



**Fisheries
and Oceans**

**Pêches
et Océans**

Contract No. F1700-150694

Conuma River Hatchery 138 kV Substation Upgrade Project

SPECIFICATIONS

3 June 2015

LIST OF CONTRACT DOCUMENTS

SPECIFICATIONS

DIVISION 01 GENERAL REQUIREMENTS

Section 01 11 00	Summary of Work
Section 01 33 00	Submittal Procedures
Section 01 35 29.06	Health and Safety Requirements
Section 01 45 00	Quality Control
Section 01 47 15	Sustainable Requirements: Construction
Section 01 74 11	Cleaning
Section 01 78 00	Closeout Submittals

DIVISION 03 CONCRETE

Section 03 10 00	Concrete Forming and Accessories
Section 03 20 00	Concrete Reinforcing
Section 03 30 00	Cast-in-place Concrete

DIVISION 26 ELECTRICAL

Section 26 05 00	Common Work Results - Electrical
Section 26 05 14	Power Cable and Overhead Conductors (>1001V)
Section 26 05 21	Wires and Cables (0 - 1000V)
Section 26 05 22	Connectors and Terminations
Section 26 05 27	Grounding – Primary
Section 26 05 28	Grounding – Secondary
Section 26 12 13	Liquid Filled, Medium Voltage Transformers
Section 26 12 13	Appendix A – T1 Shop Drawings
Section 26 12 13	Appendix B – T2 Shop Drawings
Section 26 12 13	Appendix C – T2 Overall Layout Shop Drawing

DIVISION 31 EARTH WORKS

Section 31 11 00	Clearing and Grubbing
Section 31 23 33.01	Excavating, Trenching and Backfilling

DIVISION 32 & 33 EXTERIOR IMPROVEMENTS & UTILITIES

Section 32 31 13	Chain-link Fences and Gates
Section 33 41 01	Oil Spill Containment & Drainage
Section 33 71 73.02	Underground Electrical Services

DRAWINGS

CIVIL & STRUCTURAL DRAWINGS

32-18-281, revision 0	Location, Key Maps, Site Plan and Drawing List
32-18-282, revision 0	Oil Containment System General Notes
32-18-283, revision 0	Foundation and Oil Containment System Layout Plan
32-18-284, revision 0	Oil Water Separator and Details
32-18-285, revision 0	Water Pipe Relocation Plan, Sections and Notes (to come)
32-18-286, revision 0	Oil Containment System Details
32-18-287, revision 0	Transformer Footings Details

ELECTRICAL DRAWINGS

32-18-288, revision 0	Main Single Line Diagram
32-18-289, revision 0	Electrical Layout–Plan and Grounding-Plan
32-18-290, revision 0	Substation Sections, Details and Fencing

1979 REFERENCE DRAWINGS

32-18-90, revision -	138 kV Substation Site Layout, Single Line Diagram, Bill of Materials
32-18-91, revision -	138 kV Substation Layout and Grounding
32-18-92, revision -	138 kV Substation Sections

Part 1 General

1.1 BACKGROUND

- .1 The Fisheries and Oceans Canada (Department of Fisheries and Oceans - referred to as DFO or Department) will be constructing upgrades to the Conuma Hatchery 138kV Switchyard in order to replace the existing transformer with two new transformers. The upgrade work includes:
 - .1 relocation of the existing transformer and 600V splice pit.
 - .2 disposal of existing buried 600V Teck power cables, transformer foundation, fencing, crushed rock surfacing and other excavated materials surplus to the work;
 - .3 excavation and backfill as required for the new foundations, oil catchment apron, water/oil drain piping, oil-stop valve & chamber, oil-water separator and water drain rock pit;
 - .4 construction of re-enforced concrete foundations for transformers and oil catchment apron;
 - .5 construction of water-oil drainage system;
 - .6 installation of two Department pre-purchased transformers (T1) and (T2);
 - .7 supply and installation of bedding, drainage & surface rock, other materials and fencing;
 - .8 providing temporary fencing and guarding from access to live 138kV area and other hazards.
- .2 The Conuma Hatchery is located at the head of Tlupana Inlet, off Nootka Sound on the West Coast of Vancouver Island, British Columbia. The hatchery is located approximately 45 minutes from the Village of Gold River. Access is via Hwy #28 to Gold River, then 36 km along Head Bay Forestry Road towards Tahsis.

1.2 CONTRACTOR EXPERIENCE

- .1 The Contractor shall have previous experience:
 - .1 Working in 138 kV switchyards and substations,
 - .2 Working with 138 kV equipment,
 - .3 Working with latest BC Hydro Safety Practice Regulations.

1.2 SCOPE

- .1 The work of this Contract consists of the supply and installation of materials, including all labour, equipment, plant and tools related to the construction of the Work in Tender No. F1700-150694; all in accordance with the Drawings and Specifications for the prices tendered in the Schedule of Quantities and Prices.
- .2 The components of the work are generally described, but not limited to, the

following:

- .1 mobilization and demobilization;
- .2 be the Prime Contractor for the area of the work, responsible for work safety within the work site;
- .3 obtain any permits and inspections required by provincial and local authorities having jurisdiction and BC Hydro.
- .4 survey to establish the Work boundaries and to reset working line references if disturbed by Contractors' activities;
- .5 site preparation, excavation, backfilling, and supply and installation of bedding materials, drain and crushed surfacing rock;
- .6 demolition, removal, and disposal of some portions of the existing buried ground grid and related ground rods near the property line, existing 600V cables into the switchyard, existing fencing, crushed rock surfacing, excess materials, vegetative growth and transformer foundation. Relocation, intact, of the existing 138kV 300kVA transformer. Relocation of existing 600V cables' splice-pit and related four 600V cables being retained;
- .7 providing temporary fencing, warning signage, and appropriate guarding to prevent non-authorized access to live 138kV areas and construction hazards. Ensuring appropriate limits-of-approach to 138kV and other live lines and components are established and followed;
- .8 supply and installation of additions to existing ground grid including ground rods, conductor, connections, interconnections to existing buried grounds, concrete rebar, equipment, fencing and other exposed metals within the switchyard in accordance with the Contract Documents and CEC Section 36.
- .9 engaging an independent testing agency to measure and provide sealed Engineer's calculations and report for the switchyard ground resistance (R), in ohms, and touch and step potentials, after buried grounding system is installed and backfilled;
- .10 constructing concrete foundations;
- .11 constructing oil catchment apron system, oil stop valve chamber, oil water separator, drain rock weeping pit and drainage system piping;
- .12 placing materials and documented testing to confirm they meet specifications;
- .13 installation of Department's pre-purchased 4MVA 138-25kV transformer (T1) and installing its radiator, HV surge arrestors and bushings, check-out with documentation including insulating oil testing, and commission;
- .14 installation of Department's pre-purchased 500kVA transformer (T2) complete with 600V PDC 400A CB and utility metering space, check-out with documentation including insulating oil testing, and commission. Obtain and install acceptable PTs and CTs for BCH metering in utility metering

- section within the 600V PDC and install insulated neutral from transformer secondary neutral bushing to the metering space;
- .15 providing outdoor NEMA 4X rated utility metering cabinet and internal components per BC Hydro secondary metering provision requirements for 600V 400A service;
 - .16 providing 600V service disconnect switch with visible break contacts in NEMA 4X enclosure with contacts viewing window and external pad-lockable switch operator.
 - .17 supply and install buried and embedded RPVC conduits;
 - .18 supply and install and connect 138kV, 25kV and 600V cables/conductors and necessary connectors and terminations; Pull-out minimum of 10m of existing buried 600V service cable to/at powerhouse and re-use duct sleeve for new 600V service conduit. Terminate 600V supply conductors at powerhouse's existing automatic transfer switch (ATS).
 - .19 supply and install 25kV stress relief kits and make shield connections to ground;
 - .20 Perform normal maintenance to 138kV disconnect switch and fuse holders (not maintained since original installation circa 1980). Supply and install 145kV 25E power fuses;
 - .21 supply and install fencing;
 - .22 constructing switchyard by-pass water pipe, 500mm diameter DHPE, and filling-in of the to-be-abandoned portion between tie-ins;
 - .23 survey and check the finished grade at the end of the project. Fill and re-grade any areas (that have been disturbed during construction) to re-establish finished elevations;
 - .24 site restoration (make good in-kind) of disturbed areas outside areas of construction. Restore roadway to as found condition; other vegetated areas shall be grassed.
 - .25 clean-up Site and dispose off-Site all refuse including unusable materials.
 - .26 It is the intent of this Scope that the Contractor is to supply all necessary material and labour and tools to provide fully functional and acceptable containment, drainage and fencing systems; and grounding and electrical systems.
- .3 See Items 2.13 and 2.14 for items supplied by Corporation.

1.3 COOPERATION WITH OTHERS

- .1 The Contractor is advised that it shall be required to cooperate with all other contractors who may be of different affiliations, parties and forces in the area including, DFO representatives and hatchery personnel.
- .2 The Contractor shall ensure that all operating components of the hatchery, and

fish, are not adversely affected by construction activities at any time.

- .3 Access to the site, allocation of Contractor's storage, office and work areas, and use of services will be coordinated by hatchery staff in order to minimize interference with hatchery operations and the public.

1.4 LIMITS OF WORK SITE

- .1 The work site shall be limited to the area east of the hatchery access road, north of the powerhouse and its diesel fuel foundations, and to 6m east of the 138kV substation east fence, unless otherwise advised and permitted in writing by the hatchery manager.

1.5 DRAWINGS

- .1 Details of the work are shown on Ausenco/DFO Drawings, and form part of the Contract with the specifications.
- .2 The drawings are supplemented by manufacturers' shop drawings listed in Section 26 12 13.
- .3 The Contractor shall examine all drawings in advance of construction and shall advise the Engineer (referred to as Consultant) of any apparent errors, discrepancies or inconsistencies, in order that the Consultant can provide instructions clarifying the design.
- .4 The Contractor shall also advise the Consultant of any discrepancies or apparent inconsistencies between the drawings and the specifications, in order that the Consultant may clarify the intent of the Contract.

1.6 WORK PLAN

- .1 The Contractor shall prepare a detailed Work Plan that covers each area of work.
- .2 The Work Plan shall cover each major phase of work, including but not limited to procurement, transportation, handling, site work, structural work, and electrical work.
- .3 The Contractor shall prepare and submit the Work Plan to the Consultant prior to commencing work on site. He shall allow sufficient time for review by the Consultant, followed by a meeting to be held between the Consultant, the Department and the Contractor to discuss activities and responsibilities, as well as potential limitations and requirements not addressed in the plan.

1.7 SEQUENCE OF CONSTRUCTION

- .1 General
The Contractor shall carry out the work of this Contract in such a manner as to:

- .1 Ensure that all aspects of the work are completed under conditions necessary for construction, installation or application of materials as required by the manufacturer or by the Contract Documents.
- .2 The Contractor shall coordinate his construction to ensure that partially constructed facilities are not subject to flooding, erosion or uplift as a result of failure to control water.
- .3 Schedule the work in a manner such that disruption of normal traffic and inconvenience to public visitors and Hatchery staff in the working area are kept to a minimum. This will require coordination with the hatchery manager.

1.8 TESTING AND START-UP

- .1 The Contractor shall be responsible for all aspects of testing, and start-up of the drainage system and electrical work, and for its documentation.
- .2 Testing and flushing of drain lines shall be performed during or shortly after completion of installation.
- .3 Detailed requirements for each system and item of equipment are provided in the appropriate specification sections.
- .4 The Contractor shall be responsible for inspection, start-up and commissioning of the completed systems. The Contractor shall coordinate its 135kV and 25kV and 600V including metering work with BC hydro and energize the switchyard equipment only after BC Hydro has accepted of the installation and agreed that energizing may proceed.
- .5 During the start-up and commissioning, the Contractor shall ensure that qualified representatives of the civil and electrical trades are on site and able to correct deficiencies, make adjustments, and assist in start-up as required.
- .6 Attendance and participation of these trades in the start-up procedures shall be at the Contractor's cost.

1.9 EQUIPMENT SUPPLIED AND WORK BY THE DEPARTMENT

- .1 The Contractor shall supply all materials and equipment required to complete the work except for the following items which will be supplied by the Corporation:
 - .1 138 – 25kV 4MVA transformer (T1),
 - .2 25 – 0.6kV, 500kVA transformer (T2).
- .2 The Contractor shall take the Department provided items from their place of present storage on the hatchery property and transport and place into their intended locations.

1.10 MATERIALS AND EQUIPMENT SUPPLIED BY THE CONTRACTOR

- .1 The Contractor shall furnish all the materials and equipment and shall:

- .1 Find, load, haul, unload, store and care for all such materials, the cost of which shall be included in the tendered price.
- .2 Pay all freight, duties, royalties, wharf age, sales tax and other charges on the materials it furnished under this contract.
- .3 Be responsible for the proper handling of all pipe, fittings, and appurtenances; any damage which may be done in handling, shipping, storage, or in any other way prior to acceptance after installation and testing shall be made good by the Contractor at its expense.
- .2 All materials incorporated into the work shall conform to this contract and to the latest edition of the appropriate specification of the ASTM, or to other standards expressly specified. Workmanship shall be first class and in accordance with the best shop practice.
- .3 Materials incorporated in the work and not specifically covered in the specifications shall be new, of good quality, and acceptable to the Consultant.
- .4 All items supplied by the Contractor shall be as specified. If the Contractor wishes to supply and install items other than specified, it shall apply for and must receive written permission from the Consultant before incorporating such items into the work.
- .5 Descriptive literature and price schedules covering such alternative items shall be supplied to the Consultant at least 15 working days in advance of the requested approval.
- .6 Equipment supplied by the Contractor shall include installation, operating and maintenance manuals.

1.11 COSTS FOR TESTING, ENGINEERING AND INSPECTION

- .1 The Contractor shall be responsible for its own quality control testing including concrete and field soil density testing in accordance with the pertinent sections of the specifications.
- .2 The Contractor shall have no claim for delays, interruptions, double-handling of materials, rejection of materials, or any other cause brought about by such tests, including awaiting the outcome of such tests.
- .3 Provide adequate notice to the Consultant to permit inspections to be conducted at appropriate times in an efficient manner.
- .4 Provide material samples to the testing agencies, and when requested to the Department, in such quantities as required by the Department for testing for conformance with the specifications. Make good, at least to original standard, area from where samples are taken.
- .5 Performance of testing, when performed by the Department, shall in no way relieve the Contractor of its responsibility for completing the Works in accordance with the specified requirements.

1.12 GEOTECHNICAL

- .1 The Department has had three test pits dug recently, near the switchyard, for

geotechnical information and the report is available from the Department on request. No representation is made as to the accuracy or completeness of any of this information, and if a Tenderer chooses to rely on such information, it does so at its own risk.

- .2 Any information pertaining to geotechnical conditions and any test pit logs that may be furnished by the Department is a matter of general information only. The test pit logs shall not be interpreted as descriptive of conditions at locations other than those described by the test pits themselves.

1.13 MEASUREMENT OF PAYMENT

.1 General

- .1 Payment for work will be made at the Prices as tendered for the various classifications of the work appearing in the Schedule 1 – Quantities and Prices of the Form of Tender.

- .2 Any work called for in the specifications or shown on the plans, or which is necessary for the completion of the work called for in the specifications and is not specifically listed as a separate item in the Quantity and Prices, shall be deemed incidental to the general purpose of the Contract and no separate payment will be made on account of any such work, but the cost of any such incidental work shall be included in the total price values as tendered for the various items appearing in the "Quantities and Prices Table".

.2 Mobilization – Item # 1

- .1 The unit of measurement will be a single fixed item. This item will include all costs associated with mobilizations, removal of debris, the General Conditions, requirements and instructions of the Contract, and preparing the site for the work.

- .2 Mobilization and demobilization required to move material, and labour within the work area is not a pay item.

.3 Site Work Including Removals and Disposals – Item # 2

- .1 The unit of measurement will be a lump sum item for site preparation including removal of cables, conductors, transformer concrete pad, fence, vegetation growth in switchyard.

- .2 The relocation of the existing transformer will be included in this pay item.

- .3 The supply and installation of safety grounds, safety equipment, and temporary fence will be included in this pay item.

- .4 The disposal of removed equipment and material will be included in this pay item.

.4 Excavation and Bedding Materials – Item # 3

- .1 The unit of measurement will be a lump sum item for excavation for transformer pads, and underground conduits.

- .2 The supply and installation bedding and backfill material will be included in this pay item.
- .5 500mm HDPE Water Pipe Relocation – Item # 4
 - .1 The unit of measurement will be a lump sum item for excavation for 500mm HDPE water pipe.
 - .2 Fill and cap abandoned portion of existing water pipe will be included in this pay item.
 - .3 The removal and disposal of material will be included in this pay item.
 - .4 The supply and installation of 500mm HDPE water pipe, bedding material, backfill and site restoration will be included in this pay item.
 - .5 The testing and commissioning of the 500mm HDPE water pipe will be included in this pay item.
- .6 Buried Conduits and Grounding – Item # 5
 - .1 The unit of measurement will be a lump sum item for supply and installation of conduits, and buried warning cable tape.
 - .2 The supply and installation of grounding conductors, ground rods, ground mat, and below grade grounding connections will be included in this pay item.
- .7 Civil Oil Stop, Oil Water Separator & Drainage Piping – Item # 6
 - .1 The unit of measurement will be a lump sum item for excavation of oil stop, oil water separator and drainage piping.
 - .2 The supply and installation of bedding material will be included in this pay item.
- .8 Concrete Forming, Rebar, Placing and Testing – Item # 7
 - .1 The unit of measurement will be a lump sum item for supply and installation of concrete forms, rebar, concrete, and concrete test samples
- .9 Equipment Placement and Assembly – Item # 8
 - .1 The unit of measurement will be a lump sum item for installation of transformers, and assembly of loose supplied transformer equipment.
- .10 HV and LV Electrical Including Above Grade Bonds & Ground – Item # 9
 - .1 The unit of measurement will be a lump sum item for supply and installation of cables, connectors, stress relief kits, fuses, and cable and conductor terminations.
 - .2 The supply and installation of disconnect switch and metering equipment will be included in this pay item.
 - .3 The supply and installation of above grade equipment bonds and grounds will be included in this pay item.
 - .4 The relocation of existing 600 V splice box, and related cables will be included in this pay item.

- .11 138 kV Disconnect Switch Maintenance – Item # 10
 - .1 The unit of measurement will be a lump sum item for maintenance of existing 138 kV disconnect switch.
- .12 Fencing – Item # 11
 - .1 The unit of measurement will be a lump sum item for supply and installation of fence including concrete footings, fence posts, gates, and barbed wire.
 - .2 The supply and installation of fence and gate grounds will be included in this pay item.
- .13 Oil Stop and Separator Including Related Piping – Item # 12
 - .1 The unit of measurement will be a lump sum item for supply and installation of oil stop, oil water separator and drainage piping.
 - .2 The supply and installation of backfill material will be included in this pay item.
- .14 Drain & Crushed Rock and Other Surface Finishing – Item # 13
 - .1 The unit of measurement will be a lump sum item for drain and crushed rock.
 - .2 The supply and installation of material required for site and roadway restoration will be included in this pay item.
- .15 Checking, Testing, Commissioning and Documentation – Item # 14
 - .1 The unit of measurement will be a lump sum item for checking, testing commissioning and documentation of the electrical, and oil water separator systems.
 - .2 Test reports will be included in this pay item.
- .16 Other – Item # 15
 - .1 The unit of measurement will be a lump sum item for Contractor specified item.
- .17 Demobilization – Item # 16
 - .1 The unit of measurement will be a lump sum item for demobilizations including all costs associated with removal of debris, the General Conditions, requirements and instructions of the Contract, and cleaning up after completion.

END OF SECTION

Part 1 General

1.1 ADMINISTRATIVE

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

1.2 SHOP DRAWINGS AND PRODUCT DATA

- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Submit drawings stamped and signed by professional engineer registered or licensed in a Province of Canada.
- .3 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been co-ordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .4 Allow seven (7) days for Consultant's review of each submission.

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

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

1.3 PHOTOGRAPHIC DOCUMENTATION

- .1 Submit electronic copy of colour digital photography in jpg format, daily, as directed Consultant. See Section 01 45 00 – 1.6
- .2 Project identification: name and number of project and date of exposure indicated.
- .3 Number of viewpoints:
 - .1 Viewpoints and their location as determined Consultant.
- .4 Frequency of photographic documentation: as directed by Consultant.
 - .1 Upon completion of: excavation, foundation, of Work as directed by Consultant.

1.4 CERTIFICATES AND TRANSCRIPTS

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

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canada Labour Code, Part 2, Canada Occupational Safety and Health Regulations
- .2 Health Canada/Workplace Hazardous Materials Information System (WHMIS)
 - .1 Material Safety Data Sheets (MSDS).
- .3 Province of British Columbia
 - .1 Workers Compensation Act, RSBC 1996 - Updated 2006.
 - .2 Occupational Health and Safety Regulation.
- .4 National Building Code of Canada (NBC)
 - .1 Part 8, Safety Measures at Construction and Demolition Sites.

1.2 WORKERS COMPENSATION BOARD COVERAGE

- .1 Comply fully with Workers' Compensation Act, regulations, and orders made pursuant thereto and any amendments up to the completion of work
- .2 Maintain Workers' Compensation Board coverage during term of Contract, until and including date that Certificate of Final Completion is issued.

1.3 COMPLIANCE WITH REGULATIONS

- .1 DFO may terminate Contract without liability to Canada where Contractor, in the opinion of DFO, refuses to comply with a requirement of Workers' Compensation Act or Occupational Health and Safety Regulations.
- .2 Contractor is responsible to ensure that all workers are qualified, competent and certified to perform work as required by Workers' Compensation Act or Occupational Health and Safety Regulations.

1.4 SUBMITTALS

- .1 Submit to Department Representative submittals listed for review.
- .2 Work affected by submittal will not proceed until review is completed.
- .3 Submit the following:
 - .1 Health and Safety Plan.
 - .2 Copies of reports or directions issued by Federal, Provincial and Territorial health and safety inspectors.
 - .3 Copies of incident and accident reports.
 - .4 Copies of Material Safety Data Sheets and all other documents required by Workplace Hazardous Materials Information System (WHMIS) requirements.

- .5 Emergency procedures
- .6 Work safety plan in 138 kV Substation

- .4 Submission of Health and Safety Plan and any revised version to the Departmental Representative is for information and reference purpose only. It will not:
 - .1 Be construed to imply as approval by Department Representative
 - .2 Be interpreted as warranty of being complete, accurate, and compliant.
 - .3 Relieve the Contractor of his legal obligations for provision of health and safety for the project.

- .5 Medical Surveillance: where prescribed by legislation, regulation or safety program, submit certification of medical surveillance for site personnel prior to commencement of Work, and submit additional certifications for any new site personnel to Departmental Representative.

1.5 WORK PERMITS

- .1 Obtain speciality permit(s) related to the project before start of work

1.6 FILING OF NOTICE

- .1 Complete and submit Notice of Project as required by Provincial authorities.
- .2 Provide copies of all notices to Department Representative.

1.7 SAFETY ASSESSMENT

- .1 Perform site specific safety hazard assessment related to project.

1.8 MEETINGS

- .1 Schedule and administer Health and Safety meeting with Departmental Representative prior to commencement of Work.

1.9 GENERAL REQUIREMENTS

- .1 Develop written site-specific Health and Safety Plan based on hazard assessment prior to beginning site Work and continue to implement, maintain, and enforce plan until final demobilization from site. Health and Safety Plan must address project specifications.
- .2 Departmental Representative may respond in writing, where deficiencies or concerns are noted and may request re-submission with correction of deficiencies or concerns.

1.10 GENERAL CONDITIONS

- .1 Provide safety barricades and lights at work site as required to provide safe working environment for workers

- .2 Ensure that non-authorized persons are not allowed in designated construction areas and work site.
 - .1 Provide appropriate means by use of barricades, fences, and warning signs.

1.11 REGULATORY REQUIREMENTS

- .1 Comply with specified codes, acts, bylaws, standards, and regulations to ensure safe operations at site.
- .2 In the event of conflict between any provision of above authorities, the most stringent provision will apply.

1.12 RESPONSIBILITY

- .1 Be responsible for health and safety of persons on site, safety of property on site and for protection of persons adjacent to site and environment to extent that they may be affected by conduct of Work.
- .2 Comply with and enforce compliance by employees with safety requirements of Contract Documents, applicable federal, provincial, territorial and local statutes, regulations, and ordinances, and with site-specific Health and Safety Plan.

1.13 UNFORSEEN HAZARDS

- .1 When unforeseen or peculiar safety-related factor, hazard, or condition occur during performance of Work, follow procedures in place for Employee's Right to Refuse Work in accordance with Acts and Regulations having jurisdiction and advise Departmental Representative verbally and in writing.

1.14 HEALTH AND SAFETY CO-ORDINATOR

- .1 Employ and assign to Work, competent and authorized representative as Health and Safety Co-ordinator. Health and Safety Co-ordinator must:
 - .1 Have site-related working experience specific to activities associated with the work outlined in the Contract.
 - .2 Have working knowledge of occupational safety and health regulations.
 - .3 Be responsible for completing Contractor's Health and Safety Training Sessions and ensuring that personnel not successfully completing required training are not permitted to enter site to perform Work.
 - .4 Be responsible for implementing, enforcing daily and monitoring site-specific Contractor's Health and Safety Plan.
 - .5 Be on site during execution of work.

1.15 HAZARDOUS PRODUCTS

- .1 Comply with the requirements of Workplace hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials and regarding labelling and provision of Material Safety Data Sheets (MSDS) acceptable to Departmental Representative and in accordance with Canada Labour Code.

1.16 POSTING OF DOCUMENTS

- .1 Ensure applicable items, articles, notices and orders are posted in conspicuous location on site in accordance with Acts and Regulations having jurisdiction, and in consultation with Departmental Representative.

1.17 CORRECTION OF NON-COMPLIANCE

- .1 Immediately address health and safety non-compliance issues identified by authority having jurisdiction or by Departmental Representative.
- .2 Provide Departmental Representative with written report of action taken to correct non-compliance of health and safety issues identified.
- .3 Departmental Representative may stop Work if non-compliance of health and safety regulations is not corrected. The Contractor will be responsible for costs arising from such "stop work order".

1.18 CONFINED SPACES

- .1 Carry out work in confined spaces in compliance with Provincial regulations.

1.19 ELECTRICAL LIMITS OF APPROACH

- .1 Carry out work to limits of approach to exposed 138 kV energized electrical conductors and equipment per BC Hydro Safety Practice Regulations.

1.20 OVERLOADING

- .1 Ensure no part of the work is subject to a load which will endanger its safety or will cause permanent deformation.

1.21 FIRE SAFETY REQUIREMENTS

- .1 Store oily/paint soaked rags, waste products, and materials subject to spontaneous combustion in ULC approved, sealed containers and remove from site on a daily basis
- .2 Handle, store, use and dispose of inflammable and combustible materials in accordance with the National Fire Code of Canada.

1.22 WORK STOPPAGE

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

END OF SECTION

Part 1 General

1.1 REFERENCES

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

1.2 INSPECTION

- .1 Allow Departmental Representatives and Consultant access to Work..
- .2 Give timely notice, at least 5 days in advance and prior to noon on a week-day, requesting inspection if Work is designated for special tests, inspections or approvals by Consultant instructions, or law of Place of Work.
- .3 If Contractor covers or permits to be covered Work that has been designated for special tests, inspections or approvals before such is made, uncover such Work, have inspections or tests satisfactorily completed and make good such Work.
- .4 Consultant will order part of Work to be examined if Work is suspected to be not in accordance with Contract Documents.

1.3 PROCEDURES

- .1 Notify at least 5 days in advance and prior to noon on a week-day, the appropriate agency, Departmental Representative and Consultant of requirement for tests in order that attendance arrangements can be made.
- .2 Submit and process samples and/or materials required for testing, as specifically requested in specifications. Submit with reasonable promptness and in orderly sequence to not cause delays in Work.
- .3 Provide labour and facilities to obtain and handle samples and materials on site.
- .4 Provide sufficient space to store and cure test samples.

1.4 REJECTED WORK

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

1.5 REPORTS

- .1 Submit one (1) signed and dated hardcopy and one (1) electronic (pdf) copy of inspection and test reports to the Consultant.

- .2 Provide copies to applicable subcontractor of work being inspected or tested

1.6 DAILY RECORD OF THE WORK PROGRESS

- .1 The Contractor shall take digital colour photographs daily of the work progress, keep a record of them, and prior to 9AM the following day provide/transmit a copy to the hatchery manager by email in jpg format with a cc to the Consultant and the Department.
- .2 Provide a minimum of four properly focused photos and as many as ten when appropriate, such that the progress and details of the work are readily determinable. Provide additional photos when requested by the Department and Engineer.
- .3 Photos shall be taken using a minimum 7 megapixel rated camera and photos transmitted shall have a resolution of 3000 by 2300 pixels nominal. Transmitted jpg file size of each photo shall be approximately 1 to 2 MB.
- .4 Photos shall be consecutively numbered and shall identify the direction of the aim toward the nearest of one of 8 cardinal directions e.g. N, NE, E, SE, S, SW, W, NW. and of what when it is not obvious. For this purpose, the fence adjacent to the property line shall be considered to be at the north end of the switchyard.
- .5 The daily photos' email shall briefly report the day's work activity(s), the approximate temperature at 2PM and the weather (e.g. sunny, cloudy, overcast, drizzle, rain; calm, breezy, windy, with modifiers: some, partially, mostly, AM, PM, all day, etc.). Point/bullet form wording will be acceptable

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals for work in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Material Safety Data Sheets (MSDS)
 - .1 Submit Material Safety Data Sheets (MSDS) in accordance with Section 01 33 00 - Submittal Procedures for the following products. Indicate VOC emissions, prior to installation or use:
 - .1 Adhesives.
 - .2 Paints.
 - .3 Lubricants.
 - .4 Oils.
 - .2 MSDS sheets to comply with Occupational Health and Safety requirements.
- .3 Construction Schedule
 - .1 Submit schedule of construction in accordance with Section 01 33 00 - Submittal Procedures, prior to start of work, in coordination with scheduling requirements, including:
 - .1 Sequence of finish applications and allowances for curing times.
 - .2 Identification of finish types.

1.2 EROSION AND SEDIMENTATION CONTROL

- .1 Follow methods and procedures specified in Section 31 23 33.01 - Excavating, Trenching and Backfilling.
- .2 Take measures to prevent loss of soil by storm water runoff.
- .3 Protect stockpiled topsoil.

1.3 REDUCING SITE DISTURBANCES

- .1 Minimize disturbances to watershed using site water management measures to ensure that watersheds and groundwater will be preserved.
- .2 Construct and erect erosion barriers.
- .3 Take measures to avoid soil compaction.
- .4 Re-grade and re-plant vegetation disturbed and removed during construction.

1.4 GENERAL CONSTRUCTION MATERIALS/PRACTICES

.1 Storage and Collection of Recyclables

- .1 Provide separate storage/handling facilities for consumer recyclables including used paper, newspaper, newsprint, cardboard, glass, metal and plastic.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 PROJECT CLEANLINESS

- .1 Maintain Work in tidy condition, free from accumulation of waste products and debris, including that caused by other Contractors.
- .2 Remove waste materials from site at daily regularly scheduled times or dispose of as directed by Departmental Representative and Consultant.
- .3 Make arrangements with and obtain permits from authorities having jurisdiction for disposal of waste and debris.
- .4 Provide on-site containers for collection of waste materials and debris.
- .5 Provide and use marked separate bins for recycling.
- .6 Dispose of waste materials and debris.
- .7 Use only cleaning materials recommended by manufacturer of surface to be cleaned, and as recommended by cleaning material manufacturer.

1.2 FINAL CLEANING

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

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate waste materials for recycling.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

.1 Not Used.

END OF SECTION

Part 1 General

1.1 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section [01 33 00 - Submittal Procedures].
- .2 Two weeks prior to Substantial Performance of the Work, submit to the Consultant, four final copies of operating and maintenance manuals in English.

1.2 FORMAT

- .1 Organize data as instructional manual.
- .2 Binders: vinyl, hard covered, 3 'D' ring, loose leaf 219 x 279 mm with spine and face pockets.
- .3 When multiple binders are used correlate data into related consistent groupings.
 - .1 Identify contents of each binder on spine.
- .4 Cover: identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents.
- .5 Arrange content under Section numbers and sequence of Table of Contents.
- .6 Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment.
- .7 Text: manufacturer's printed data, or typewritten data.
- .8 Drawings: provide with reinforced punched binder tab.
 - .1 Bind in with text; fold larger drawings to size of text pages.

1.3 CONTENTS - PROJECT RECORD DOCUMENTS

- .1 Table of Contents for Each Volume: provide title of project;
 - .1 Date of submission; names.
 - .2 Addresses, and telephone numbers of Consultant and Contractor with name of responsible parties.
 - .3 Schedule of products and systems, indexed to content of volume.
- .2 For each product or system:
 - .1 List names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
- .3 Product Data: mark each sheet to identify specific products and component parts, and data applicable to installation; delete inapplicable information.
- .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
- .5 Typewritten Text: as required to supplement product data.

- .1 Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Section 01 45 00 - Quality Control.

1.4 AS -BUILT DOCUMENTS AND SAMPLES

- .1 Maintain at site Consultant one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
- .2 Store record documents and samples in field office apart from documents used for construction.
 - .1 Provide files, racks, and secure storage.
- .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual.
 - .1 Label each document "PROJECT RECORD" in neat, large, printed letters.
- .4 Maintain record documents in clean, dry and legible condition.
 - .1 Do not use record documents for construction purposes.
- .5 Keep record documents and samples available for inspection by Consultant.

1.5 RECORDING INFORMATION ON PROJECT RECORD DOCUMENTS

- .1 Record information on set of black line opaque drawings, provided by Consultant .
- .2 Use felt tip marking pens, maintaining separate colours for each major system, for recording information.
- .3 Record information concurrently with construction progress.
 - .1 Do not conceal Work until required information is recorded.
- .4 Contract Drawings and shop drawings: mark each item to record actual construction, including:
 - .1 Measured depths of elements of foundation in relation to finish first floor datum.
 - .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
 - .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction.

- .4 Field changes of dimension and detail.
- .5 Changes made by change orders.
- .6 Details not on original Contract Drawings.
- .7 References to related shop drawings and modifications.
- .5 Specifications: mark each item to record actual construction, including:
 - .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items.
 - .2 Changes made by Addenda and change orders.
- .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections.
- .7 Provide digital photos, if requested, for site records.

1.6 EQUIPMENT AND SYSTEMS

- .1 Include installed colour coded wiring diagrams.
- .2 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences.
 - .1 Include regulation, control, stopping, shut-down, and emergency instructions.
 - .2 Include summer, winter, and any special operating instructions.
- .3 Maintenance Requirements: include routine procedures and guide for troubleshooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
- .4 Include manufacturer's printed operation and maintenance instructions.
- .5 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .6 Provide installed control diagrams by controls manufacturer.
- .7 Include test reports as specified in Section 01 45 00 - Quality Control.

1.7 WARRANTIES AND BONDS

- .1 Develop warranty management plan to contain information relevant to Warranties.
- .2 Submit warranty management plan, 30 days before planned pre-warranty conference, to Consultant approval.
- .3 Warranty management plan to include required actions and documents to assure that Consultant receives warranties to which it is entitled.
- .4 Provide plan in narrative form and contain sufficient detail to make it suitable for use by future maintenance and repair personnel.
- .5 Submit, warranty information made available during construction phase, to Consultant for approval prior to each monthly pay estimate.

- .6 Assemble approved information in binder, submit upon acceptance of work and organize binder as follows:
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within [ten] days after completion of applicable item of work.
 - .4 Verify that documents are in proper form, contain full information, and are notarized.
 - .5 Co-execute submittals when required.
 - .6 Retain warranties and bonds until time specified for submittal.
- .7 Except for items put into use with Department Representative's permission, leave date of beginning of time of warranty until Date of Substantial Performance is determined.
- .8 Include information contained in warranty management plan as follows:
 - .1 Roles and responsibilities of personnel associated with warranty process, including points of contact and telephone numbers within the organizations of Contractors, subcontractors, manufacturers or suppliers involved.
 - .2 Provide list for each warranted equipment, item, feature of construction or system indicating:
 - .1 Name of item.
 - .2 Model and serial numbers.
 - .3 Location where installed.
 - .4 Name and phone numbers of manufacturers or suppliers.
 - .5 Names, addresses and telephone numbers of sources of spare parts.
 - .6 Warranties and terms of warranty: include one-year overall warranty of construction. Indicate items that have extended warranties and show separate warranty expiration dates.
 - .7 Cross-reference to warranty certificates as applicable.
 - .8 Starting point and duration of warranty period.
 - .9 Summary of maintenance procedures required to continue warranty in force.
 - .10 Cross-Reference to specific pertinent Operation and Maintenance manuals.
 - .11 Organization, names and phone numbers of persons to call for warranty service.
 - .12 Typical response time and repair time expected for various warranted equipment.

- .3 Contractor's plans for attendance at 6 and 12 month post-construction warranty inspections.
- .4 Procedure and status of tagging of equipment covered by extended warranties.
- .5 Post copies of instructions near selected pieces of equipment where operation is critical for warranty and/or safety reasons.
- .9 Respond in timely manner to oral or written notification of required construction warranty repair work.
- .10 Written verification to follow oral instructions.
 - .1 Failure to respond will be cause for the Departmental Representative to proceed with action against Contractor.

1.8 WARRANTY TAGS

- .1 Tag, at time of installation, each warranted item. Provide durable, oil and water resistant tag approved by Consultant.
- .2 Attach tags with copper wire and spray with waterproof silicone coating.
- .3 Leave date of acceptance until project is accepted for occupancy.
- .4 Indicate following information on tag:
 - .1 Type of product/material.
 - .2 Model number.
 - .3 Serial number.
 - .4 Contract number.
 - .5 Warranty period.
 - .6 Inspector's signature.
 - .7 Construction Contractor.

Part 2 Products

2.1 NOT USED

- .1 Not Used.

Part 3 Execution

3.1 NOT USED

- .1 Not Used.

END OF SECTION

Part 1 General

1.1 Description of Work

The Work includes all materials, labour, equipment and services for designing, supplying, installing and removing formwork for all cast-in-place concrete work.

1.2 RELATED REQUIREMENTS

.1 Related sections of the Work include:

Section 03 20 00 Concrete Reinforcing

Section 03 30 00 Cast-in-Place Concrete

.2 This section of the Specifications is not necessarily complete in itself. Read it in conjunction with the other sections of the Contract Documents.

1.3 REFERENCES

Unless specified otherwise, the following Standards are the minimum acceptable for performance of the Work.

.1 Canadian Standards Association (CSA International)

.1 CSA-A23.1-14 /A23.2-14, Concrete Materials and Methods of Concrete Construction/ Test Methods and Standard Practices for Concrete.

.2 CSA-O86, Engineering Design in Wood.

.3 CSA O121-08(R2013), Douglas Fir Plywood.

.4 CSA O151, Canadian Softwood Plywood.

.5 CSA O153-13, Poplar Plywood.

.6 CAN/CSA-O325.0-07(R2012), Construction Sheathing.

CAN/CSA-S269.3-M92 (R2013), Concrete Formwork, National Standard of Canada

.2 Underwriters' Laboratories of Canada (ULC)

.1 CAN/ULC-S701-[11], Standard for Thermal Insulation, Polystyrene, Boards and Pipe Covering.

Part 2 Products

2.1 MATERIALS

.1 Formwork materials:

.1 For concrete without special architectural features, use wood and wood product formwork materials to CSA-O121, CAN/CSA-O86, and CSA-O153.

- .2 Rigid insulation board: to CAN/ULC-S701.
- .2 Form ties:
 - .1 Use removable or snap-off metal ties, fixed or adjustable length, free of devices leaving holes larger than 25 mm diameter in concrete surface.
- .3 Form stripping agent:
 - .1 use a pre-approved colourless mineral oil, non-toxic, biodegradable, low VOC, free of kerosene, with viscosity between [70 and 110s Saybolt Universal] [15 to 24 mm²/s] at 40 degrees C, flashpoint minimum 150 degrees C, open cup. Ensure material will not stain, penetrate or discolour the concrete.

Part 3 Execution

3.1 FABRICATION AND ERECTION

- .1 Verify lines, levels, and Work done by others before proceeding with formwork/false work. Ensure dimensions agree with drawings.
- .2 Design, fabricate and erect formwork in accordance with CAN/CSA-S269.3 to produce finished concrete conforming to shape, dimensions, locations and levels indicated within tolerances required by CSA-A23.1/A23.2.
- .3 Align form joints and make watertight.
 - .1 Keep form joints to minimum.
- .4 Use 20 mm chamfer strips on external corners and/or 20 mm fillets at interior corners, joints, unless specified otherwise.
- .5 Form chases, slots, openings, drips, recesses, expansion and control joints as indicated.
- .6 Clean formwork in accordance with CSA-A23.1/A23.2, before placing concrete.

3.2 REMOVAL AND RESHORING

- .1 Leave formwork in place until concrete has attained sufficient strength to adequately support its own weight together with construction loads likely to be imposed.
- .2 With proper curing and protection, the minimum formwork removal times for conventional concrete are:

Construction Category	Minimum Formwork Removal Times ¹	
	Cold Weather Conditions ²	Normal/Hot Weather Conditions ³
Footings	2 days	24 hours
Walls (≤ 1.2 m high)	3 days	2 days

¹ This table applies to conventional concrete made with ASTM Type I, II, GU or MS cement. Earlier formwork removal can be achieved using high early strength concrete.

² Cold weather here is defined as that in which the average daily temperature is less than 4°C for 3 successive days.

³ Normal weather is defined as that in which the average daily temperature is greater than or equal to 10°C for 3 successive days.

3.3 CLEAN-UP

- .1 At completion and during progress of the work maintain premises in a neat and orderly manner. Dispose of all rubbish, construction debris and surplus materials at least on a weekly basis.

END OF SECTION

Part 1 General

1.1 Description of Work

- .1 The Work includes the furnishing of all materials, labour, equipment, and services for supplying and placing concrete reinforcement.

1.2 RELATED REQUIREMENTS

- .1 Related sections of the Work include:
 - Section 03 30 00 – Cast-in-Place Concrete
- .2 This section of the Specifications is not necessarily complete in itself and must be read in conjunction with the other sections of the Contract Documents.

1.3 REFERENCES

Unless specified otherwise, the following Standards are the minimum acceptable for performance of the Work.

- .1 American Concrete Institute (ACI)
 - .1 SP-66-04, ACI Detailing Manual.
- .2 ASTM International
 - .1 ASTM A185/A185M, Standard Specification for Steel Welded Wire Reinforcement, Plain, for Concrete.
- .3 CSA International
 - .1 CSA-A23.1-14/A23.2-14, Concrete Materials and Methods of Concrete Construction/Test Methods and Standard Practices for Concrete.
 - .2 CAN/CSA-A23.3-14, Design of Concrete Structures.
 - .3 CSA-G30.18, Carbon Steel Bars for Concrete Reinforcement.
 - .4 CSA G40.20/G40.21, General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.
 - .5 CSA W186-M1990 (R2007), Welding of Reinforcing Bars in Reinforced Concrete Construction.
- .4 Reinforcing Steel Institute of Canada (RSIC)
 - .1 RSIC, Reinforcing Steel Manual of Standard Practice.

1.4 SOURCE QUALITY CONTROL

- .1 Submit in accordance with Section 01 45 00 - Quality Control and as described below:
 - .1 Mill Test Report: provide Department Representative with certified copy of mill test report of reinforcing steel, showing physical and chemical analyses as well as yield strengths minimum 2 weeks prior to beginning reinforcing work.
 - .2 Submit copies of test data demonstrating the strength of mechanical connectors supplied, where applicable.
 - .3 Upon request submit in writing to Department Representative proposed source of reinforcement material to be supplied.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Storage and Handling Requirements:
 - .1 Store materials off ground on platforms, skids or racks and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area. Protect reinforcing steel from prolonged exposure to weather.
 - .2 Replace defective or damaged materials with new, at no cost to Department.

Part 2 Products

2.1 MATERIALS

- .1 Substitute different size bars only if permitted in writing by Department Representative.
- .2 Reinforcing steel: billet steel, Grade 400R, deformed bars to CSA-G30.18, unless indicated otherwise.
- .3 Welded reinforcing steel: weldable billet steel, Grade 400W deformed bars to CSA-G30.18.
- .4 Chairs, bolsters, bar supports, spacers: to CSA-A23.1/A23.2.

2.2 FABRICATION

- .1 Fabricate reinforcing steel in accordance with CSA-A23.1/A23.2, SP-66 RSIC Manual of Standard Practice.

Part 3 Execution

3.1 FIELD BENDING

- .1 Do not field bend or field weld reinforcement except where indicated or authorized by Department Representative.
- .2 When field bending is authorized, bend without heat, applying slow and steady pressure. Maximum bar size for bending: 25M, 30M. Carry out bending in accordance with RSIC Manual.
- .3 Replace bars which develop cracks or splits, at no cost to Department.

3.2 PLACING REINFORCEMENT

- .1 Place reinforcing steel as indicated on placing drawings in accordance with CSA-A23.1/A23.2.
- .2 If location is not specifically noted on the drawings, place reinforcing steel symmetrically with respect to supports or mid-span.
- .3 Use bar supports for all reinforcement, including slab-on-grade construction.
- .4 Prior to placing concrete, obtain Department Representative approval of reinforcing material and placement. Provide 24 hours notice prior to concrete casting.
- .5 Ensure the specified cover to reinforcement is maintained during concrete pour.
- .6 Provide the following minimum concrete protection cover for reinforcement ties, or principal bars if no ties are present, unless indicated otherwise on the engineering drawings:
 - .1 Where concrete surface is to be exposed to ground or weather and where concrete is:

Placed against ground	75mm
Placed against formwork or lean mix concrete	50mm
- .7 Maintain the specified concrete cover to the surface of mechanical splices and to any ties in the vicinity of such splices.
- .8 Tighten mechanical connectors to the manufacturer's recommended wrench setting.
- .9 Protect projecting dowels from damage and cold bending.
- .10 Clean all reinforcing steel before placing concrete.

3.3 CLEANING

- .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Related sections of the Work include:
 - Concrete Formwork Section 03 10 00
 - Concrete Reinforcement Section 03 20 00

- .2 This section of the Specifications is not necessarily complete in itself. Read it in conjunction with the other sections of the Contract Documents.

1.2 REFERENCES

- .1 Unless specified otherwise the following standards are the minimum acceptable Standards for performance of the Work. If a more recent edition is available at the time of construction, use the most recent edition.

- .2 Reference Standards:
 - .1 ASTM International
 - .1 ASTM C260/C260M-10, Standard Specification for Air-Entraining Admixtures for Concrete.
 - .2 ASTM C309-11, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - .3 ASTM C494/C494M-13, Standard Specification for Chemical Admixtures for Concrete.
 - .4 ASTM C1017/C1017M-07, Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete.
 - .2 Canadian General Standards Board (CGSB)
 - .1 CAN/ CGSB 41 GP 35M: Polyvinyl Chloride Waterstop
 - .3 CSA International
 - .1 CSA A23.1/A23.2- 14, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.
 - .2 CSA A283-06 (R2011), Qualification Code for Concrete Testing Laboratories.
 - .3 CSA A3000-13, Cementitious Materials Compendium (Consists of A3001, A3002, A3003, A3004 and A3005).

1.3 ACTION AND INFORMATIONAL SUBMITTALS

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

- .2 Provide mix design and testing results for review by Department Representative and do not proceed without written approval when deviations from mix design or parameters are found.

- .1 The Department Representative review of mix designs is for general conformity with specified requirements only, and in no way mitigates the Contractor's obligation to provide concrete suitable for placing in the locations shown and meeting all specified requirements.
- .3 Concrete pours: provide accurate records of poured concrete items indicating date and location of pour, quality, air temperature and test samples taken as described in PART 3 - FIELD QUALITY CONTROL.
- .4 Concrete hauling time: provide for review by Department Representative deviations exceeding maximum allowable time of 120 minutes for concrete to be delivered to site of Work and discharged after batching.

1.4 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Provide Department Representative, minimum 2 weeks prior to starting concrete work, with valid and recognized certificate from plant delivering concrete.
- .3 Provide test data and certification by qualified independent inspection and testing laboratory that all materials and mix designs used in concrete mixture will meet specified requirements and will comply with CSA A23.1 and that materials and mix design are adjusted to prevent excessive expansion due to alkali aggregate reactivity.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Concrete hauling time: deliver to site of Work and discharged within 120 minutes maximum after batching.
 - .1 Do not modify maximum time limit without receipt of prior written agreement from Departmental Representative and concrete producer as described in CSA A23.1/A23.2.
 - .2 Deviations to be submitted for review by Department Representative.
 - .2 Concrete delivery: ensure continuous concrete delivery from plant meets CSA A23.1/A23.2.
 - .3 Measure, batch, mix and deliver concrete with a delivery ticket for each load in accordance with CSA A23.1, Clause 18.

Part 2 Products

2.1 MATERIALS

- .1 Portland Cement: to CSA A3001, Type GU.
- .2 Water:

Potable water is suitable for use in the manufacture of concrete. Water will not contain impurities that adversely affect concrete strength, setting time or cause

efflorescence, staining, corrosion of reinforcement, volume instability or reduced durability. Water of unknown quality will not be used in concrete unless it produces 28-day concrete strengths equal to at least 90 percent of a control mixture. Where the quality of the water is in question, Department Representative has the option to test the water to meet the following criteria below:

Acceptance Criteria for Questionable Water Supplies		
	Limit	Test Method
Compressive strength, minimum percentage of control mixture at 28 days ¹	90%	CSA A23.2-8A

¹ The control mixture will be produced using the same materials, proportions and a known acceptable water supply.

Chemical Limits for Water Used for Making Concrete		
Chemical or Type of Construction	Maximum Concentration in Mixing Water (mg/L)	Test Method
Chlorides	1,000	ASTM D512
Sulphates (as SO ₄)	3,000	ASTM D516
Alkalis	500	ASTM D4191
Alkalies (as Na ₂ O + 0.658 K ₂ O)	600	ASTM D4192
Total Solids	50,000	AASHTO T26

- .3 Aggregates: to CSA A23.1/A23.2. Use normal density aggregates.
- .4 Admixtures:
 - .1 Air entraining admixture: to ASTM C260.
 - .2 Chemical and super plasticizing admixtures: to ASTM C494 ASTM C1017. Department Representative to approve accelerating or set retarding admixtures during cold and hot weather placing and before using any other than specified. Do not allow moisture of any kind to come into contact with retarder film.
 - .3 Do not use admixtures containing calcium chloride.
- .5 Waterstop:
 - .1 Waterstop will be a multi-ribbed, dense, homogeneous extruded polyvinylchloride (PVC) material in accordance with Canadian General Standards Board CGSB 41-GP-35M Type II and free of welds, splices or other imperfections.

- .2 PVC waterstops splices for T and Corner joints will be factory formed and only butt splices will be allowed in the field. Butt splices will be formed by applying a thermostatically controlled electric source of heat and welding material in accordance with the manufacturer's splicing instructions. Lapped splices will not be permitted. Splices will have a tensile strength not less than 60 percent of the unspliced materials' tensile strength. Maintain continuity of waterstop and bulbs.
- .3 Correct positioning of waterstops is critical and will be as per manufacturers written directions. Ensure that, voids, honeycombing, segregations of the concrete mix or any condition which leads to greater permeability around the waterstop is avoided.

2.2 MIXES

- .1 All concrete will be proportioned to provide a homogeneous workable mix, consistent with placement and finishing requirements specified herein. Proportioning and mixing of admixtures will be in accordance with the manufacturer's specifications.
- .2 The Contractor will be responsible for the design of the concrete mix. The Contractor will make available to Department Representative the concrete mix design and the concrete test results. The mix will be designed in accordance with CSA A23-M and as a minimum will meet the following requirements:

Location	28 Days Minimum Compressive Strength, fc' (MPa)	Cement Type (except as noted below)	Maximum Aggregate Size (mm)	Maximum Water/Cement Ratio (by weight)	Air Content by Volume (%)	Maximum Slump (mm)	Exposure Condition
Fence Posts and Duct banks	25	10	20	0.5	5 - 8	80± 20	F-2
All Concrete structures	30	10	20	0.5	5 - 8	80± 20	F-2

Part 3 Execution

3.1 PREPARATION

- .1 Place concrete reinforcing in accordance with CSA A23.1 and Section 03 20 00 - Concrete Reinforcing.
- .2 Ensure reinforcement and inserts are not disturbed during concrete placement.
- .3 Clean and remove stains prior to application for concrete finishes.
- .4 Maintain accurate records of poured concrete items to indicate date, location of pour, quality, air temperature and test samples taken.
- .5 Do not place load upon new concrete until authorized by Departmental Representative.

3.2 CONSTRUCTION

- .1 Do cast-in-place concrete work to CSA A23.1/A23.2.
- .2 Finishing and curing:
 - .1 Remove defective concrete, blemishes and embedded debris and repair as directed by the Department Representative .
 - .2 Cure and protect all concrete.
 - .3 Protect fresh concrete from rain, flowing water and mechanical damage.
 - .4 Initial curing period: 7 days. without interruption. Do not allow any part of the concrete surface to become dry, even for a short period of time.
 - .5 Final curing period: 7 cumulative days, not necessarily consecutive, where the temperature of the air in contact with the concrete is above 10°C.
 - .6 Maintain concrete above 10°C during the initial curing period. When using heating units, wet down exposed concrete surfaces within the vicinity of heating units with a hose stream at least once every 6 hours. Prevent drying of the concrete around any heating units. At the end of the curing period, discontinue artificial heating such that the fall in temperature at any point in the concrete will not exceed 5°C in 24 hours.
 - .7 Initial curing for horizontal and unformed surfaces:
 - .1 Thoroughly wet surface once it has set sufficiently to allow foot traffic without marking. Apply jute fabric and keep continually soaked, or cover with curing mats or blankets coverings, during the initial curing period. Ensure fabric, mats or blankets are firmly fixed in place to prevent exposing the surface being cured to air currents.
 - .2 Moist cure with ponded water. Wet down entire surface being cured at least two times a day, and more frequently during hot weather.
 - .8 Initial curing for formed surfaces:

- .1 Keep steel forms heated by the sun and all wood forms in contact with the concrete wet during the initial curing period.
 - .2 Where forms are to be removed during the curing period, immediately soak surface after stripping and apply curing compound in two coats at a rate of 3.75 m²/litre per coat.
 - .3 Wet down entire surface being cured at least two times a day, and more frequently during hot weather.
-
- .9 Do not allow any spot on the surface temperature of the concrete to exceed 35°C during the curing period
- .3 Waterstops:
 - .1 Install waterstops to provide continuous water seal.
 - .2 Do not distort or pierce waterstop in way as to hamper performance.
 - .3 Do not displace reinforcement when installing waterstops.
 - .4 Use equipment to manufacturer's requirements to field splice waterstops.
 - .5 Tie waterstops rigidly in place.
 - .6 Use only straight heat sealed butt joints in field.
 - .7 Use factory welded corners and intersections unless otherwise approved by Department Representative.
 - .4 Construction and Control Joints
 - .1 Locate joints as indicated on the Drawings and Standards or as approved by the Department Representative.
 - .2 If construction joints are required, conform to CSA A23.1, Clause 20.
 - .3 Provide control joints conforming to CSA-A23.1, Clause 20.2.
 - .4 Fill control joints as shown in the drawings.

3.3 FIELD QUALITY CONTROL

- .1 Site tests: conduct tests as follows in accordance with Section 01 45 00 - Quality Control and submit report as described in PART 1 - ACTION AND INFORMATIONAL SUBMITTALS.

The Contractor will be responsible for the quality control of the concrete and will provide concrete for all tests. Testing will be arranged and paid for by the Contractor.

The Contractor will prepare at least one set of test cylinders per day and no less than one set of test cylinders for each 50 m³ of concrete placed. Standard 100 mm x 200 mm cylinders or 150 mm x 300 mm cylinders will be supplied by the Contractor.

Each test set will consist of four cylinders taken from the point of placement. Two cylinders from each set will be tested at 7 days and two at 28 days. When Sulfite Resistant concrete is specified two additional cylinders for a 56 day tests will be required.

The Contractor will identify, cure and ship the cylinders. Testing will be in accordance with the requirements of CSA A23.2.

3.4 CLEANING

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

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.1-2015, Canadian Electrical Code, Part 1 (21st Edition), Safety Standard for Electrical Installations.
 - .2 CAN/CSA-C22.3 No. 1-[01(Update March 2005)], Overhead Systems.
 - .3 CAN3-C235-83(R2010), Preferred Voltage Levels for AC Systems, 0 to 50,000 V.
- .2 Electrical and Electronic Manufacturer's Association of Canada (EEMAC)
 - .1 EEMAC 2Y-1, Light Gray Colour for Indoor Switch Gear.
- .3 Institute of Electrical and Electronics (IEEE)/National Electrical Safety Code Product Line (NESC)
 - .1 IEEE SP1122-2000, The Authoritative Dictionary of IEEE Standards Terms, 7th Edition.

1.2 DEFINITIONS

- .1 Electrical and electronic terms: unless otherwise specified or indicated, terms used in these specifications, and on drawings, are those defined by IEEE SP1122.

1.3 DESIGN REQUIREMENTS

- .1 Operating voltages: to CAN3-C235.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard.
 - .1 Equipment to operate in extreme operating conditions established in above standard without damage to equipment.
- .3 Language operating requirements: provide identification nameplates for control items in English.

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submittals: in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data: submit WHMIS MSDS in accordance with Section 01 47 15 - Sustainable Requirements
- .3 Submit for review single line electrical diagram under Plexiglas in glazed frame and locate in:
 - .1 Electrical distribution system in main electrical room (600V Powerhouse).

1.5 QUALITY ASSURANCE

- .1 Quality Assurance: in accordance with Section 01 45 00 - Quality Control.
- .2 Qualifications: electrical Work to be carried out by qualified, licensed electricians who hold valid Master Electrical Contractor license SPEC NOTE: Use the following paragraph to schedule a project start meeting with key personnel representing the general and sub-contractors.
- .3 Schedule and Site Meetings:
 - .1 Per Section 01 11 00

1.6 DELIVERY, STORAGE AND HANDLING

- .1 Construction/Demolition Waste Management and Disposal: separate waste materials for recycling.
- .2 Provide recycling plan to the Department Representative and Consultant.

1.7 SYSTEM STARTUP

- .1 Instruct operating personnel in operation, care and maintenance of systems, system equipment and components.
- .2 Arrange and pay for services of transformer T-1 manufacturer's factory service representative to supervise start-up of installation, assemble, check, adjust, balance and calibrate components and instruct operating personnel.
- .3 Provide these services for such period, and for as many visits as necessary to put T1 equipment in operation.
- .4 Ensure that operating personnel are conversant with aspects of the care and operation of transformer T1 and transformer T2 unit equipment.

1.8 OPERATING INSTRUCTIONS (for equipment supplied by the Contractor)

- .1 Provide for each system and principal item of equipment specified in technical sections for use by operation and maintenance personnel.
- .2 Operating instructions to include following:
 - .1 Wiring diagrams, control diagrams, and control sequence for each principal system and item of equipment.
 - .2 Start up, proper adjustment, operating, lubrication, and shutdown procedures.
 - .3 Safety precautions.
 - .4 Procedures to be followed in event of equipment failure.
 - .5 Other items of instruction as recommended by manufacturer of each system or item of equipment.
- .3 Print or engrave operating instructions and frame under glass or in approved laminated plastic.
- .4 Post instructions where directed.
- .5 For operating instructions exposed to weather, provide weather-resistant materials or weatherproof enclosures.

- .6 Ensure operating instructions will not fade when exposed to sunlight and are secured to prevent easy removal or peeling.

Part 2 Products

2.1 MATERIALS AND EQUIPMENT

- .1 Material to be CSA certified. Where CSA certified material is not available, obtain special approval from authority having jurisdiction before delivery to site and submit such approval as described in PART 1 - SUBMITTALS.
- .2 Factory assemble disconnect switches, panels and component assemblies.

2.2 WARNING SIGNS

- .1 Warning Signs: in accordance with requirements of authorities having jurisdiction, inspection authorities, Consultant and CEC.
- .2 Porcelain enamel signs, minimum size 175 x 250 mm.

2.3 WIRING TERMINATIONS

- .1 Ensure lugs, terminals, screws used for termination of wiring are suitable for either copper or ACSR conductors, as applicable.

2.4 EQUIPMENT IDENTIFICATION

- .1 Identify electrical equipment with nameplates as follows:
 - .1 Nameplates: lamicoid 3 mm thick, matt white finish face, black core, lettering accurately aligned and engraved into core mechanically attached with self tapping screws.
 - .2 Sizes as follows:

NAMEPLATE SIZES			
Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	3 mm high letters
Size 4	20 x 90 mm	1 line	8 mm high letters
Size 5	20 x 90 mm	2 lines	5 mm high letters
Size 6	25 x 100 mm	1 line	12 mm high letters
Size 7	25 x 100 mm	2 lines	6 mm high letters

- .2 Labels: embossed plastic labels with 6 mm high letters unless specified otherwise.
- .3 Wording on nameplates to be approved by Consultant prior to manufacture.
- .4 Allow for minimum of twenty-five (25) letters per nameplate.

- .5 Nameplates for terminal cabinets and junction boxes to indicate system and/or voltage characteristics.
- .6 Not used.
- .7 Transformers: indicate capacity, primary and secondary voltages.

2.5 WIRING IDENTIFICATION

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

2.6 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Code with plastic tape or paint at points where conduit or cable enters wall, ceiling, or floor, and at 15 m intervals.
- .3 Colours: 25 mm wide prime colour and 20 mm wide auxiliary colour.

<u>Purpose</u>	<u>Prime</u>	<u>Auxiliary</u>
up to 250 V	Yellow	
up to 600 V	Yellow	Green
up to 25 kV	Yellow	Red
Telephone	Green	
Other Communication Systems	Green	Blue
Emergency Voice	Red	Blue
Other Security Systems	Red	Yellow

2.7 FINISHES

- .1 Touch up transformer paint surfaces that are scratched with application of rust resistant primer, and at least two coats of finish enamel. Paint to match existing finish.

Part 3 Execution

3.1 INSTALLATION

- .1 Do complete installation in accordance with CSA C22.1 except where specified otherwise.
- .2 Do overhead and underground systems in accordance with CSA C22.3 No.1 except where specified otherwise.

3.2 NAMEPLATES AND LABELS AND SIGNS

- .1 Ensure manufacturer's nameplates, CSA labels and identification nameplates are visible and legible after equipment is installed.

Install HV hazard symbol/warning sign on switchyard fence, on each side, per CEC, and adjacent to each personnel access gate, on padlock side. On each gate install a sign engraved using black 25mmH lettering on white background: **AUTHORIZED PERSONNEL ONLY**

3.3 CONDUIT AND CABLE INSTALLATION

- .1 No cable or conduit may penetrate the top of the containment apron slab. Pass through the transformer foundations, clear of equipment and 70mm clear of sides.
- .2 Install conduits and sleeves prior to pouring of concrete.
 - .1 Conduits through concrete: rigid PVC sized for free passage of cables and conductors and protruding 150 mm minimum.
 - .2 Sleeves through concrete for ground conductors: rigid PVC sized for free passage of conductors and protruding 5 mm minimum.
 - .3 Install nylon pull string in all ducts and conduits.
 - .4 Install caps on spare ducts and conduits.

3.4 CO-ORDINATION OF PROTECTIVE DEVICES

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

3.5 FIELD QUALITY CONTROL

- .1 Conduct following tests in accordance with Section 01 45 00 - Quality Control.
 - .1 Power system including phasing, voltage, and grounding.
 - .2 Insulation resistance testing:
 - .1 Hi-pot 28 kV cables.
 - .2 Megger circuits, feeders and equipment up to 350 V with a 500 V instrument.
 - .3 Megger 350-600 V circuits, feeders and equipment with a 1000 V instrument.
 - .4 Check resistance to ground before energizing.
- .2 Carry out tests in presence of Department Representative and Consultant.
- .3 Provide instruments, meters, equipment and personnel required to conduct tests during and at conclusion of project.

- .4 Manufacturer's Field Services:

- .1 Obtain written report from manufacturer verifying compliance of Work, in handling, installing, applying, protecting and cleaning of product and submit Manufacturer's Field Reports as described in PART 1 - SUBMITTALS.
- .2 Provide manufacturer's field services consisting of product use recommendations and periodic site visits for inspection of product installation in accordance with manufacturer's instructions.
- .3 Schedule site visits, to review Work, as directed in PART 1 - QUALITY ASSURANCE.

3.6 CLEANING

- .1 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint.
- .2 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 22.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA-C22.2 No. 131-07, Type TECK 90 Cable.
 - .2 CAN/CSA-C61089-2003, Round Wire Concentric Lay Overhead Electrical Stranded Conductors.
- .2 National Electrical Manufacturers' Association (NEMA)/Insulated Cable Engineers Association (ICEA)
 - .1 ICEA S-93-639/NEMA WC74-06, 5-46 KV Shielded Power Cable for Use in the Transmission and Distribution of Electrical Energy.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Provide product data in accordance with Section 01 33 00 - Submittal Procedures.
 - .1 Provide manufacturer's printed product literature, specifications, data sheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
 - .1 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling.

Part 2 Products

2.1 PRIMARY OVERHEAD CONDUCTORS (138kV)

- .1 Bare aluminum conductors steel reinforced: to CAN/CSA-C61089, size as indicated.

2.2 ETHYLENE PROPYLENE RUBBER (EPR) INSULATED CABLES (28kV)

- .1 Conductor: copper, size as indicated.
- .2 Conductor shield: extruded semi-conducting thermoset polymeric layer.
- .3 Insulation: EPR, 133% insulation level, 105 deg C.
- .4 Insulation shielding: copper tape shield.
- .5 Cable jacket: black PVC, FT-4.

Part 3 Execution

3.1 INSTALLATION

- .1 Install overhead conductors as indicated.
- .2 Install power cables in ducts as indicated and in accordance with manufacturer's instructions.
- .3 Provide supports and accessories for installation of high voltage power cables.
- .4 Install stress cones, terminations and splices in accordance with manufacturer's instructions.
- .5 Install grounding in accordance with manufacturer's recommendations and local inspection authority having jurisdiction.
- .6 Provide cable identification tags and identify each phase conductor of power cable.
- .7 Remove existing overhead conductor phase nameplates from existing 300kVA transformer, position and re-install similarly on 4,000MVA transformer **T1**.

3.2 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical, and manufacturers' recommendations.
- .2 Use qualified tradespersons for installation, splicing, termination and testing of high voltage power cables.
- .3 Engage an independent testing company to test high voltage power cables. Submit test results and inspection certificate to Consultant.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

.1 Section 26 05 22.

1.2 REFERENCES

.1 See Section 26 05 00.

1.3 PRODUCT DATA

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

1.4 DELIVERY, STORAGE AND HANDLING

.1 Packaging Waste Management: remove for reuse (cable reels), and recycling.

Part 2 Products

2.1 INSULATED AND NON-INSULATED CONDUCTORS

.1 Conductors:

- .1 Grounding conductor: copper, size as indicated.
- .2 Circuit conductors: copper, size as indicated

.2 Insulation:

- .1 Cross-linked polyethylene (XLPE).
- .2 Rating: 1000 V

2.2 TECK 90 CABLE

.1 Cable: in accordance with Section 26 05 00 - Common Work Results for Electrical.

.2 Conductors:

- .1 Grounding conductor: copper as indicated.
- .2 Circuit conductors: copper size as indicated.

.3 Insulation:

- .1 Cross-linked polyethylene (XLPE).
- .2 Rating: 1000 V.

.4 Inner jacket: [polyvinyl chloride] material.

.5 Armour: interlocking aluminum.

.6 Overall covering: thermoplastic polyvinyl chloride, FT-4.

- .7 Fastenings:
 - .1 One-hole aluminum straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables at 900 mm centers.
 - .3 Threaded rods: 6 mm diameter to support suspended channels.
- .8 Connectors:
 - .1 Watertight, approved for TECK cable.

Part 3 Execution

3.1 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction over installation.
- .3 Perform tests before energizing electrical system.

3.2 GENERAL CABLE INSTALLATION

- .1 Install cable in trenches in accordance with Section 33 71 73.02 - Underground Electrical Service.
- .2 Cable Colour Coding: to Section 26 05 00 - Common Work Results for Electrical.
- .3 Conductor length for parallel feeders to be identical.
- .4 Lace or clip groups of feeder cables at distribution centres, pull boxes, and termination points.
- .5 Provide numbered wire collars for control wiring. Numbers to correspond to control shop drawing legend. Obtain wiring diagram for control wiring.

3.3 INSTALLATION OF TECK-90 CABLE (0 -1000 V)

- .1 Group cables wherever possible on channels.
- .2 Install cable securely supported by straps and hangers.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sections 26 05 14 and 26 05 21.

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CSA C22.2 No. 65-13.
 - .2 CSA C22.2 No.41-M1987 (R1999), Grounding and Bonding Equipment.

1.3 PRODUCT DATA

- .1 Submit product data in accordance with Section 01 33 00 - Submittal Procedures.

1.4 CERTIFICATES

- .1 Obtain inspection certificate of compliance covering high voltage stress coning from supplier/manufacturer, and include it with maintenance manuals.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Separate and recycle waste materials.
- .2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .3 Collect and separate for disposal packaging and other material for recycling in accordance with Contractor's Waste Management Plan.

Part 2 Products

2.1 CONNECTORS AND TERMINATIONS

- .1 For copper conductors: Copper long barrel compression connectors, two holes, sized for conductors.
- .2 For 138 kV ACSR conductors: Connectors suitable for the purpose and material.

Part 3 Execution

3.1 INSTALLATION

- .1 Install stress cones, terminations, and splices in accordance with manufacturer's instructions.
- .2 Bond and ground as required to CSA C22.2 No.41.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 American National Standards Institute/Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-[02], Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Provide manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.
- .3 Quality assurance submittals: provide in accordance with Section [01 45 00 - Quality Control].
 - .1 Manufacturer's Instructions: provide manufacturer's written installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.4 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Waste Management and Disposal:
 - .1 Separate waste materials for recycling.

Part 2 Products

2.1 MATERIALS

- .1 Rod electrodes: copper clad steel, 19 mm diameter by 3m and 6m long.
- .2 Conductors: bare, stranded, soft annealed copper wire.
Size No. 4/0 AWG for buried ground grid, electrode interconnections, metal structures, gradient control mats, surge arrestors, transformers' ground connections.
Size No. 2/0 AWG, minimum, for fencing ground risers.
- .3 Bolted removable test-links.

- .4 Gradient control mat: hot dip galvanized steel, size 1.2 m x 1.8 m, 150 mm x 150 mm mesh and 0.635 mm thick. Use silicone bronze connectors, bolts, nuts and lock washers.
- .5 Accessories: non-corroding, necessary for complete grounding system, type, size material as indicated, including:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Bonding jumpers, straps
 - .5 Compression connectors.
 - .6 Pressure wire connectors.

Part 3 Execution

3.1 CARE, AVOIDANCE, AND ADJUSTMENTS TO EXISTING UNDERGROUND WIRES AND CABLE(S)

- .1 Use and interpret the drawings to determine location and pathways for existing underground cables and ground grid wires.
- .2 Use electrical experience, knowledge, and judgement to determine location and pathways for existing underground cables and ground grid.
- .3 Based on the above information, avoid contact or interference with any of the underground cables and ground grid wires except when necessary for the Work
- .4 When required to expose or excavate near underground cable locations, and substation ground grid wires, uses hand digging methods to locate and expose the cables and ground wires.
- .5 It will be necessary to make minor adjustments to the existing ground grid to accommodate some civil works. This may include minor downward movement and bending of the existing grid wires for new foundations and containment basin. Cables beneath containment shall remain but may be lowered to the extent of the excavation such that they are beneath the concrete being placed.
- .6 Any adjustments that are made to the grounding grid shall be made with proper care and attention so that the existing ground grid arrangement remains intact and satisfies the original design purposes. Any damages or loosened connections to the existing ground grid wires shall be repaired or replaced in accordance with the original design purpose of the ground grid.
- .7 Ground grid wires shall not be cut, removed, or otherwise disconnected unless a temporary or permanent shunt of equal size and design is first connected across or around the area to be cut, removed, or disconnected. Exception; ground wires that are being permanently removed.
- .8 Damage to any underground cable or ground grid wires shall be reported to the Department Representative and Consultant. This includes damage caused during execution of the Work as well as any pre-existing damage discovered by the Contractor.

3.2 INSTALLATION

- .1 Install continuous grounding system including, electrodes, conductors, connectors and accessories as indicated and to requirements of local authority having jurisdiction.
- .2 Ground fences to buried grounding system.
- .3 Install compression connectors in accordance with manufacturer's instructions.
- .4 Protect exposed grounding conductors during and after construction.
- .5 Make buried connections, and connections to electrodes, rebar, structural steel work, using compression connectors.
- .6 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .7 Use No. 4/0 AWG bare copper cable for main ground of substation. Bury ground grid conductors 600mm below finished grad except 1000mm deep beneath road and to 300mm from the road.
- .8 Do not use bare copper conductors near un-jacketed lead sheath cables.

3.3 ELECTRODE INSTALLATION

- .1 Install ground rod electrodes. Make grounding connections to substation ground.
- .2 Install gradient control mat. Connect mat to substation ground.
- .3 Where rock or sand terrain prevails, make special provision for installing electrodes that will give acceptable resistance to ground value.

3.4 EQUIPMENT GROUNDING

- .1 Install grounding connections as indicated to substation equipment, non-current carrying parts of transformers, cable sheaths, raceways, substation fence, transformer T1 surge arresters.
- .2 Ground hinged doors to main frame of electrical equipment enclosure with flexible jumper.
- .3 Ground fence-gates to fixed fencing with flexible jumper.

3.5 NEUTRAL GROUNDING

- .1 Connect system ground for each system installation.
- .2 Solidly ground the secondary neutral of transformer T1 and T2 to substation ground grid.
- .3 Supply and install insulated neutral between T2 secondary and BCH metering compartment, size per BC Hydro requirements.

3.6 CABLE SHEATH GROUNDING

- .1 Use No. 6 AWG flexible copper wire soldered, not clamped, to cable sheath.
- .2 Connect bonded cables to ground with No. 2/0 AWG copper conductor.

3.7 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Perform tests before energizing electrical system.
- .3 Engage an independent testing company, such as Levelton Consultants, or Eaton Services, or similar, to perform substation ground resistance test to obtain the substation R, after backfilling but prior to installing crushed rock surfacing. Perform earth loop test and resistance tests using a method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction. Provide step-and-touch potential calculations using substation ground resistance measurements.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

1.2 REFERENCES

- .1 American National Standards Institute /Institute of Electrical and Electronics Engineers (ANSI/IEEE)
 - .1 ANSI/IEEE 837-[02], IEEE Standard for Qualifying Permanent Connections Used in Substation Grounding.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Submit in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for grounding equipment and include product characteristics, performance criteria, physical size, finish.

1.4 CLOSEOUT SUBMITTALS

- .1 Submit in accordance with Section 01 78 00 - Closeout Submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for incorporation into manual.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect grounding equipment from damage.
- .4 Packaging Waste Management: remove for recycling.

Part 2 Products

2.1 EQUIPMENT

- .1 Clamps for grounding of conductor: size as indicated.
- .2 Rod electrodes: copper clad steel 19 mm diameter by minimum 3 m and 6 m long.
- .3 Grounding conductors: bare stranded copper, soft annealed, size as indicated.

- .4 Non-corroding accessories necessary for grounding system, type, size, material as indicated, including but not necessarily limited to:
 - .1 Grounding and bonding bushings.
 - .2 Protective type clamps.
 - .3 Bolted type conductor connectors.
 - .4 Compression connectors.
 - .5 Pressure wire connectors
 - .6 Bonding jumpers, straps.

Part 3 Execution

3.1 INSTALLATION GENERAL

- .1 Install complete permanent, continuous grounding system including, electrodes, conductors, connectors, and accessories.
- .2 Install connectors in accordance with manufacturer's instructions.
- .3 Protect exposed grounding conductors from mechanical injury.
- .4 Make buried connections, and connections to electrodes, using compression connectors
- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Soldered joints not permitted.
- .7 Connect exposed metals to ground.
- .8 Ground secondary service pedestals.
- .9 600V Powerhouse and hatchery site grounding system shall not be interconnected with substation ground or bond conductors. Bonding conductor in 600V supply conduit to powerhouse shall be insulated with 5kV heat shrink for 200mm at powerhouse end and pulled to 100mm short of PVC conduit/duct-end at powerhouse.
- .10 Install two 3m ground electrodes (rods) at powerhouse and interconnect with powerhouse system ground using conductor size required by CEC.

3.2 ELECTRODES

- .1 Install rod electrodes and make grounding connections as indicated.
- .2 Bond separate and multiple electrodes together. Use size 4/0 AWG copper conductors for connections to electrodes.
- .3 Do not bond 600V powerhouse and downstream electrodes with 138kV switchyard electrodes.

3.3 EQUIPMENT GROUNDING

- .1 Install grounding connections to typical equipment included in, but not necessarily limited to following list: transformers, duct systems, steel work.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Engage an independent testing company such as Levelton Consultants, or Eaton Services or similar to perform ground continuity and resistance test after backfill, but prior to installing crushed rock surfacing.
- .3 Perform ground continuity and resistance tests using method appropriate to site conditions and to approval of Consultant and local authority having jurisdiction.
- .4 Perform tests before energizing electrical system.

3.5 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 11 - Cleaning.
 - .1 Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment in accordance with Section 01 74 11 - Cleaning.
- .3 Waste Management: separate waste materials for recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 00.

Part 2 Products

2.1 TRANSFORMERS

- .1 Transformers T1 and T2 were pre-purchased by the Department.
 - a. T1: 138 – 25 kV, 4 MVA
 - b. T2: 25 – 0.6 kV, 500 kVAThese are at the Conuma Hatchery site beside the nearby 600V powerhouse.
- .2 For transformer vendor drawings and data, see Appendixes - A, - B and - C.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Install **T1** identification nameplate above manufacturer's specifications nameplate. Since **T2's** is behind a door, install outside, 150mm below top of compartment door. Use Department's equipment reference label: size 6.
- .3 Label center of T2's instrument compartment left door and right door as follows, respectively:

**25kV ISOLATON SWITCH
AND CIRCUIT BREAKER**

**T2 NAMEPLATE AND
RELAYS & INSTRUMENTS**

- .4 Use Department's equipment reference label: size 7 for nameplates below:
 - a. Label T1's instrument TB panel cover door as follows:
 - b. Label both T1's LV and T2's HV termination compartment covers as follows:

INSTRUMENT CONNECTION BOX

CAUTION

25kV TERMINATIONS

- c. Label T2's 600V compartment door as follows

**600V PDC & 400A SERVICE CB
AND BCH METERING XFMRS**

- d. Label BC Hydro metering panel (outside south fence) cover door as follows:

BC HYDRO SERVICE METER

- e. Label 600V Disconnect Switch (outside south fence) cover door as follows:

**POWERHOUSE 600V SERVICE
ISOLATION SWITCH**

Part 3 Execution

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 INSTALLATION

- .1 Contractor shall engage Powertech Labs Inc for T-1 and T-2 oil sampling.
- .1 Powertech to test, analyse, and make recommendations of the oil samples.
- .2 If oil is not suitable than Powertech to recommend actions to be taken.
- .3 Powertech to provided written report of test and analyse results, and recommendations to Contractor and Consultant.
- .2 Install transformers only after other work in area is completed.
- .3 Install transformers in accordance with manufacturer's instructions.
- .4 Ensure concrete pad is properly cured before installation of transformers.
- .5 Use spreader bars on slings when lifting transformers into place.
- .6 Set and secure transformers in place rigid, plumb, square.
- .7 Assemble to T1:
- .1 Three high voltage bushings,
- .2 Three surge arresters on high side. Ground surge arresters together, to ground pads, and to ground grid on both sides of Transformer,
- .3 Radiators.
- .8 Ensure internal connections are mechanically tight.
- .9 Make connections.
- .10 Connect transformer ground terminal to system ground.
- .11 Set taps to produce rated secondary voltage at no-load.

3.3 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
- .2 Carry out following insulation tests using megger with 20,000 megohm scale and resulting insulation resistance corrected to base of 20 degrees C.
 - .1 High voltage to ground with secondary grounded for duration of test.
 - .2 Low voltage to ground with primary grounded for duration of test.
 - .3 High to low voltage.
- .3 Inspect primary and secondary connections for tightness and for signs of overheating.
- .4 Inspect and clean bushings and insulators.
- .5 Check oil level and temperature indicators.
- .6 Set transformer taps to rated voltage as specified.
- .7 Inspect for oil leaks and excessive rusting.
- .8 Inspect oil level.
- .9 Check fuses for correctness of type and size.
- .10 Set T2's circuit breaker relay settings and test.
- .11 Check for grounding and neutral continuity between primary and secondary circuits of transformer.

3.4 CLEANING

- .1 Proceed in accordance with Section 01 74 11 - Cleaning.
- .2 On completion and verification of performance of installation, remove surplus materials, excess materials, rubbish, tools and equipment.

END OF SECTION

T1 Shop Drawings

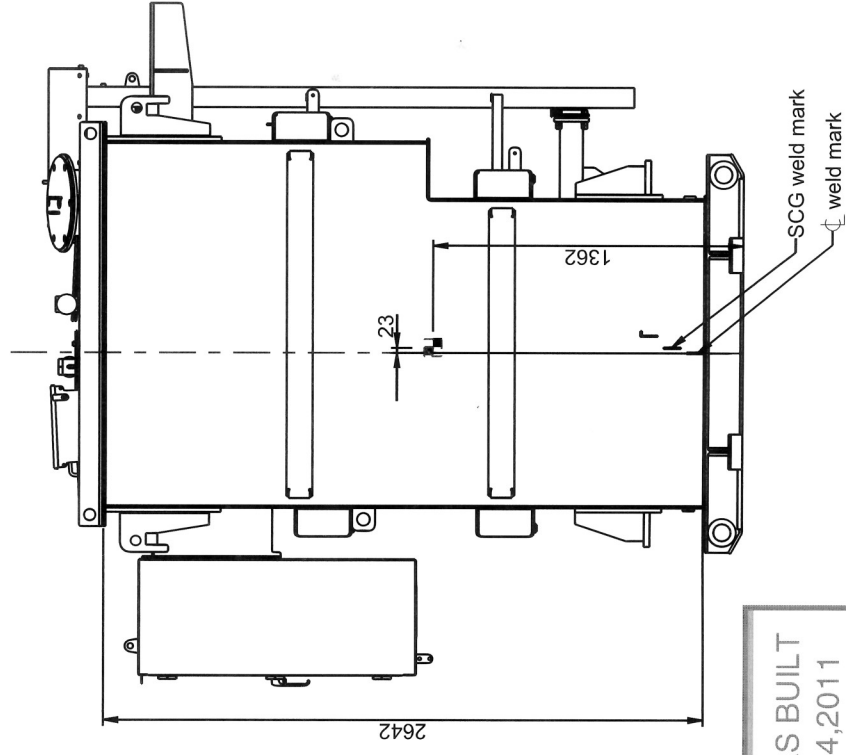
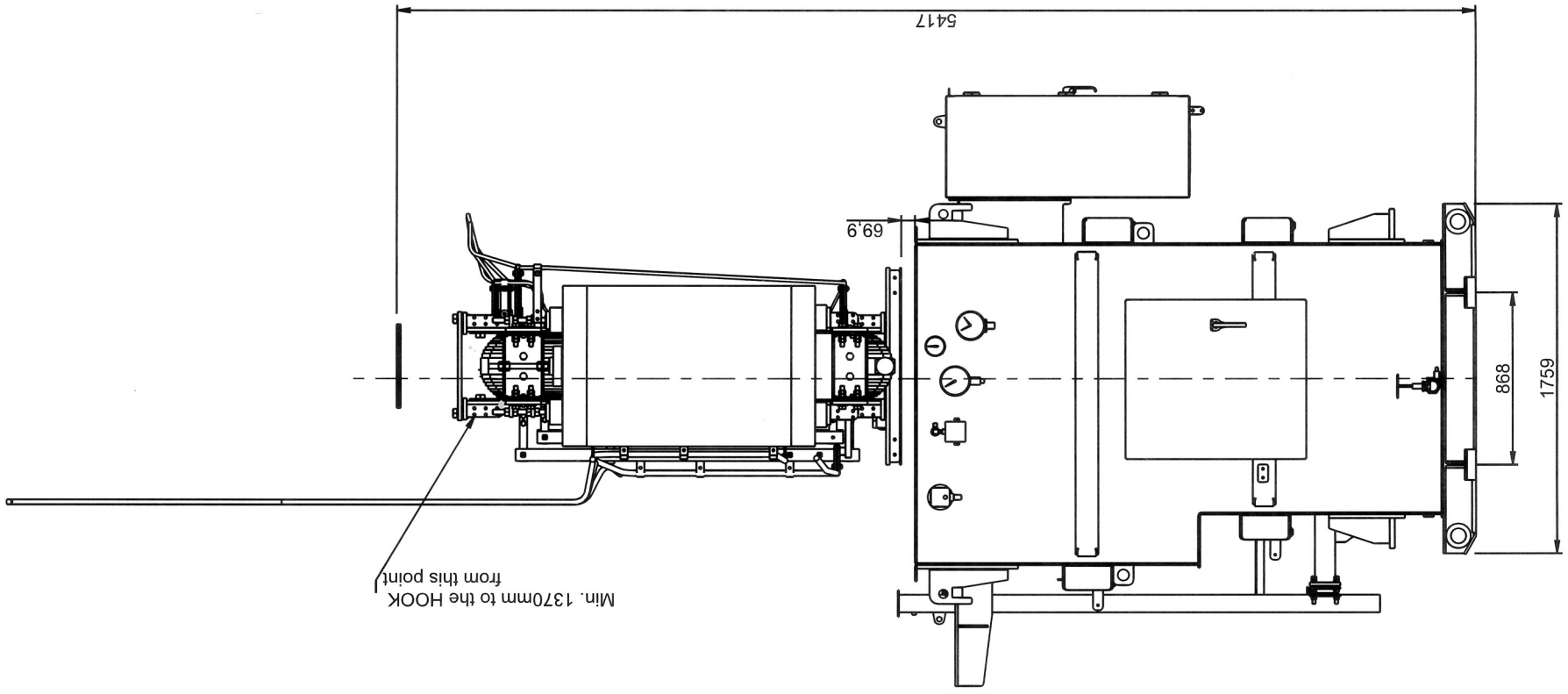
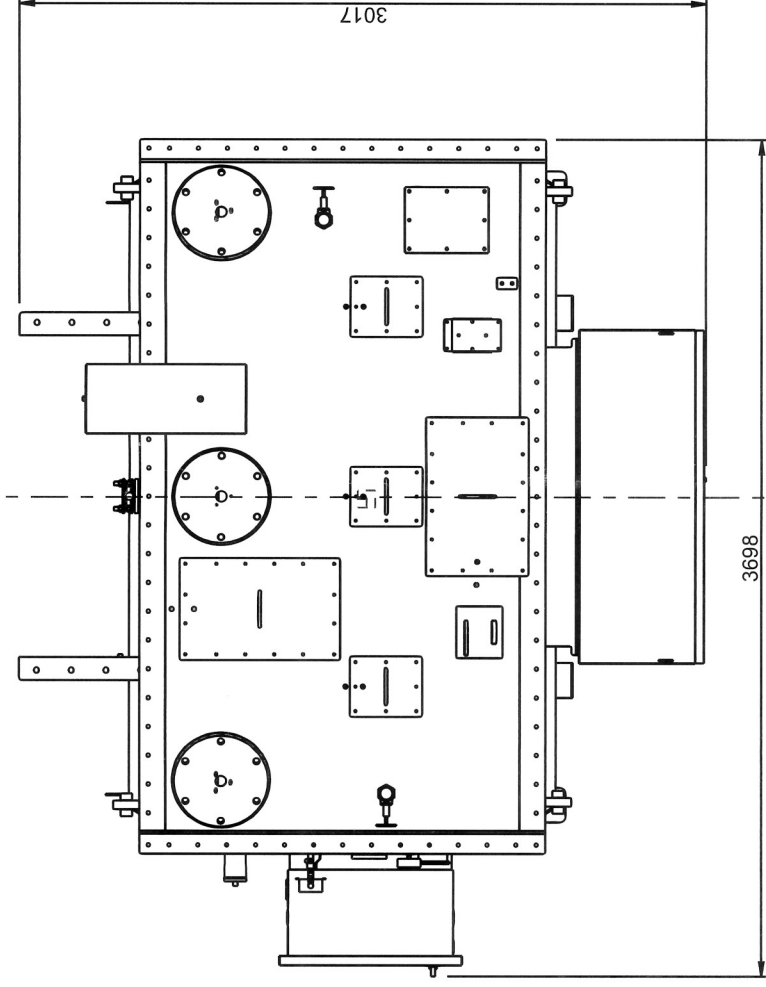
TYPE: THREE PHASE, ONAN
MVA: 4
HIGH VOLTAGE: 138000 V DELTA
HV BIL: 550 KV WINDING / 650 KV BUSHING
HVFC TAPS: ±2 1/2%, ±5%
LOW VOLTAGE: 24940Y/14400V
LV BIL: 125 KV

WINDING TEMPERATURE RISE: 65°C
FREQUENCY: 60 HZ

CALCULATED SHIPPING MASS:

SHIPPING MASS: 22100 KG
SHIPPING PARTS MASS: 1205 KG

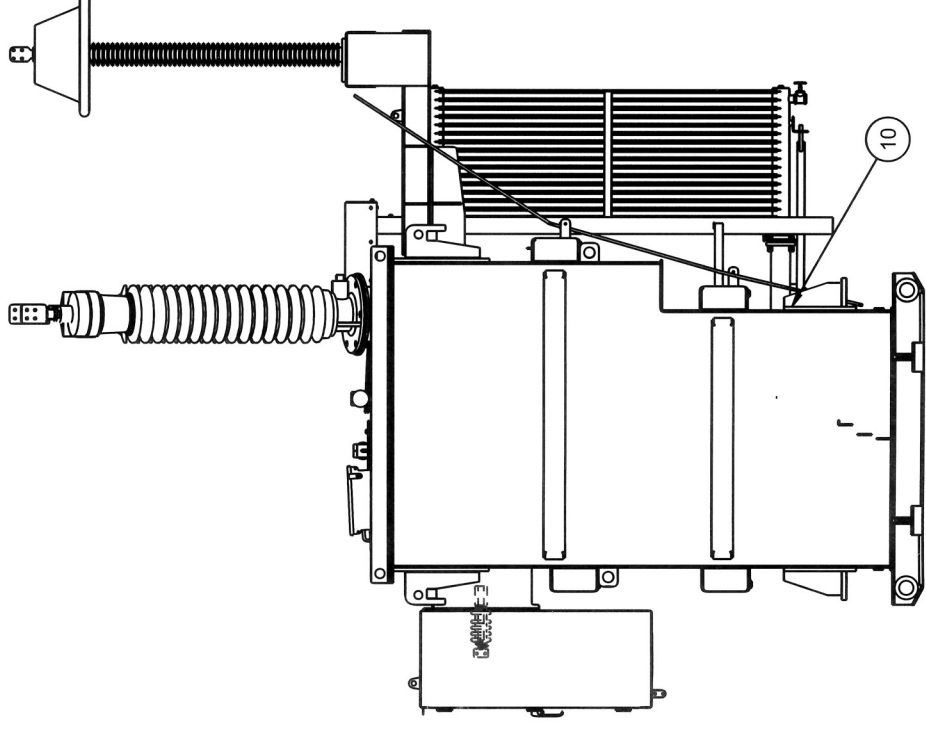
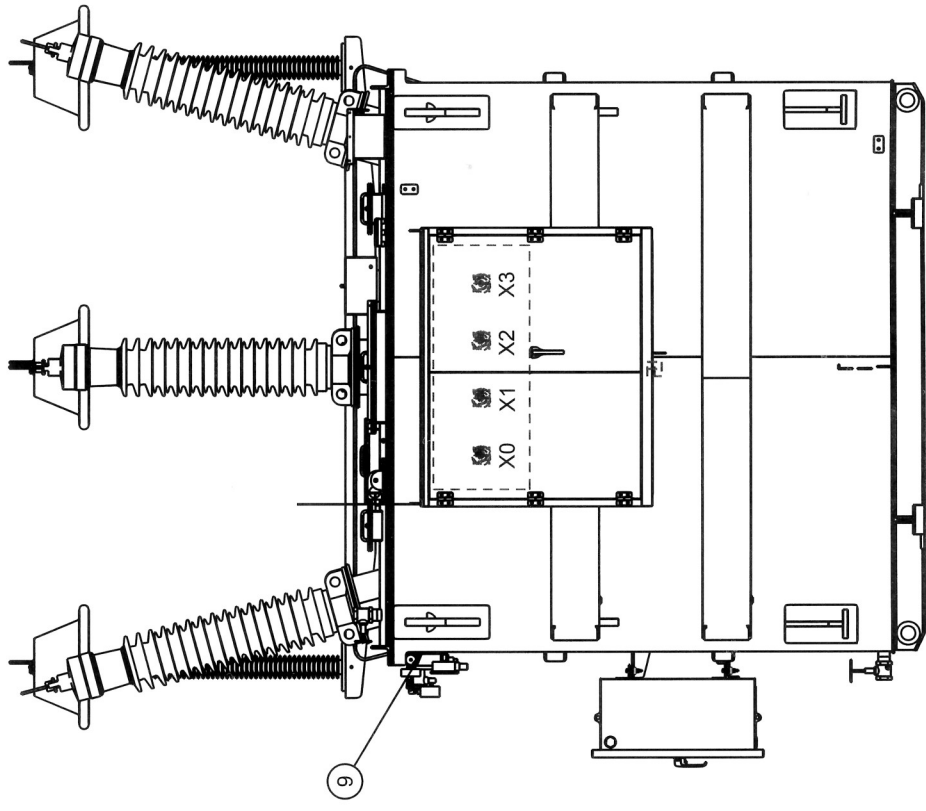
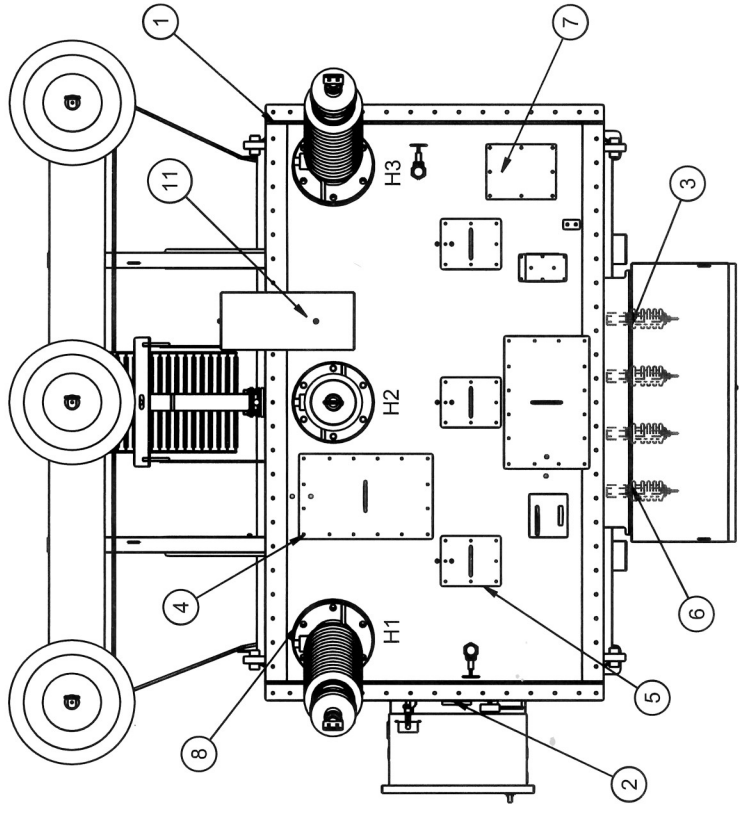
SHIPPING CENTER OF GRAVITY



FINAL AS BUILT
MAR 24, 2011

PARTNER TECHNOLOGIES INCORPORATED		DATE	REV	DATE	BY	DESCRIPTION	TAG No.:	CUSTOMER:	Department of Fisheries and Oceans	FTI QUOTE No.	TITLE
		DRAWN BY	22-Dec-10				FTI SO No.	Fisheries and Oceans		Q-14873	Transformer Shipping Assy
		APP BY	S. Galubovic				DOCUMENT CODE:			0.030	REV
								ULTIMATE LOCATION:		1/1	DWG NO
											0
											01-12189-SHIPPING

All Dimensions in millimeters
Tolerances ± 10 mm



FINAL AS BUILT
MAR 24, 2011

QTY	NO	GASKET POSITION	DRAWING NO OR DIMENSIONS	MATERIAL
1	1	Tank rim flange	SM-12189-TA-DTRGA	0.375 HC-60, Cork-Nitrile
1	2	Oil level gauge Lo-LoLo 01372A	2.625" OD x 2.25" ID x 0.093" thick	0.093 BUNA-N
1	3	LV Throat	SM-12189-SWAR-TGH	0.250 HC-60, Cork-Nitrile
2	4	LV Throat handhole	SM-12189-HHAG	0.250 HC-60, Cork-Nitrile
3	5	Core & collis assy fixing openings	SM-11605-HH-G	0.250 HC-60, Cork-Nitrile
3	6	LV and LVN porc. bushing -150 KV BIL	FKG01812 (16-0100-G1 dwg - Argus Ind.)	0.250 HC-60, Cork-Nitrile
3	7	Core Ground flange A200-386	2.4" OD x 1.813" ID x 0.1875" thick	0.1875 HC-60, Cork-Nitrile
3	8	HV Bushings	SM-11605-LA-TUG1A	0.250 HC-60, Cork-Nitrile
3	9	Rapid Rise PR 900-010-63	PTI 16-0100 dwg-G1 (part FKG01812)	0.250 HC-60, Cork-Nitrile
4	10	Radiator valves RV080P	Parker #345, O-ring	
1	11	Qualitrol PRD - series 208	Gasket 207-60-14B	



PARTNER
TECHNOLOGIES
INCORPORATED

DATE: 02-March-10
DRAWN BY: S. Golubovic
APP BY:

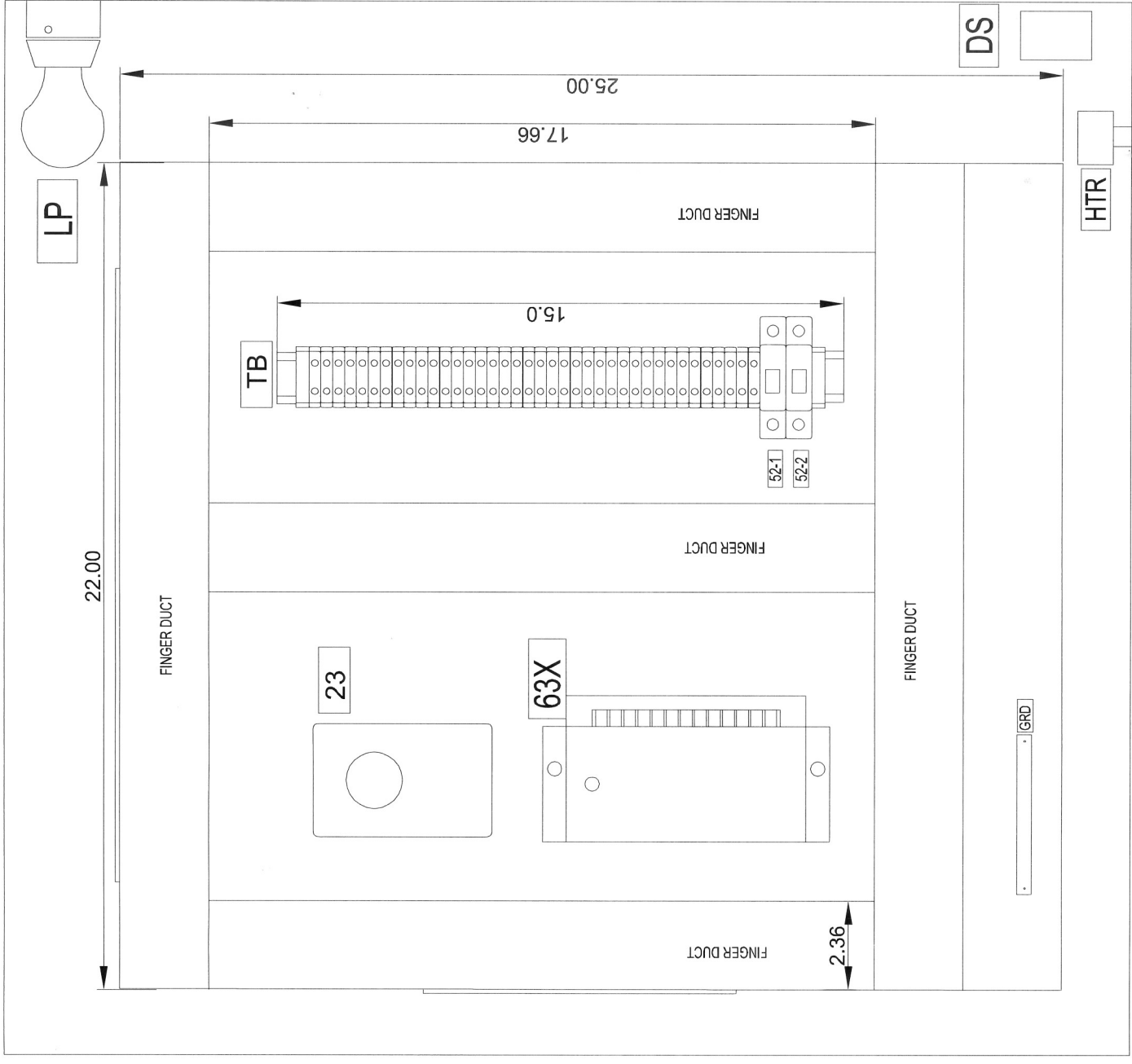
REV: -
DATE: -
BY: -

DESCRIPTION: -
TAG No.: -
PTI SO No.: -
DOCUMENT CODE: -

CUSTOMER: Department of Fisheries and Oceans
CUSTOMER PO No.: F1700-091000/001/VAN
ULTIMATE LOCATION: -

TITLE: Transformer Gaskets
PTI QUOTE No.: Q-14873
SCALE: 0.025
SHEET: 1/1
REV: 0
DWG NO: 01-12189-GASKETS

CONTROL PANEL FRONT VIEW



PVS	QUALITROL	DESCRIPTION
52-1/2	ABB	PRESSURE-VACUUM SWITCH #148-007-01
HTR	WATLOW	CIRCUIT BREAKER, #S201-C2, 1PHASE, 2A
LP	LEVITON	STRIP HEATER 120VAC 150W #SCATJ8AW2 (FOR CONTROL CABINET)
23	STELPRO	LIGHTHOLDER C/W 120VAC 60W BULB, #LMC49B75
DS	LEVITON	THERMOSTAT, #RJ32W1
26Q	ORTO	DOOR OPERATED LIGHT SWITCH, #1885
63X	QUALITROL	LIQUID THERMOMETER, #0256 2A
71Q	ORTO	SEAL-IN-RELAY, #909-200-01
63P	HEARTLAND	OIL LEVEL INDICATOR, 01372A
REF.	QUALITROL	PRESSURE RELIEF DEVICE, #TW10102098
	MANUFACTURER	SUDDEN PRESSURE RELAY, #910-010-63
		DESCRIPTION

- NOTE:
- ALL DEVICES SHOWN DE-ENERGIZED OR IN NON-OPERATING POSITION
 - ALL CONTROL WIRING TO BE MINIMUM #14AWG
 - WIRING EXTERNAL TO THE CONTROL CABINET RUN IN RIGID CONDUIT
 - GROUND SHALL BE GREEN WIRE

CUSTOMER	PTI QUOTE NO.	PTI S.O. NO.
DEPARTMENT OF FISHERIES AND OCEANS	Q-14873	N12189

TITLE:
SCHEMATIC, WIRING AND PANEL LAYOUT

DATE:
12/23/2010

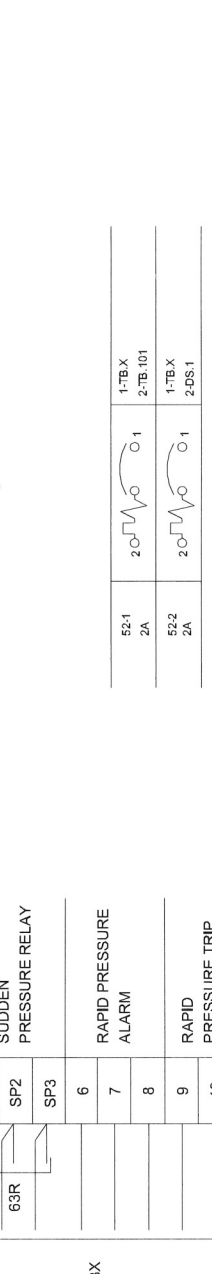
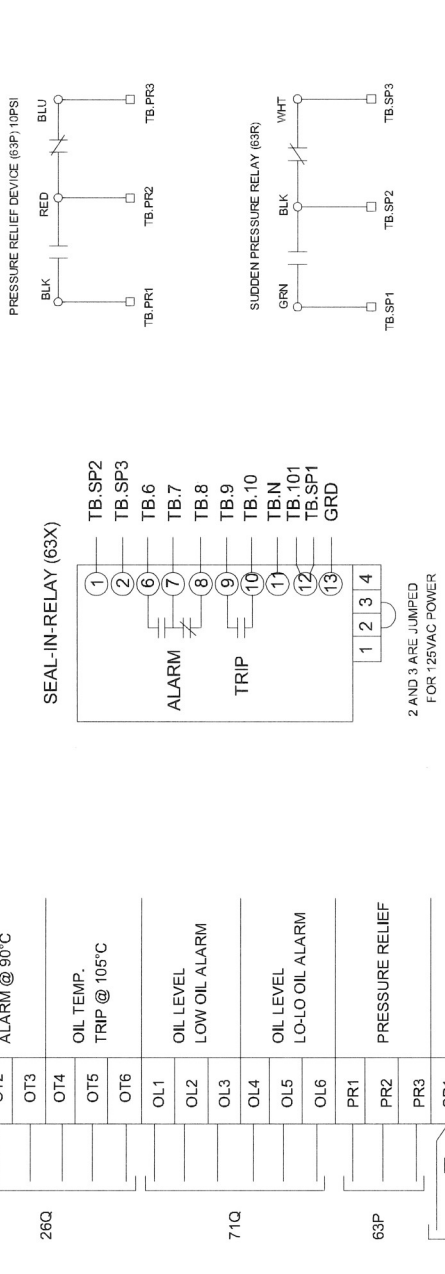
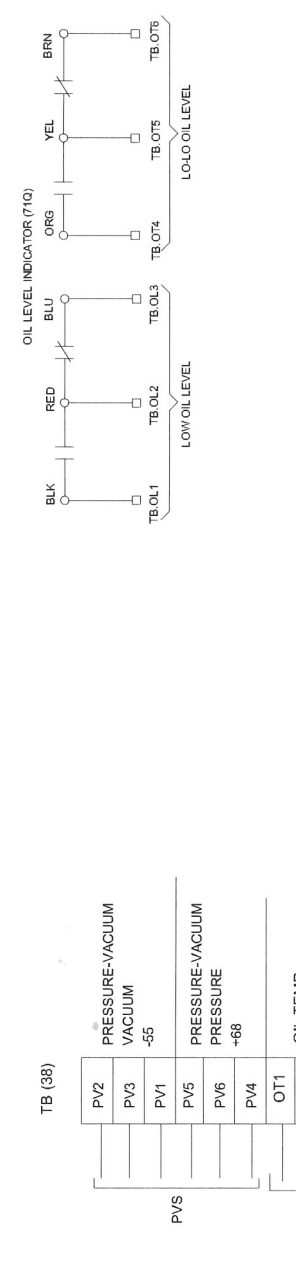
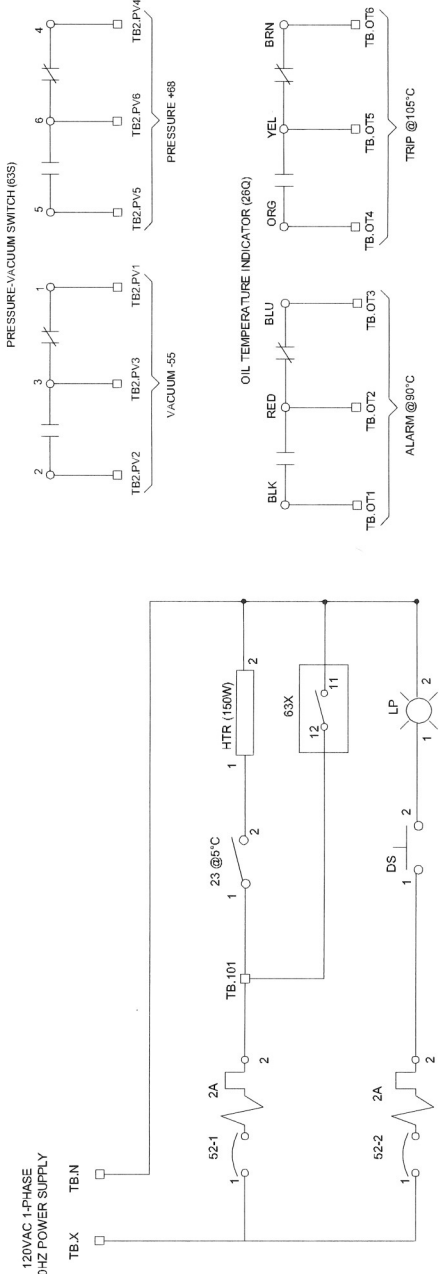
DRAWN BY:
E. ESPARZA

APPROVED BY:

ULTIMATE USER / LOCATION
DEPARTMENT OF FISHERIES AND OCEANS

DRAWING NO:
03-12189

Rev
2



FINAL AS BUILT
MAR 24, 2011

Rev No.	Revision Description	Rev By.	Date
R1	ADDED 63S, UPDATED TERMINAL BLOCK, GRD, BAR & CTRL. PANEL	EES	MAR/15/11
R2	FINAL "AS BUILT"	EES	MAR/23/11

CUSTOMER	PO.NO.	SCALE:	PTI QUOTE NO.	PTI S.O. NO.
F1700-091000/001/MAN		NTS	Q-14873	N12189

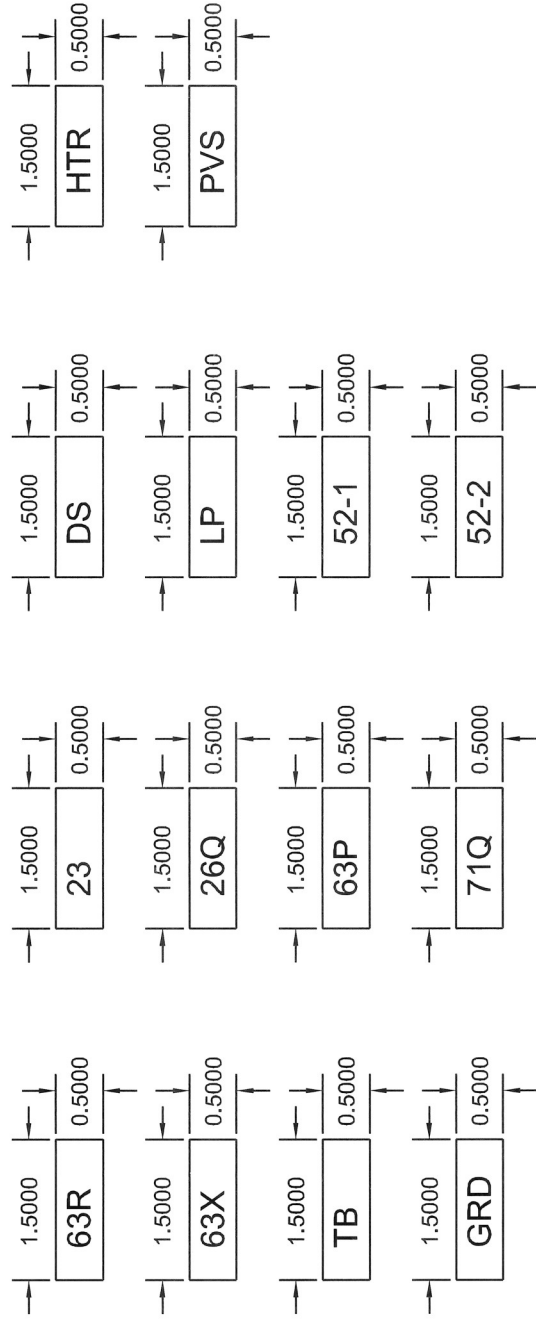
Rev No.	Revision Description	Rev By.	Date
R1	ADDED 63S, UPDATED TERMINAL BLOCK, GRD, BAR & CTRL. PANEL	EES	MAR/15/11
R2	FINAL "AS BUILT"	EES	MAR/23/11

5 SPARE BLOCKS

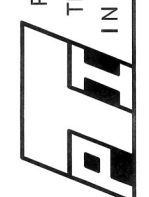


LAMACOID NAMEPLATE

QTY: 1 EA. WHITE BACKGROUND
WITH BLACK 2/8" HIGH LETTERING



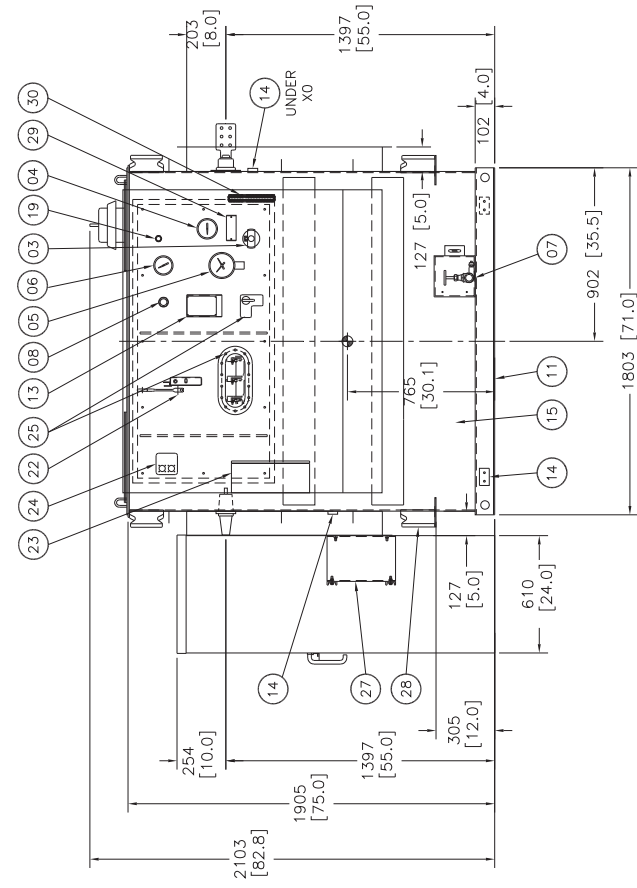
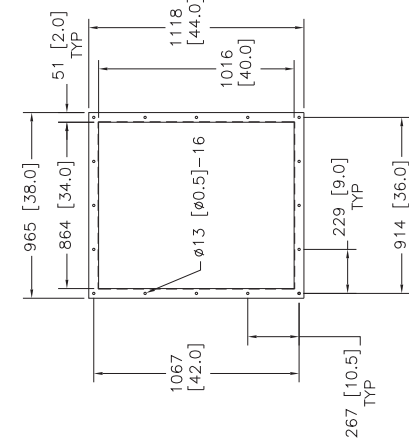
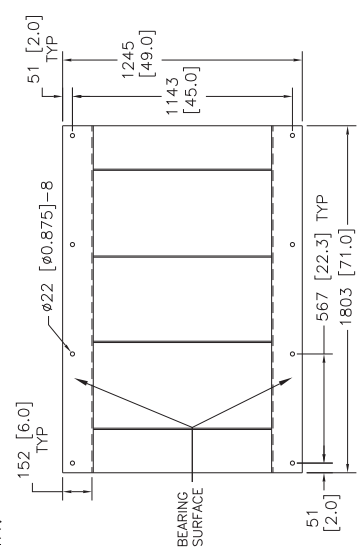
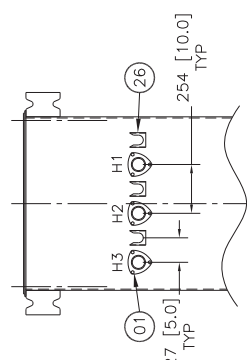
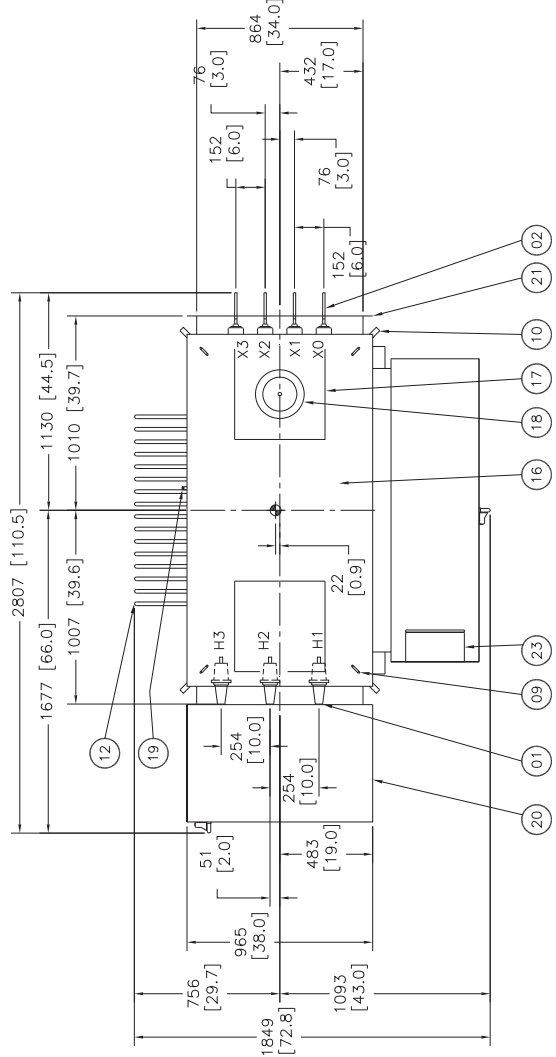
FINAL AS BUILT
MAR 24, 2011

 PARTNER TECHNOLOGIES INCORPORATED	Rev No. Revision Description R1 ADDED PVS	Rev By. Date EES MAR/16/11	CUSTOMER PO. NO. F1700-091000/001/VAN	SCALE: NTS	PTI QUOTE NO. Q-14873	PTI S.O. NO. N12189	CUSTOMER: DEPARTMENT OF FISHERIES AND OCEANS
	DRAWN BY: E. ESPARZA			DATE: 12/23/2010	TITLE: LAMACOID NAMEPLATE		
APPROVED BY:			DATE:	ULTIMATE USER / LOCATION DEPARTMENT OF FISHERIES AND OCEANS			Rev 1

T2 Shop Drawings

- DESCRIPTION
- 01 HV BUSH: CPS 2689191A211, 35.0KV CLASS, 600 AMPS.
 - 02 LV BUSH: CPS 2605060B01, 1.2KV CLASS, 2400 AMPS.
 - 03 TAP CHANGER WITH 3/8" HOLE FOR PADLOCKING.
 - 04 MAGNETIC LIQUID LEVEL INDICATOR.
 - 05 LIQUID TEMPERATURE INDICATOR WITH CONTACTS.
 - 06 PRESSURE VACUUM GAUGE ±10 PSI.
 - 07 COMBINATION DRAIN AND LOWER FILTER PRESSURE VALVE WITH 3/8" SAMPLER, 1.0" DIAMETER WITH COVER.
 - 08 1.0" UPPER FILTER PRESS PLUG.
 - 09 LIFTING EYES FOR LIFTING COVER ONLY.
 - 10 LIFTING LUGS FOR LIFTING COMPLETE TRANSFORMER.
 - 11 TRANSFORMER BASE WITH PROVISIONS FOR JACKING PER ANSI STANDARD AND FOR ROLLING IN EITHER DIRECTION, CORRUGATE.
 - 12 STAINLESS STEEL NAMEPLATE.
 - 13 STAINLESS STEEL GROUND PADS WITH NEMA DRILLING.
 - 14 TRANSFORMER TANK: SEALED TANK LIQUID PRESERVATION.
 - 15 TRANSFORMER COVER: WELDED.
 - 16 (2) MANHOLES: 15.5" X 15.5" WITH BOLTED COVER.
 - 17 PRESSURE RELIEF DEVICE WITH INDICATOR.
 - 18 PURGE VALVE, QTY: 2
 - 19 HV CABINET: FULL HEIGHT BOTTOM ENTRY WITH HINGED PADLOCKABLE DOOR.
 - 20 LV PARTIAL FLANGE.
 - 21 VACUUM FAULT INTERRUPTER (VFI) HANDLE.
 - 22 CONTROL BOX FOR VFI WITH TPG GROUND.
 - 23 VFI 35KV, 12KA WITH VISIBLE DISCONNECT AND AUXILIARY CONTACTS.
 - 24 VFI OPEN-CLOSED 2 POSITION SWITCH WITH VIEWING WINDOW.
 - 25 PARKING STANDS.
 - 26 CABLE SUPPORTS.
 - 27 JACKING PADS.
 - 28 TAP CHANGER WARNING NAMEPLATE.
 - 29 TERMINAL BLOCK FOR CONTACT WIRING.
 - 30

- NOTES:
1. UNIT IS SHIPPED WITH 3PSI NITROGEN BLANKET AT TIME OF MANUFACTURE.
 2. SHIPPED WITH 4 AEROSOL CANS OF TOUCH-UP PAINT.
 3. DIMENSION FORMAT: MM [INCH].
 4. UNIT SHIPS ON PALLET ASSEMBLY.
 5. \diamond = CENTER OF GRAVITY.



3 ϕ POWER TRANSFORMER
 500KVA ONAN 55/65°C
 HV: 25000 DELTA
 LV: 600Y/346
 MINERAL OIL FILLED
 CUSTOMER: PRIME ENGINEERING
 P.O. #: 3224-KC-7586
 JOB: TAVIS FISH FARM
 COOPER ORDER #: 205563623
 CATALOG #: 00006A11CFAA
 PAINT: BELL GREEN

WEIGHTS: kgs [POUNDS]
 CORE & COIL: 1050 [2315]
 TANK & FITTINGS: 1242 [2740]
 LIQUID: 1864 [4110]
 TOTAL: 4156 [9165]
 LITERS: 2086 [US GALS: 551]

MATERIAL: COOPER Power Systems
 TITLE: OUTLINE DRAWING
 SUB: ALL DIMENSIONS ARE IN INCHES
 TOLERANCES UNLESS OTHERWISE SPECIFIED
 ONE PLACE DECIMAL ± .1
 TWO PLACE DECIMAL ± .06
 THREE PLACE DECIMAL ± .030
 ANGLE ± 2
 DATE: 05/12/14 REF: DWG: 05/12/14 REV: 1 OF 1 DT
 (CONFIDENTIAL) MUST NOT BE USED IN ANY WAY WITHOUT THE APPROVAL OF THE MANUFACTURER
 4241200B6341

COOPER Power Systems

3 ϕ TRANSFORMER
WAUKESHA, WI U.S.A

V 500-560 55-65°C 60Hz

MPCSE 00006A11CFAA

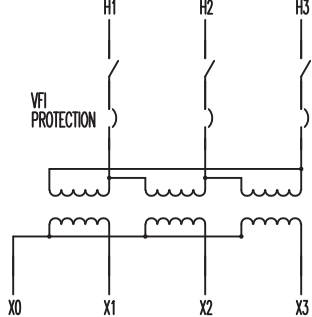
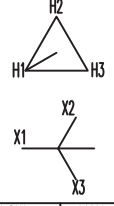
H 25000 ONAN

L 600Y/346 3.75 %IZ @75°C MFG DATE

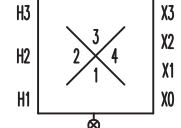
HV KV BIL 150 PCB CONTENT LESS THAN 1 PPM AT TIME OF MANUFACTURE
 HV NEUTRAL KV BIL -- CAUTION - READ INSTRUCTION MANUAL S210-15-10
 LV KV BIL 30 MANUFACTURED IN ACCORDANCE WITH CAN/CSA C88-M90
 HV/LV CONDUCTOR CU/ CU SUITABLE FOR NON-SINUSOIDAL CURRENT WITH A K-FACTOR NOT TO EXCEED 13

APPROX. WEIGHT IN KGS.

CORE & COIL UNTANKING	1050
TANK & FIT	1242
FLUID: OIL LITERS: 2086	1864
TOTAL	4156



TAP	VOLTAGE	MAX AMPS	LOW VOLTAGE	MAX AMPS
A	26250	12.3	600	539
B	25630	12.6		
C	25000	12.9		
D	24380	13.3		
E	23750	13.6		



MAX AMPS AT 560 KVA
 %IZ AT BASE KVA AND RATED VOLTAGE
 ENERGY EFFICIENCY COMPLIES WITH CSA C802.1

PHYSICAL BUSHING ARRANGEMENT



LIQUID-FILLED DISTRIBUTION TRANSFORMER
 LIQUID-IMMERSED DISTRIBUTION TRANSFORMER

25 DEG.C LIQUID LEVEL 432 MM BELOW TOP OF MANHOLE FLANGE. LIQUID LEVEL CHANGES 12 MM PER 10 DEG.C CHANGE IN LIQUID TEMPERATURE. MAXIMUM OPERATING PRESSURES OF LIQUID PRESERVATION SYSTEM 40 kPA POSITIVE AND 15 kPA NEGATIVE. TANK DESIGNED FOR 20 kPA VACUUM FILLING.

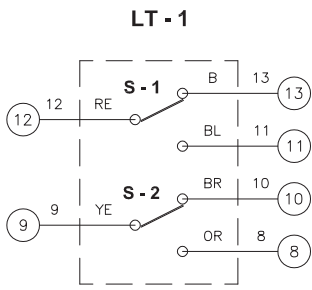
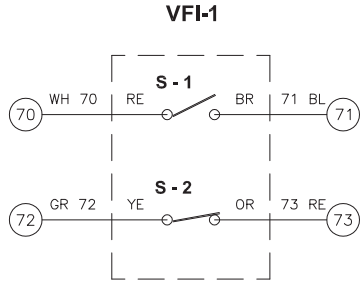
- NOTES:**
- 1) ACTUAL PLATE IS A NEGATIVE OF THE ABOVE DRAWING.
 - 2) ACTUAL %IZ TO BE STAMPED IN AFTER TESTING.

NAMEPLATE MATERIAL: STAINLESS STEEL

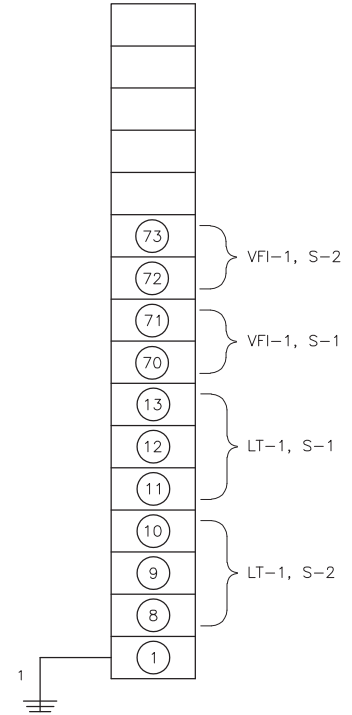
205562623~

1189609A0194 REVISIONS

MATERIAL:					
ALL DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED ONE PLACE DECIMAL ± .1 TWO PLACE DECIMAL ± .06 THREE PLACE DECIMAL ± .030 * CRITICAL DIMENSION ANGULAR ± 2°				TITLE: LASER NAMEPLATE SUBJ: 00006A11CFAA	
DWG: NPS	DATE: 5/14/2014	REF:	SHEET #: 1 of 1	SCALE: 1=1	REV: 00
[CONFIDENTIAL] MUST NOT BE USED IN ANY WAY DETRIMENTAL TO COOPER POWER SYSTEMS		1189609A0194			



TB - 1



LT-1 LIQUID TEMPERATURE GAGE (26Q)
 TB-1 TERMINAL BLOCK, 600V, 35A
 VFI-1 VACUUM FAULT INTERRUPTER
 WHEN VFI IS IN OPEN OR TRIPPED POSITION
 S-1 IS OPEN AND S-2 IS CLOSED

LEGEND

- INDICATES PREWIRED DEVICE
- INDICATES REMOTE DEVICE
- INDICATES WIRE HEAT SHRINK NUMBER LABEL
- INDICATES TERMINAL BLOCK CONNECTION
- INDICATES INTRINSICALLY SAFE TERM BLOCK CONN
- INDICATES RELAY TERM AND #
- INDICATES SPLICE
- INDICATES NORMALLY CLOSED CONTACT (NC)
- INDICATES NORMALLY OPEN CONTACT (NO)
- INDICATES CUSTOMER CONNECTION
- POLARITY MARK
- INDICATES CT SHORTING PINS - TO BE REMOVED WHEN LOAD IS CONNECTED TO CT
- WIRE COLORS APPLICABLE ONLY WHEN USING CORD CONNECTORS TO SWITCHES

DEVICE	GAGE SWITCH RATINGS (AMPS)			
	120/240VAC	48VDC	125VDC	250VDC
LT/LL/PRD/RRR	15	1.3	.50	.25
SPC	10	2.0	.50	.25
PS/VS	5	1.0	.40	.20
WTI	15	1.3	.50	.25
TPG	1	-	-	-
LCP	3	-	-	-
U	5	2.0	2.0	N/A

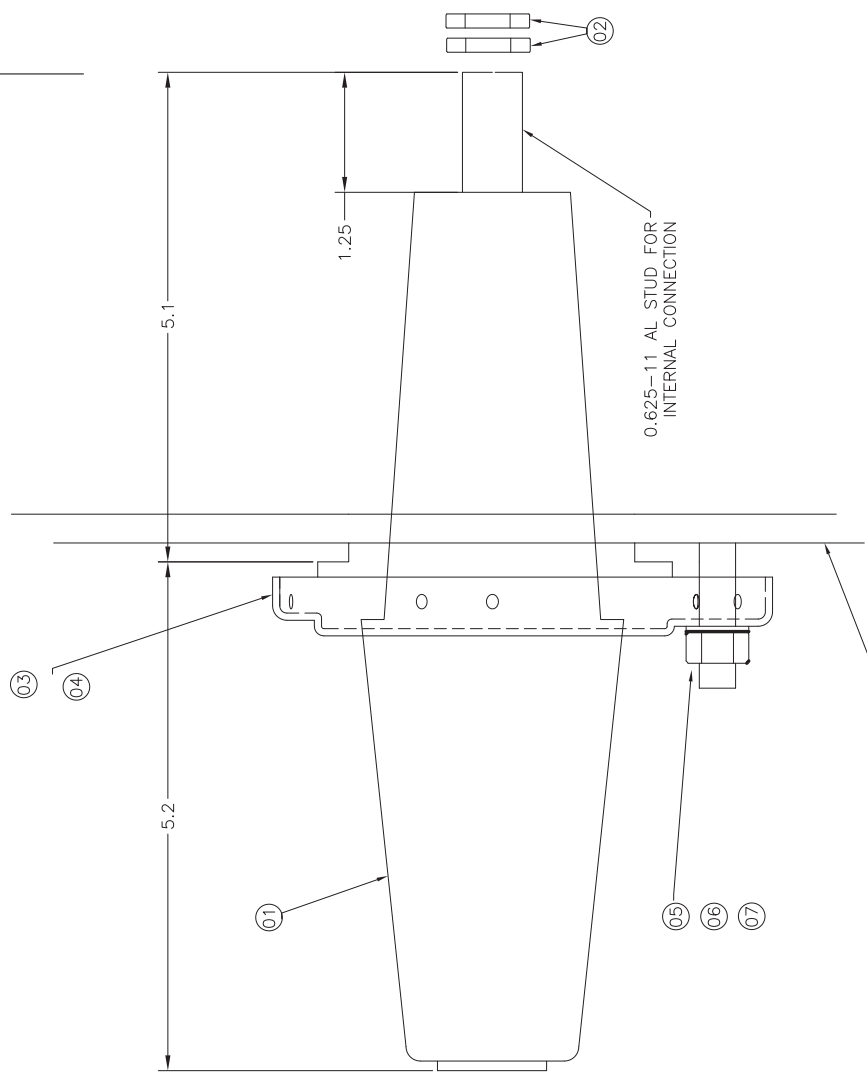
DEVICE	GAGE SWITCH SETTINGS		
	LT 55°C AWR	LT 65°C AWR	WTI
S-1 (FANS)	60°C	70°C	80°C
S-2 (ALARM)	80°C	90°C	120°C
S-3 (TRIP)	105°C FIXED	105°C FIXED	130°C FIXED

NOTE: AC LOADS = INDUCTIVE P.F. 75%
 DC LOADS = NON-INDUCTIVE

- WH - WHITE
- GR - GREEN
- BL - BLACK
- B - BLUE
- OR - ORANGE
- RE - RED
- BR - BROWN
- YE - YELLOW

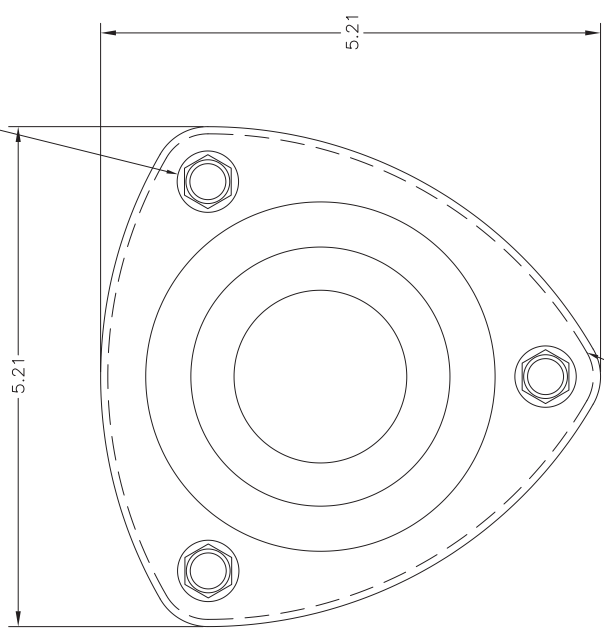
MATERIAL:		COOPER Power Systems			
ALL DIMENSIONS ARE IN INCHES TOLERANCES UNLESS OTHERWISE SPECIFIED		TITLE: SCHEMATIC			
ONE PLACE DECIMAL ± .1 TWO PLACE DECIMAL ± .06 THREE PLACE DECIMAL ± .030 * CRITICAL DIMENSION ANGULAR ± 2°		SUB:			
DWG: DWL	DATE: 05/13/14	REF:	SHEET # 1 of 1	SCALE: N/A	REV: 00
4256906C0979					

[CONFIDENTIAL] MUST NOT BE USED IN ANY WAY DETRIMENTAL TO COOPER POWER SYSTEMS



RATING:
 600 AMPS MAX.
 150KV BIL
 INTERFACE PER ANSI/IEEE
 386-1985, FIG. 10

4.69/4.36 DIA. BOLT
 CIRCLE REQ'D
 (0.375-16 HDWR)



CLAMP-MILD STEEL-ZINC DICHROMATE

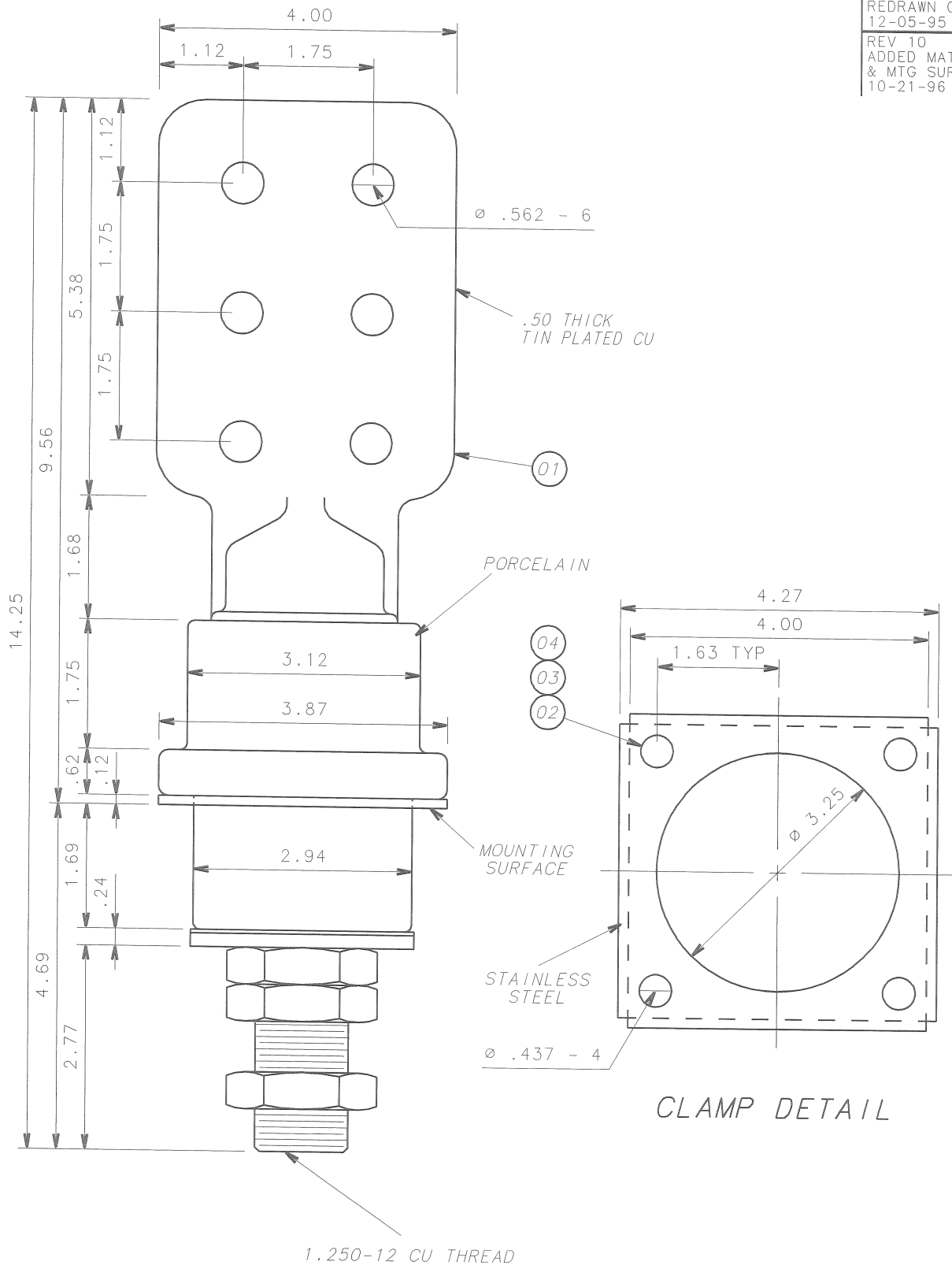
(DEADBREAK)

MATERIAL:	N/A
ALL DIMENSIONS ARE IN INCHES UNLESS OTHERWISE SPECIFIED	
TOLERANCES UNLESS SPECIFIED	
ONE PLACE DECIMAL	± .1
TWO PLACE DECIMAL	± .06
THREE PLACE DECIMAL	± .030
* CRITICAL DIMENSION	ANGULAR ±2°
CONFIDENTIAL, MUST NOT BE USED IN ANY WAY DETRIMENTAL TO COOPER POWER SYSTEMS	

COOPER Power Systems	
TITLE:	BUSH ASSY HV
SUB#: 600 AMP	
REV#	150 KV BIL
DATE	08/06/10
DESIGNER	DTA
CHECKED	
SCALE	1 of 1
REV#	01
2689191A211	

REVISION	
REV 09	REDRAWN ON CAD
12-05-95	TAM
REV 10	ADDED MATERIAL & MTG SURFACE.
10-21-96	TAM

2605060B01



REQUIRES 3.062 MTG HOLE & .38-16 X 1.63 MTG STUD

KV CLASS: 1.2
BIL (KV): 30
RATED CONT. CURRENT: 2400 A

UNLESS OTHERWISE SPECIFIED		TRANSFORMER PRODUCTS WAUKESHA, WI	
1 - PLACE DECIMAL ± .1 2 - PLACE DECIMAL ± .06 3 - PLACE DECIMAL ± .030		PART NAME	
REF: --		BUSH ASSY	
PRINT DIST: 9	CRITICAL DIMENSION *	DWG T.A.M.	CHK D.A.A.
CONFIDENTIAL-MUST NOT BE USED IN ANY WAY DETRIMENTAL TO COOPER POWER SYSTEMS	ANGULAR ± 2°	DATE 12-05-95	DATE 12-05-95
		ISS T.A.M.	DATE 12-05-95
		SCALE .500	26 05060 B01

DESCRIP 1.2KV 2400A 6-HL SP EXT 1.25-12 IN*

T2 Overall Layout Shop Drawings

Part 1 General

1.1 SCOPE OF WORK

- .1 This section covers clearing and grubbing of areas indicated on contract drawings or as designated by the Engineer.

1.2 DEFINITIONS

- .1 Close-cut clearing consists of cutting off at or near flush with original ground surface standing trees, brush, scrub, roots, stumps and embedded logs and disposing of fallen timber and surface debris, including stockpiling and slash burning as directed.
- .2 Grubbing consists of excavation and disposal of stumps and roots to not less than a specified depth below original ground surface.

1.3 REGULATORY AGENCY REQUIREMENTS

- .1 As required, obtain necessary permits.

1.4 PROTECTION

- .1 Protect trees, shrubs, plants and other features which are to remain as shown on the drawings and where specified by the Engineer.
- .2 Do not clear outside of limits designated on contract drawings or as designated by the Engineer.
- .3 Apply approved tree paint to cuts or scars suffered by vegetation designated to remain.

1.5 PAYMENT

- .1 Payment for all work in this section shall be included in the lump sum price for Item 2 in Schedule 1 of the Form of Tender.

Part 2 Products

2.1 TREE PAINT

- .1 Use only tree paint that has prior approval of the Engineer.

Part 3 Execution

3.1 CLEARING

- .1 In areas to be subsequently grubbed, clearing shall be close-cut.
- .2 Cut off unsound branches and cut down dangerous trees overhanging area cleared.
- .3 Remove trees, shrubs, uprooted stumps and surface debris not designated to remain.

3.2 GRUBBING

- .1 Grub out stumps and roots to not less than 300 mm below original ground surface.
- .2 Remove all roots sized from 15 mm to 40 mm to a depth of 300 mm below ground level and all larger roots to a depth of one meter below ground level.

3.3 REMOVAL AND DISPOSAL

- .1 All waste materials, including debris from clearing or any debris or rubbish encountered on the site are to be removed from the site and disposed of at locations obtained by the Contractor.
- .2 Burning of debris will not be permitted on site.
- .3 The cost for removal and disposal off site of all waste materials is to be included in the lump sum tender prices.

END OF SECTION

Part 1 General

1.1 SCOPE OF WORK

- .1 This section includes all labour, equipment and materials required to excavate, fill and, backfill.
- .2 The scope of work includes but is not limited to:
 - 1. Excavation for transformers foundation.
 - 2. Excavation for oil containment system, manholes, oil water separator, oil stop valve chamber, and drain rock pit.
 - 3. Excavation and trenching for buried pipes and duct banks.
 - 4. Disposal of surplus excavated materials off site.
 - 5. Fill underneath structures.
 - 6. Fill adjacent to underground structures.
 - 7. Drain rock and crushed rock surfacing for oil containment structures.
 - 8. Site crushed rock surfacing.
 - 9. Stone bedding and granular pipe bedding material for buried pipelines.
 - 10. Pipe trench backfill.
 - 11. Compaction testing.
 - 12. Lab testing for materials gradation and density data

1.2 RELATED WORK

- .1 Summary of Work Section 01 11 00

1.3 DEFINITIONS

- .1 Common excavation material: Excavated material of any nature, including, but not limited to earth, glacial till, muskeg, hard-pan, fractured rock, tree stumps, asphalt, concrete, timber, pipes, snow, ice, or any combination of these. This also includes hard rock material that can be removed by mechanical ripping buckets.

1.4 SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Submit gradation curves for all imported fill materials.

1.5 EXCAVATED MATERIAL

- .1 All excavated material shall be disposed of in designated areas, except that which is approved for re-use.
- .2 Grade disposal areas to minimize erosion and facilitate re-growth of vegetation.

1.7 COMPACTION TEST STANDARD

- .1 Maximum dry density shall be Modified Proctor maximum dry density determined in accordance with ASTM D1557.

1.8 GEOTECHNICAL REPORT

- .1 Refer to Geotechnical Report “Final Report - Transformer Geotechnical Investigation, revision (0)” submitted by McElhanney Consulting Services Ltd dated April 30, 2015.

Part 2 Products

2.1 FILL MATERIALS – GENERAL

Materials proposed to be used in the Work will be subject to laboratory confirmation testing prior to the start of construction and throughout the construction process. The contractor will arrange and pay for the tests required. Results of the laboratory tests (gradation curve, maximum dry density and optimum moisture content) will be provided to the field testing company and Department Representative so they will be available for reference as needed. The Contractor will supply the test results of each proposed material to Department Representative 7 days prior to the first scheduled placement.

2.2 NATIVE FILL MATERIAL

- .1 Do not use native fill except where specifically shown or approved by the Consultant.
- .2 Native fill material, where approved, shall be mineral soil material selected from site excavations or other sources, unfrozen and free from cinders, ashes, sods, refuse or other deleterious materials, and having maximum 10% clay and silt fraction. All rocks in excess of 150 mm size shall be removed.

2.3 Site Grading Fill

a. Application

Site grading fill will be used to achieve the site grade as shown on the drawings.

b. Material Type

Granular A fill is specific for use as general site grading fill unless noted otherwise. Granular A material will consist of pit run sand and gravel conforming to the following gradation limits:

Granular A Fill		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
6"	150.00	100
3"	75.00	80 - 100
1.5"	37.50	65 - 100

Granular A Fill		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
3/4"	19.00	35- 100
3/8"	9.50	25 - 85
#4	4.75	15 - 75
#50	0.30	3 - 37
#200	0.075	0 - 10

All cobbles larger than 150 mm in maximum dimension will be removed. Native excavated material meeting the above requirements and approved by the Geotechnical Engineer may be used as Granular A fill.

c. Placement and Compaction

Site grading fill will be placed in approximately horizontal layers not to exceed 300 mm in loose thickness. Cobbles larger than 100 mm will not be placed in the top layer of the fill. The material will be compacted to a density of not less than the greater of 95 percent Standard Proctor Maximum Dry Density (ASTM D698) or as shown on the drawings and Geotechnical Report.

2.4 Fill Underneath Structures

a. Application

Fill immediately below all structures as shown on the drawings will include, but not be limited to, spread footings and other foundations, floor slabs, cable tunnels, cable trenches, duct banks.

b. Material Type

Granular B fill is specified for use underneath structures and in frost-susceptible regions. Granular B material will be well-graded, granular material that will not degrade from exposure to water, freeze-thaw cycles or handling, spreading or compacting. It must not contain organic materials or an excess of flat or elongated stones. It will conform to the following gradation limits except that cobbles and boulders larger than 150 mm in diameter will be removed:

Granular B Fill		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
3"	75.00	100

Granular B Fill		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
1.5"	37.50	60 - 100
3/4"	19.00	35 - 100
3/8"	9.50	25 - 80
#4	4.75	15 - 60
#50	0.297	3 - 10
#200	0.075	0 - 5

c. Placement and Compaction

Granular B in this application fill will be placed in near horizontal layers not to exceed 200 mm in loose thickness and compacted to a density of not less than 100 percent Standard Proctor Maximum Dry Density (ASTM D698).

2.5 Fill Adjacent to Cable Trenches, Cable Tunnels, Catchment Basin Parapet Walls and Minor Retaining Walls

a. Application

This application relates to hollow structures or structures for which fill is placed on one side of the component as shown on the Drawings. This includes, but may not be limited to, cable trenches, cable tunnels, duct banks, underground manhole and chamber walls, basement walls, catchment basin parapet walls and minor retaining walls (less than 1.2 metres high).

b. Material Type

Granular B material is specified for this application. Gradation requirements are identical to those given in 2.4.

c. Placement and Compaction

Granular B fill in this application will be compacted in 150 mm loose height layers using hand-operated vibratory tampers or hand-operated vibratory rollers. Beyond a distance of 900 mm from the structure, both laterally and vertically, fill will be compacted in loose height layers of 300 mm using self-propelled vibratory rollers. Self-propelled vibratory rollers will not be used within 900 mm of a hollow structure such as a cable tunnel, duct bank, basement or retaining wall. The material will be compacted to a density of not less than 95 percent Standard Proctor Maximum Dry Density.

2.6 Fill for Trenches Containing Direct Buried Cables (Low Voltage and AC & DC Control)

a. Application

This application relates to fill for trenches excavated for the placement of directly buried low voltage (less than 600 volts) and AC & DC control cables.

Direct buried AC & DC control cables will be installed in a bed of sand, protected with planks, marked by warning tape and backfilled with Granular B fill as shown on the drawings.

Direct buried low voltage power cables will be installed in a bed of sand, protected with concrete slabs, marked by warning tape and backfilled with Granular B fill as shown on the drawings.

b. Material Type

Fill above the sand bedding and protection will be Granular B as defined in section 2.3 except that all gravel and cobbles larger than 50 mm will be removed.

Sand for bedding will be clean sand conforming to the following grading requirements:

Bedding Sand		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
#20	0.85	100
#40	0.425	45 - 90
#60	0.25	10 - 65
#200	0.075	0 - 12

c. Placement and Compaction

The cable bedding sand will be placed to provide uniform support along the complete length of the trench and compacted with a hand tamper.

Granular B fill will be placed evenly and carefully above the sand and planks or concrete slabs as shown on the drawings in approximately horizontal loose layers not to exceed 150 mm. Each layer will be hand tamped until 300 mm of cover exists over the cables. The remainder of the granular fill will be placed in 150 mm layers and compacted with hand-operated vibratory tampers or hand-operated vibratory rollers.

The material will be compacted to a density of not less than 95 percent Standard Proctor Maximum Dry Density.

2.7 Fill for Trenches Containing Direct Buried High Voltage Power Cables

a. Application

This application relates to fill for trenches excavated for the placement of directly buried power cables greater than 600 volts up to and including 69,000 volts.

Direct buried cables will be installed in crushed screenings, protected with concrete slabs, marked by warning tape and backfilled with Granular B fill as shown on the drawings.

b. Material Type

Crushed screenings will be durable, inert, crushed stone screenings with a dry density 1926 kg/m³ or greater free from organic material that conforms to the following grading requirements:

Crushed Screenings		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
3/8"	9.50	100
#4	4.75	82 - 100
#10	2.00	49 - 71
#20	0.85	28 - 49
#40	0.425	18 - 34
#100	0.15	8 - 19
#200	0.075	5 - 15

Seventy-five percent of the thermal backfill passing each sieve will have one or more fractured face.

Crushed screenings will not exceed a maximum thermal resistivity of 0.80 m°C/W at 2 percent moisture content at 95 percent Standard Proctor Maximum Dry Density when tested according to IEEE Standard 442 "IEEE Guide for Soil Thermal Resistivity Measurements".

c. Placement and Compaction

The crushed screenings will be placed to provide uniform support along the complete length of the trench and compacted with a hand tamper.

Granular B fill will be placed evenly and carefully above the crushed screenings and planks as shown on the drawings in approximately horizontal loose layers not to exceed 150 mm. Each layer will be hand tamped until 300 mm of cover exists over the cables. The remainder of the granular fill will be placed in 150 mm layers and compacted with hand-operated vibratory tampers or hand-operated vibratory rollers.

The material will be compacted to a density of not less than 95 percent Standard Proctor Density.

2.8 Fill for Trenches Containing Pipes and Ducts

a. Application

This application relates to fill for trenches excavated for the placement of pipes and ducts.

Pipe bedding sand will be placed underneath and halfway up pipes and ducts to provide uniform support along the complete length of the structure and backfilled with Granular B fill.

b. Material Type

Fill above the sand bedding for piping and ducts will be Granular B as defined in section 2.4 except that all gravel and cobbles larger than 75 mm will be removed for fill around pipes.

Sand for bedding will be clean sand conforming to the following grading requirements:

Bedding Sand		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
3/8"	9.50	100
#4	4.75	95 - 100
#10	2.00	75 - 100
#20	0.85	35 - 75
#40	0.425	15 - 45
#60	0.25	8 - 25
#200	0.075	0 - 10

c. Placement and Compaction

Pipe bedding sand will be placed a minimum of 100 mm below the invert elevation and halfway up the pipe that it is to support, or as shown on the design drawings. The bedding sand will be shaped and tamped in layers not to exceed 150 mm in loose thickness to provide uniform support along the entire length of the structure.

Bedding sand will be compacted to a density of not less than 95 percent Standard Proctor Density.

Granular B fill in this application will be placed evenly and carefully around and over pipes in approximately horizontal loose layers not to exceed 150 mm. Each layer will be hand tamped until 300 mm of cover exists over the pipe. The remainder of the granular fill will be placed in 150 mm layers and compacted with hand-operated vibratory tampers or hand-operated vibratory rollers.

The material will be compacted to a density of not less than 95 percent Standard Proctor Density.

2.9 Backfill for Concrete Encased Duct Banks

a. Application

This application relates to fill for trenches excavated for the placement of concrete encased duct banks where thermal backfill for heat dissipation is not specified.

b. Material Type

Granular A material is specified for this application. Gradation requirements are identical to those given in section 2.3.

c. Placement and Compaction

Granular A fill in this application will be compacted in 150 mm loose height layers using hand-operated vibratory tampers or hand-operated vibratory rollers. Each layer will be hand tamped until 300 mm of cover exists over the duct banks. The remainder of the granular fill will be placed in 150 mm layers and compacted with hand-operated vibratory tampers or hand-operated vibratory rollers.

The material will be compacted to a density of not less than 95 percent Standard Proctor Density.

2.10 Thermal Backfill for Concrete Encased Ductbank

a. Application

This application relates to fill for trenches excavated for the placement of concrete encased duct banks where thermal backfill for heat dissipation has been specified by the Transmission Cable Specialist.

b. Material Type

Thermal backfill will be durable, inert, crushed gravel made of granite or limestone screenings with a dry density of 1926 kg/m³ and free from clay and organic material that conforms to the following grading requirements:

Thermal Backfill		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
3/4"	19.00	100
3/8"	9.50	50 - 100
#4	4.75	35 - 70
#10	2.00	22 - 45
#40	0.425	5 - 20
#200	0.075	0 - 8

Seventy-five percent of the thermal backfill passing each sieve will have one or more fractured face.

- c. Thermal backfills will not exceed a maximum thermal resistivity of 0.80 m°C/W at 2 percent moisture content at 95 percent Standard Proctor Maximum Dry Density When tested according to IEEE Std 442 "IEEE Guide for Soil Thermal Resistivity Measurements". Placement and Compaction.**

Thermal backfill will be placed evenly and carefully around and over pipes in approximately horizontal loose layers not to exceed 150 mm. Each layer will be hand tamped until 300 mm of cover exists over the duct banks. The remainder of the granular fill will be placed in 150 mm layers and compacted with hand-operated vibratory tampers or hand-operated vibratory rollers.

The material will be compacted to a density of not less than 95 percent Standard Proctor Maximum Dry Density.

2.11 Washed Drain Rock for Oil Containment Pits

a. Application

Washed drain rock will be used to fill containment pits around oil filled equipment as shown in the Contract Documents.

b. Material Type

Washed drain rock for containment pits will be washed round river rock, clean and evenly graded from 19 mm to 37.5 mm and free from sand, silt, clay and organic matter. Washed crushed drain rock meeting the following requirements may be substituted for the specified material. Washed crushed drain rock will be washed, fractured on at least two faces, evenly graded from 19 mm to 37.5 mm and free from clay, silt, sand and organic matter. For the purpose of calculating liquid storage volume capacity of the rock, an average void ratio of void space to rock volume of 35 percent is required.

c. Placement and Compaction

Containment pits will be backfilled with washed drain rock loosely placed without compaction.

2.12 Drain Gravel

a. Application

Drain gravel will be used to surround perforated or slotted drain pipe as shown on the drawings.

b. Material Type

Drain gravel is specified as the material for this application and will consist of durable, inert and granular material for perforated pipe with perforations greater than 5 mm diameter. Drain gravel will be washed round river rock, clean and evenly graded from 19 mm to 37.5 mm and free from sand, silt, clay and organic matter.

Drain gravel for slotted perforated pipe will conform to the following gradation requirements:

Drain Gravel		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
1.5"	37.50	100
3/4"	19.00	50 - 100
3/8"	9.50	0 - 50
#4	4.75	0 - 5

In addition, the particle diameter of the drain gravel corresponding to 5 percent by weight passing, D_5 , will be greater than the width of the slots in the drain pipe.

c. Placement and Compaction

The drain gravel will be placed as shown on the drawings in layers not to exceed 150 mm. Each layer will be hand tamped unless otherwise directed by Department Representative.

2.13 Native Fill for Grounding Cables

a. Application

Native fill will be used to backfill the trenches excavated for the placement of grounding cables.

b. Material

The trenches for the grounding cables will be backfilled with the same material that was excavated from the trenches. This material is called native fill. All cobbles larger than 75 mm in greatest dimension will be removed before use.

c. Placement and Compaction

The native fill will be placed in near horizontal layers of 150 mm and compacted with hand-operated vibratory compactors to the same density as the adjacent soil.

2.14 Crushed Gravel Base

a. Application

Crushed gravel base will be used immediately below the road mulch wearing surface and parking areas in non-frost-susceptible regions.

b. Material

Crushed gravel base will be durable, inert crushed gravel free from clay and organic material that conforms to the following grading requirements:

Crushed Gravel Base		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
3/4"	19.00	100
3/8"	9.50	50 - 100

Crushed Gravel Base		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
#4	4.75	35 - 70
#10	2.00	22 - 45
#40	0.425	5 - 20
#200	0.075	0 - 8

Seventy-five percent of the crushed gravel base material passing each sieve will have one or more fractured face.

c. Placement and Compaction

Crushed gravel will be placed in layers not to exceed 300 mm in loose thickness. The crushed gravel will be compacted to 100 percent of Standard Proctor Maximum Dry Density.

2.15 Well Graded Base

a. Application

25 mm minus well graded base will be used immediately below road surfacing or parking areas where the Site is in a frost-susceptible region or as noted on the drawings.

b. Material

25 mm minus well graded base will be clean, durable, inert crushed gravel free from clay and organic material that conforms to the following grading requirements:

25 mm minus Well Graded Base		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
1"	25.00	100
3/4"	19.00	80 - 100
3/8"	9.50	50 - 100
#4	4.75	35 - 70
#8	2.36	25 - 50
#16	1.18	15 - 35
#50	0.30	5 - 20
#200	0.075	0 - 5

c. Placement and Compaction

Well graded base will be placed in layers not to exceed 200 mm in loose thickness. The well graded base will be compacted to 100 percent of Standard Proctor Maximum Dry Density.

2.16 Crushed Rock Surfacing

a. Application

After construction is completed 150 mm of crushed rock surfacing will be placed on the substation site to the lines shown in the Contract Documents. Any crushed rock surfacing contaminated during placing will be removed and replaced with new crushed rock surfacing.

b. Material

Crushed rock surfacing will meet the following requirements:

1. Crushed rock surfacing will be a 100 percent quarried material, clean washed rock, granitic in nature, 100 percent fractured on at least two faces, well graded and free from sand, silt, clay and organic matter. The material will meet the following gradation requirements:

ASTM Sieve	ISO Metric Sieve (mm)	Percent Passing
2"	50.00	100
1.5"	37.50	90 - 100
1"	25.00	20 - 55
3/4"	19.00	0 - 15
3/8"	9.50	0 - 5

2. The minimum average ratio of void space to rock will be 30 percent.
3. Minimum wet resistivity will be 3000 ohm metre unless otherwise specified by the consultant.

Crushed rock surfacing produced by crushing round river rock will not meet the requirements of these specifications and will not be accepted.

c. Placement and Compaction

Prior to placement of crushed rock surfacing, the Contractor will backfill and re-establish rough grade elevation that may have been disturbed or worn down during the construction work. Crushed rock used as surfacing material will be placed according to the Contract

Documents. Compaction of Crushed Rock Surfacing will occur through the use of light duty drum rollers or equivalent compaction equipment. Vibratory compactors will not be used.

2.17 Road Mulch Surfacing

a. Application

The material for unpaved road surfacing acts as the wearing surface or the top course of unpaved roads. The road mulch wearing surface will be a minimum 150 mm thick unless noted otherwise on the drawings.

b. Material

Road mulch is specified for this application and will consist of durable rock with a minimum of 50 percent single crushed material and will conform to the following gradation:

Road Mulch		
ASTM Sieve	ISO Metric Sieve (mm)	Percent by Weight Passing
3/4"	19.00	100
3/8"	9.50	60 - 100
#4	4.75	40 - 75
#10	2.00	25 - 55
#40	0.425	10 - 30
#200	0.075	2 - 10

c. Placement and Compaction

Prior to placement of road mulch surfacing, the Contractor will backfill and re-establish rough grade elevation that may have been disturbed or worn down during the construction work. Road mulch will be placed in loose height layers not to exceed 150mm and compacted with self-propelled vibratory rollers. The road mulch will be compacted to a density of not less than 100 percent Standard Proctor Density.

Part 3 Execution

3.1 Site Excavation

The Site will be graded so as to produce the finished grades as shown on the drawings. Rough grades will be established in accordance with the grade elevations and the finished surfaces will be sloped evenly so that there will be no ponding of water on the Site surface.

3.2 Trench Excavation

Trenches for underground services and grounding cables will be excavated to a true line and to a depth of at least 100 mm below the bottom of the pipe or cable. The trench will be excavated only so far in advance of the actual laying of the pipe or cable as Hydro's Representative will permit. Care will be exercised to avoid disturbing or softening the trench bottom below the required elevation. Any such disturbed, softened or loosened material will be removed and replaced with an accepted granular material thoroughly compacted.

3.3 Excavation for Structures and Foundations

Excavation will take place to the lines and grades as shown on the drawings. Bottoms of all excavations will be level, cleaned of all loose materials and will be protected from being disturbed or softened. Softened or loosened material will be removed and made good by the addition of compacted granular fill to the required level.

Excavation wrongly carried deeper than that shown in the Contract Documents will be backfilled with granular material and compacted to the required level.

3.4 Dewatering

The Contractor will keep the construction areas free from water during the performance of the Work.

The water table will be kept sufficiently below the surface of granular fill during placement and compaction so as not to affect the densities obtained by the compaction process.

Protection of Excavation

The Contractor will slope, shore, brace, strut or close excavations as required to prevent collapse or cave-in.

The Contractor will provide barricades and lights for the protection of people and property adjacent to all excavations for the duration of the excavation and will maintain, relocate and remove them as necessary.

The Contractor will protect the excavated surfaces from softening under the action of construction traffic, seepage and rainfall by a layer of granular fill, ditching or trenching as indicated in the Contract Documents or as directed by Department Representative.

All final excavated areas will be properly protected from freezing prior to placing concrete or fill. After subsequent placement of concrete, the soil support of the foundation will be adequately frost protected during open excavation and until excavation is fully backfilled.

3.5 Resurfacing

Existing areas of crushed rock surfacing or road mulch surfacing affected during the construction work in this Contract will be "made good". The Contractor will supply additional crushed rock material, as required, to provide a layer of 150 mm minimum compacted thickness to the finish grade elevations.

Where required, any existing surfacing material will be removed, stored and kept in a clean condition before any subgrade excavation is done and will be replaced and compacted to match the original and surrounding surfacing. The Contractor will remove any soiled surfacing material and replace it with clean surfacing material.

3.6 TESTING OF COMPACTION

- .1 The testing of compaction shall be performed by a recognized materials testing firm engaged by the Contractor.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Sections:
 - .1 03 30 00 - Cast-in-Place Concrete
 - .2 26 05 27 - Grounding – Primary

1.2 MEASUREMENT AND PAYMENT

- .1 Measure supply and erection of chain link fence in metres erected.
- .2 Measure supply and erection of chain link fence gates as units of each size erected.

1.3 REFERENCES

- .1 ASTM International
 - .1 ASTM A53/A53M-10, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated Welded and Seamless.
 - .2 ASTM A90/A90M-09, Standard Test Method for Weight [Mass] of Coating on Iron and Steel Articles with Zinc or Zinc-Alloy Coatings.
 - .3 ASTM A121-07, Standard Specification for Zinc-Coated (Galvanized) Steel Barbed Wire.
 - .4 A653/A653M-10, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 - .5 ASTM F1664-08, Standard Specification for Poly(Vinyl Chloride) (PVC)-Coated Steel Tension Wire Used with Chain-Link Fence.
- .2 Canada Green Building Council (CaGBC)
 - .1 LEED Canada-NC Version 1.0-2004, LEED (Leadership in Energy and Environmental Design): Green Building Rating System Reference Package for New Construction and Major Renovations (including Addendum 2007).
- .3 Canadian General Standards Board (CGSB)
 - .1 CAN/CGSB-138.1-96, Fabric for Chain Link Fence.
 - .2 CAN/CGSB-138.2-96, Steel Framework for Chain Link Fence.
 - .3 CAN/CGSB-138.3-96, Installation of Chain Link Fence.
 - .4 CAN/CGSB-138.4-96, Gates for Chain Link Fence.
 - .5 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.
- .4 CSA International
 - .1 CSA-G164-M92 R2003, Hot Dip Galvanizing of Irregularly Shaped Articles

1.4 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for concrete mixes, fences, posts and gates and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Sustainable Design Submittals:
 - .1 Construction Waste Management:
 - .1 Submit project Waste Management Plan Waste Reduction Workplan highlighting recycling and salvage requirements.
 - .2 Submit calculations on end-of-project recycling rates, salvage rates, and landfill rates demonstrating that 5075% of construction wastes were recycled or salvaged.
 - .2 Recycled Content:
 - .1 Submit listing of recycled content products used, including details of required percentages or recycled content materials and products, showing their costs and percentages of post-industrial content, and total cost of materials for project.
 - .2 Submit evidence, when Supplementary Cementing Materials (SCMs) are used, to certify reduction in cement from Base Mix to Actual SCMs Mix, as percentage.
 - .3 Regional Materials: submit evidence that project incorporates required percentage 20% of regional materials and products, showing their cost, distance from project to furthest site of extraction or manufacture, and total cost of materials for project.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle materials in accordance [with manufacturer's written instructions.
- .2 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .3 Storage and Handling Requirements:
 - .1 Store materials in accordance with manufacturer's recommendations.
 - .2 Store and protect fence and gate materials from damage.
 - .3 Replace defective or damaged materials with new.
- .4 Develop Construction Waste Management Plan

Part 2 Products

2.1 MATERIALS

- .1 Concrete mixes and materials: in accordance with Section 03 30 00 - Cast-in-Place Concrete.
 - .1 Nominal coarse aggregate size: 20mm.
 - .2 Compressive strength: 30 MPa minimum at 28 days.
- .2 Chain-link fence fabric: to CAN/CGSB-138.1.
 - .1 Type 1, Class A, medium style, Grade 1.
 - .2 9 gauge (3.55 mm diameter) 50 mm mesh, galvanized
Height of fabric: as indicated
- .3 Posts, braces and rails: to CAN/CGSB-138.2, Schedule 40 galvanized steel pipe. Dimensions as indicated.
 - .1 Top and brace rails: 42 mm nominal outside diameter, wall thickness 3.55 mm.
 - .2 End and corner posts: 75 mm nominal outside diameter, wall thickness 5.15 mm.
 - .3 Line posts: 60 mm nominal outside diameter, 3.90 mm wall thickness.
 - .4 Gate posts: 89 mm minimum nominal outside diameter, or as otherwise specified.
- .4 Top and bottom tension wire: to CAN/CGSB-138.2, single strand, galvanized steel wire, 6 gauge (4.50 mm diameter).
- .5 Tie wire fasteners: steel wire. 9 gauge (3.55 mm diameter).
- .6 Tension bar: to ASTM A653/A653M, 4.76 x 19 mm minimum galvanized steel.
- .7 Gate frames: to ASTM A53/A53M, Schedule 40 galvanized steel pipe, standard weight 42 mm outside diameter pipe for outside frame, 35 mm outside diameter pipe for interior bracing.
 - .1 Fabricate gates as indicated with electrically welded joints, and hot-dip galvanized after welding.
 - .2 Fasten fence fabric to gate with twisted selvage at top.
 - .3 Furnish gates with galvanized malleable iron hinges, latch and latch catch with provision for padlock which can be attached and operated from either side of installed gate.
 - .4 Furnish double gates with chain hook to hold gates open and centre rest with drop bolt for closed position.
- .8 Fittings and hardware: to CAN/CGSB-138.2 galvanized.
 - .1 Tension bar bands: 3 x 20 mm minimum galvanized steel or 5 x 20 mm minimum aluminum.
 - .2 Post caps to provide waterproof fit, to fasten securely over posts and to carry top rail.

- .3 Overhang tops to provide waterproof fit, to hold top rails and an [outward] projection to hold barbed wire overhang.
- .4 Include projection with clips or recesses to hold 3 strands of barbed wire spaced 100 mm apart.
- .5 Projection of approximately 300 mm long to project from fence at 45 degrees above horizontal.
- .6 Turnbuckles to be drop forged.
- .9 Organic zinc rich coating: to CAN/CGSB-1.181.
- .10 Barbed wire: to ASTM A1212 mm diameter galvanized steel wire 4 point barbs 125 mm spacing.
- .11 Grounding rod: to Section 26 05 27 - Grounding - Primary

2.2 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1 Grade 2.
 - .2 For pipe: 550 g/m² minimum to ASTM A90.
 - .3 For barbed wire: to ASTM A121, Class 2
 - .4 For other fittings: to CSA-G164-M92.
- .2 Aluminum coating:
 - .1 For barbed wire: to ASTM A121 Class2.

Part 3 Execution

3.1 EXAMINATION

- .1 Verification of Conditions: verify conditions of substrate previously installed under other Sections or Contracts are acceptable for fence and gate installation in accordance with manufacturer's written instructions.
 - .1 Visually inspect substrate in presence of Consultant.
 - .2 Inform Consultant of unacceptable conditions immediately upon discovery.
 - .3 Proceed with installation only after unacceptable conditions have been remedied and after receipt of written approval to proceed from Consultant.

3.2 PREPARATION

- .1 Temporary Erosion and Sedimentation Control:
 - .1 Provide temporary erosion and sedimentation control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction, specific to site, whichever is more stringent.

- .2 Grading:
 - .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts.
 - .1 Provide clearance between bottom of fence and ground surface of 50 mm.

3.3 ERECTION OF FENCE

- .1 Erect fence along lines as indicated on contract drawings or [as directed by Consultant and to CAN/CGSB-138.3.
- .2 Excavate post holes to dimensions indicated. Space line posts 3 m apart, measured parallel to ground surface.
- .3 Space straining posts at equal intervals not to exceed 150 m if distance between end or corner posts on straight continuous lengths of fence over reasonably smooth grade, is greater than 150 m.
- .4 Install additional straining posts at sharp changes in grade and where directed by Consultant.
- .5 Install corner post where change in alignment exceeds 10 degrees.
- .6 Install end posts at end of fence and at buildings.
 - .1 Install gate posts on both sides of gate openings.
- .7 Place concrete in post holes then embed posts into concrete to depths indicated.
 - .1 Extend concrete 50 mm above ground level and slope to drain away from posts.
 - .2 Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .8 Install fence fabric after concrete has cured, minimum of 5 days.
- .9 Install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface.
 - .1 Install braces on both sides of corner and straining posts in similar manner.
- .10 Install overhang tops and caps.
- .11 Install top rail between posts and fasten securely to posts and secure waterproof caps and overhang tops. Connect rails with slip-on sleeves: use expansion springs at 40 m spacing.
- .12 Install bottom tension wire, stretch tightly and fasten securely to end, corner, gate and straining posts with turnbuckles and tension bar bands.

- .13 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced at 375 mm intervals.
 - .1 Knuckled selvedge at bottom.
 - .2 Twisted selvedge at top.
- .14 Secure fabric to top rails, line posts and bottom tension wire with tie wires at 450 mm intervals.
 - .1 Give tie wires minimum two twists.
- .15 Where specified, install barbed wire strands and clip securely to lugs of each projection.
- .16 Where specified, install grounding rods as indicated.

3.4 INSTALLATION OF GATES

- .1 Install gates in locations as indicated.
- .2 Level ground between gate posts and set gate bottom approximately 50 mm above ground surface.
- .3 Install gate stops where indicated.

3.5 TOUCH UP

- .1 Clean damaged surfaces with wire brush removing loose and cracked coatings. Apply two coats of organic zinc-rich paint to damaged areas as indicated.
 - .1 Pre-treat damaged surfaces according to manufacturers' instructions for zinc-rich paint.

3.6 CLEANING

- .1 .Leave Work area clean at end of each day.
- .2 Final Cleaning: upon completion remove surplus materials, rubbish, tools and equipment. Waste Management: separate waste materials for reuse or recycling.
 - .1 Remove recycling containers and bins from site and dispose of materials at appropriate facility.

END OF SECTION

Part 1 GENERAL

1.1 SCOPE OF WORK

- .1 Major items include but are not limited to:
 1. Determine methods of construction, including selection of equipment and special safety measures, suitable for construction work in an operating, energized electrical transformer yard with circuits functioning at up to 138,000 volts.
 2. Do construction survey layout
 3. Do pipe trench excavation and excavation for manholes and chambers
 4. Supply and place geotextile fabric on excavation bottom and up sides of drain rock pit
 5. Supply, place and compact pipe bedding or granular base
 6. Supply and install PVC pipe in the trenches
 7. Supply and install manholes and cleanouts including cover frames and lids
 8. Supply and install oil stop chamber, including interconnecting pipes
 9. Supply and install oil-water separator
 10. Supply and install oil stop valve and chamber
 11. Supply, install and compact granular pipe bedding and pipe surround material
 12. Supply, install and compact trench (and excavation) granular backfill
 13. Construct drain rock pit at downstream end of runoff oil water separator outlet pipe
 14. Neatly mark up drawings indicating actual location and elevation of the installed works, and indicating all construction changes to the design, for transfer to the project record drawings
 15. Perform incidental work not specifically described that is necessary to properly complete the Contract Work.

1.2 GENERAL REQUIREMENTS

- .1 The Contractor shall prepare the subgrade, place topsoil, and hydro-seed in all areas disturbed by construction, and as otherwise indicated on the drawings.

- .2 All material, labour and plant installation shall be in accordance with the B.C. Landscape Standard jointly produced by the B.C. Society of Landscape Architects and the B.C. Nursery Trades Association.
- .3 The Consultant shall be contacted to arrange inspections before and after hydraulic seeding; allow for a minimum of one days notice.

1.3 PAYMENT

- .1 Payment for all work in this section shall be included in the lump sum price for Item 2 in Schedule 1 of the Form of Tender.

Part 2 Products

2.1 GEOTEXTILE

1. Geotextile Fabric shall be Nilex 4516 (non-woven), or as indicated on the Contract drawings, or approved equivalent.

2.2 GRANULAR MATERIAL

1. Stone bedding shall conform to sub-section above.
2. Granular pipe bedding and surround shall conform to sub-section above.
3. Excavation backfill around manholes and chambers shall be as indicated on the drawings, and conform to the relevant subsection.
4. Trench backfill shall be as indicated on the drawings and shall be select native excavation spoil as and where indicated on the drawings.

2.3 PIPE

1. Drain pipe shall be Polyvinyl Chloride, DR35, manufactured in compliance with AWWA C900 (100 mm to 300 mm diameter) or AWWA C905 (350 mm to 1200 mm diameter), and certified as compliant with CSA B137.3. Joints shall be thickened-integral-bell and spigot-end push-on type, with a formed groove for single rubber gasket, conforming to ASTM D3139. Elastomeric gaskets shall conform to ASTM F477.

2.4 PIPE FITTINGS

1. Manufactured wyes shall be injection moulded PVC or shall be fabricated PVC fittings manufactured to the requirements of AWWA C900 or AWWA C905, and CSA B137.3, with integral bell ends including gasket grooves and rubber gaskets. Fabricated fittings shall be made from segments of AWWA

C905 PVC pipe, butt fused or bonded together, and over-wrapped with fibreglass reinforced polyester.

2. Bends shall conform to PVC mainline pipe specification, and come with at least one integral bell end including gasket groove and rubber gasket.
3. PVC connections to manholes or chambers shall use a spigot end with a pre-fabricated manhole adaptor ring or shall have a carefully sanded outer surface (0.2 mm high profile) for a length corresponding to the concrete wall thickness.

2.5 MANHOLES

1. Manhole sections shall be pre-cast reinforced concrete cylinders conforming to ASTM C478M WITHOUT ladder rungs.
2. Manhole lids shall be pre-cast reinforced concrete designed to withstand H20 loading.
3. Cast iron frame and over shall conform to ASTM A48, be designed for H20 loading, and have manufacturer's identity permanently marked.
4. Joints shall be made watertight using both rubber gaskets to ASTM C443 and cementitious grout on both the inside and the outside of the joint.
5. Manhole Grade Riser Rings shall be:
 - a. In 50 or 100 mm thicknesses
 - b. Designed for installation under cast iron frames subject to H20 loads
 - c. Manufactured to ASTM C478.
6. Manhole bases shall be pre-fabricated pre-benched to pipeline line and grade, and be produced by a manhole supplier or long-established (minimum 5 years) manhole pre-benching manufacturer. Bell end stubs facing upstream and spigot ends facing downstream may be pre-fabricated.

2.6 CHAMBERS

1. Liquid storage and oil-water-separator chambers shall be as indicated on Contract drawings, or approved equivalents.
2. Chambers shall be pre-cast reinforced concrete with tongue-in-groove joints sealed with mastic supplied by the manufacturer.
3. Chambers shall be designed for H20 loading.

4. Chambers shall have designed and manufactured “knock-out” panels at the design locations and elevations for pipe connections. Knock-out panels shall be designed for subsequent watertight cementitious grout sealing after pipe connection is installed on site. Stub end connections may be pre-fabricated.
5. Manhole access risers shall be pre-cast reinforced concrete cylinders conforming to subsection 2.8.2 (f) 1, 2, 4 and 5 above.

2.7 MANHOLE COVER FRAMES AND LIDS

1. Cast iron frame and cover shall conform to ASTM A48, be designed to withstand H2O loading, and be marked in accordance with BC Hydro requirements.

2.8 NON-SHRINK MORTAR

1. M-Bed Standard or approved equivalent machine-base-grout, prepared in plastic condition in accordance with manufacturer’s recommendations.

Part 3 Execution

3.1 GENERAL

1. Verify with Owner’s Representative and switchyard operators that construction can proceed in the designated areas.
2. Establish all safety measures and protocols for construction in a fully operating, live electrical switchyard prior to commencing construction. Comply with WorkSafeBC safety requirements, especially maintaining safe clearances, maintaining stable excavations, and having safety watchers.
3. Verify alignment reference points and establish horizontal and vertical alignment for chambers, manholes and pipelines.
4. Verify connection locations and elevations, especially at catchment basins.
5. Identify locations for stockpiling excavation spoil intended for use as select native backfill, and for disposing of (surplus) excavation spoil, and obtain agreement from BCTC’s Representative.

3.2 EXCAVATION AND GRANULAR BEDDING

1. Excavate to line and grade for chambers, manholes and pipelines. Cut side slopes at stable gradient. Provide shoring as required. Do not excavate any wider than necessary. Do not jeopardize adjacent works.

2. Grade, slope and tamp excavation bottom.
3. Place geotextile fabric on bottom and up sides of excavation. Comply with manufacturer's recommendations for installation, including overlapping seams.
4. Place, grade, shape and tamp stone bedding across full width of trench bottom. Create uniform surface within plus or minus 15 mm of required elevation, but not uniformly higher or lower.
5. Place, grade, shape and compact granular pipe bedding across full width of bottom of trench. Shape compacted granular lid to provide uniform, smooth, continuous bearing surface for pipe. Shape transverse depressions where required for joint bells. Compact granular bedding to 100% Standard Proctor Density.

3.3

PIPE LAYING

1. Handle pipe in accordance with manufacturer's recommendations. Lay and join pipes in accordance with CSA B182.11. Lay pipes true to line and grade, and ensure full control with shaped bed for entire length of pipe.
2. Tolerable horizontal deviation: plus or minus 25 mm from design alignment.

Tolerable vertical deviation: plus or minus 10 mm from design alignment, and less than 3 mm variation from straight line over a 12 m distance.
3. Lay pipes from lower downstream end in upstream direction to catchment basins, with the bell (socket) ends of pipe facing upstream.
4. Do not deflect joints. Do not bend pipe barrel. Do not deform (roundness of) pipe.
5. Keep pipe and jointing materials clean. Keep dirt, water and foreign materials out of pipe.
6. Cut pipes where required in accordance with manufacturer's recommendations. Trim ends square to axis of pipe, and carefully create 15° bevel.
7. Align pipes carefully prior to joining, keeping soil, granular material and debris out, and supporting pipe sufficiently to minimize any lateral or eccentric pressure on gasket.
8. Install gasket in accordance with both pipe and gasket manufacturers' recommendations, including recommended lubrication, keeping the gasket clean, and not distorting the gasket.

9. Insert spigot into bell to the length of penetration recommended by manufacturer, typically indicated by the two insertion limit lines on the pipe spigot.
10. Ensure completed joints are properly and fully supported and restrained by compacting layers of granular bedding material alongside and over the installed pipes.
11. Install bends, wye laterals, tees and cleanouts in accordance with the typical details and with the manufacturer's recommendations, and in a manner similar to pipe installation described above. Use only pipe fittings conforming to AWWA C905 and certified to CSA B137.3 by a third party.
12. Hand place granular bedding material uniformly along each of the haunches, and hand tamp to create well-compacted even support. Then surround the pipe by carefully hand placing granular bedding in simultaneous balanced uniform layers on each side. Keep the thickness of each pipe surround layer to less than 150 mm or less than one-half of the pipe diameter, whichever is lesser.
13. Compact each pipe surround layer to 100% Standard Proctor Density.
14. Extend the compacted granular bedding pipe surround to 150 mm above the crown of the pipe.
15. Supply and place the Styrofoam insulation on the compacted granular bedding material above the buried pipe, in accordance with the drawings. Install the insulation so that the Styrofoam panels form a tight, stable, well-supported insulation layer across the trench, at the thickness and width indicated in the drawings.
16. Continue to extend the geotextile filter cloth up the sides of the trench to an elevation above the pipe bedding granular material zone, with a length-allowance for overlap wrapping the granular pipe surround material.
17. At the depth indicated in the standard utility trench detail, extend the geotextile fabric from each of the trench wall sides over the compacted granular pipe surround material, overlapping at least 300 mm.
18. Carefully place lifts of select native backfill (fractured stone) into the trench to complete backfilling to existing finished grade. Compact the select native material by a combination of tamping and vibration or by similar suitable methods. Match the adjacent existing finished grading elevations and patterns.

3.4 MANHOLES

1. Construct manholes in accordance with the typical details on the Drawings at the locations and at the elevations required to suit the pipe elevations, all shown on the Drawings.
2. Excavate, provide granular bedding including geotextile fabric subgrade and excavation wall "liner", supply and install compacted pipe surround, and backfill in accordance with sub-sections above using only Granular B Fill all the way up to the Ground Finished Grade Elevation.
3. Manhole base shall be pre-benched integral base and lower barrel unit with channelling corresponding to inlet and outlet invert elevations and pipe sizes.
4. Form channelling in manhole base using half-sections of pipe of same diameter or using U-channel forms. Channel depth shall be equal to, or greater than, full diameter of inlet and outlet pipe.
5. Sand circumferential surface of pipe to be connected to manhole to create good bonding surface, with a 0.25 mm profile for length equal to thickness of barrel wall plus 150 mm. Extend non-shrink mortar used to seal annulus of pipe penetration through wall for additional 100 mm outside of manhole wall. Create 100 mm thick x 100 mm wide circumferential collar on pipe at external wall penetration. Ensure grout "collar" is fully supported by extra-well-compacted underlying granular bedding.
6. Supply and install pre-fabricated "Tylox" or approved equivalent gasket in barrel and lid joints. "Butter" inside and outside faces of joints with non-shrink grout to complete sealing of barrel joints.
7. Plug barrel lifting holes with non-shrink mortar.
8. Use pre-cast concrete manhole grade riser rings, and the specified general purpose, machine-base grout, to adjust manhole frame elevation to meet design finished grade. Butter inside and outside faces of grade ring(s) with mortar to create neat even finish.
9. Set manhole cover frames and lids to the rim finished grade elevations shown on the drawings.

3.5 CHAMBERS

1. Supply and install chambers in accordance with the drawings and the sub-sections above.
2. Install joint mastic supplied by chamber manufacturer in perimeter key. Apply non-shrink grout to inside and outside of chamber joint creating neat, smooth, fully sealed surface.
3. Construct manhole risers similarly to manholes as described above. Use specified machine base grout on chamber cover at base of riser to achieve full riser wall thickness contact between riser and chamber in accordance with Drawing detail.

END OF SECTION

Part 1 General

1.1 RELATED REQUIREMENTS

- .1 Section 26 05 14, 26 05 21 and 26 05 28

1.2 REFERENCES

- .1 Canadian Standards Association (CSA International)
 - .1 CAN/CSA A23.1-04/A23.2-04, Concrete Materials and Methods of Concrete Construction/Methods of Test and Standard Practices for Concrete.

1.3 ACTION AND INFORMATIONAL SUBMITTALS

- .1 Provide submittals in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Product Data:
 - .1 Submit manufacturer's printed product literature, specifications and datasheet and include product characteristics, performance criteria, physical size, finish and limitations.

1.4 QUALITY ASSURANCE

- .1 Quality assurance submittals: submit following in accordance with Section 01 45 00 - Quality Control.
- .2 Regulatory Requirements:
 - .1 Perform Work to comply with applicable Provincial regulations.
 - .2 Co-ordinate and meet requirements of power supply authority.
 - .1 Ensure availability of power when required.
- .3 Certificates: submit certificates signed by manufacturer certifying materials comply with specified performance characteristics and physical properties.
- .4 Manufacturer's Instructions: submit manufacturer's installation instructions and special handling criteria, installation sequence, cleaning procedures.

1.5 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements:
 - .1 Deliver materials to site in original factory packaging, labelled with manufacturer's name, address.
- .2 Packaging Waste Management: remove for reuse (cable reels) and recycling.

Part 2 Products

2.1 MATERIALS

- .1 Direct buried ducts and concrete encased ducts: Rigid PVC, size as indicated.
- .2 RPVC elbows: install manufactured elbows, with bells when terminating at concrete wall.
- .3 Meter socket: in NEMA 4 enclosure, and as required and approved by supply authority.
- .4 Concrete: to CAN/CSA A23.1/A23.2.
- .5 Backfill: clean and free of debris.

Part 3 Execution

3.1 APPLICATION

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

3.2 INSTALLATION

- .1 Install 150 mm wide warning tape above direct buried ducts, concrete encased duct banks and direct buried power cables, 300mm below final grade. Where raceways are direct buried under the concrete containment apron, install 50 to 100mm beneath the slab i.e. on the soil or backfill and beneath concrete bedding material.
- .2 Install clean sand minimum 100mm all around direct buried ducts.
- .3 Install bonding conductor in all ducts, and bond to ground. Bonding conductor from 138kV switchyard shall not be connected at 600V Powerhouse. See Section 26 05 28 - 3.1.
- .4 Allow adequate conductor length for connection to supply by power supply authority.
- .5 Install conduit and meter socket panel.
- .6 Install conduit and 600V Service Disconnect Switch.
- .7 Allow adequate conductor length for connection to service equipment.
- .8 Make grounding connections in accordance with Section 26 05 28 - Grounding - Secondary.
- .9 Install concrete encased ducts for electrical systems as indicated and in accordance with CAN/CSA A23.1.
- .10 After installation of cable(s), seal ducts and conduits and openings at splice-pits, pull-boxes, and at equipment locations.

3.3 FIELD QUALITY CONTROL

- .1 Site Tests:
 - .1 Perform tests in accordance with Section 26 05 00 - Common Work Results for Electrical.
 - .2 Perform additional tests if required by authority having jurisdiction.
- .2 Submit written test results to Departmental Representative for review.

3.4 CLEANING

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

END OF SECTION