it is not displaced before concrete has hardened.

- .4 Reinforcement and Ties
 - a) Joint reinforcement: Duro-wall or Block-Lok fabricated from twin No. 9 gauge cold drawn steel wire, galvanized, conforming to ASTM A82.
 - b) Corrugated metal ties: 25 mm side, 22 gauge galvanized coated sheet steel not less than 150 mm long.
 - c) Dovetail anchor ties; 40 mm wide, 16 gauge galvanized coated sheet steel with end dovetailed to fit anchor slot.

- .5 Accessories:
 - a) Control joint filler: "Rodofill" fibre expansion filler by W.R. Grace or equal.
 - b) Metal lath: galvanized corrugated diamond mesh, 3.4 lbs, conforming to CSA A82.30.

- .6 Grout:
 - a) Unless otherwise shown on plans, grout for pouring to be of fluid consistency and mixed to a 28 day strength of 20 MPa and be designed by a recognized testing laboratory and approved by the Engineer.
 - b) Conforming to C.S.A. S304.

- c) Grout for pumping to be of fluid consistency and with not less than 9 sacks of cement in each cubic metre of grout.
 - d) All grout to have a water reducing admixture approved by the Engineer added per manufacturer's specification.
- .7 Masonry Coating
- a) See Section 09900.

PART 3 - EXECUTION

3.1 Workmanship

- .1 Build masonry plumb, level and true to line, with vertical joints in proper alignment.
- .2 Lay out coursing and bond to achieve correct coursing heights, and continuity to bond above and below openings, with minimum of cutting.
- .3 Remove chipped, cracked and otherwise damaged units in exposed masonry and replace with undamaged units.
- .4 See drawings for location of split face and smooth face block to provide desired architectural pattern shown.

3.2 Tolerances

- .1 Conform to CAN3-A371-M.

3.3 Laying Concrete Masonry Units

- .1 Bond: running stretcher
- .2 Coursing height: 200 mm for one block and one joint
- .3 Jointing: concave where exposed or where paint or other finish coating is specified.

3.4 Jointing

- .1 Where concave joints are specified, allow joints to set just enough to remove excess water, then tool with round jointer to provide smooth, compressed, uniformly concave joints.
- .2 Where joints are concealed in walls and where walls are to receive plaster, tile, insulation, or other applied material except paint or similar finish coating, strike flush.

3.5 Joining of Work

- .1 Where necessary to temporarily stop horizontal runs of masonry, and in building corners, step back masonry diagonally to lowest course previously laid. Do not "tooth" new masonry. Fill in adjacent courses before heights of stepped masonry reach 1200 mm.

3.6 Cutting

- .1 Cut out neatly for recessed or built-in objects.
- .2 Make cuts straight, clean, and free from uneven edges. Use masonry saw where necessary.

3.7 Grouting

- .1 Secure reinforcing steel in place for inspection by Engineer before grouting starts.
- .2 Complete grouting of bond beams over openings in one continuous operation.
- .3 Fill all vertical cores with or without reinforcement solidly with concrete grout.
- .4 Provide cleanout openings at the bottoms of all cores containing reinforcement at each lift or pour of grout where such lift or pour of grout is in excess of 1200 mm in height.
- .5 Remove any overhanging mortar or other obstruction or debris from the insides of such cell walls.
- .6 Seal cleanouts before grouting and after inspection.
- .7 Cure hollow unit masonry at least 24 hours before grouting.
- .8 Vibrate all grout with a 20 mm vibrator immediately after placement; do not over-vibrate.

~~3.8 Drainage of Non-Grouted Cells~~

- ~~.1 Fill all cells in the first course above the floor slab (except for grouted cells) with pea gravel.~~
- ~~.2 Provide 10 mm diameter drain holes.~~

3.9 Building-In

- .1 Build in metal frames, and other items supplied under this Section or other Sections of the Specifications which are required to be built in to Masonry including doors, louvers, air ducts, conduits and related items.

- .2 Prevent displacement of built-in items during construction. Check for plumbness, alignment, and correctness of position, as work progresses.
- .3 Brace frames to maintain plumbness. Fill spaces between frames and masonry with mortar.

3.10 Lintels

- .1 Install reinforced concrete block lintels over openings in masonry where steel or reinforced in-situ concrete lintels are not indicated.
- .2 End bearings of masonry lintels shall not be less than 200 mm or as indicated on the contract drawings.
- .3 Reinforce masonry lintels with reinforcing steel as shown on the contract drawings and fill lintel blocks with grout.

3.11 Reinforcement

- .1 Reinforce masonry as shown on the contract drawings.
- .2 Provide and place a minimum of one 15M reinforcing bars unless otherwise indicated on the contract drawing at the following locations:
 - a) End of Walls
 - b) Jambs, heads and sills of openings
 - c) Bond beams
 - d) All courses under load bearing plates
 - e) Facings, anchors and emedments.
- .3 Fill all reinforced voids or voids containing anchorage devices with masonry grout.

3.12 Control Joints

- .1 Provide continuous vertical joints in masonry walls as indicated.
- .2 Provide and install joint fillers at locations shown on the contract drawings.

3.13 Cleaning

- .1 Allow mortar droppings on unglazed concrete masonry to partially dry, then remove by means of trowel, followed by rubbing lightly with small piece of block and finally by brushing.
- .2 Walls to be painted shall be suitably finished and ready for painting.

3.14 Clean-Up

- .1 As the work progresses remove all debris and surplus material from the site and leave the site broom clean. On completion of the work of this Section, remove all protection erected in conjunction with the work. Make good all damage to this work and adjoining work and remove all surplus materials, debris, tools, plant and equipment from the site. Leave site in condition satisfactory to Engineer.

END OF SECTION 04220

PART 1 - GENERAL

1.1 Description

- .1 The work of this section comprises all that is necessary for the fabrication and supply of all required metal components or items for the lift station including:
 - .1 All pipe supports and related items.
 - .2 All metal platforms, stairs, hand railings, metal gratings.
 - .3 Miscellaneous straps, fasteners, and other fabricated or supplied metal items necessary for the work.
 - .4 See Section 09900 for painting and 15452 for pump discharge piping.

1.2 Related Work

- .1 Section 01330 - Submittals
- .2 Section 09900 - Painting
- .3 Section 15452 - Pump Station Piping
- .4 Division 16 Sections - Electrical

1.3 Reference Standards

- .1 Do welding work in accordance with CSA W59-1989 unless specified otherwise.
- .2 Do structural steel work in accordance with CAN3-S16.1-M.
- .3 CSA W47.1-92 for certification if companies for fusion welding of steel structures.
- .4 CGSB 1-GP-18M Coatings, Zinc Rich, Organic, Ready Mixed CSA G164 Hot Dip Galvanizing of Irregularly shaped Objects.

1.4 Shop Drawings

- .1 Submit shop drawings in accordance with Section 01330 for all fabricated items including pipe supports, frames, channels, brackets and all other fabricated metal items or related works.
- .2 Indicate materials, core thicknesses, finishes, principal dimensions, member sizes, connections, joints, welding symbols defined in CSA W59-82, Appendix D, method of anchorage, number of anchors, supports, reinforcement details, and accessories.
- .3 Shop drawings shall be clearly dimensioned and fully detailed and shall

distinguish between mechanical fasteners and welds required for shop fabrication and those required in the field.

- .4 It is the Contractor's responsibility to confirm all dimensions, clearances, elevations for related assemblies in field prior to fabrication. If dimensional changes are required, inform Engineer immediately in writing of new dimensions.

PART 2 - PRODUCTS

2.1 Materials

- .1 Steel sections, angles, plates: to CAN3-G40.21-92, Grade 300W.
- .2 Steel pipe for pipe supports: to ASTM A53-82, Grade B, standard weight finished as indicated.
- .3 Welding materials: to CSA W59-1989.
- .4 Bolts and anchor bolts: to ASTM A307 and CAN3-G40.21-92. Embedded bolts and anchor bolts to be hot dip galvanized.
- .5 Galvanizing: hot dipped galvanizing with zinc coating 600 g/m² to CSA G164-M92.
- .6 Zinc Primer: Zinc rich ready mix to CAN CGSB-1.181.
- .7 Grout: Non-shrink as specified in Section 03300.

2.2 Fabrication

- .1 Build work square, true, straight and accurate to required size, with joints closely fitted and properly secured.
- .2 Confirm all dimensions, clearances, elevations in field prior to fabrication.
- .3 Fabricate steel as indicated, in accordance with CAN3-S16.1.
- .4 Shop weld all fabrications unless otherwise indicated or specifically approved by the Engineer.
- .5 Fit and shop assemble work, ready for erection.

- .6 Ensure exposed welds are continuous for length of each joint. File or grind exposed welds smooth and flush.

2.3 Painting

- .1 All metal items fabricated under this section shall either be painted in accordance with Section 09900 or hot dip galvanized.
- .2 Pump discharge piping is lined and coated carbon steel in accordance with Section 15452.
- .3 Stainless steel piping is not painted.

PART 3 - EXECUTION

3.1 Erection

- .1 Erect metalwork square, plumb, straight, and true, accurately fitted, with tight joints and intersections.
- .2 Touch-up approved field welds, bolts and burnt or scratched steel or other painted surfaces after completion of erection as directed.

END OF SECTION

PART 1 - GENERAL

1.1. Related Work

1. Concrete Section 03300
2. Structural Masonry Section 04220

1.2. Work Included

1. This section refers to supply and installation of sealants and caulking for building construction.

1.3. Reference Standards

1. Perform work in accordance with the version of the following standards current on 1 July 2008:
2. British Columbia Building Code.
3. Canadian General Standards Bureau (CGSB)
 - a. CAN/CGSB 19.13: Sealing Compound, One-Component, Elastomeric, Chemical Curing
 - b. CAN/CGSB. 19.22: Mildew-Resistant Sealing Compounds for Tubs and Tile
 - c. CAN/CGSB 19.24: Multi-Component, Chemical Curing Sealing Compound

1.4. Submittals

1. Submit technical information for approval of all materials.
2. Submit colour chart for colour selection.

2 - PRODUCTS

2.1. Sealants

1. One-Component Polysulphide Base. To CAN/CGSB 19.13-M.
2. Multi-Component, Chemical Cure. To CAN/CGSB 19.24-M90.
3. Mildew Resistant Sealant. To CAN/CGSB. 19.22-M.

2.2. Primers

1. As approved by sealant manufacturer, and compatible with sealant.

2.3. Joint Backing

1. Closed cell round polyethylene, 25% to 50% larger than opening. Shore hardness 20, tensile strength 140-200 kPa (20-30 psi).

2.4. Solvents, Cleaners and Bond Breakers

1. As recommended by approved sealant manufacturer.

3 - EXECUTION

3.1. Surface Condition

1. Examine all joints, spaces and surfaces to be sealed and caulked, including temperatures and conditions which may impair finished work, and report all unsatisfactory conditions in writing to Engineer.
2. Start of work implies acceptance of conditions and surfaces and this trade must assume responsibility and rectify all unsatisfactory finish resulting.

3.2. Preparation

1. Joints and spaces must be clean, dry, free from dust, paint, and other foreign materials.
2. Clean ferrous metals of all rust, mill scale and coatings by wire brush, grinding or sandblasting; remove oils and grease with xylol, toluol, or methylethyl ketone.
3. Remove protective and strippable coatings on metallic surfaces by a solvent leaving no residue. Apply solvent and wipe dry, using clean white cotton cloths, using fresh cloths for each process.
4. Do not allow solvent to air dry before wiping. Treat areas covered by masking tape (after removal) similarly to above.
5. Etch bond concrete with 5% solution of muriatic acid to remove excess alkalinity, rinse thoroughly with water and dry prior to installation of sealants.
6. Joints and spaces to receive caulking: 6mm (1/4") deep minimum 4mm (3/16") wide minimum and 25mm (1") wide maximum unless otherwise shown. Where these requirements are not met, obtain written permission from Engineer before proceeding with work. Fill joints where more than 12mm (2") deep, to within 12mm of surface with a joint backing.
7. Prime sides of joints in porous material immediately prior to caulking, in accordance with manufacturer's instructions. Mask adjacent surfaces with tape prior to priming and caulking; remove tape after joint has been tooled.

3.3. Schedule

1. External door frames and louvres, inside and outside - head and jambs: one-component polysulphide or multi-component.
2. Interior joints between dissimilar materials where shown: one component polysulphide or multi-component.
3. Exterior thresholds: set in two full beads multi-component.

4. All areas noted and obviously required and to protect interior from exterior water and air infiltration: one component polysulphide.

3.4. Application

1. Apply sealant with a gun, with proper size nozzle, or knife as required. Use sufficient pressure to fill all voids and points solid, superficial pointing with a skin bead will not be accepted.
2. Surface of sealant shall form a full bead, smooth, free from ridges, wrinkles, sags, air pockets and embedded impurities. Neatly tool surface to a slight concave.
3. Clean adjacent surfaces immediately, and leave work neat and clean; remove excess and droppings using recommended cleaners as work progresses. Do not apply when temperature below 4 degrees C.

3.5. Curing and Protection

1. Cure compounds and sealants in accordance with manufacturer's instructions, to obtain maximum bond to surfaces, cohesive strength and durability at earliest possible time.
2. Maintain a minimum temperature of 4° C. During installation and curing of compounds and sealants, unless manufacturer specifically recommends application at lower temperatures.
3. Installer shall advise the Contractor of proper procedures for protections of compounds and sealants during construction period, so that they will be without any indication of deterioration or damage at time of acceptance by the Band.

END OF SECTION 07900

PART 1 - GENERAL

1.1 Scope

- .1 This section includes all labour, materials and equipment required for the installation of exterior steel doors, frames, hardware and related accessories.

1.2 Related Work Specified in Other Sections

- .1 Section 04220 - Masonry
- .2 Section 03300 - Concrete
- .3 Section 09900 - Painting

1.3 Standards

- .1 Doors and frames shall exceed the minimum requirements of the "Specifications for Commercial Steel Door and Frames" published by the Canadian Steel Door Manufacturers Association (CSDMA).

1.4 Quality Assurance

- .1 Steel doors, frames and hardware to be provided only by firms specializing in the design and manufacture of steel doors and frames.
- .2 Doors and frames supplied are to be certified to comply with CDSMA specifications and requirements in all respects.

1.5 Shop Drawings

- .1 Submit shop drawings for doors, frames and door hardware in accordance with Section 01330.

1.6 Warranty

- .1 A written warranty is to be supplied with all door assemblies signed by Contractor and installer, agreeing to repair or replace door components or entire assemblies that fail due to materials or workmanship during the specified warranty period. Warranty period shall be one year from date of project total completion.

PART 2 - PRODUCTS

2.1 Steel Doors

- .1 Exterior doors shall be manufactured from paintable Galvanneal Sheet Steel to ASTM A653 with coating designation G90 fabricated with 1.52 mm thick steel panels. Finish exterior doors with zinc oxide galvanized steel primer ready for

- top coating. See Section 09900. Exterior doors shall be steel stiffened vertically and filled with polystyrene.
- .2 Doors shall be 45 mm (1 ¾ inches) thick.
 - .3 Doors and frames shall have seamless flush surfaces with continuous welds on vertical edges. All welds to be round and polished smooth.
 - .4 All exterior doors to be insulated.
 - .5 Doors shall have vertical interlocking stiffeners at 150mm centres, spot welded at 150mm centre to centre.
 - .6 Mortise, reinforce, drill and tap doors for hardware to ANSI 115 "Specifications for Door and Frame Preparation of Hardware and manufacturers recommendations. Use manufacturers templates.
 - .7 Top and bottom of doors to be closed with 18 gauge steel channels.
 - .8 Provide closure angle at top edge of exterior doors.
 - .9 Provide weep holes in bottom channel for exterior doors.
 - .10 Provide weather stripping for all exterior doors.
 - .11 Provide steel astragals for exterior double door.

2.2 Steel Door Frames

- .1 Exterior door frames shall be manufactured from 1.52 mm thick paintable Galvanneal Sheet Steel to ASTM A 653 with coating designation G90. Finish exterior doors with zinc oxide galvanized steel primer ready for top coating. See Section 09900.
- .2 Frames shall have seamless flush surfaces with continuous welds on all edges. All welds to be round and polished smooth.
- .3 Frames for installation in concrete walls shall have anchors suitable for use with reinforced concrete construction and shall be located as required and immediately above and below each hinge reinforcement on the hinge jamb and as indicated on the drawings.
- .4 Provide spreader bars at bottom of welded frames during transport. Remove spreader bars after installation.
- .5 Frames shall be blanked, reinforced, drilled and tapped for mortised, templated hardware. Mortised cutouts shall be protected with steel guard boxes. Frames shall be reinforced for surface mounting hardware.

- .6 Provide 10 gauge galvanized steel guard boxes for locksets.
- .7 Steel reinforcement for hardware:
Strikes: 1.62mm Butts: 3.42mm Bolts: 1.62mm
Closers: 2.64mm Holders: 2.64mm
- .8 Door bumpers to be replaceable resilient black neoprene. Install 3 bumpers on strike jamb for each door.
- .9 Reinforce door jambs on exterior doors with welded 2.66mm thick formed steel channels packed with glass fibre insulation.
- .10 Use removable panel stops with countersunk flush head screws welded in place on exterior side.

2.3 Door Hardware

- .1 All doors shall be provided complete with full hardware as specified.
- .2 Thresholds for all doors and weather stripping for all exterior doors shall be Pemko as supplied by A.K. Draftseal Ltd, Coquitlam B.C. or equal by Zero International and supplied by G.P. Distributors, Surrey, B.C.
- .3 Hinges shall conform to GCSB 69-GP-1, satin stainless steel, with tamper proof non-removable pins and opening outwards. See drawings for number of hinges per door.
- .4 Exterior Doors (Active Leaf):
 - .1 "L9000" Series Schlage Extra Heavy Duty Mortise deadbolt lever lock, Series 1000 Grade 1, UL listed and to ANSI 156.13 keyed as specified.
 - .2 Concealed cylinder ANSI 156.13, Grade 1 Operational and Security;
 - .3 Exposed Trim:
 - .1 Lever: stainless steel, Rhodes design 630 finish;
 - .2 Escutcheon: N type stainless steel;
 - .3 Roses: B stainless steel
 - .4 Trim: Lever both sides;
 - .5 Deadbolt: 25 mm stainless steel;
 - .6 Latchbolt: 19 mm stainless steel;
 - .7 Armoured Front and Strike: Stainless steel
- .5 Exterior Pump Station Door Hardware (all doors except washrooms) - Panic Bar lockset to be:
 - .1 Von Duprin exit device 98L x 630.
 - .2 Trim to be 996L x 06 x 626 with cylinder for keyed entry.
- .6 Door closures shall be LCN "super smoothee 4041" and shall be installed on all doors.

- .7 Door stops: Glynn-Johnson Type 60C aluminum wall and rubber wall bumper, GJ FB13/14 where wall bumper not possible.
- .8 Steel kickplates shall 1.5 mm (16 gauge), 250 mm high and finished with satin aluminum finish.
- .9 Exterior doors shall be fitted with a steel astragals.
- .10 All door hardware shall be machined, cleaned, buffed and polished and free of burrs. Countersink all screws.
- .11 Weather stripping to be draft seal DS100 ACV to head and jambs, DS14 ACV at sills of all exterior doors.
- .12 Use stainless steel countersunk screws for fixing all hardware items to doors.

2.4 Door Keying

- .1 Coordinate keying and deadbolt selection with City of Vancouver Operations personnel. Keying shall be compatible with existing City of Vancouver master keys.
- .2 Provide three keys for each lockset.
- .3 Provide construction cores.
- .4 Construction Key System (Interchangeable core):
 - .1 External lockset to be installed without a permanent cylinder.
 - .2 Install a temporary construction cylinder for use during construction period, and until building is handed over to City of Surrey, at which time the City will replace the temporary cylinder with permanent type as specified.
 - .3 Contractor shall provide the City and Engineer a control key to permit removal of the interchangeable lock core.
 - .4 The City will provide all permanent cores and keys.

PART 3 - EXECUTION

3.1 Installation

- .1 Install door frames plumb, square, level at correct elevations and locations shown on the drawings.
- .2 Secure frame anchorages and connections to masonry and cast in place concrete to suit door frames and construction. Secure frames rigidly with minimum three anchors for each jamb for concrete and masonry walls.

- .3 Coordinate door frames with all other trades involved and affected by the work. Install as indicated on the drawings.
- .4 Brace frames rigidly while under construction. Remove temporary steel spreaders and replace with wooden spreaders and third heights of frame to maintain frame width. Provide vertical support for center of head.
- .5 Ensure structural loads are not transmitted to frames. Grout fill frames.
- .6 Touch up with primer where galvanized finish is damaged.
- .7 Prepare frame to receive prime and finish paint. Prime to be minimum 1.2 mils of inorganic zinc primer. See Section 09900.
- .8 Install hardware and test and adjust all doors for correct operation without binding.
- .9 Install astragals on exterior doors.
- .10 Install thresholds level by providing shims or a leveling compound where required.
- .11 Install all weather stripping to ensure an air tight seal is provided on exterior doors.

PART 1 - GENERAL

1.1 Work Included

- .1 The following items generally describe the work of this section.
 - .1 Painting of:
 - Pipe supports, clamps, fasteners, exposed metal;
 - Doors;
 - Ventilation ductwork;
 - All electrical or mechanical equipment requiring painting;
 - .2 Painting of electrical room interior concrete floors and walls.
 - .3 Painting masonry block surfaces.
 - .4 See Section 15452 for lining and coating requirements for fabricated piping and piping appurtenances.
 - .5 See Division 16 for finishes on electrical equipment.

1.2 Related Work

- | | | |
|----|-----------------------------|---------------|
| .1 | Metal Doors | Section 08100 |
| .2 | Metal Fabrications | Section 05500 |
| .4 | Piping and Mechanical Items | Section 15452 |
| .5 | Electrical | Division 16 |

1.3 Workmanship

- .1 Workmanship shall conform to Master Painters Association (MPA) of B.C. standards.

PART 2 - PRODUCTS

2.1 Materials

- .1 Paint materials for each coating formula to be products of a single manufacturer.
- .2 Interior Finishes:
 - .1 Formula 37: For metal doors and frames see Exterior finishes
- .3 Exterior Finishes:
 - .1 Formula 36: for primed metal ferrous surfaces apply
 - .1 One Coat Spot Primer CGSB 1-GP - 40M

- .2 One Coat lead primer CGSB 1-GP-140M
- .3 Two coats exterior enamel CGSB 1-GP-59M
- .2 Formula 37: for metal doors and frames
 - .1 One coat vinyl wash primer CGSB 1-GP-121M
 - .2 One coat steel primer CGSB 1-GP-40M
 - .3 Two coats exterior enamel CGSB 1-GP-59M

2.2 Concrete Floor Paint

- .1 Mills Paint: non slip marine plastic urethane enamel to City of Vancouver standard.
- .2 Colour: slate grey (confirm with City).

2.3 Interior Wall Paint

- .1 Mills Paint: marine plastic urethane enamel to City standard or as specified by the Engineer.
- .2 Colour: off white (confirm with City).

2.4 Masonry Paint

- a) Block to be painted:
 - .1 Elastomeric paint; colour to be approved by Owner;
 - .2 Surface preparation as per paint manufacturers recommendations.

PART 3 - EXECUTION

3.1 Preparation of Surfaces

- .1 Preparation of new metal surfaces:
 - .1 Clean surfaces of new metal to be painted by removing rust, loose mill scale, welding slag, dirt, oil, grease and other foreign substances in accordance with the following:
 - .1 Commercial blast cleaning: SSPC-SP-6
 - .2 Prepare new and existing concrete surfaces to CGSB 85-GP-31M and the following:
 - .1 Clean with water and detergent to clean and remove grease, oil, dirt or loose material.
 - .3 Do not apply paint until prepared surfaces have been accepted by the Engineer.

3.2 Mechanical Equipment

- .1 Paint all exposed metal equipment and all items that are not hot dip galvanized. Colours to be selected by Owner.

3.3 Protection of Metal Surfaces

- .1 Protect surfaces not to be painted and if damaged, clean and restore such surfaces as directed by the Engineer.
- .2 Apply primer, paint, or pre-treatment as soon as possible after surface has been cleaned and before deterioration of surface occurs.
- .3 Clean surfaces again if rusting occurs after completion of surface preparation.
- .4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of paint. Remove contaminants from surface and apply paint immediately.

3.4 Applying Paint

- .1 Apply paint by brushing, spraying or combination of both.
- .2 Where surface to be painted is not under cover, do not apply paint when:
 - .1 Air temperature is below 5 degrees C or when temperature is expected to drop to 0 degrees C before paint has dried.
 - .2 Temperature of surface is over 50 degrees C unless paint is specifically formulated for application at high temperatures.
 - .3 Fog or mist occur at site; it is raining or snowing; there is danger of rain or snow; relative humidity is above 85%.
 - .4 Surface to be painted is wet, damp or frosted.
 - .5 Previous coat is not dry.
- .3 Provide cover when paint must be applied in damp or cold weather. Protect, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions specified in 3.4.2. Protect until paint is dry or until weather conditions are suitable.
- .4 Remove paint from areas which have been exposed to freezing, excess humidity, rain, snow or condensation. Prepare surface again and repaint.
- .5 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.
- .6 Shop painting:
 - .1 Do shop painting after fabrication and before any damage to surface occurs

- from weather or other exposure.
- .2 Spray paint contact surfaces of field assembled, bolted, friction type joints with primer coat only. Do not brush primer after spraying.
- .3 Do not paint metal surfaces which will be embedded in concrete.
- .4 Paint metal surfaces to be in contact with wood with either full paint coats specified or three shop coats of specified primer.

- .7 Field touch-Up painting:
 - .1 Touch up metal which has been shop coated with same type of paint and to same thickness as shop coat. This touch-up to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts, and damaged or defective paint and rusted areas.
 - .2 Where painting does not meet with requirements of specifications, remove all defective paint, thoroughly clean affected surfaces and repaint in accordance with these specifications.

- .8 Handling painted metal.
 - .1 Do not handle painted metal until paint has dried, except for necessary handling for painting or stacking for drying.
 - .2 Scrape off and touch up paint which is damaged in handling, with same number of coats and kinds of paint as were previously applied to metal.

3.5 Applying Concrete Floor and Wall Paint

- .1 Prepare all concrete and wall surfaces to manufacturers recommendations prior to painting.
- .2 Apply primer coat or as directed by manufacturer.
- .3 Apply top coat as directed by manufacturer to provide specified film build.
- .4 Application shall be by spray equipment or by roller if approved by paint manufacturer as adequate to provide necessary film build.
- .5 Manufacturer's recommended curing and drying conditions shall be strictly adhered to.

3.6 Painting Masonry Block

- .1 Prepare all surfaces in accordance with manufacturers recommendations prior to application of elastomeric paint.
- .2 Apply paint in accordance with manufacturer's instructions.

END OF SECTION

PART 1 - GENERAL

1.1 Description

- .1 The work of this section includes the removal of four (4) existing pumping assemblies including motors and piping.
- .2 Shipping of two removed pumps for rebuilding.
- .3 Installation of two rebuilt and two new pumping assemblies and associated piping systems in the sewage pump station dry pit.
- .4 Scheduling of pump and pipe removals to ensure station operation is maintained as specified at all times.
- .5 Pumping equipment and valves are Owner Supplied to the extent specified.
- .6 See section 01105 for Owner Supplied equipment.
- .7 Other Contractor's will be installing new forcemains outside the Kitsilano pump station and will need to drain existing forcemains into the Kitsilano wet well. The Pump Station Contractor will co-operate and co-ordinate with the forcemain Contractor as required. The City and Engineer will provide guidance and assistance during draining and shutdown of any forcemains.

1.2 Work Included

- .1 The work of this section includes but is not limited to the items generally described following:
 - .1 The scheduled removal of all four (4) existing pumping equipment in the dry pit in accordance with the Contract drawings including shipping two of the four pumps to Smart Turner Pumps in Toronto for rebuilding. All shipping costs from the site to Toronto and return to the site of the rebuilt pumps are to be paid for by the Contractor and included in the tendered price. The costs for rebuilding pumps and supplying new pumps are paid for by the Owner as specified.
 - .2 The pump stools and suction elbows for the two rebuilt pumps are not being replaced and do not require removal. The pump stools and suction elbows for the two new pumps are being replaced and require removal for fitting of the new pump suction elbows and stools.
 - .3 The new pumps require fitting and grouting of new pump stools to match the existing suction and discharge piping.
 - .4 Co-ordination with Smart Turner pumps during the rebuilding of the two pumps specified for rebuilding and ensuring the timely delivery and return of the two rebuilt pumps to the pump station.
 - .5 Installation of new and rebuilt pumps (Owner Supplied pumps) in the pump station dry pit as indicated on the drawings and described in the specifications.

- .6 Supply and install new discharge piping in the pump station dry pit for all pumps as indicated on the drawings and described in the specifications.
- .7 Installation of new owner supplied pump discharge check and isolation plug valves. See section 01105 for Owner supplied equipment.
- .7 Detailed scheduling of the pump, piping and electrical installations to ensure the pump station is operational at all times. Pump station operational requirements are detailed in the Contract Documents.
- .8 Co-ordination with pump supplier (Smart Turner) and others for commissioning of pumping equipment. Site costs for Smart Turner will be paid for by the Owner except as specified.
- .9 Testing and commissioning of installed pumping equipment and related piping systems and related mechanical and electrical equipment and appurtenances in co-ordination with Division 15 and Division 16 specification requirements including co-ordination of equipment suppliers.
- .10 Coordination with others in implementing a PLC control program for pump operation (Consultant to provide and load PLC program).
- .11 Supply and installation of new steel piping discharge piping for all four new and rebuilt pumps complete with all related equipment as indicated on the drawings.
- .12 All piping cutting, fitting, welding and touch up of coatings required for the new discharge piping.
- .13 Coordination with Division 16 work to ensure all equipment is wired, connected and approved for start-up.
- .14 Supply and installation of all other mechanical items, equipment and components required or necessary to provide a complete working installation.
- .15 **Inspection of pump installations.** The pump supplier shall inspect the installation of all pumps and all related items prior to start up and confirm in writing that the assemblies have been installed in accordance with the pump supplier's recommendations.
- .16 **Certification from the pump supplier (Smart Turner) that the pumps have been correctly installed** by the Contractor and that all warranties are in effect prior to start-up.
- .17 **Start-up and commissioning services** to confirm correct operation of the new pumps over the specified speed range when operating on VFD'S and specified.
- .18 Testing and commissioning of all piping & pumping systems and all related mechanical and electrical equipment and appurtenances. Testing and commissioning to be in co-ordination with other Division 15 work and Division 16 electrical work.

1.2 Shop Drawings

- .1 Provide shop drawings for new pumps (Owner will supply) and discharge piping and all related mechanical equipment in the wet well and valve chamber room including valves, couplings, fittings, pipe supports, brackets, fasteners and other equipment.
- .2 Submit mill certificates for all carbon steel pressure piping showing mechanical and chemical properties and indicating compliance with steel pipe specification requirements.
- .3 Shop drawings to Section 01330.

1.3 Related Work

- | | | |
|----|-------------------|---------------|
| .1 | Metals | Section 05500 |
| .2 | Pumping Equipment | Section 15542 |
| .4 | Ventilation | Division 15 |
| .5 | Electrical | Division 16 |

1.4 Co-ordination with Forcemain Contractor

- .1 Co-ordinate and schedule operations with forcemain Contractor as required.

PART 2 - PRODUCTS

2.1 Carbon Steel Pipe and Fittings to 600 mm Nominal Diameter

- .1 All steel pipe shall be ASTM A53, ERW, Grade B or steel pipe with equivalent or better mechanical, chemical properties with the following wall thickness:
 - .1 100 mm to 250 mm diameter inclusive: schedule 40.
 - .2 300 mm diameter: standard weight, 0.375 inch wall.
 - .3 350 - 600 mm diameter: 0.375 inch wall thickness.
- .2 Steel butt weld fittings: Steel butt weld fittings shall be in accordance with ANSI B16.9 with wall thickness to match connecting pipe wall.
 - .1 Steel butt weld reducers as shown on the drawings.
- .3 Steel Pipe Flanges: Steel pipe flanges for steel fittings shall be forged carbon steel to ASTM A181, Grade II, Class 150.

- .4 Steel Pipe Flange faces: Flanges shall be flat face where connection is to flat face flanges and raised face where connection is to raised face flanges. Raised face flange facings shall be the same for connecting flanges.
- .5 Steel Plate: to CAN3-G40.21-92, Grade 300W.
- .6 Victaulic Couplings: Style 07

2.2 Sewage Pumps

- .1 See Section 01105 for Owner Supplied pumps.

2.4 Level Floats

- .1 Provide Flygt ENM-10 liquid level float switches, standard version complete with form-C contact, 10 m cable (minimum unless otherwise noted), strain relief connectors and cable weights for each float. Provide additional strain relief connector, Flygt Cat. No. 130598310 for each float switch.
- .2 See drawings for installation of floats in wet well.

2.5 Ultrasonic Level Sensing Equipment

- .1 Ultrasonic level monitors shall be Siemens unit as indicated on the drawings c/w XPS 15 transducer, submergence hood and extra cable.
- .2 Transducers shall be XPS 15 c/w submergence shield and adequate cable to reach explosion proof junction box, shall be mounted to manufacturer's specifications as shown on the drawings.
- .3 Level equipment rated Class 1 Zone 1.

2.6 Pipe Mounted Pump Discharge Pressure Transmitters

- .1 Pressure transmitters are required on the following applications:
 - .1 On the 12 inch diameter discharge header - one required as shown;
 - .2 On the 16 inch diameter discharge header - one required as shown;
- .2 All locations in the pump room area require a CSA electrical rating of Class 1, Zone 2.
- .3 Pressure transmitter shall be industrial grade transmitter with 4-20 ma output, factory calibrated for a specified spans, rated for 600 psi working pressure and

- operated from a 24 VDC power supply.
- .4 Zero, and span shall be field adjustable on-site using LCD display or Hart communicator. **Hart communications unit to be supplied with pressure transmitters.**
- .5 Transmitters shall be flush thread mounted as detailed in the Contract Drawings.
- .6 Transmitters shall have:
 - .1 -15 psi to 100 psi range;
 - .2 0.2% accuracy of specified range;
 - .3 4-20ma output;
 - .4 316 stainless construction including process connections, ceramic diaphragm; diaphragm seal
 - .5 Stainless steel brackets and stainless steel bolts for pipe mounting;
 - .6 LCD display meter, linear, -15psi to 100 psi, user scalable integral with transmitter;
 - .7 Factory calibrated for spans shown in span table.
- .7 Shop drawings and complete product data are required for all pressure transmitters.
- .8 Unit assembly
 - .1 Transmitters shall be factory spanned and calibrated for the specified pressure spans within the specified pressure range of the transmitter and shall be factory certified and tagged to confirm the span and range of the transmitter.
- .9 Span Table for Pressure Transmitters:

Location	Install On	Calibrated Span	CSA rating	No.s of Units
Pump Room	12 inch header On Sewage pump	-15 psi to + 100 psi	Class 1 Zone 2	1
Pump Room	18 inch header On Sewage pump	-15 psi to + 100 psi	Class 1 Zone 2	1

- .1 Confirm spans prior to ordering.
 - .2 Transmitters shall be spanned for **4 - 20ma output over the specified span** (or as instructed by the Engineer. Confirm all spans prior to ordering).
- .10 Contractor to confirm model number with options & submit product data for review by Engineer prior to ordering.
- .11 Acceptable models:
 - .1 Endress and Hauser - PMC 45 1 ½ inch MNPT flush thread mount with integral LCD;
 - .2 Approved equal.

2.7 Submersible Pressure Transmitters

2.7.1 Description

- .1 Pressure transmitters shall be submersible 2 wire DC excited (4-20ma output) units specifically designed for level measurements in groundwater wells and shall use piezoresistive machined silicon strain gauge with atmospheric vent to provide pressure compensation.
- .2 Pressure transmitters shall be constructed of materials suitable for use in raw sewage and corrosive environments.
- .3 Pressure transmitters shall be vented to atmosphere using a dedicated atmospheric vent tube connecting to a desiccant chamber.
- .4 Transmitter and cable shall be waterproof and fitted with strain relieve.
- .5 Transmitter cable shall terminate in a junction box fitted with dessicant.

2.7.2 Materials of Construction

1. Materials of construction of pressure transmitters shall be as follows:
 - .1 Body: titanium.
 - .2 Measurement diaphragm: flush coated elastomeric
 - .3 Cable: Polyurethane with integral strain relieve to prevent signal cable damage or elongation and rated for 100 lb load;
 - .4 Internally potted, with molded cable.

2.7.3 Measuring Range and Output Accuracy

1. Pressure transmitters shall be calibrated for a liquid water depth range of 0 to 10 meters.
2. Combined non linearity, hysteresis, and repeatability shall be within +/- 0.25% of full scale.
3. Long term stability: Less than +/- 0.1% full scale.
4. Zero offset and span setting: +/- 0.25% of FS
5. Temperature effects: +/- 0.3% full scale maximum. Temperature compensated.
6. Over-pressure: not less than four times measuring range.
7. Burst pressure: not less than six times measuring range.

2.7.4 Electrical Requirements

1. Power Supply: 9 - 32 VDC.

2.7.5 Transmitter Output Requirements

1. Output Signal:
 - .1 4-20 ma 2 - wire , loop powered;
 - .2 Output to be factory scaled such that 4 ma = lower range value and 20 ma = upper range value;
 - .3 Transmitter suitable for 300 meter distance from 24VDC power supply over twisted, shielded, armored 16 AWG cable.

2.7.6 Dimensions

1. Diameter not to exceed (½) one half the inside diameter of mounting dip tube as indicated.
2. Fitted with 60 feet of cable.

2.7.7 Accessories

1. Sensor termination enclosure with desiccant or approved bellows.

2.7.8 Approvals

1. Assembly shall be CSA approved for use in Class 1 Zone 1 areas.
2. CE marked.
3. Waterproof to NEMA 6 (IP 68).

2.7.9 Location

1. Install one in each wet well as level backup to ultrasonic units.
2. Units are 4-20ma transmitter which connect to the station PLC.

2.7.10 Standard of Acceptance

1. Druck PTX 1290;

2.8 Compound Pressure Gauge Assemblies

- .1 Pressure gauges shall be liquid filled, 85 mm diameter size, 0.5% accuracy to ANSI/ASME B40.1, grade 2A, with black phenolic case. Gauge calibration shall be -14.7 psi to 100 psi.
- .2 MA Stewart G2 stainless steel ball valves shall be used for gauge isolation.
- .3 All pipe and fittings in the gauge assemblies to be brass.
- .4 Gauge spans shall be confirmed with the Engineer prior to ordering.

- .5 Gauges to be Ashcroft Duragauge or equivalent Wika or approved equal and fitted with diaphragm seal.

2.9 Magnetic Flow Meters and Remote Converters

- .1 Two magnetic flow tubes are being installed on the forcemains outside the station by others. The flow tubes have remote transmitters which are to be installed, wired and connected **in the pump station under this contract**.
- .2 The Remote converters/transmitters will be supplied to the contractor by either the forcemain contractor, or by the City (along with technical documentation) at not cost to the Contractor.
- .3 The Contractor shall be responsible for mounting, installation, wiring and commissioning of the whole flowmeter assembly as shown and indicated on the drawings.

2.10 Grout for Pipe Supports and Piping Inserts

- .1 Grout for base elbow and pipe supports shall be a high strength non shrink grout as detailed on the drawings. All grout shall be Masterflow 928.

2.11 Pipe Linings and Coatings for Carbon Steel Pipe and Related Items

- .1 Pipe linings and coatings for steel pipe shall be shop applied following fabrication and all welding.
- .2 All steel pipe, fittings, flanges, couplings, fasteners and all attached accessories shall be coated and lined to pipe standards except where noted otherwise.
- .3 Pipe linings and coatings shall conform in all respects with the following AWWA standard:
 - a) AWWA C210 - 84: "Liquid epoxy coating systems for the interior and exterior of steel water pipelines."
 - b) Colour: green (confirm with Owner).
 - c) Top coat: two coats urethane to match existing colour or colour as specified by Owner.
- .4 The supplier will be required to provide certification that the lining and coating material meets the required specification and that the application contractor is a qualified AWWA applicator and has proper facilities.

- .5 Acceptable Products:
 - .1 Interior pipe linings: ICI Devoe - Bar Rust 236 or approved equal with black colour;
 - .2 Exterior pipe coatings: ICI Devoe - Bar Rust 236 or approved equal;
 - .3 Exterior pipe top coat: ICI Devoe - Devthane 379 or approved (confirm colour with Owner).
 - .4 Coatings and linings do not require NSF 61 approval.
- .6 Fabricated metal items shall also be coated using same products (and colour) used for pipe coatings. See Section 05500 and 09900.

2.12 Bolts & Nuts for Joining Steel and Non Stainless Components

- .1 Where supplied as an integral part of manufactured products including: couplings, joint restraint assemblies and similar items:
 - .1 Bolts and nuts to be high strength low alloy steel to AWWA C111.
 - .2 All bolts and nuts shall have hexagonal heads and shall be zinc coated. Bolts shall not protrude more than 1/2 inch through nuts.
- .2 Low Strength Bolts and Nuts for use in joining mechanical components including flanges and similar products not covered under manufactured products (to be used unless otherwise specified):
 - .1 Bolts to be carbon steel, Grade B to ASTM A307, heavy hex style, hot dip galvanized to ASTM A153, zinc plated to ASTM B633 or cadmium plated to ASTM B766. Bolt sizes to AWWA C110.
 - .2 Nuts and Washers: Nuts to be heavy hex carbon steel, to ASTM A563 Grade A, Washers to be flat hardened steel to ASTM F436. Nuts and washers to be zinc plated to ASTM B633 or cadmium plated to ASTM B766.
- .3 Field paint all nuts and bolts after installation using same paint materials used for pipe coatings.

2.13 Bolts & Nuts for Joining Stainless Steel to Non Stainless

- .1 Bolts to be B8M, 316L stainless steel to ASTM A 193.
- .2 Nuts and washers to ASTM A 194 8M or approved equal 316 material grade bolt.

2.14 Flange Gaskets

- .1 Flange gaskets for flat face flanges shall be full face type, manufactured from black natural rubber with a layer of cotton on both sides.

2.15 Pipe Supports and Brackets

- .1 Pipe supports and brackets shall be provided as shown on the drawings.
- .2 All pipe supports and brackets shall be hot dip galvanized or painted using same materials and requirements as pipe coatings.
- .3 Pipe supports shall be installed using approved procedures for:
 - .1 grouting;
 - .2 leveling and setting of pipe supports;
 - .3 snugging up of pipe support to induce small amount of compression into support and then using wedges to maintain setting until anchor bolts and anchor bolt inserts are installed.
 - .4 installation of anchor bolts and inserts.

PART 3 - EXECUTION

3.1 General

- .1 Prior to all work in this section, the Contractor shall become thoroughly familiar with the site and all portions of the work within this section and other related sections, including electrical work.

3.2 Piping Layout and Installation

- .1 Fabricate all pipe systems as detailed on the drawings.
- .2 Welding shall be performed only by qualified companies and welders certified under CSA Specification W47.1 for the type of welding to be employed during the work.
- .3 All piping shall be fabricated, welded, assembled, examined, inspected and tested in accordance with the requirements of ANSI/ASME code for pressure piping 31.3.
- .4 The Contractor shall be responsible for taking accurate measurements in the pump station to ensure accurate fabrication and exact fit of all piping and closure pieces required for the pump station piping and pipe specials. Piping fabrication shall involve both shop and field work with pipe closure pieces field fit with final fabrication in the shop to ensure proper fit and alignment of all piping closures.
- .5 Discharge piping for the station pumps shall not be finish bolted to the pump discharge head flange until discharge head and motor have been installed and the alignment and fit of pump components has been checked and approved by the pump supplier to ensure no residual stresses are induced in the pump or attached piping systems.
- .6 Pump discharge piping shall connect to pump discharge elbow with correct alignment without displacement or torque on piping or pump and with no residual stresses induced in the pump or attached piping systems.

3.3 Steel Pipe Welds

- .1 Unless otherwise approved, all steel pipe welds shall be full penetration butt welds and shall be used for pipe to pipe joint welds, pipe to component welds.

- .2 Unless otherwise approved all welds shall be shop welds.
- .3 Steel pipe supplied by the contractor shall be provided with bevel ends suitable for butt welding.
- .4 All steel pipe, fittings and other components shall have butt ends in conformance with the requirements of Section 7 of CSA Z662-94.
- .5 Coatings and linings systems shall be installed on all welded joints in accordance with the requirements of the specifications.

3.4 Pipe Welding Procedures and Qualifications

- .1 Prior to any shop production welding of steel pipe, the Contractor shall have all welding procedure specifications established, qualified and approved by the Engineer in accordance with the requirements of these specifications.

3.5 Pipe Shop Welding

- .1 All welds shall be shop welds unless otherwise approved by the Engineer. Field welds shall not be carried out unless approved by the Engineer.
- .2 All pipe welds shall be in full compliance with WCB health and safety regulations.
- .3 Where steel pipe has been previously shop coated and is required to be field or shop cut and welded (if approved by the Engineer), existing pipe coatings and linings shall be removed from the interior and exterior of the pipe for the distance required for proper welding procedures and to eliminate damage to the existing coatings and linings systems.
- .4 Coatings and linings systems shall be installed on all welded joints in accordance with the requirements of the specifications.
- .5 All shop welds shall be non-destructively examined by the a qualified testing agency retained by the Contractor for imperfections and defects to determine their acceptability in accordance with these specifications. The Owner may retain a testing agency for independent testing.
- .6 All welds which do not meet the acceptance criteria of these specifications shall be considered defective.

- .7 Defective welds shall be repaired in accordance with AWWA C200 and AWWA C208 if such defective welds are considered repairable by the Engineer. Welds shall be repaired only after receiving approval from the Engineer.

3.6 Welding Inspection and Testing

- .1 All welds including full and partial length pipe sections, specials, mitre bends, bends, fittings shall be examined by the Contractor's testing agency by radiographic or other approved methods to confirm the adequacy of the weld.
- .2 The Owner may also retain an independent testing agency for welding inspections in which case the Contractor shall schedule and arrange for the Owners' testing agency to conduct all welding tests, inspections required under these specifications and as necessary for completion of the work

3.7 Installation of Pumping Equipment:

- .1 Install pumping equipment in accordance with the manufacturers recommendations, data sheets, drawings or applicable shop drawings.
- .2 Support, anchor and brace all pumping, piping and assemblies adequately and securely as shown on the drawings and/or directed by the Engineer.
- .3 Clean all flanges, gaskets and other connection fittings.
- .4 Do not fix piping assembly in place until all components are properly aligned and installed.
- .5 Piping assemblies shall permit normal pipe contraction and expansion without undue strain on any portion.
- .6 Ensure no foreign material is left in piping runs.
- .7 Use approved methods for grouting between discharge elbow and floor and ensure pump and discharge elbow is level and free of distortion or unbalanced forces prior to grouting.
- .8 Install, fit and grout all pipe supports to same standards and procedures as pumps.
- .9 Touch up shop or field applied paint any surfaces damaged during installation

or other work activities.

3.8 Pump Operating Requirements

- .1 The new pumps will be operated on VFD`s and may operate on PID wet well level loops or on specified wet well levels.
- .2 **Pump operating requirements and a description of operations will be confirmed by the Engineer prior to testing and commissioning including written instructions on level settings and required pump discharge rates for the new pumps.**

3.9 Application of Pipe Linings and Coatings (and for other specified metal items)

- .1 Surface preparation shall be to SSPC SP 10 or as recommended by the lining manufacturer or required by AWWA standards or NSF requirements for potable water use.
- .2 The lining and coating material shall be applied in strict accordance with the manufacturer's recommendations. Final DFT thickness of cured linings and coatings shall not be less than 18 mils as determined by shop inspection.
- .3 Linings and coatings shall be heat cured.
- .4 Linings and coatings shall be tested for imperfections as specified by the governing AWWA specifications. Any deficiencies found shall be repaired to specification requirements.
- .5 Linings and coatings shall be applied after all shop welding for the pipe mitres has been completed. Top coat to be applied after coatings have cured and colour specified by the Owner.
- .6 Field application of linings and coatings will not be permitted except for field touch-up of damaged surfaces or as directed by the Engineer.

3.10 Pressure Testing of Piping Systems

- .1 All station piping and/or piping assemblies including pipe spools, valves, flanges, gaskets and related appurtenances shall be pressure tested to 100 psi water pressure.

- .2 The pipe assembly will be deemed to have passed the pressure test when the pipe under test pressure maintains the 100 psi pressure without drop for a 1 hour period and does not require any make-up water to return the pressure to 100 psi.
- .3 Should the piping assembly fail to meet the pressure test requirements, the pipe shall be repaired where leakage may be occurring and then retested. This procedure shall be repeated until the pressure test requirements are met.
- .4 Co-ordinate pipe and valve equipment test with other Division 15 and Division 16.

3.11 Flushing of Piping Systems

- .1 Pump station piping and components shall be flushed in accordance with instructions from the Engineer.

3.12 Testing and Commissioning of Pumping Systems

- .1 Following all mechanical and electrical work the Contractor shall carry out adequate testing and commissioning of all installed components to adequately confirm satisfactory and correct operation of all components over a range of operating conditions. The Engineer will assist the Contractor in setting up the testing and commissioning activities but the Contractor will be responsible for carrying out all activities.
- .2 Testing of pumping systems shall be done jointly with the testing of electrical power and control systems.
- .3 Mechanical and Electrical Components to be tested include:
 - .1 Piping systems including couplings and spool pieces.
 - .2 Existing level sensor, gauges and switches which may have been disturbed during construction.
 - .3 All electrical power and control systems
 - .4 VFD's
- .4 Testing of pump start/stop and alarm points to confirm the correct operation and sequence of operations of the pumping system under normal and alarm conditions including:
 - .1 Start levels
 - .2 Stop levels
 - .3 High level alarms.
 - .4 Low level alarms.
 - .5 VFD operating levels

- .6 PID parameters and set points
- .5 The Contractor shall arrange and pay for the onsite services for equipment suppliers including pumps, VFD'S (see division 16), flow meter, pressure transmitter. Onsite service of up to (1 ½) one and one half days for each supplier shall be provided by the Contractor as well as any additional time required to correct any deficiencies.
- .6 Any test items which overlap with the district work, shall be tested jointly with both present.

3.13 Test Reports

- .1 The Contractor shall prepare a test report based on the testing and commissioning work at the site and shall include all calibration calculations, all set points and observed readings.
- .2 The test reports shall include confirmation of manufacturers and suppliers recommended procedures for installation, testing and calibration. The following data shall also be provided:
 - .1 Pump flows;
 - .2 Discharge pressures;
 - .3 Liquid levels in wet wells;
 - .4 VFD speeds to obtain required flows;
 - .5 PID parameters;
 - .6 Other information requested by the Engineer.
- .3 Test report data shall be included in the Operations and Maintenance Manuals.

PART 1 - GENERAL

1.1 Description

- .1 The work of this section includes the supply, installation, testing, calibration and commissioning of installation of instruments in the sewage pump room a wet well area only including:
 - .1 Flow meter converters (Owner Supplied);
 - .2 Pressure transmitters;
 - .3 Pressure gauges;
 - .4 Level sensing equipment;
 - .5 Related items and accessories.
- .2 Other instrumentation equipment may also be installed in the pump station and is not included in this specification. Refer to other sections for instrumentation not included in this specification but required for installation by the contract documents.

1.2 Work Included

- .1 The work of this section includes but is not limited to the items generally described following:
 - .1 Supply, installation, testing, calibration and complete commissioning of the equipment specified in this section and to be installed in the sewage pump station and as noted on the drawings.
 - .2 Coordination with pumping equipment installations in the Pump Room and Wet Well Area. See Section 15542.
 - .3 Coordination with Division 16 work to ensure all equipment is wired, connected and tested.
 - .4 Supply and installation of all other mechanical items, equipment and components required or necessary to provide a complete working installation.
 - .5 Testing and commissioning to be in co-ordination with other related work including Division 15 mechanical work and Division 16 electrical work.

1.3 Shop Drawings

- .1 Provide shop drawings for all equipment covered in this section.
- .2 Submit detailed manufacturers technical literature and specifications for all equipment including installation and testing recommendations.

- .3 Shop drawings to Section 01330 Requirements.
- 1.4 Related Work

- .1 Pumping Equipment Section 15542
- .2 Mechanical Equipment Division 15
- .3 Electrical Equipment Division 16

PART 2 - PRODUCTS

2.1 Level Floats for Sump Pumps and High Level Alarms in Wet Wells

- .1 Provide Flygt ENM-10 liquid level float switches, standard version complete with form-C contact, 20 m cable (minimum unless otherwise noted), strain relief connector and cable weight. Provide additional strain relief connector, Flygt Cat. No. 130598310 for each float switch.
- .2 See drawings for location and installation details of floats.

2.2 Ultrasonic Level Sensing Equipment

- .1 Ultrasonic level equipment shall be Siemens Sitrans LUC500 level controller complete with XPS-15 transducers, submergence hood and extra cable. Available from E.B. Horsman or Siemens Canada as shown on the Contract Drawings.
- .2 Transducers shall be XPS-15 c/w submergence shield and adequate cable to reach explosion proof junction box, shall be mounted to manufacturer's specifications as shown on the drawings. Rated for Class 1 Zone 1 areas.
- .3 See Drawings for mounting locations of level controller and transducers.

2.3 Pipe Mounted Discharge Pressure Transmitters

- .1 Pressure transmitters are required on the following applications:
 - .1 Discharge header for the 12 inch diameter header - one required;
 - .2 Discharge header for the 16 inch diameter header - one required;
- .2 Each location requires a specified pressure span;
- .3 Pressure transmitter shall be industrial grade transmitter with 4-20 mA output, factory calibrated for a specified spans, rated for 600 psi working pressure and operated from a 24 VDC power supply.
- .6 Zero, and span shall be field adjustable on-site using LCD display or Hart communicator. **Hart communications unit to be supplied with pressure transmitters.**
- .7 Transmitters shall be flush thread mounted as detailed in the Contract

- Drawings.
- .8 Transmitters shall have:
 - .1 be spanned **-15 psi to +100 psi**;
 - .2 0.2% accuracy of specified range;
 - .3 4-20mA output;
 - .4 316 stainless construction including process connections, ceramic diaphragm;
 - .5 Stainless steel brackets and stainless steel bolts for pipe mounting;
 - .6 **LCD display meter, linear, -15 -100 psi, user scalable integral with transmitter**;
 - .7 Factory calibrated for spans shown in span table.
 - .9 Shop drawings and complete product data are required for all pressure transmitters.
 - .10 Unit assembly
 - .1 Transmitters shall be factory spanned and calibrated for the specified pressure spans within the specified pressure range of the transmitter and shall be factory certified and tagged to confirm the span and range of the transmitter.
 - .11 Span Table for Pressure Transmitters:

Location	Install On	Calibrated Span	CSA rating	No. of Units
Pump Room	12 inch header	-15 psi to + 100 psi	Not rated	1
Pump Room	16 inch header	-15 psi to + 100 psi	Not rated	1

- .1 Confirm spans prior to ordering.
 - .2 Transmitters shall be spanned for **4 - 20mA output over the specified span** (or as instructed by the Engineer. Confirm all spans prior to ordering).
- .12 Contractor to confirm model number with options & submit product data for review by Engineer prior to ordering.
- .13 Acceptable models:
 - .1 Endress and Hauser - PMC 45 1 ½ inch MNPT flush thread mount with integral LCD;
 - .2 Approved equal.

2.4 Submersible Pressure Transmitters in Wet Wells

2.4.1 Description

- .1 Pressure transmitters shall be submersible 2 wire DC excited (4-20mA

output) units specifically designed for level measurements in groundwater wells and shall use piezoresistive machined silicon strain gauge with atmospheric vent to provide pressure compensation.

- .2 Pressure transmitters shall be constructed of materials suitable for use in raw sewage and corrosive environments.
- .3 Pressure transmitters shall be vented to atmosphere using a dedicated atmospheric vent tube connecting to a desiccant chamber.
- .4 Transmitter and cable shall be waterproof and fitted with strain relieve.
- .5 Transmitter cable shall terminate in a junction box fitted with desiccant.

2.4.2 Materials of Construction

1. Materials of construction of pressure transmitters shall be as follows:
 - .1 Body: titanium.
 - .2 Measurement diaphragm: flush coated elastomeric
 - .3 Cable: Polyurethane with integral strain relief to prevent signal cable damage or elongation and rated for 100 lb load;
 - .4 Internally potted, with molded cable.

2.4.3 Measuring Range and Output Accuracy

1. Pressure transmitters shall be calibrated for a liquid water depth range of 0 to 10 meters.
2. Combined non linearity, hysteresis, and repeatability shall be within +/- 0.25% of full scale.
3. Long term stability: Less than +/- 0.1% full scale.
4. Zero offset and span setting: +/- 0.25% of FS
5. Temperature effects: +/- 0.3% full scale maximum. Temperature compensated.
6. Over-pressure: not less than four times measuring range.
7. Burst pressure: not less than six times measuring range.

2.4.4 Electrical Requirements

1. Power Supply: 9 - 32 VDC.

2.4.5 Transmitter Output Requirements

1. Output Signal:
 - .1 4-20 mA 2 - wire, loop powered;
 - .2 Output to be factory scaled such that 4 mA = lower range value and 20 mA = upper range value;

- .3 Transmitter suitable for 300 meter distance from 24VDC power supply over twisted, shielded, armored 16 AWG cable.

2.4.6 Dimensions

1. Diameter not to exceed (½) one half the inside diameter of mounting dip tube as indicated.
2. Fitted with 60 feet of cable.

2.4.7 Accessories

1. Sensor termination enclosure with desiccant or approved bellows.

2.4.8 Approvals

1. Assembly shall be CSA approved for use in Class 1 Zone 1 areas.
2. CE marked.
3. Waterproof to NEMA 6 (IP 68).

2.4.9 Location

- .1 Install one in each wet well as level backup to ultrasonic units.
- .2 Units are 4-20mA transmitter which connect to the station PLC.

2.4.10 Standard of Acceptance

1. GE/Druck PTX 1290;

2.5 Pressure Gauge Assemblies for Piping

- .1 Pressure gauges shall be liquid filled, 64 mm diameter size, 0.5% accuracy to ANSI/ASME B40.1, grade 2A, with black phenolic case. Gauge calibration shall be 0-100 psi.
- .2 MA Stewart G2 stainless steel ball valves shall be used for gauge isolation.
- .3 All pipe and fittings in the gauge assemblies to be brass.
- .4 Gauge spans shall be confirmed with the Engineer prior to ordering.
- .5 Gauges to be Ashcroft Duragauge or approved equal.

2.6 Magnetic Flow Meter Converters - Owner Supplied

- .1 Magnetic flow tubes will be installed on two forcemains outside the pump station by others. Wiring from the flow tubes will extend back to and into the pump station as shown on the drawings also by others.
- .2 The Contractor will install the Owner Supplied flow converters for the flow tubes and connect the wiring to the flow converters and to the control panel as shown on the drawings and all other associated work in the pump station required to operate the flow meters.
- .3 Details on the flow meter assemblies will be provided to the Contractor as well as required flow spans.
- .4 The Contractor shall span the flow meters in accordance with the flow spans provided by the Owner or Engineer.
- .5 Power supply: 120VAC.
- .6 Flow meter transmitters shall provide a 4-20mA flow signal to the electrical room PLC.

PART 3 - EXECUTION

3.1 General

- .1 Prior to all work in this section, the Contractor shall become thoroughly familiar with the site and all portions of the work within this section and other related sections, including related civil, mechanical and electrical work.
- .2 The Contractor shall ensure a qualified representative from each equipment supplier is onsite to confirm the correct installation, calibration and overall operation of the equipment supplied. The equipment representative shall inspect the installation, check the spans, operating parameters, wiring and all other related items and confirm in writing that all equipment supplied by the specific supplier has been installed and configured in accordance with the manufacturers recommendations and is operating correctly.
- .3 Equipment suppliers shall also be onsite during start up and testing to confirm that all instruments are operating correctly and as required under operating conditions.

3.2 Installation of Pressure Transmitters, switches and Gauges

- .1 Install all pressure transmitters, and pressure gauges as indicated on the drawings.
- .2 Prior to installation ensure all gauges are of proper range and transmitters are calibrated with 4-20mA output corresponding to specified spans.
- .3 Ensure all pressure instruments are operating correctly by field testing. If any pressure instruments are found to be operating incorrectly as determined by testing, replace instruments with new units or repair if approved by the Engineer.

3.3 Float Switches

- .1 Mount float switches for float actuation at levels indicated on the drawings.
- .2 Ensure that floats are suspended clear from walls or other surfaces to prevent the floats from jamming against these as the floats tilt during operation. Low level floats shall be carefully secured and 2 cable weights installed to minimize movement of the floats.

3.3 Ultrasonic level Sensing Equipment

- .1 Install ultrasonic level sensing equipment (controllers and transducers) in accordance with manufacturers instructions and recommendations.
- .2 Wire and connect equipment in co-ordination with Division 16.
- .3 Program level sensing equipment as instructed by the Engineer and provide services of equipment supplier for checking and commissioning.
- .4 Carry out all adjustments, calibration and programming necessary for correct operation of equipment.

3.4 Installation of Two (2) Owner Supplied Flow Meter Converters

- .1 Install two (2) Owner supplied flow meter converter assemblies as indicated on the drawings. Ensure manufacturer's field representative is present to assist with this phase of the work.
- .2 Prior to installation ensure all gauges are of proper range and transmitters are calibrated with 4-20mA output corresponding to specified spans.

1. **GENERAL**

1.1 Execute all work and furnish all products as specified herein and in accordance with the contract documents.

1.2 **Work Included**

- .1 Electric heaters
- .2 Fans

2. **PRODUCTS**

2.1 **Fans**

- .1 Provide fans as shown on the drawings
- .2 Use neoprene vibration isolators when supporting fan from structure.
- .3 Paint all wall caps to match exterior wall.
- .4 Provide flexible duct connections.
- .5 Install fans in accordance with manufacturer's instructions.

2.2 **Electric Heaters**

- .1 Provide electric heaters as shown on the drawings.

3. **EXECUTION**

3.1 **General**

- .1 Install all equipment in accordance with the manufacturer's recommendations.
- .2 Ensure that installed equipment is not subject to any undue stress or strain.
- .3 Check that all equipment is vibration free, and where necessary adjust equipment or supports to ensure that equipment is quiet in operation and / or provide external vibration isolators, if necessary, so that no vibration is transmitted to the building structure.
- .4 Adequately protect all finished work, and make good, without cost any damage caused during the execution of the works prior to acceptance.

3.2 **Miscellaneous Metal**

- .1 Provide and install all miscellaneous metalwork associated with this section of the works. This includes steel and angle iron supports required for air handling equipment.

END OF SECTION

1. GENERAL

1.1 General

- .1 Execute all work and furnish all products as specified herein and in accordance with the contract documents.
- .2 The general intent is to furnish ductwork in accordance with the recommendations of the current ASHRAE guide unless otherwise noted herein.

1.2 Work Included

- .1 Ductwork and all accessories.
- .2 Air outlets.

1.3 Quality Assurance

- .1 Ductwork shall be in accordance with the requirements of NFPA 90A.
- .2 Fabricate ductwork in accordance with SMACNA standards and ASHRAE handbooks.

1.4 Seismic Restraints

- .1 Provide earthquake restraining devices for resiliently mounted equipment, where indicated.
- .2 Provide flexible connections for all ductwork connections to fans on plenums.
- .3 Provide flexible conduit connections for all electrical connections to isolated equipment.
- .4 All seismic restraints shall be designed for a Post Disaster importance factor.
- .5 All attachment points and fasteners shall be capable of withstanding a load of three times the sized capacity of the seismic restraint.
- .6 Slack cables shall be sized to withstand the calculated earthquake loading on the isolated equipment, with a safety margin of 4. Slack cable restraint systems shall be Vibron, Mason, or other approved.

2. PRODUCTS

2.1 Ductwork

- .1 Rectangular and round low velocity, low pressure ductwork, unless specifically noted otherwise, is made from ASTM designation A527-67 steel with 1-1/4 oz. zinc coating. Galvanizing quality must allow the sheets to be bent flat upon themselves with no fracture to the coating or base metal.
- .2 Provide round ductwork in 3.5 metre lengths to minimize joints.

- .3 Fabricate all ductwork in accordance with SMACNA Duct Construction Standards to suit the application and pressure developed.

2.2 Volume Dampers

- .1 Provide volume dampers in the specified locations and where required to facilitate air system balance.
- .2 Volume Dampers Description for Ducts Over 200 mm
 - .1 Opposed multi-blade design, for squeeze action unless noted otherwise.
 - .2 Mechanism with friction lock wide pitched screw.
 - .3 Hardware to be as follows riveted to the duct and dampers:

<u>Duct Type</u>	<u>Dial Regulator</u>
Uninsulated	Ventlock #635
Insulated	Ventlock #637

Mark all damper rods with end slots to indicate damper position.

2.3 Grilles, Registers and Diffusers

- .1 Furnish grilles, registers and diffusers as shown on the drawings and with frames suitable for the application. All equipment with a baked enamel finish in finished areas or anodized aluminum in other areas.

2.4 Intake and Exhaust Louvres

- .1 Provide extruded aluminum louvres as shown and specified on the drawings.
- .2 Louvres shall be fabricated from extruded aluminum and painted with a baked enamel finish with colour as selected by the Owner.
- .3 Provide 12 mm mesh birdscreen behind the louvre.
- .4 Louvres to be Airolite K6776.

2.6 Control Dampers

- .1 Provide opposed blade control dampers where shown on the drawings Only use parallel blade dampers where indicated.
- .2 Damper blades to be of galvanized steel or extruded aluminum, adequately stiffened and provided with stainless steel shafts with oil impregnated sintered bronze bearings. Outdoor air and exhaust air dampers to be low leakage type with continuous neoprene edge stops and seals on all sides. Dampers to be Ruskin CD60 or other approved.

2.7 Backdraft Dampers

- .1 Provide backdraft dampers where shown on the drawings.

- .2 Damper blades to be of galvanized steel or extruded aluminum, adequately stiffened and provided with stainless steel shafts with oil impregnated sintered bronze bearings. Outdoor air and exhaust air dampers to be low leakage type with continuous neoprene edge stops and seals on all sides. Dampers to be Ruskin CD60 or other approved.

3. EXECUTION

3.1 Ductwork

- .1 Route and run ducts approximately as diagrammatically shown. Report all deviations to the Engineer for approval before proceeding. Carefully co-ordinate installation of exposed ductwork with other services.
- .2 Insofar as possible, construct the ducts in accordance with the dimensions shown on the drawings. Where necessitated by building construction, alter the dimensions maintaining the same equivalent size. Size ducts from ASHRAE table of equivalent rectangular and round ducts, latest edition.
- .3 Use a centreline radius not less than 1-1/2 times the width of the duct in the plane of rotation of the radius for all bends, tees and elbows unless dimensioned otherwise. Where this radius is not possible, fit formed airfoil blade duct-turns of approved design in low velocity ductwork. Obtain approval from the Consultant before using splitters or radii larger than 1-1/2 duct width.
- .4 Construct transitions with maximum expansion angles of 30 degrees and maximum contraction angles of 45 degrees.
- .5 Construct collars between ducts and diffusers with length equal to or greater than the diffuser neck diameter. All grilles, dampers and diffuser accessories are the same manufacturer as the diffusers.
- .6 Make straight collars between the supply ducts and grilles not less than 300 mm in length and provide individual adjustable blade type distribution grids at the connection. Provide suitable cushion heads at the end of the low pressure ducts.
- .7 Duct dimensions shown are required clear inside dimensions. Where internal insulation is used, increase sheet metal dimensions by the thickness of the insulation maintaining the net dimensions shown.
- .8 Support vertical ducts where they pass through the floor using angles, riveted and/or bolted to the duct, bearing on the structure with rubber pads. In addition, where required seal all openings around ducts and pipes with sheet metal of sufficiently heavy gauge to constitute a fire, noise and smoke separation. The separation must have a rating to match the rating of the barrier through which the ducts and pipes are passing. Use galvanized clamps drawn tight to support round ductwork at the floors, bearing on the structure with rubber pads. On exposed ductwork, provide galvanized angle collars to conceal the above construction both above and below the floor.
- .9 Leave a smooth interior surface on all seams and joints. Break the corners and groove the longitudinal seams using Pittsburgh lock, button or lock slide or double seam corners. Bolt all bracing with backing plates. Do not use aluminum pop rivets.

- .10 Construct ductwork in accordance with SMACNA standards.
- .11 Fittings are of the slip joint type with all 90 degree elbows of the fabricated 5 piece type or miter elbows where shown on drawings. No crimping of the fittings is allowed. Lap all joints in the direction of air flow wherever possible and make them smooth on the inside. Stagger lockseam joints at least 90 degrees. Seal all joints with solder or a woven fabric material coated with a water based sealant which shall be non-toxic, non-combustible and non-flammable in a wet or dry state tested in accordance with ULC S-102. Flame spread not to exceed 25, and smoke developed not to exceed 50. Apply sealer to inside of joints on ducts and plenums under positive pressure where accessible and to outside of joints on ducts and plenums under negative pressure.
- .12 Provide and mount flexible connections in ductwork connecting to fans and equipment. Construct coupling with Duro-Dyne grip-loc 6" wide flame resistant, neoprene coated heavy glass fabric, having a weight of 0.27 lb/ft², in accordance with the requirements of NFPA bulletins #90A (1978).
- .13 Do not leave pockets, ledges or projections inside the ducts. Remove all dirt, rubbish, duct accumulation of any description from the ductwork during erection. Block all duct openings immediately to prevent the entrance of construction dirt and materials.
- .14 Seal all low velocity ductwork with Duro-Dyne S-3 standard grade fire resistant low velocity duct sealer. Sealer shall be in accordance with the requirements of NFPA 90A, 1978.
- .15 Construct the ductwork to the following pressure classifications:
 - Supply ductwork: +500 Pa [+2" wg]
 - Exhaust ductwork: -500 Pa [-2" wg]

3.2 Interior Duct Insulation

- .1 Insulate the ductwork on the interior where shown on the drawings, using material characteristics and methods as specified.

3.3 Grilles, Registers and Diffusers

- .1 Provide and install all grilles, registers and diffusers as shown on drawings.

3.4 Cleaning of Air Distribution Systems

- .1 The ductwork shall be cleaned using a standard hand vacuum cleaner unit prior to balancing.

3.5 Miscellaneous Metal

- .1 Provide and install all miscellaneous metalwork associated with this section of the work. This includes but is not limited to all steel and angle iron supports for air handling equipment and all steel and angle iron supports for ductwork.
- .2 Prime coat all steelwork and paint to Section 09900 and COV standards.

END OF SECTION

1.0 Scope of Work

- .1 The work of Division 16 includes all electrical work required to provide a complete working installation at the site as shown on the drawings and contained in the Contract Documents. Work includes but is not limited to the following:
 - .1 Co-ordinate with BC Hydro for electrical power service work and related activities for the pump station upgrade;
 - .2 Scheduling and co-ordination to ensure the existing pump station is operational at all times at the new or existing MCC is powered either by BC Hydro or a temporary on site generator. Co-ordination and scheduling shall also include pump replacement work activities as described in the Contract Documents;
 - .3 Removal of the exiting switch gear and transformer and installation of the new Owner supplied MCC/PDC assembly. See Owner supplied equipment in Section 01105;
 - .4 Main Power Distribution Centre and Manual Transfer Switch (Owner Supplied - part of MCC);
 - .5 Electric power metering (Owner Supplied MCC);
 - .6 Secondary Feeders and ducts;
 - .7 Motor Control Centre, PDC (Owner Supplied MCC);
 - .8 VFD assemblies and enclosures (Owner Supplied MCC);
 - .9 Supply and installation of temporary VFD panels (three VFD`s) for operating the station pumps at 600VAC to maintain the station in operation;
 - .10 Control Panel (Owner Supplied MCC);
 - .11 Programmable Logic Controller (Owner Supplied MCC);
 - .12 Heating, Lighting and ventilation;
 - .13 Receptacles;
 - .14 Instrumentation;
 - .15 Connection to existing SCADA system;
 - .16 Programmable Operator Interface Display (HMI);
 - .17 Process alarms;
 - .18 Fire Alarm System;
 - .19 Intrusion Alarm System;
 - .20 Wiring and connection if all devices and equipment;
 - .21 Co-ordination and related for Division 15 work;
 - .22 Testing and Commissioning of all systems.

2.0 Work Not Included

- .1 The following equipment and work items will be supplied or carried out by others:
 - .1 MCC/PDC complete with VFD sections and control panel as indicated on the drawings and described in the Contract Documents is Owner Supplied.
 - .2 Programming of the PLC's and HMI's.
 - .3 Programming SCADA systems (Contractor to provide wiring connections from PLC to HMI and SCADA panels as shown on the drawings).

3.0 Product Data and Operations and Maintenance Manuals

- .1 Provide product data for all electrical equipment in accordance with Section 01330 including but not limited to:
 - .1 Wires and Cables
 - .2 Switches
 - .3 Receptacles
 - .4 Lighting
 - .5 Boxes and Covers
 - .6 Relays
 - .7 Indicating Lights
 - .8 Instrumentation Equipment
 - .9 Pump Disconnect Plugs and Receptacles
 - .10 Temporary VFD's
 - .11 Temporary Transformers
- .2 Operations and Maintenance Manuals shall be provided for electrical and instrumentation systems and shall be included as part of overall operations manuals in strict accordance with the requirements of Section 01740. Brief, but comprehensive written descriptions must be provided for all equipment, devices and components.

4.0 Shop drawings

- .1 Provide shop drawings in accordance with Section 01330 and these specifications.
- .2 Submit two hard copies of shop drawings and PDF files to the Engineer for approval.

- .3 Shop drawings shall include catalogue sheets, manufacturer's bulletins, wiring diagrams, dimensional data and operating descriptions of all items listed under Part 2 Products, in each section of the Specification.
- .4 Shop drawings shall include an interconnection diagram showing terminal numbers, number of conductors between components and requirements of inter-wiring conductors. This shall include any requirements for shielding, twisting or pairs, minimum and maximum resistance, capacitance, reactance, etc.
- .5 Submit breaker trip curves and fuse curves for all breakers or fuses of more than 50 ampere rating.
- .6 The Engineer will check shop drawings. Approval of shop drawings does not relieve the Contractor from the requirement to provide equipment and systems in accordance with this specification and the contract drawings.
- .7 The Contractor shall also check manufacturers shop drawings. The Contractor shall ensure that the drawings and equipment meet the requirements of this specification.
- .8 Where equipment indicated in shop drawings is a manufactured, fabricated, or assembled item which is unique, custom built or not mass produced, the equipment supplier shall **NOT** begin manufacture, fabrication or assembly of the item prior to receipt of approved shop drawings from the Engineer. The Contractor shall advise his suppliers of this requirement. The Contractor and supplier shall allow time for the Engineer's checking of shop drawings when estimating delivery dates (allow minimum 2 weeks for Engineer's check).

5.0 Record drawings

- .1 Provide two sets of marked up record drawings as specified in Section 01720 showing the correct installation information for all electrical and instrumentation/control equipment and items installed.

6.0 Contract Drawings

- .1 The electrical drawings do not show structural details.
- .2 Accurate dimensions shall be taken from structural or other drawings or by measurement of the buildings. The electrical drawings show approximate location of apparatus, equipment and wiring. The arrangement is diagrammatic in some areas. The exact location of apparatus, equipment and wiring shall be

- determined in the field in accordance with good practice and shall be approved by the Engineer prior to installation.
- .3 Check the location of all items fed by conduit embedded in or below the floor or wall slabs. Ensure that the conduit is located correctly.
 - .4 Ensure adequate clearance in front of all electrical panels and equipment.
 - .5 Check all electrical equipment and motor nameplates to ensure that the breakers fuses, overload heaters and conductor is sized in accordance with Canadian Electrical Code requirements.
 - .6 Check all equipment against the power distribution one line drawing to ensure that the voltage and frequency are correct.
 - .7 The drawings show sufficient detail to indicate the scope of work. Minor changes may be made after award of contract, and after receipt of shop drawings. Changes made as a result of receiving the Contractor's shop drawings shall not be considered extra work.
 - .8 The Engineer reserves the right to change the location of equipment, switches, outlets, etc., to within 3000 mm of points indicated on drawings without involving an extra, providing the electrical trade is advised of the change in time to avoid removal of material already installed.
 - .9 Obtain ruling, prior to tender closing, from Engineer, on any discrepancy between specification and drawings. If this is not done, the expensive alternative will be assumed.
 - .10 Arrange wiring and apparatus to conform to architectural and structural details, in approved manner.

7.0 Owner Supplied Equipment

- .1 See Section 01105.

8.0 Contractor Supplied equipment

- .1 All equipment is to be supplied by the Contractor except where noted otherwise.

9.0 Equals and Substitutions

- .1 Where equipment and materials is specified by manufacturer, "or approved equal" is implied unless specifically noted otherwise. Submit full technical data with request for approval of equals, a minimum of 10 days prior to tender closing.
- .2 Contractors who supply approved equals shall furnish revised wirings and mounting details where required. The Contractor shall pay for all additional Engineering costs related to installation of substituted equipment.

10.0 Site Inspection

- .1 Examine construction site prior to submitting tender and ascertain all conditions affecting work. Base tender on site conditions. Advise Engineer of any potential problems observed during the site visit within 24 hours of visit.

11.0 Installation of Equipment

- .1 Wire and connect all items supplied and/or installed under Division 16.
- .2 Wire and connect all items supplied and/or installed under Division 15 by Mechanical trades.

12.0 Codes and Standards

- .1 CSA C22.1 latest edition of the Canadian Electrical Code.
- .2 EEMAC M1-7
- .3 IEEE 519-1992
- .4 NEMA MG1
- .5 CSA Approval Labels shall be attached to all components.
- .6 Do complete installation in accordance with the latest revision of CSA code and with all Provincial, Municipal and local By-laws and regulations in force during the work.
- .7 Comply with CSA Certification Standards and Electrical Bulletins in force at

time of tender.

- .8 Abbreviation for electrical items: to CSA Z85-1983.
- .9 Wiring to conform to the more stringent provisions of the National Code or the Canadian Electrical Code.
- .10 Ensure all complete work is free of short circuits and unspecified grounds and operates properly to the satisfaction of the Engineer.
- .11 Check all electrical equipment for continuity and conformance to drawings and report any discrepancies to the Engineer in writing.
- .12 The Contractor will be responsible for the safekeeping of all equipment at the job site and shall provide adequate storage facilities protected from the environment and possible vandalism.
- .13 Provide brackets, supports and hardware for installation of electrical equipment. All installations must meet the requirements of the Canadian Electrical Code.
- .14 Inspect, test, megger, clean, adjust and calibrate equipment and services installed by the contractor prior to energizing as specified by the Engineer or manufacturer, to the approval of the Engineer,
- .15 Place "HOLD" tags on all electrical power and control systems, tagging out power to the panels and racks, as required, to protect work from damage which could result from premature use.

13.0 Safety

- .1 Contractor shall be responsible for the safety of all personnel, his and others, working on the electrical equipment.
- .2 Contractor shall establish lock-out procedures and enforce these procedures.
- .3 Contractor shall provide training and instruction as required, for all his personnel, and others working on the electrical equipment.
- .4 Contractor shall obtain assistance from outside agencies or specialists, where required, to insure a safe operating workplace.

- .5 The workplace shall be kept neat and tidy during construction. Tools will not be left exposed while not in use and material shall not be allowed to accumulate in the work area.

14.0 Permits, Fees

- .1 Submit to Electrical Inspection Department necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees for all permits and inspections.
- .3 Electrical inspections and certificates will be required:
 - .1 For BC Hydro service connection;
 - .2 On completion of electrical work;

15.0 Voltage Ratings

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

16.0 Inspection

- .1 Furnish Final Certificate of Acceptance from Inspection Department on completion of work.

17.0 Materials

- .1 Equipment and material to be new, CSA certified, and manufactured to standard quoted.
- .2 Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from Inspection Department.

18.0 Finishes

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.

- .2 Clean, prime and paint exposed hangers, racks, fastenings to prevent rusting.

19.0 Equipment Identification

- .1 Identify electrical equipment with nameplates as follows:
 - .1 All sensors (tags on chain).
 - .2 Switches.
 - .3 Terminal blocks.
 - .4 Other similar or related equipment requiring identification.
 - .5 Relays, power supplies.
 - .6 Panels and displays units.
 - .7 Digital displays.
 - .8 Indicating Lights.
- .2 Nameplates:
 - .1 Lamicaid 3 mm thick plastic engraving sheet, 6 mm high letters unless specified otherwise, white face, black core, self adhesive.
 - .2 Provide a preliminary list of nameplates for review and approval by Engineer prior to manufacture and installation. Revise as directed by Engineer.

20.0 Wiring & Cable Identification

- .1 All cables (both power and control) shall be clearly identified with the cable numbers shown on the drawings.
- .2 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of feeders and branch circuit wiring. Use "Grafoplast" Trasp system 2000 with medium size black print as per 050C field kit. Provide one additional spare marking kit in the station after completion of contract work.
- .3 Provide Electrovert "strap-on S markers" or T & B Tyrap identification cable ties. Ties are to be applied at every entrance or exit from a structure or piece of equipment.
- .4 Maintain colour coding throughout.
- .5 Colour code: to CSA C22.1-1986.
- .6 Use numbered and colour coded wires in instrumentation and communication cables, matched throughout system.

21.0 Mounting

- .1 Mounting height of equipment is from finished floor to centerline of equipment unless specified or indicated otherwise.
- .2 If mounting height of equipment is not indicated, verify before proceeding with installation.
- .3 Permanent installations on walls should be mounted using Unistrut (or equivalent) and Hilti Kwik Bolt expansion anchors, unless noted otherwise.

22.0 Protection

- .1 Protect exposed live equipment during construction for personnel safety.
- .2 Shield and mark live parts "LIVE 120 VOLTS", or with appropriate voltage in English.

23.0 Test and Commissioning

- .1 The Contractor shall be responsible for obtaining "Final Inspection" certificate from authorities having jurisdiction and notifying the engineer.
- .2 Except where specifically noted otherwise, the Contractor shall be responsible for testing, commissioning, programming, calibration and adjustment of all electrical, control, instrumentation and other related equipment installed under this contract as necessary or required to provide a complete working installation. The Engineer will provide details specifying testing procedures prior to the start of testing. The Engineer shall be the sole judge in determining if a device or piece of equipment is operating correctly. The Contractor shall abide by any decisions or instructions issued by the Engineer concerning the correct operation of devices or equipment.
- .3 Equipment shall be tested jointly and in co-ordination with **Division 15 for mechanical equipment.**
- .4 The Contractor shall complete initial testing and commissioning of all systems and components to confirm the adequacy of all items. When all items are operating satisfactorily, the Contractor shall then conduct the following tests **in the presence of the Engineer:**
 - .1 Power distribution system including grounding.

- .2 Circuits originating from branch distribution panels.
 - .3 Motors and associated control equipment.
 - .4 Ground resistance test and report.
 - .5 Verify and confirm all wiring and each instrumentation loop including all PLC inputs and outputs.
 - .6 Operating demonstration of pumping system showing correct operation of alarms, normal operations, correct functioning of PLC.
 - .7 Correct functioning of the each VFD and associated pump over a speed range between 30 to 60 Hz. See also testing and commissioning requirements in Sections 15452, 15600 and 15834 and other Division 15 Sections for pump testing.
-
- .5 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.
 - .6 Submit test results for Engineer's review.
 - .7 Engineer will:
 - a) Witness the proper operation of the systems
 - b) Witness the verification of all wiring and instrument loops.
 - c) Inspect the installation.
 - d) Give final approval for the installation.

24.0 Start-up services

- .1 The Contractor shall include in his price for the onsite services of suppliers of all equipment supplied by the Contractor for commissioning and start up testing and calibration services for pressure transmitters, digital displays, PID controller and other equipment.
- .2 The Contractor shall coordinate the site services required for Owner Supplied Equipment including the MCC and all components (VFD's, PLC's HMI's, transfer switch).

25.0 Insulation Resistance Testing

- .1 Megger circuits, feeders and equipment. Megger circuits, feeders and equipment up to 350 V with a 500 V instrument and megger circuits above 350 V with a 1000 V instrument.
- .2 Check resistance to ground before energizing. Minimum resistance to ground is 50 megohms.

- .3 Make certain that no solid state components are exposed to excessive voltages.
- .4 Carry out insulation testing in presence of the Engineer. Provide 48 hours advance notice prior to testing.

26.0 Protective Devices

- .1 Ensure circuit protective devices such as overcurrent trips, relays, fuses, are installed to values and settings as indicated or to CEC.

1. BACKGROUND AND GENERAL DESCRIPTION OF WORK

Kitsilano Pump Station and Upgrading:

- .1 The Kitsilano pump station is a wet well dry pit sewage station which pumps combined flows from the Kitsilano area via forcemains to Metro Vancouver's the English Bay Interceptor. Flows are generally low in the summer period and high during wet winter periods.
- .2 Alterations to the forcemain systems currently being carried out by others will allow the Kitsilano pump station to pump to Metro Vancouver's higher capacity 8th Ave Interceptor. Pumping to the new 8th Ave forcemain requires mechanical and electrical upgrades the Kitsilano pump station which will be carried out under this contract.
- .3 To expedite the work and minimize the upgrading construction time period the City has **pre-purchased specified long delivery equipment** for the project for installation by the Contractor. Time is of the essence for completion of the work of this contract. Owner Supplied Equipment is described in the Contract Documents.
- .4 The Kitsilano pump station must be kept operational during the upgrade work and will require specific procedures and schedules to be developed by the Contractor.
- .5 During the work of the contract, the Contractor will be responsible for operating the pump station as the prime contractor but will cooperate with City of Vancouver personnel and crews who will need access to the station and who will assist the Contractor in operating the station.
- .6 To assist the Contractor in developing procedures and schedules, suggested procedures and sequences are provided in the Special Provisions and are intended only to provide the Contractor with information which should allow the Contractor to prepare and develop his own specific procedures and schedules for the work. The suggested procedures and sequences contained herein are not complete and the **Contractor is solely responsible for preparing his own procedures and sequences and for carrying out the work of the contract and keeping the station pumping system operational at all times.**
- .7 There are two possible methods to maintain the pumping capacity of the station during the work:
 - .1 Bypass pumping/ or
 - .2 Staging electrical and mechanical equipment upgrades.

- .8 The methods detailed in the Special Provisions and Contract Documents deal only with item 1.7.2 - "Staging electrical and mechanical equipment upgrades" since this has been deemed as the preferred method. The tender price shall be based solely on method 1.7.2 only. Should the Contractor alternatively wish to implement bypass pumping and shut down the pump station (1.7.1) in lieu of staging the electrical and mechanical equipment upgrades, this alternative method will only be considered after award of contract at which time the Contractor would be required to submit complete detailed shop drawings and written procedures for review and consideration by the City and Engineer. After review, the City at its sole discretion would then decide if method 1.7.1 is an acceptable alternative to method 1.7.2.
- .9 The Contractor shall supply, assemble and install two (2) temporary VFD panels (total of three (3) temporary VFD`s) complete with transformers at the site as shown and indicated on the drawings and in the specifications. The temporary VFD panels will be used to operate the pump station operational during the installation of the new BC Hydro power service and the removal and installation of the new MCC. Both panels to be delivered to the City's work`s yard at the completion of work. Panels will be powered by a contractor supplied genset as specified.
- .10 In submitting a tender for the Kitsilano pump station Upgrade, the Contractor shall submit his tender based on **method 1.7.2 only** as a means of maintaining the pump station in service at all times during the work.
- .11 Contractor shall supply and install and wire an additional MCC bucket in the Owner Supplied MCC as shown on the drawings. Bucket to be installed in MCC section 4 and contain
- .1 15A, 3 phase, 600V breaker
 - .2 2 x 500VAr, 3 phase 600V capacitors, c/w build in fuse protection
 - .3 15A, 3 pole contactor
- .12 Contactor to add relay R5 to the control panel and provide all wiring for operation of "no load" power factor capacitors as shown on the electrical drawings.
- .13 Contractor to install all interconnecting wiring between Owner supplied RTU panel, new control panel, VFD panels and all equipment as shown on the drawings.

2. MAINTAINING PUMP STATION IN SERVICE USING METHOD 1.7.2 "STAGING ELECTRICAL AND MECHANICAL EQUIPMENT UPGRADES

.1 The following brief description summarizes the intent of method 1.7.2:

- .1 It is intended to keep the Kitsilano pump station in service by staging civil, mechanical and electrical work;
- .2 The staging will involve providing temporary power to the existing 480 VAC MCC (using a portable genset) and supplying and installing temporary transformers and VFD's. The temporary VFD's and transformers (Contractor supplied) will allow the new and rebuilt 600 VAC pump motors to operate from the existing 480 VAC MCC;
- .3 The installation of new pumps (Owner Supplied) and pump discharge piping (with Owner Supplied Valves) will be staged such that three pumps will always be in operation except for short periods (1-2 days as approved by Owner) where it may be necessary to maintain fewer than three pumps in operation;
- .4 The removal of the existing high voltage switch gear and transformer (unit substation) and installation of the new Owner supplied MCC;
- .5 The installation of new BC Hydro power service using an outside pad mounted transformer. Duct work includes primary and secondary ducts and PMT base. New primary ducts will extend to the BC Hydro underground vault as shown. Secondary ducts will connect the new PMT to the new MCC in the pumps station.
- .6 Field wiring of the new MCC and switchover from the existing MCC to the new MCC.
- .7 All associated equipment and work.

3. SUGGESTED GUIDELINES FOR STAGING MECHANICAL AND ELECTRICAL INSTALLATIONS

- .1 The following table provides suggested guidelines for staging major pump station activities with the intention of maintaining the pump station in operation at all times.

STEP	DESCRIPTION	COMMENTS	DATE
1	Shut down Pumps P1, P2 and P3. P4 remains in service	Station is operating with one (1) pump and step 1 and 2 must be complete in 1 - 2 days.	Estimated to be the end of September
2	Install plug valve c/w blind flange on P1. Install Plug valve, steel spool and restrained couplings on P2 & P3.	See Drawing 1972-202 (Step #1)	
3	Pumps P2, P3 and P4 are operational. P1 is out of service.	See Drawing 1972-202 (Step #2)	
4	Supply and install temporary VFDs and transformers as indicated on Drawing 1972-411 <ul style="list-style-type: none"> • 3 x 75HP, 600VAC VFD's c/w NEMA 1 enclosures & conduit boxes • 3 x 75KVA booster transformers, 480V - 600V • Connect to load side of existing pump starters through booster transformers to the line side of the VFD's via temporary Teck (or TC) cables <i>See Drawing 1972-411</i> Note: Three (3) pumps must be operational at any given time.	See Drawing 1972-411 for temporary VFD's and transformers. The temporary VFD's and transformers will be used to operate UP TO three pumps from the existing MCC and will allow minimum of three pumps to remain operational.	
5	Two new owner supplied pumping units are delivered to site. Remove and replace P1 (first pump) with new pump complete with new discharge piping and valves. <i>See Drawing 1972-202 (Step #2)</i>	Replace first pump. Motor will need to be coupled to the pump.	
6	Connect new motor to the temporary VFD panel using temporary SOW type cables. Test and commission new pump. Ensure motor to pump coupling meets manufacturer's requirements. Program temporary 50 hp VFD to run the new 75Hp pump motor in current limiting mode (50 Hp)	Wire, connect and program temporary VFD to operate the new pump	

	<p><i>See Drawing 1972-411</i> Note: Three (3) pumps must be operational at any given time.</p>		
7	<p>Remove and replace P2 (second pump) with new pump complete with new discharge piping and valves. <i>See Drawing 1972-202 (Step #3)</i></p>	Replace second pump. Motor will need to be coupled to the pump.	
8	<p>Connect new motor to the temporary VFD panel using temporary SOW type cables. Test and commission new pump. Ensure motor to pump coupling meets manufacturer's requirements. Program temporary 50 hp VFD to run the new 75Hp pump motor in current limiting mode(50 Hp) <i>See Drawing 1972-411</i> Note: Three (3) pumps must be operational at any given time. Start working on new wiring in wet well and dry pit</p>	Wire, connect and program temporary VFD to operate the new pump	
9	Ship the removed pumps P1 & P2 for rebuilding	These are the pumps that have been replaced, leaving two existing pumps still in place and operating.	
10	Commence work in other areas while pumps are being rebuilt		
11	<p>Two Owner supplied pumps are returned to site as rebuilt units. Replace P3 with rebuilt pump complete with new discharge valves and piping. <i>See Drawing 1972-202 (Step #4)</i></p>	Replace third pump. Motor will need to be coupled to the pump.	
12	<p>Connect new motor to the temporary "VFD panel" using temporary SOW type cables. Test and commission rebuilt pump. Ensure motor to pump coupling meets manufacturer's requirements. Program temporary 50 hp VFD to run the new 75Hp pump motor in current limiting mode (50 Hp)</p>	Wire, connect and program temporary VFD to operate the rebuilt (third) pump. Three pumps (two new and one rebuilt will be operating)	

	<i>See Drawing 1972-411</i>		
13	Excavate trench from new PMT location to the station and to the existing BC Hydro junction box north of the station. Install conduits secondary conduits from the station to the PMT and primary conduits from the PMT to the junction box. Obtain Electrical Inspection by Electrical & BC Hydro inspectors <i>See Drawing 1972-400</i>	BC Hydro secondary ducts from new PMT to station and primary ducts to the BC Hydro junction box #4461	
14	Prepare site for PMT c/w: <ul style="list-style-type: none"> • 1.7m x 1.6m Base concrete base to BC Hydro standards • Counterpoise grounding to BC Hydro standards • Secondary conduits - 2 x 100mm ducts • Primary conduits - 3 x 75mm - to junction box as shown on drawing <i>See Drawing 1972-400</i>	BC Hydro service	
15	Provide 480VAC generator and connect to manual transfer switch in existing MCC using existing generator cord from transfer switch. Generator sized to run: <ul style="list-style-type: none"> • 15kW lighting load • 4 x 50HP pumps on across-the-line starters • in five steps Estimated generator run time = 10 working days or as required Note: Contractor shall have second generator on "hot standby" in case of emergency.	Up to this time the pump station has been and still is operating on unit substation (existing switch gear and transformer in the station). The station will now be operated on portable generator to permit the existing unit substation to be removed and replaced with the PMT and new MCC	
16	Working in close coordination with BCH, switch service from the existing unit substation to the new 600V PMT and MCC. BC Hydro and the Contractor to schedule and coordinate and clearly confirm the all work items,	Install new BC Hydro service with close coordination, scheduling and planning with BC Hydro	

	<p>demarcation and work by each party prior to starting switchover. Work items will include but not be limited to:</p> <ul style="list-style-type: none"> .1 BCH to disconnect high voltage power to the existing high voltage switchgear .2 BCH to remove existing primary feeder .3 Contractor to tie-in new primary ducts from stub (previously installed) and connect to existing junction box .4 New PMT (Hydro to supply and install PMT only), install new primary feeders to PMT and connect transformer primary .5 Remove the existing high voltage equipment in the station .6 Remove the existing housekeeping pad and repair floor .7 Remove existing primary ducts entering the pump station and install new secondary conduits inside the station from the corner of the pump station building to the BCH incoming section in the MCC assembly. .8 Install drainage for secondary conduits in same location as previous incoming BCH conduits .9 Install new housekeeping pad for new MCC (as shown on drawing 1972-302) .10 Install new MCC assembly and seismic bracing (as shown on drawings 1972-302 & 410) .11 Install and connect secondary conductors (BCH) 		
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	.12 Energize the new MCC assembly		
17	Complete site/field wiring for new MCC	New MCC site work	
18	Test and commission new BC Hydro 600VAC power and control system (genset operating pumps and controls).	Confirm new BC Hydro service and new 600 VAC MCC	
19	Install permanent pump power cables and control wiring, complete with load-rated plugs and cable supports in the dry pit.		
20	Replace existing P4 with second rebuilt pump complete with new valves & new piping. <i>See Drawing 1972-202 (Step #5)</i> Commission P4 prior to proceeding with next steps.		
21	Connect second rebuilt pump to VFD 4 in new MCC. Commission P4 and run for 3 days as lead pump before proceeding with the next step	Second rebuilt pump becomes first pump connected to new MCC	
22	Install 100mm PVC sleeve from new MTS to wall beside existing MTS, complete with SOW cable and genset plug (Cable P3 on drawing 1972-401). COV to confirm genset size and genset plug model number for Contractor		
23	Disconnect pumps P1, P2 and P3 (separately, one at the time) from the temporary "VFD panel" and rewire to new MCC and permanent VFD's complete with permanent power and control wiring.	Rewire new pumps from temporary VFD panel to new permanent VFD's	
24	Commission pumps (one at the time) on the new 600V MCC and the new control panel. Run each pump as lead pump for 2 days before proceeding with work on next pump in step 23 above.	Program instruments and equipment as required	

25	Operate three (3) pumps on 600VAC from new MCC for specified period (3 days minimum) to confirm operation prior to disconnecting genset. Remedy all operating deficiencies	Confirm new MCC and new/rebuilt pumps prior to disconnecting genset.	
26	Connect and commission the RTU with COV assistance		
27	Complete field wiring in pump station, including instrumentation, heating and lighting		
28	Remove compressor from pump station		
29	Remove 480V MCC and manual transfer switch		
30	Complete all remaining work items		

5. SCHEDULE

- .1 Time is of the essence on this project and the City will require the Contractor to keep three pumps in the Kitsilano station in operation at all times and complete the work of the contract to restore complete pump station capacity as soon as possible.
- .3 **Critical Schedule dates are included on the schedule form included in the Form of Tender.**
- .4 The project is partially funded by both levels of senior government and must be substantially complete by the dates shown.
- .5 Dates provided in the schedule for work in the Kitsilano pump station are based on the best estimate for delivery of the Owner Supplied equipment. **Should actual dates of equipment delivery be later than indicated the Contractor will be required to adjust his schedule to accommodate the later delivery date.**

ACTIVITY	DATE
NOTICE TO PROCEED (Estimated)	End of September, 2010
ESTIMATED DELIVERY OF TWO NEW OWNER SUPPLIED PUMPING UNITS	
ESTIMATED SHIPMENT DATE OF TWO EXISTING PUMPING UNITS TO REBUILD SHOP	To be determined
ESTIMATED RETURN DELIVERY DATE OF TWO EXISTING OWNER SUPPLIED REBUILT PUMPS	Approximately 7-14 days after contractor removes pump(s)
ESTIMATED DELIVERY DATE OF OWNER SUPPLIED MCC TO SITE	Mid to end of September, 2010
ESTIMATED DATE OF OWNER SUPPLIED VALVES TO SITE	Mid to end of September, 2010
SUBSTANTIAL COMPLETION	MARCH 1, 2011
TOTAL COMPLETION	MARCH 31, 2011

- .6 Substantial completion shall be deemed to have occurred when all contract work has been completed and the station has been returned to continuous

service with only minor deficiencies remaining to be completed by the date required for total completion.

- .7 The Contractor shall submit a complete and detailed construction schedule individually showing each construction activity and the activities start and completion dates and clearly outlining all critical project dates.

7. SITE ACCESS

- .1 Access to the pump station is restricted by locked doors.
- .2 The City will provide station door keys on a temporary basis. The Contractor will be responsible for ensuring that authorized personnel only are admitted to the site.

8. WORK AREAS

The Contractor will be restricted to working within specified areas at the site as directed by the City. All work vehicles and equipment shall also be restricted to specified areas. Access to the site by Corporation personnel for inspection or maintenance or other purposes shall not be interfered or interrupted with by the work of the Contract.

9. NOISE FROM TEMPORARY GENERATORS

The Contractor is advised that operating equipment noise levels shall not exceed 70 db as measured at a distance of 20 meters from the operating equipment.

The Contractor is advised that the temporary generator set must meet noise levels of 50 db at 7 meters from the operating equipment and is to be located behind the pump station as indicated on the drawings.

10. TRAFFIC CONTROL AND SITE SECURITY

The Contractor will be required to submit a traffic control plan for any work affecting access roads at the site including Arbutus Street, parking lot access and Arbutus Street parking. The Contractor's work areas will be confirmed by the City of Vancouver.

11. WORK AND DISTURBANCE TO PARK LAND

The Contractor will abide by Vancouver Parks requirements for any work carried out on Park property and will be responsible for all damages to Park property by the work of the Contract and will repair damages in accordance with instructions from Vancouver Parks and the City of Vancouver.

PART 1 - GENERAL

1.1 Description

- .1 The work of this section shall include all that is necessary for the supply and installation of all required underground cables and wiring in ducts at the site as required and as shown or indicated on the drawings.

1.2 Related Work

- | | | |
|----|---------------------------------|---------------|
| .1 | Electrical General Requirements | Section 16010 |
| .2 | Excavation and backfilling: | Section 02315 |

PART 2 - PRODUCTS

2.1 Warning Tape

- .1 PVC 150 mm wide, yellow, indicating "CAUTION BURIED ELECTRIC LINE." Place over buried electrical line as per the CEC. Tape to be buried 450mm below grade.

2.2 Concrete Encasement

- .1 To CEC requirements.

PART 3 - EXECUTION

3.1 Cable Installation in Underground Ducts

- .1 Install cables or wires as indicated in ducts.
- .2 Do not pull spliced cables or wires inside ducts.
- .3 Install multiple cables or wires in ducts simultaneously.
- .4 Use CSA approved lubricants of type compatible with cable jacket to reduce pulling tension.
- .5 After installation of cables, seal duct ends with duct sealing compound.

3.2 Markers

- .1 Mark cable every 5 m along cable runs and changes in direction.

3.3 Testing

- .1 Perform tests in accordance with Section 16010.
- .2 Perform tests using qualified personnel. Provide necessary instruments and equipment.
- .3 Check each feeder for continuity, short circuits and grounds. Ensure resistance to ground of circuits is not less than 50 megohms. Do not megger solid state components.
- .4 Pre-acceptance tests.
 - .1 After installing cable but before terminating, perform insulation resistance test on each phase conductor.
 - .2 Check insulation resistance after each termination to ensure that cable system is ready for acceptance testing.
 - .3 Ensure that terminations and accessory equipment are disconnected.
 - .4 Ground shields, ground wires, metallic armour and conductors not under test.
- .5 **Provide Engineer with list of test results showing location at which each test was made, circuit tested and result of each test.**
- .6 Remove and replace entire length of cable at no cost to Owner if cable fails to meet any of the test criteria.
- .7 Megger installed cables and wiring in accordance with Section 16010.

END OF SECTION

PART 1 - GENERAL

1.1 Description

- .1 The work of this section shall include all that is necessary to supply and install buried ducting for the new power service to the pump station as well as all other miscellaneous cable duct work required for the project including connections to existing above and below ground duct work.
- .2 Work shall include removal of existing buried duct work not required for the new installation, tie-ins to existing buried duct work and all new buried and concrete encased primary and secondary ducts required to provide a complete working system as indicated on the drawings.
- .3 The location of existing buried ducts are shown approximately only on the drawings. The Contractor shall be responsible for locating all existing underground ducts prior to carrying out the work and shall make all field adjustments necessary to install new ducts and connect new ducts to existing ducts or new and existing structures.

1.2 Related Work

- .1 Section 16010 - Electrical General Requirements

PART 2 - PRODUCTS

2.1 PVC Ducts

- .1 Rigid PVC ducts: size as indicated with minimum wall thickness at any point of 2.8 mm. Nominal length 3 m. CSA 22.2 No. 211.1 for buried service duct.
- .2 Rigid PVC couplings, reducers, bell end fittings, plugs, caps, adaptors as required to make complete installation.
- .3 Rigid PVC bends and offsets as required.

2.2 Solvent Weld Compound

- .1 Solvent weld compound for PVC duct joints and primer as recommended by manufacturer.

2.3 Fish Cord

- .1 6 mm polypropylene pull rope tensile strength 5 kN.

2.4 Warning Tape

- .1 PVC, 150 mm wide, yellow, indicating "CAUTION BURIED ELECTRIC LINE."

2.3 Concrete Encased Ducts

- .1 See drawings for concrete encasement of ducts.

PART 3 - EXECUTION

3.1 Installation

- .1 Install RPVC duct as indicated and in accordance with manufacturer's instructions.
- .2 Clean inside of ducts before laying.
- .3 Ensure full, even support throughout duct length. Spacing of supports shall be in accordance with CEC requirements.
- .4 Slope ducts where indicated with 1 to 400 minimum slope toward drain or as instructed by the Engineer.
- .5 During construction, cap ends of ducts to prevent entrance of foreign materials.
- .6 Pull through each duct, a mandrel not less than 300 mm long and of a diameter 6 mm less than internal diameter of duct, followed by stiff bristle brush to remove sand, earth and other foreign matter. Pull stiff bristle brush through each duct immediately before pulling-in cables.
- .7 In each duct, install pull rope continuous throughout each duct run with 3 m spare rope at each end.
- .8 BC Hydro existing primary service ducts are 3 x 50mm RPVC encased in concrete to be abandoned. New 3 x 75mm concrete encased ducts to be installed under this contract will become new BCH primary conduits. Excavate for new ducts in the area indicated on the drawings. New BCH

conduits to be installed from BCH junction box to the new Pad Mounted Transformer as shown. Ducts to be concrete encased to BC Hydro requirements.

- .9 New secondary ducts to be 2 x 100mm RPVC encased in concrete to BC Hydro requirements. Ducts to be installed in the new trench from the Pad-Mounted Transformer to the sidewalk and from there the ducts to be laid as indicated on Drawing 1972-400.

END OF SECTION

PART 1 - GENERAL

1.1 Description

- .1 The work of this section shall include all that is necessary to supply and install all conduits for the Kitsilano Pump Station and related items and accessories for all power, control and instrumentation circuits.

1.2 Location of Conduits

- .1 Drawings do not show all conduits. Those shown are in diagrammatic form only.
- .2 Provide sketches of all proposed conduit runs to be installed in concrete before concrete is poured.

1.3 Wiring Method

- .1 Conduits encased in concrete:
BC Hydro primary and secondary conduits to BC Hydro specifications.
Approximate area is shown on Drawings 1972-400.
- .2 Surface mounted conduits and boxes: All conduits in the brick block MCC room are to be surface mounted EMT. Transitions from embedded conduits in cast in place concrete pump station structure to surface mounted conduit on brick block walls shall be installed as follows:
 - .1 RPVC and EMT complete with all required fittings as described under Item 1.3.1 above.
- .3 All conduit and wiring is not shown on the drawings. The Contractor shall provide conduit and wiring as per circuit numbers shown. He shall install this in accordance with good practice with no conflicts with other trades.
- .4 Interior control panel wiring shall be "TY-RAP'ed" bundles, secured to rear mounting panel or installed in "Panduit" type wiring trough.
- .5 All conduits installed in wet well room and wet well:
Wiring method to adhere to CEC Class 1, Zone 1 requirements.

1.4 Ground Conductor

- .1 Provide separate ground conductor in all conduits and ducts, except for primary underground duct.
- .2 Provide separate ground conductor in all flexible conduit for bonding

continuity.

PART 2 - PRODUCTS

2.1 Conduit

- .1 Rigid Steel Conduit: As shown on the drawings.
- .2 Provide galvanized steel electro metallic tubing (EMT) in all areas shown on the drawings, except where direct buried or exposed to mechanical damage.
- .3 Provide rigid PVC duct CSA 22.2 No. 211.1 - M1984 where direct buried or encased in concrete. Use approved jointing cement. Run ground conductor.
- .4 Provide rigid hot dipped galvanized steel in areas where exposed to mechanical damage.
- .5 Areas where conduit is exposed to mechanical damage are as follows:
 - (a) Surface mounted outdoors, from 600 mm below ground to 1600 mm above ground.
 - (b) Stubbed up through floor to motors and control pilot devices
 - (c) Where noted on drawings.
- .6 All conduit shown are 25 mm diameter unless otherwise noted, or where the code calls for a larger size because of conduit fill.

2.2 Flexible Conduit

- .1 Provide flexible metallic liquid tight conduit where shown on the drawings. Sizes as indicated. CSA 22.2 No. 56 - 1977
- .2 Flexible conduit shall be Hydrotite or Sealtite with extruded PVC Jacket and clearly marked for use in the electrically rated area (i.e. Class 1, Zone 1).

2.3 Secondary Distribution Duct

- .1 Provide 100 mm Rigid PVC where direct buried or encased in concrete.
- .2 Adapt to rigid galvanized steel where exposed to mechanical damage.

2.4 Conduit Fastenings

- .1 One hole RPVC straps to secure surface conduit 32 mm and smaller. Two hole RPVC straps for conduits larger than 32 mm.

2.5 Conduit Fittings

- .1 Fittings: RPVC manufactured for use with conduit specified.
- .2 RPVC Factory fittings (LL,LR,LB, or other) where 90 deg bends are indicated or required for conduits.
- .3 Rigid steel for use with RSC.
- .4 EMT for use with EMT conduit.

2.6 Field Bends

- .1 Conduit bends carried out in the field or on-site shall be bent using proper bending tools only including bending jig to ensure correct radius.

2.7 Fish Cord

- .1 Polypropylene, 6 mm.

2.8 Waterstop Sealant

- .1 Provide GE RTV 108 general purpose silicone rubber adhesive sealant.

2.9 Duct Sealant

- .1 Provide Iberville Duct Sealant DUCT-1.

2.10 Flame Stop Sealant

- .1 Provide Thomas & Betts flame-safe firestop compound.

PART 3 - EXECUTION

3.1 Installation

- .1 Install conduits to conserve headroom in exposed locations and cause minimum interference in spaces through which they pass.
- .2 Surface mount conduits where indicated.
- .3 Use liquid tight flexible metal conduit for connections as shown.
- .4 Where conduits become blocked, remove and replace blocked section.
- .5 Dry conduits out before installing wire.
- .6 Use mandrel to CEC requirements.

3.1 Conduit

- .1 Exposed conduit shall be parallel or perpendicular to building lines.
- .2 Provide expansion joints where required.
- .3 Provide thermal breaks where required.
- .4 Support conduit to eliminate visible deflection.
- .5 Conduit installed in areas where building finish is painted, shall be painted to match, with two coats of same color and quality. Paint type shall be suitable for type of conduit painted.
- .6 Conduit entering, or passing through an electrical enclosure shall have locknut and washer on both sides of the enclosure. Connection shall be to standard of the enclosure.
- .7 Hole in enclosures, for conduit, shall be made with a knockout.
- .8 Seal with fire stop sealant all points where wiring or conduit passes through fire separations.
- .9 Flexible conduit shall only be used where flexibility is required for future equipment changes or small equipment movement.

3.3 Rigid Steel Conduit to PVC Conduit Adaptor

- .1 Provide PVC female adapter fitting. Rigid Steel conduit shall be threaded into female adapter at points of transition.

3.4 Duct

- .1 Connections shall be watertight.
- .2 Slope to provide drainage.
- .3 Provide drainage tap-offs complete with check valves as required by Electrical Utility. Provide "T" connection on BC Hydro secondary conduits inside the dry pit area. Downpipe from this "T" to be 37mm nominal diameter and be extended to the existing drainage trench. This arrangement will provide drainage to BC Hydro requirements.

3.5 Waterstop Sealant Installation

- .1 After all instruments and controls have been tested, seal cable entry with water stop sealant between the following areas:
 - a) Pump Station and Outside
- .2 Apply with pump or gun.

3.6 Flamestop Sealant Installation

- .1 After all instruments and controls have been tested, seal cable entry with flame stop sealant, TSB "flame-safe" or equivalent between the following areas:
 - a) Fan Rooms & Electrical Room.
- .2 Apply with pump or gun.

END OF SECTION

PART 1 - GENERAL

1.1 Description

- .1 This section shall include all that is necessary for the supply and installation of all power, control, instrumentation and other wiring required to complete all wiring inside and outside the Pump Station.

PART 2 - PRODUCTS

2.1 Cables

- .1 Cables:
 - .1 Grounding Conductor: copper sized to CEC requirements
 - .2 Circuit conductors: copper, size as indicated
 - .3 Inner jacket: polyvinyl chloride material
 - .4 Armour: aluminium interlocked armour
 - .5 Overall Covering: polyvinyl chloride material
 - .6 Fastenings:
 - .1 One hole steel straps to secure surface cables 25mm and smaller. Two hole steel straps for cables larger than 25 mm.
 - .2 Channel type supports for two or more cables at maximum 900 mm centres.
 - .3 Unistrut (or equivalent) channel and P clamps at bottom entry to control panel.
 - .7 Connectors:
 - .1 Rated for wet locations and approved for specified cable.

2.2 Building Wires

- .1 Conductors: stranded. Minimum size 12 AWG.

2.3 Control Wiring

- .1 Control panel wiring:
 - .1 120 VAC: Minimum 14 AWG.
 - .2 All other: Minimum 16 AWG or as shown on the drawings.

2.4 Instrument Wire

- .1 Shielded pair or triad cables shall be #18 AWG Belden Cat. No 8760 or 8770 respectively.
- .2 Instrumentation wiring shall be in accordance with the manufacturer's

instructions.

- .3 All instrument wiring shall have both ends identified with Grafoplast Trasp system 2000 medium size black print as per 050C field kit wire marking sleeves and shall be colour coded with white conductor (+) and black wire (-) negative.

2.5 Insulation

- .1 All copper conductors: with minimum 600 V insulation of chemically cross-linked thermosetting polyethylene material (rated RW90 for building wiring).

PART 3 - EXECUTION

3.1 Installation of Wires and Cables

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 16111 and as indicated on the drawings.
 - .2 In duct systems in accordance with Section 16106.
 - .3 All wires and cables shall be installed in ducts or conduits except for surface run Teck type cables.
 - .4 Teck type cable surface runs to meet CEC requirements.

3.2 Installation of Instrumentation Wires

- .1 Install wiring as follows:
 - .1 In conduit systems in accordance with Section 16111 and as indicated on the drawings and in accordance with manufacturer's recommendations for the particular instrument or device.

END OF SECTION

PART 1 - GENERAL

1.1 Related Work

- .1 Section 16010 - General Requirements

PART 2 - PRODUCTS

2.1 Pull and Junction Boxes

- .1 Provide pull and junction boxes appropriately sized where required.
- .2 Provide cast FS type boxes of same material as conduit, CSA approved. Larger boxes may be enameled, complete with grounding lugs and terminal blocks, and screw on or hinged cover and sized per Canadian Electrical Code requirements.
- .3 Provide labeled terminal blocks in all control junction boxes with more than two junctions.

2.2 Outlets and Switchboxes

- .1 Size boxes to suit the number of conductors and connections required therein.
- .2 Use gang boxes as required for the number of switches. Check latest drawings for door swings, counter heights and locations, shelf locations, etc., prior to installing boxes.
- .3 Unless otherwise noted or specified herein, all outlets shall be installed flush. Duplex receptacles and light switches on the ground floor of the pump station shall be mounted flush, except as shown on the drawings. Provide sketches of proposed conduit runs before concrete is poured.
- .4 Outlet and switchboxes installed in concrete shall be of a type specifically designed and approved for this service. 87mm deep type MB boxes may be used in concrete and masonry.
- .5 Where receptacles, switches, etc. are mounted in the block walls, they shall be installed in close co-operation with the masonry trade. Boxes shall be surface mounted on brick block walls connecting to EMT. Prior to installation of outlets in block walls, the Contractor shall check with the Engineer to determine if the basic outlet level matches with the nearest brick block course line.
- .6 Provide switch and receptacle boxes suitable for installation required.
- .7 In areas where conduit is surface run provide type F.S. boxes, constructed of RPVC and rated for surface mounting.

2.3 Receptacles

- .1 Receptacles and matching plugs shall be in accordance with CSA configuration for non locking receptacles unless otherwise noted
- .2 Duplex receptacles shall be specification grade Hubbell Cat. No. 5262-I, complete with galvanized sheet steel cover plates.
- .3 Weatherproof duplex receptacles shall be complete with Hubbell Cat. No. 5222 fiberglass flip-cap cover.
- .4 Weatherproof ground fault interrupter type duplex receptacles shall be Hubbell Cat. No. GF5262-I, Ivory, complete with Hubbell Cat. #856 cover plate.

2.4 Light Switches

- .1 Single pole light switches shall be specification grade Hubbell Cat. No. 1221-I.
- .2 Three-way light switches shall be specification grade Hubbell Cat. No. 1203-I ivory.

2.5 Wiring Connections

- .1 Use insulated twist on type for #10 AWG and smaller conductors.
- .2 Use bolted type for #8 and larger. Use Burndy Compression fittings for connecting spade type terminals to wiring.

2.6 Cover Plates

- .1 Plates in all inside areas shall be stainless steel.
- .2 Exterior surface plates for receptacles shall be gasketed weatherproof polycarbonate.

PART 3 - EXECUTION

3.1 Co-ordination With Other Trades

- .1 Where receptacles, switches, etc. are mounted in block walls, they shall be installed in close co-operation with the masonry trade and shall be surface mounted and plates shall completely cover the openings. Prior to installation of outlets in block walls, the Contractor shall check to determine if basic outlet elevations are to be adjusted to locate outlets level with the nearest course line.

3.2 Mounting of Wiring Devices

- .1 Location of switches, thermostats, etc. shall be grouped inside doors in a coordinated manner on vertical or horizontal centre lines.
- .2 Receptacles shall be installed vertically, as noted on the drawings. Generally, outlets shall be installed 500 mm above finished floor. Where they occur over counters, work tables, etc., they shall be installed approximately 150 mm above the tops of such surfaces, except that where "splash-backs" are fitted, receptacles shall be entirely within or without these backs.
- .3 Switches shall be mounted at 1300 mm in all areas. Refer to civil drawings for final location of door frames, hinges, etc. Switches shall generally be located on the strike side of the door.
- .4 Engineer may relocate switches and receptacles up to 3000 mm at no extra cost, provided the relocation is done prior to rough in.
- .6 Where pull boxes are flush mounted, overlapping covers with flush head cover retaining screws, prime coated and painted to match wall or ceiling finish shall be provided.
- .7 Pull boxes and junction boxes shall have lamicoid labels as outlined in Section 16010 "Equipment Identification".
- .8 Where control devices for lighting, etc. and outlets for duplex receptacles, etc. are indicated adjacent to one another or where they appear in the same approximate position on different drawing sheets, they shall be grouped together and provided with a common coverplate.

END OF SECTION

PART 1 - GENERAL

1.1 Scope of Work

- .1 Establish electrical building station ground electrode.
- .2 Ground all equipment as per Canadian Electrical Code.
- .3 Install counterpoise supplied by utility. See section 16400 requirements.

PART 2 - PRODUCTS

2.1 Ground Conductor - Electrode and Interconnections

- .1 Provide #4/0 AWG bare stranded copper ground conductor.

2.2 Ground Plate

- .1 Provide galvanized steel plate, minimum 6 mm thick, 0.2m².
- .2 Provide connector for #4/0 ground conductor.

2.3 Ground Connections

- .1 Provide Burndy Hyground compression connections, conductor to conductor, conductor to rods.
- .2 Use approved mechanical connector, conductor to equipment.

2.4 Ground Conductor - Conduit and Ducts

- .1 Provide appropriately sized stranded copper ground conductor in all conduits and ducts except primary service and secondary service ducts.

PART 3 - EXECUTION

3.1 Station Electrode

- .1 Establish a ground electrode in accordance with Canadian Electrical Code. Connect to new MCC ground lugs.
- .2 Ground plate must be minimum 600 mm below finished grade, located as shown on Drawing 1972-410.
- .3 Run ground conductor through station wall with new BC hydro secondary conduits. Grout and waterproof around new installation.

3.2 Connections

- .1 Use Penetrox "E" joint compound on all connections.
- .2 Make connections with Burndy Hyground compression fittings.
- .3 Ground all non-current carrying metal parts of electrical equipment.

3.3 Buried Ground Conductor

- .1 Bury ground conductor 300 mm below final grade.

3.4 Branch Circuit Grounding Conductor

- .1 Circuits that are installed in conduit located in or below the main floor slab, or in direct buried conduit, shall have a ground conductor installed.

3.5 Transformers and Sub Panels

- .1 Ground transformer neutrals with #8 AWG copper (minimum) or #6 AWG if exposed to mechanical damage.
- .2 Ground Panel neutral with #6 AWG copper.
- .3 Ground equipment to main service ground electrode.

END OF SECTION

PART 1 - GENERAL

1.1 Service - General

- .1 Provide service in accordance with the requirements and standards of the BC Hydro.
- .2 All materials and equipment shall be approved by the BC Hydro.
- .3 Co-ordinate all work by the Utility.
- .4 Provide a 400 amp, 347/600 volt, 3 phase, 4 wire, underground service.
- .5 Contractor will provide all civil work for underground service including trenching, primary and secondary concrete encased ducts, backfilling and drainage. **All civil work related to new BC Hydro service shall be conducted by a BC Hydro-approved Contractor.**
- .6 Provide pull boxes, junction boxes, primary duct, secondary duct, and all associated accessories. B.C. Hydro meter to be located inside the MCC and installed to BC Hydro specifications.
- .7 See other Division 16 Sections for other requirements.

1.2 Service Drawings

- .1 The scope of work is outlined in the tender drawings. BC Hydro may issue detail drawings to the Contractor. He shall do the work in accordance with these detailed drawings and the standard requirements of BC Hydro. If the Contractor is unfamiliar with their standards he shall acquire these standards prior to tender close, and base his price on these standards. The Contractor must be approved by BC Hydro.

1.3 Inspection of Service Installation

- .1 BC Hydro will inspect the service work to insure compliance with their standards.

1.4 Work by BC Hydro

- .1 BC Hydro will supply and install (at no cost to the Contractor):
 - a) Pad mount transformer
 - b) Primary and secondary service conductor (from the existing junction box to the new PMT and from the PMT to the existing station).
Contractor to install all primary and secondary ducts.
 - c) Metering transformers
 - d) Utility meter

- .2 BC Hydro will supply for installation by the Contractor (at no cost to the Contractor. Contractor is responsible for picking up and delivering materials to work site):
 - a) Counterpoise for transformer pad
 - b) Precast concrete transformer mounting pad.
- .3 The City of Vancouver will pay for BC Hydro work and equipment noted in items 1.5.1 and 1.5.2. Should the Contractor incur additional costs or cause BC Hydro to incur additional costs attributable to poor workmanship, inadequate scheduling or co-ordination as determined by the Engineer, such costs will be paid for by the Contractor.

PART 2 - PRODUCTS

2.1 Primary and Secondary Ducts

- .1 See Section 16107.

2.2 Drainage

- .1 Provide drainage of duct system in accordance with Utility standards.

2.3 Lighting Panel (supplied by Owner)

2.4 Circuit Breakers

- .1 Enclosed circuit breakers shall have minimum instantaneous trip of 12 times breaker rating.
- .2 Submit breaker trip curves with shop drawings.
- .3 Enclosure shall be surface mount EEMAC 1.
- .4 Service main breaker shall be CSA rated for service entrance application.

2.5 Metering Transformer Enclosure (supplied by Owner)

2.6 Transformers

- .1 Transformers installed indoors in non hazardous areas shall be Hammond Type F (single phase) and Type K (three phase) dry type air cooled of voltage and KVA rating as shown on Single Line Diagram.
- .2 Transformers shall have full capacity primary taps; 1 - 2.5% to 5 KVA, 4 - 2.5% above 5 KVA for single phase; 2 - 5% to 9 KVA, 4 - 2.5% above 9 KVA for 3 phase.

2.7 Surge Suppressor (Supplied by Owner)

PART 3 - EXECUTION

3.1 Balancing of Load

- .1 The Contractor shall connect all feeders to the panels so that the load is equally balanced on the 3 phases. Upon completion he shall submit ampere readings from all 3 phases to the Engineer for his approval.

3.2 Earthquake Restraint

- .1 Provide earthquake restraint support bracing and anchor bolt fastening to prevent horizontal movement or tipping of all service equipment.
- .2 Seismic restraint drawings stamped by a P.Eng registered with the APEGBC shall be provided for all electrical equipment showing details of seismic restraint systems.

3.3 Surge Suppressor

- .1 Connect alarm contacts as shown on the drawings for remote alarming.

END OF SECTION

PART 1 - GENERAL

1.1 Scope of Work

- .1 Supply and installation of all lighting fixtures shown on the drawings and noted in the contract documents. Fixtures shall be complete with the necessary accessories and components required to install them where intended.
- .2 Fixtures shall be as described on the drawings.

1.2 Acceptance of Lighting Equipment

- .1 Prior to ordering of lighting equipment as per fixture type schedule and/or pre-accepted substitutes, submit to the Engineer, a fixture type schedule showing fixture makes and catalogue numbers intended for installation under this contract.
- .2 Lighting fixtures and all other equipment in the wet well and wet well room are to be rated Class 1, Zone 1 and installed to CEC rules for this area.
- .2 Submit product data for all lighting equipment in accordance with the requirements of Section 01330.
- .3 After the Engineer's final acceptance has been obtained, no other changes to the list shall be made, unless reasons for such changes have been explained in writing to the Engineer and his acceptance has been obtained.
- .4 Contractor shall indicate specified ballast types on shop drawings.

PART 2 - PRODUCTS

2.1 Fixtures

- .1 As shown on the drawings.

2.2 Lamps

- .1 All fixtures shall be provided with suitable lamps.
- .2 Provide 2500 hour, 115-125 volt extended service incandescent lamps.
- .3 Provide 32W fluorescent rapid start T8 lamps, colour temperature 3000K, CRI=70 minimum, 2550 mean lumens and rated 18,000 hours average life based on 3 hours per start.

- .4 Provide (diffused and coated colour improved) metal halide lamps rated 24,000 hours at 3 hrs per start.

2.3 Emergency Exit Lighting

- .1 Emergency lighting power supply units shall be 12 volt with long life lead dioxide battery and automatic constant voltage charger. Mount on wall 2285 mm above the finished floor.
- .2 Emergency lighting fixtures shall be 12 volt, 12 watt Quartz Halogen Single Fixture.
- .3 All DC wiring shall be 2 #10 conductors in conduit, except that wiring shall be larger if required to limit voltage drop.
- .4 Emergency lighting equipment shall conform to CSA, C22.2 No. 141, "Unit Equipment for Emergency Lighting".

2.4 Emergency Lighting Receptacle

- .1 Provide an AC outlet above power supply unit, with the lower edge of the coverplate at the same height as the top of the battery unit. The AC outlet shall be a recessed or surface box to suit wiring method with Hubbell 5251 or Leviton 5015 single receptacle and stainless steel coverplate.
- .2 Emergency lighting and receptacles installed in wet well room must meet Class I, Zone 1 requirements.
- .3 Alternately wire directly into unit from wall mounted outlet box complete with blank coverplate and flex conduit out to battery pack.

2.5 Fluorescent Fixture Ballasts

- .1 Provide fluorescent fixtures complete with electronic ballasts which are approved by the "Power Smart" program and by the Engineer. Non-approved ballasts will not be considered. Approved ballast manufacturers are Philips and Universal Lighting Technologies.

PART 3 - EXECUTION

3.1 Installation of Fixtures

- .1 Fixtures shall be positioned to suit final piping and duct work, shelving, etc.
- .2 Generally speaking, fixtures are located closely to scale. However, the Contractor is cautioned that the exact location may be determined by site installation conditions.

- .3 Non current-carrying metal parts shall be grounded.
- .4 Where required, all fixtures shall be complete with a suitable ballast.
- .5 All fixtures shall be complete with a suitable lamp. The fixtures shall have the wording "RELAMP ONLY WITH (colour and type) LAMPS" stenciled above each lamp and visible only when the lamp is removed.

END OF SECTION

PART 1 - GENERAL

1.1 Scope of work

- .1 Supply, fabrication site installation and commissioning of "Temporary VFD panels" all related components. A total of two (2) panels (three VFD's) will be required as shown on electrical drawings.
 - .1 Panel no. 1 will include two (2) VFDs and two (2) booster transformers;
 - .2 Panel no. 2 will consist of one (1) VFD and one (1) booster transformer.
- .2 VFDs are required to power two new and one refurbished station sewage pumps. VFD acceleration and deceleration ramp to be adjustable in the range of 1-20 seconds. VFDs to be programmed in variable torque and current limiting modes. Current limiting to correspond to 50 Hp.
 - .1 Estimated preliminary VFD current limiting = 48A @ 600V (to be confirmed on site).
- .3 Provide field services to program, start up, test, commission and confirm the operation of the VFD'S and other related equipment supplied and requiring setup for temporary operation of pumps.

1.2 Standards

- .1 CSA C22.1 latest edition of the Canadian Electrical Code.
- .2 EEMAC M1-7
- .3 IEEE 519-1992
- .4 NEMA MG1
- .5 All cabinets and equipment shall conform and be designed and manufactured in accordance with applicable and current CSA Standards and all Local and Provincial regulations.
- .6 CSA Approval Labels shall be attached to all components.

1.3 Shop Inspections

- .1 A shop inspection of the VFD assemblies by the Engineer shall be carried out before shipment to the site. Notify Engineer minimum four (4) working days in advance. Shop inspection shall consist of the following activities:
 - .1 Checking all components and wiring inside enclosures and confirming the correct operation of all connected equipment and devices.

- .2 All equipment and other items found deficient during testing as determined by the Engineer shall be corrected and retested for approval by the Engineer.

1.4 Power Service

- .1 Primary electrical power to the site will be from BC Hydro or from Contractor supplied generator set.
- .2 Standby Generator Power Supply:
 - .1 A standby portable generator shall be provided by the Contractor and installed outside the pump station as part of the contract work and in the event of a BC Hydro power failure, the generator will start automatically and operate specified pumps and house loads in the station. Generator will be the sole power supply during the BC Hydro service switchover and during the new MCC installation.
 - .2 VFD'S supplied under this contract must be operable with the station's standby generator system provided by the Contractor. Written submission from VFD supplier and generator supplier confirming operation will be required.

1.5 Booster transformers

See 2.1

1.6 Documentation to be provided with tender

- .1 Provide two (2) copies of the following:
 - .1 Complete catalogue drawings showing arrangement, outline, dimensional details and weight of the two VFD panels
 - .2 Complete technical and specification information describing all VFD, components including one copy of users manual. Complete warranty information for all equipment.
 - .3 Delivery dates.

1.7 Documentation to be provided on Award of Contract

- .1 Submit the following information following award of the contract:

- .1 Two (2) copies of the following information for approval within the time period specified following the award of contract.
 - .1 Vendor submissions shall include:
 - a) Schematic diagrams showing complete control circuits and wiring connections;
 - submit within two weeks of award.
 - b) Wiring connection diagram drawings showing each component in correct orientation with each wire identified;
 - submit within two weeks of award.
 - c) Fully detailed and dimensioned shop drawings showing physical panel layout assembly;
 - submit within one week of award.
 - d) Modified wiring diagrams with wire numbers changes.
 - submit within two weeks of award.
 - e) Complete operating instruction books including users manuals, installation procedures, spare parts lists.
 - submit prior to site installation.
 - f) Maintenance manuals shall include component specifications, instructions, part numbers, complete operating manuals, details of guarantees and recommended spare parts list.
 - submit three weeks prior to site commissioning.

PART 2 - PRODUCTS

2.1 Booster transformers

75kVA, dry type, 3 phase, Nema 1 enclosure, floor mounted
Primary voltage: 480V
Secondary voltage: 600V

2.2 Variable Frequency Drives (VFD'S) for Pumps

- .1 The drives shall be microprocessor based solid state AC units, using fully digital sensorless flux vector motor control with IGBT power components. Drives shall be rated for variable torque pumping application, shall have frequency control, V/F characteristic with IR compensation
- .2 Drive Features: VFD's shall provide the following features:
 - a) 120VAC control voltage;
 - b) Self tuning with comprehensive diagnostics;
 - c) Programmable by front digital display and keypad. Display and keypad shall be remotely mounted in panel door.
 - d) Built in RS-232 port;
 - e) Input signals: 120 VAC and 4-20mA;
 - f) Analog I/O;
 - .1 Minimum 2 analog inputs;
 - .2 Minimum 2 analog outputs;
 - g) Digital I/O;
 - .1 Minimum 5 digital inputs;
 - .2 Minimum 3 form C relay outputs;
 - h) Frequency avoidance settings;
 - i) Memory feature to retain programmed settings on loss of input power.
 - J) Power outage ride-thru;
 - k) Auto restart option to allow drive to restart on power failure or other fault and either return with VFD matching the motor rotating speed or VFD to wait until rotation has stopped before starting.
 - l) -10 degrees C to +40 degrees C operating temperature range;
 - m) Adjustable carrier frequency;
 - n) Protection:
 - .1 Timed Motor Overload;
 - .2 Undervoltage;
 - .3 Overvoltage;
 - .4 Instantaneous overcurrent protection;
 - .5 Motor pullout;
 - .6 Ground fault;

- .7 External fault;
- .8 Short circuit;
- o) Fully programmable PID control;
- p) Adjustments:
 - .1 Minimum and maximum frequency;
 - .2 Switching frequency;
 - .3 Run/stop mode;
 - .4 Analog Frequency setpoint;
 - .5 Frequency rejection points;
 - .6 Current limit;
 - .7 Overload limit;
 - .8 Automatic reset and restart;
 - .9 Acceleration time;
 - .10 Password parameter protection;
 - .11 Three mode PID parameters;
 - .12 Motor overload;
- q) Current Output Regulation:
 - .1 VFD to have adjustable maximum current (amps) output, above which setting the VFD will reduce frequency output (ie pump speed) to avoid pump tripping on overload.

2.3 VFD Size Constraints

- .1 Maximum physical size of VFD enclosures is shown on the drawings and VFD assemblies must fit within these dimensions.

2.4 VFD Output Characteristics

- .1 Voltage rise: not to exceed Nema standards for general purpose motors as per Nema MG-1
- .2 CONTINUOUS VFD OUTPUT RATING: VFD'S supplied under this contract must have a continuous current output rating in rms amps at least **8 % greater than the pump motor VFD nameplate full load current** based on variable torque pump loading at the rated motor voltage.
- .3 INTERMITTENT OUTPUT RATING: intermittent rating shall be 125% of continuous output rating for minimum 60 seconds.
- .4 VFD'S shall accept nominal 600 VAC, plus or minus 10% (540 to 660 VAC), 3 phase 60 Hz power and shall accommodate plus or minus 2% line frequency variations without fault.
- .5 VFD'S shall present a displacement power factor of 0.98 or better to the AC

input line under any load or speed.

- .6 VFD efficiency shall be not less than 97% at 60Hz at full load.

2.5 VFD Construction

- .1 VFD'S shall be of modular construction containing printed circuit boards with plug in connections for ease of maintenance.
- .2 VFD'S shall consist of the following major components:
 - .1 Input rectifier section;
 - .2 Phase to phase and phase to ground MOV protection;
 - .3 Smoothing reactor for DC bus;
 - .4 DC bus capacitors;
 - .5 Inverter section;
 - .6 Built in ground fault protection;
 - .7 Remote digital display for programming, operation and diagnostic information.
 - .8 Forced air ventilation adequate for the intended installation arrangement;
 - .9 Line filters and external load filters and reactors and other devices as specified;

2.6 RFI Filters for VFD'S

- .1 RFI filters supplied must be suitable for suppressing radio or other low, medium and high frequency transmissions which may affect electronic components in the pump station control systems or radio and television reception in nearby residential premises.
- .2 RFI filter shall be parallel device, Termac or equivalent.

2.7 Acceptable Variable Frequency Drive Products

- .1 Yaskawa (Vector Drives)
- .2 MGI (Mitsubishi);
- .3 ABB;
- .4 Toshiba;
- .5 Alstrom;
- .6 Fluxmaster.

VFD's must fit within space constraints of VFD panel assembly to be acceptable.

PART 3 - EXECUTION

3.1 Installation

- .1 Install VFD assemblies and sections as indicated on the drawings.

3.2 Start-Up Services

- .1 Following installation, the contractor shall provide start up services for VFD'S including:
 - .1 Inspection of installed installation to confirm VFDs and other equipment is installed in conformance with the manufacturers recommendations and written confirmation that the installation has been inspected and is acceptable and all warranties are in place and in effect.
 - .2 Setting and recording of all VFD parameters. Records to be submitted to the Engineer.
 - .3 Programming all parameters under the direction of the Engineer.
 - .4 Providing explanation and demonstration and brief tutorial on setting and changing VFD parameters.
 - .5 Confirmation that VFD ventilation and cooling air flows are correct and operating satisfactorily. Confirmation shall include taking air temperature measurements (in the pump station and across the VFD) while the VFD's are under full load.

3.3 Testing and Commissioning Procedures

- .1 Except where specifically noted otherwise, the Contractor shall be responsible for testing, commissioning, programming, calibration and adjustment of all VFD'S and other related equipment supplied under this contract as necessary or required to provide a working pump station installation. The Engineer will provide details specifying testing procedures prior to the start of testing but testing shall be carried out to confirm the correct operation of VFDs over the normal operational conditions of the pump station including the starting and stopping of all pump units over the programmed sequence of pump operation. The Engineer shall be the sole judge in determining if a device or piece of equipment is operating correctly. The Contractor shall abide by any decisions or instructions issued by the Engineer concerning the correct operation of devices or equipment.
- .2 The Contractor shall complete initial testing and commissioning of all systems

and components to confirm the adequacy of all items. When all items are operating satisfactorily, the Contractor shall then conduct the following tests in the presence of the Engineer:

- .1 Correct functioning of the VFD and pump over a speed range between 30 to 60 Hz. Acceleration and deceleration rates and current limiting feature to be programmed to Engineers approval.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project including:
- .4 Submit test results for Engineer's review.
- .5 Engineer will:
 - a) Witness the proper operation of the systems
 - b) Inspect the installation.
 - c) Give final approval for the installation.