PART 1 GENERAL

1.1 WORK INCLUDED

.1 Materials and installation for non load bearing, plant produced precast architectural concrete.

1.2 RELATED SECTIONS

.1 Section 03200 –Concrete Reinforcement

.2 Section 03300 – Cast-in-Place Concrete

.3 Section 04060 – Masonry Mortar and Grout

.4 Section 04200 – Unit Masonry

.5 Section 04211 – Brick Masonry

1.3 REFERENCE STANDARDS

.1 American Society for Testing and Materials International, (ASTM)

.1 ASTM A775/A775M-01, Standard Specification for Epoxy-Coated Reinforcing Steel Bars.

.2 ASTM C494/C494M-99ae1, Standard Specification for Chemical Admixtures for Concrete.

.2 Canadian General Standards Board (CGSB)

.1 CAN/CGSB-1.181-99, Ready-Mixed Organic Zinc-Rich Coating.

.3 Canadian Standards Association (CSA International)

.1 CAN/CSA-A23.1/A23.2-00, Concrete Materials and Methods of Concrete Construction/Methods of Test for Concrete.

.2 CAN/CSA-A23.4-05, Precast Concrete-Materials and Construction

.3 CAN/CSA-A3000-98(April 2001), Cementitious Materials Compendium (Consists of A5-98, A8-98, A23.5-98, A362-98, A363-98, A456.1-98, A456.2-98, A456.3-98).

.1 CAN/CSA-A23.5-98, Supplementary Cementing Materials.

.4 CAN/CSA-G40.20/G40.21-98(June 2000), General Requirements for Rolled or Welded Structural Quality Steel/Structural Quality Steel.

.4 CAN/CSA G164-M92(R1998), Hot Dip Galvanizing of Irregularly Shaped Articles.

1.4 DESIGN REQUIREMENTS

.1 Design precast elements to CAN/CSA A23.4-05 and to resist handling, stockpiling, shipping and erection stresses.

.2 Design precast elements to carry loads in accordance with applicable codes. Design shall include resistance to creep, shrinkage and temperature effects, as well as wind and earthquake loads.

.3 Design connections/attachments of precast elements to each other and to supporting and back-up members. Connections shall be designed to withstand long-term corrosion for exposed elements.

1.5 PERFORMANCE REQURIEMENTS

.1 Tolerance of precast elements to CAN/CSA A23.4-05.

1.6 SUBMITTALS

.1 Submit shop drawings to CAN/CSA-A23.4-05 and . Include the following items:

.1 Design calculations for items designated by manufacturer.

.2 Tables and bending diagrams of reinforcing steel.

.3 Camber.

.4 Finishing schedules.

.5 Methods of handling and erection.

.6 Openings, sleeves, inserts and related reinforcement. Including embedded handling hardware .

.2 Each drawing submitted shall bear stamp and signature of qualified professional engineer registered or licensed in provinces of Ontario.

.3 Produce, deliver and erect where directed by Consultant on project site, full size precast concrete units incorporating required details and showing specified colour, finish and quality for Consultant approval prior to beginning full production.

1.7 QUALIFICATIONS

.1 Precast concrete elements to be fabricated and erected by manufacturing plant certified by Canadian Standards Association in appropriate categories according to CSA A251.

.2 Precast concrete manufacturer to be certified in accordance with CSA's certification procedures for precast concrete plants prior to submitting tender and to specifically verify as part of tender that plant is currently certified in appropriate architectural precast category, Architectural .

.3 Only precast elements fabricated in such certified plants to be acceptable to owner, and plant certification to be maintained for duration of fabrication, erection until warranty expires.

1.8 WASTE MANAGEMENT AND DISPOSAL

.1 Separate waste materials for reuse and recycling.

.2 Remove from site and dispose of all packaging materials at appropriate recycling facilities.

1.9 WARRANTY

.1 The Contractor hereby warrants that the precast architectural elements will not spall or show visible evidence of cracking, except for normal hairline shrinkage cracks, in accordance with General Conditions, but for 2years.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Cement, colouring material, aggregates, water, admixtures: to CAN/CSA-A23.4-05 and CAN/CSA-A23.1/A23.2.

.2 Exposed aggregate and special facing materials : to match selected finish sample.

.3 Use same brands and source of cement and aggregate for entire project to ensure uniformity of colouration and other mix characteristics.

.4 Reinforcing steel: epoxy coated .

.5 Prestressing steel: to CAN/CSA-S6 and CSA G279.

.6 Forms: to CAN/CSA-A23.4-05 .

.7 Hardware and miscellaneous materials: to CAN/CSA-A23.1/A23.2.

.8 Anchors and supports: to CAN/CSA-G40.20/G40.21 galvanized after fabrication .

.9 Welding materials: to CSA W48 .

.10 Galvanizing: hot dipped galvanizing with minimum zinc coating of 610 g/m2 to CAN/CSA G164 .

.11 Epoxy coating: to ASTM A775/A775M .

.12 Shims: plastic .

.13 Surface retardant: to ASTM C494/C494M Type B , , solvent free. Do not allow moisture of any kind to come in contact with the retarder film.

.14 Weephole tubes: purpose made galvanized steel .

.15 Sealers:

.1 Shop applied: 1 coat penetrating silane sealer Tremco Dektite 440, Enviroseal 40, or Meadows CS309-25.

.2 Field applied: 1 coat penetrating sealer as above following final installation and finishing of joints.

2.2 CONCRETE MIXES

.1 Proportion concrete in accordance with CAN/CSA-A23.1/A23.2 to give following properties:

.1 Cement: use Portland cement and supplementary cementing materials to achieve strength and consistent colour properties.

.2 Minimum compressive strength at 28 days: 30 MPa.

.3 Class of exposure: c-1.

.4 Nominal size of fine and coarse aggregates: to match PCI Guide reference.

.5 Maximum water cement ratio: 0.45.

.6 Air content: 5 % minimum.

2.3 FABRICATION

.1 Manufacture units in accordance with CAN/CSA-A23.4-05 .

.2 Mark each precast unit to correspond to identification mark on shop drawings for location with date cast on part of unit which will not be exposed.

.3 Design and attach anchors and inserts to precast concrete elements to carry design loads.

.4 Shop prime anchors and steel inserts after fabrication and touch up primer on anchors after welding. Do not apply primer to embedded portion of anchors or inserts.

.5 Galvanize anchors and steel embedments after fabrication and touch up with zinc-rich primer after welding.

.6 Employ stainless steel dowels to anchor base of units to structural supports.

2.4 FINISHES

.1 Finish of pre-cast units to closely match Colour and Texture Guide selection as published by the Precast/prestressed Concrete Institute (PCI), and available online at www.PCI.org.

.2 PCI guide number: 478 : with the following characteristics:

.1 Acid etched – light

.2 Cement – dark grey pigmented

.3 Fine aggregate - crushed grey granite

.4 Coarse aggregate – 12mm to 6mm grey granite

.3 Finish and colour of precast units to match sample on site once approved.

.4 Smooth float back surface of precast units.

.5 Protect exposed surfaces with 2 coats of sealer as approved by Consultant.

2.5 SOURCE QUALITY CONTROL

.1 Provide Consultant with certified copies of quality control tests related to this project as specified in CAN/CSA-A23.4-05.

.2 Inspect prestressed concrete tendons in accordance with CSA G279 .

.3 Provide records from in-house quality control programme based upon plant certification requirements to Departmental Representative Consultant for inspection and review.

.4 Upon request, provide Departmental Representative Consultant with certified copy of mill test report of reinforcing steel supplied, showing physical and chemical analysis.

.5 Precast plants should keep complete records of supply source of concrete material, steel reinforcement, prestressing steel and provide to Departmental Representative Consultant for review upon request.

PART 3 EXECUTION

3.1 GENERAL

.1 Do precast concrete work in accordance with CAN/CSA-A23.4-05 and CAN3-A23.3 CAN/CSA-S6.

3.2 ERECTION

.1 Erect precast elements within allowable tolerances as indicated specified.

.2 Non-cumulative erection tolerances in accordance with CAN/CSA-A23.4-05 .

.3 Set elevations and alignment between units to within allowable tolerances before connecting units.

.4 Bed precast units in mortar in accordance with Section 04 20 00 – Masonry . Point joints with coloured mortar to match pre-cast colour. Rake out joints 10 mm to receive sealant at control joints and as indicated..

.5 Grout underside of unit bearing plates with shrinkage compensating grout.

.6 Fasten precast panels in place as indicated on reviewed shop drawings.

.7 Secure bolts with tack-weld nut to bolt.

.8 Clean field welds with wire brush and touch-up galvanized finish with zinc-rich primer.

.9 Remove shims and spacers from joints of non-load bearing panels after fastening but before sealant is applied.

.10 Apply sealers to precast panels to manufacturer's recommendations unless specified otherwise.

3.3 CLEANING

.1 Obtain approval of cleaning methods from Consultant before cleaning soiled precast concrete surfaces.

.2 Clean final installed products at completion of work.

END OF SECTION

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PART 1 GENERAL

1.1 WORK INCLUDED

.1 Supply and installation of countertops and cupboards in accordance with the Contract Documents.

1.2 SUBMITTALS

.1 Submit shop drawings of all items.

.2 Submit samples of finishes and hardware for approval.

1.3 PRODUCT HANDLING

.1 Do not deliver to site until there is an acceptable heated, dry storage area. Deliver with protective coverings.

.2 Protect installed work and keep countertops covered until final inspection.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Standard institutional quality millwork complete with post-formed plastic laminated tops.

.2 Two year written guarantee for tops.

.3 Cupboards to be laminated MDF. Base cabinets to be 900mm high and 600mm deep. Upper cabinets to be 760mm high and 305mm deep.

.4 Colours and patterns to be chosen by owner.

.5 Wood trim as detailed.

.6 Hardware including hinges and style pulls will be supplied and installed by this section. They shall be of standard commercial grade to be chosen by owner from samples supplied by this section.

PART 3 EXECUTION

3.1 ERECTION

.1 Sand smooth all exposed wood to be finished. Joints shall be accurately fitted, coped or mitered, well glued up. In finished surfaces, set nail heads and in stained work countersink screw or bolt heads and cover with side grain plugs.

.2 At counter backsplash/wall joint, apply small bead of sealant.

.3 Fastenings for cupboards in public areas to be heavy duty.

3.2 FINISHING

.1 Submit samples to Engineer for approval.

3.3 ADJUSTING AND CLEANING

.1 Adjust hinged doors to swing freely and easily, to remain stationary at any point of swing, to close evenly and tightly against stops without binding and to latch positively when doors are closed with moderate force. Adjust sliding doors to operate smoothly without binding and to close evenly and tightly against jambs.

.2 Adjust hardware so that latches and locks operate smoothly and without binding, and closers act positively with the least possible resistance in use. Lubricate hardware if required by supplier's instructions.

.3 Clean hardware after installation in accordance with supplier's instructions. Clean woodwork to leave free from finish defects in any exposed part.

END OF SECTION

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PART 1 GENERAL

1.1 WORK INCLUDED

.1 Labour, materials, plant, tools and equipment to provide the bituminous dampproofing membrane to concrete foundation walls in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

.1 CAN/CGSB-37.9M: Primer, Asphalt, Unfilled for Asphalt Roofing, Dampproofing and Waterproofing.

.2 CAN/CGSB-37.2M: Emulsified Asphalt, Mineral-Colloid Type, Unfilled, for Dampproofing and Waterproofing and for Roof Coatings

.3 CAN/CGSB-37.16M: Filled, Cutback Asphalt for Dampproofing and Waterproofing.

1.3 SUBMITTALS

.1 Prior to commencing the Work, submit copies of manufacturers current certification to ISO 9000. Membrane, primers, sealants, adhesives and associated auxiliary materials shall be included.

.2 Prior to commencing the Work, submit references clearly indicating that the materials proposed have been installed for not less than fifteen (15) years on projects of similar scope and nature. Submit references for a minimum of ten (10) projects.

.3 .3 Prior to commencing the Work submit manufacturers complete set of standard details for dampproofing systems.

1.4 QUALITY ASSURANCE

.1 Perform Work in accordance with the printed requirements of the membrane manufacturer and this specification. Advise designer of any discrepancies prior to commencement of the Work.

.2 Maintain one (1) copy of manufacturers literature on site throughout the execution of the Work.

.3 At the beginning of the Work and at all times during the execution of the Work, allow access to site by the dampproofing membrane manufacturer's representative.

.4 Submit documentation certifying that the primary dampproofing materials comply with CAN/CGSB 37.9, CAN/CGSB-37.16 & CAN/CGSB-37.2 as appropriate for the application.

.5 Materials used in this Section shall be fully compatible and shall be sourced and or produced by one (1) manufacturer.

.6 Submit copies of the membrane manufacturers current ISO certification including the manufacturing of all the specified materials.

1.5 DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

.2 Store membrane at temperature of 5 degrees C (40 degrees F) and above to facilitate handling.

.3 Membrane contain petroleum solvents and are flammable. Do not use near open flame.

.4 Store role materials horizontally in original packaging.

.5 Store adhesives and primers at temperatures of 5 degrees C and above to facilitate handling.

.6 Keep solvents away from open flame or excessive heat.

1.6 SITE CONDITIONS

.1 No installation work shall be performed during rainy or inclement weather and on frost or wet covered surfaces.

.2 Protection

.1 Provide adequate protection of materials and work of this section from damage by weather backfilling operations and other causes.

.2 Protect work of other trades from damage resulting from work of this section. Make good such damage at own expense to satisfaction of the consultant.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Components and materials must be obtained as a single-source from the membrane manufacturer to ensure total system compatibility and integrity.

.2 Dampproofing materials

.1 Dampproof Coatings for Temperatures Below 5 degrees C:

.1 Asphalt dampproof primer conforming to the requirements of CAN/CGSB 37.9, 910-01 Penetrating Asphalt Primer manufactured by Bakor or approved equivalent.
.2 Premium grade fibrated asphalt coating for foundation wall applications conforming to the requirements of CAN/CGSB-37.16, 710-11 Premium Grade Foundation Coating manufactured by Bakor or approved equivalent.

.2 Dampproofing Coating for Temperatures Above 5 degrees C:

.1 Dampproof asphalt emulsion primer conforming to the requirements of CAN/CGSB-37.2, 700-01 Asphalt Emulsion Dampproofing manufactured by Bakor diluted 20% with clean water, or approved equivalent.
.2 Asphalt emulsion dampproofing conforming to the requirements of CAN/CGSB-37.2, 700-01 Asphalt Emulsion Dampproofing manufactured by Bakor or equivalent.

PART 3 EXECUTION

3.1 CONDITION OF SURFACE

.1 Before commencing work, ensure environmental and site conditions are suitable for installation of dampproofing.

3.2 APPLICATION OF DAMPPROOFING COATING FOR TEMPERATURES BELOW 5 DEGREES C

.1 Apply a coat of primer at rate of 0.5 to 2.0l/m2 and allow to cure until touch dry.

.2 Apply a coat of fibrated asphalt dampproofing at rate of 1.0 to 1.5 l/m2 and allow to cure.

3.3 APPLICATION OF DAMPPROOFING COATING FOR TEMPERATURES ABOVE 5 DEGREES C

.1 Apply a coat of asphalt emulsion dampproofing diluted 20% with clean water at the rate of 0.5l/m2 as a primer and allow to dry.

.2 Apply a second coat of asphalt emulsion dampproofing at rate of 1.0 to 1.5 l/m2 and allow to dry.

3.4 CLEAN-UP

.1 Promptly as the work proceeds and on completion clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing work.

END OF SECTION

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PART 1 GENERAL

1.1 WORK INCLUDED

.1 Labour, materials, plant, tools and equipment to provide the dimpled drainage membrane to concrete foundation walls in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

.1 ASTM D1621 (modified) – Standard Test Method for Compressive Properties Of Rigid Cellular Plastics.

.2 ASTM D1777 - Standard Test Method for Thickness of Textile Materials.

.3 ASTM D3776 - Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.

.4 ASTM D3786 - Standard Test Method for Hydraulic Bursting Strength of Textile Fabrics-Diaphragm Bursting Strength Tester Method.

.5 ASTM D4491 - Standard Test Methods for Water Permeability of Geotextiles by Permittivity.

.6 ASTM D4632 - Standard Test Method for Grab Breaking Load and Elongation of Geotextiles.

.7 ASTM D4716 – Test Method for Determining the (In-plane) Flow Rate per Unit Width and Hydraulic Transmissivity of a Geosynthetic Using a Constant Head.

.8 ASTM D4751 - Standard Test Method for Determining Apparent Opening Size of a Geotextile.

1.3 SUBMITTALS

.1 Comply with Section 01340 - Submittals.

.2 Submit manufacturer's product data and application instructions.

1.4 QUALITY ASSURANCE

.1 Perform Work in accordance with the printed requirements of the manufacturer and this specification. Advise designer of any discrepancies prior to commencement of the Work.

.2 Maintain one (1) copy of manufacturers literature on site throughout the execution of the Work.

.3 At the beginning of the Work and at all times during the execution of the Work, allow access to site by the manufacturer’s representative.

.4 Materials used in this Section shall be fully compatible and shall be sourced and or produced by one (1) manufacturer.

1.5 .DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

.2 Store materials in a clean dray area in accordance with manufacturer’s instructions.

.3 Protect materials during handling and application to prevent damage or contamination.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Components and materials must be obtained as a single-source from the manufacturer to ensure total system compatibility and integrity.

.2 Geocomposite Drainage Board shall consist of a dimple raised core bonded to a high strength geotextile fabric.

PART 3 EXECUTION

3.1 CONDITION OF SURFACE

.1 Examine surfaces to receive membrane. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

.1 Protect adjacent surfaces not designated to receive drainage system.

.2 Clean and prepare surfaces to receive drainage system in accordance with manufacturer's instructions.

3.3 APPLICATION

.1 Unroll drainage board with flat, core side against the wall or waterproofing membrane. Drainage board can be fastened at the top side with a suitable mechanical fastening system that is compatible with the substrate.

.2 Adhere remainder of drainage board with mastic, compatible with this installation.

.3 Overlap the flat side core lip with second sheet of drainage board to provide a continuous drainage layer (shingle fashion). Ensure excess filter fabric is overlapped with this next sheet.

3.4 PROTECTION

.1 Backfill immediately using care to avoid damaging drainage layer and to ensure permanent placement of the drainage board.

3.5 CLEAN-UP

.1 Promptly as the work proceeds and on completion clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing work.

END OF SECTION

PART 1 GENERAL

1.1 WORK INCLUDED

.1 Labour, materials, plant, tools and equipment to provide the PVC wall and ceiling cladding in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

.1 American Society for Testing and Materials (ASTM)

.1 ASTM C 36-97, Standard Specification for Gypsum Board.

.2 ASTM C 1002-98, Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases.

.2 Canadian Standards Association (CSA)

.1 CAN/CSA IS09001 9002 9003, Requirements for Quality Assurance, Parts 1, 2 and 3.

1.3 SUBMITTALS

.1 Comply with Section 01340 - Submittals.

.2 Submit proof of manufacturer's CCMC Listing and listing number to Engineer Consultant.

.3 Submit proof of manufacturer's ISO 9001 9002 9003 registration and compliance to Engineer Consultant.

.4 Manufacturer's Instructions: Provide to indicate special handling criteria, installation sequence and cleaning procedures.

.5 .2 Submit WHMIS MSDS Material Safety Data Sheets in accordance with Section 01340 - Submittals.

1.4 QUALITY ASSURANCE

.1 Perform Work in accordance with the printed requirements of the manufacturer and this specification. Advise designer of any discrepancies prior to commencement of the Work.

.2 Maintain one (1) copy of manufacturers literature on site throughout the execution of the Work.

.3 At the beginning of the Work and at all times during the execution of the Work, allow access to site by the manufacturer's representative.

.4 Materials used in this Section shall be fully compatible and shall be sourced and or produced by one (1) manufacturer.

1.5 .DELIVERY, STORAGE AND HANDLING

.1 Deliver materials to the job site in undamaged and original packaging indicating the name of the manufacturer and product.

.2 Store materials in a clean dry area in accordance with manufacturer's instructions.

.3 Protect materials during handling and application to prevent damage or contamination.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Components and materials must be obtained as a single-source from the manufacturer to ensure total system compatibility and integrity.

PART 3 EXECUTION

3.1 CONDITION OF SURFACE

.1 Examine surfaces to receive cladding. Do not begin surface preparation or application until unacceptable conditions have been corrected.

3.2 SURFACE PREPARATION

.1 Clean and prepare surfaces to receive cladding in accordance with manufacturer's instructions.

3.3 APPLICATION

.1 Fasten cladding in accordance with manufacturer’s installation instructions and details.

.2 Provide flashing and trim in accordance with manufacturer’s installation instructions and details.

.3 Seal all joints in accordance with manufacturer’s installation instructions and details.

3.4 CLEAN-UP

.1 Promptly as the work proceeds and on completion clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing work.

END OF SECTION

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PART 1 GENERAL

1.1 WORK INCLUDED

.1 Supply and install:

.1 Painting to exposed mechanical and electrical equipment in finished rooms.

.2 Painting to pumps, pump motors, process piping, fitting, valves and appurtenances in rooms, valve chambers, pumping stations, structures, buildings and exposed areas.

.3 Identification labels for all valves, pumps, flow measurement equipment, motors, controllers and transmitters supplied under Division 15.

1.2 RELATED WORK SPECIFIED ELSEWHERE

.1 The General Contractor is responsible for review of all contract documents for related sections.

1.3 REFERENCE STANDARDS

.1 Do work in accordance with CGSB 51 GP 39M and the Canadian Painting Contractors Association "Architectural Painting Specification Manual.

1.4 SUBMITTALS

.1 Submit colour samples and product data sheets for approval in accordance with Section 01340 - Submittals. Colour samples and product data sheets shall be consider Category 1 submittals.

1.5 ADDITIONAL MATERIALS

.1 Leave on the premises for touch up a sufficient quantity of all colours and paint types. In any case not less than 1 litre.

.2 Containers shall be full, tightly sealed and clearly labelled for identification.

1.6 MEASUREMENT FOR PAYMENT

.1 Payment for identification labels, surface preparation and painting will not be made directly but shall be included in the applicable lump sum price bid.

PART 2 PRODUCTS

2.1 PUMPS, PUMP MOTORS, PIPING, VALVES AND TANKS IN BUILDINGS, CHAMBERS, PUMPING STATIONS AND EXPOSED AREAS.

.1 Galvanized pipe:

.1 Two coats 182 Series Coronado Direct to Metal Acrylic Enamel 4-5 mils wet, 1.6 to 2 mils dry per coat.

.2 Ferrous metal surfaces:

.1 One coat 180-11 Coronado High Performance Rust Inhibiting Primer 4-5 mils wet, 1.6 to 2 mils dry. Two coats 182 Series Coronado Direct to Metal Acrylic Enamel 4-5 mils wet, 1.6 to 2 mils dry per coat.

.3 Ductile iron pipe and bituminous coated fittings:

.1 One coat 142-11 Amine Adduct Water Based Epoxy Primer 3.5 mils wet, 1.5 mils dry.

.2 One coat 142 Amine Adduct Water Based Epoxy 4 mils wet, 1.8 mils dry.

.4 Piping in potable water reservoirs to be painted with non-toxic paint.

.5 Canvas covered plumbing and drainage piping:

.1 One coat - filler, sealer.

.2 One coat - alkyd enamel undercoat.

.3 One coat - alkyd gloss enamel.

2.2 COLOUR CODE

.1 Pipes - As specified in 3.6

2.3 EQUIPMENT IDENTIFICATION LABELS

.1 For all valves, pumps, flow measurement equipment, motors, controllers and transmitters supplied under Division 15 provide lamicoid identification labels.

.2 Labels shall be installed after all painting has been completed and shall be secured with self-tapping screws, adhesive or non-ferrous chains.

.3 Ensure that all stamped, etched or engraved lettering on plates is perfectly legible. Do not paint over nameplates and where apparatus is to be concealed, attach the nameplate in an approved location on the equipment support or frame.

.4 Identify all equipment with the corresponding remote controls.

.5 Identify equipment with nameplates as follows:

.1 Nameplates:

.1 Lamicoid 3 mm thick plastic engraving sheet, black face, white core, self adhesive or mechanically attached unless specified otherwise.

Nameplate Sizes

Size 1	10 x 50 mm	1 line	3 mm high letters
Size 2	12 x 70 mm	1 line	5 mm high letters
Size 3	12 x 70 mm	2 lines	2 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 Wording on nameplates to be approved by Engineer prior to manufacture.

.3 Allow for average of twenty-five (25) letters per nameplate.

.4 Identification to be English.

PART 3 EXECUTION

3.1 GENERAL

.1 Paint all piping, tanks and equipment supplied under Division 15.

.2 Touch up shop applied finishes damaged during installation.

.3 Apply finish coats to shop primed equipment.

3.2 PREPARATION OF EQUIPMENT, PIPING, VALVES AND TANKS

.1 Commercial blast cleaning.

.2 Drain water from vessels to prevent condensation whenever possible.

3.3 PROTECTION OF SURFACES

.1 Protect surfaces not to be painted and if damaged, clean and restore such surfaces as directed.

.2 Apply primer, paint, or pretreatment as soon possible after surface has been cleaned and before deterioration of surface occurs.

.3 If rusting occurs after completion of surface preparation, clean surfaces again.

.4 Prevent contamination of cleaned surfaces by salts, acids, alkalis, other corrosive chemicals, grease, oil and solvents before prime coat is applied and between applications of remaining coats of paint. Remove contaminants from surface and apply paint immediately.

.5 Protect cleaned and freshly painted surfaces from excessive dust.

3.4 MIXING PAINT

.1 Do not dilute or thin paint for brush application; use as received from manufacturer.

.2 Mix ingredients in container before use and ensure breaking up of lumps, complete dispersion of settled pigment, and a uniform composition.

.3 Mix paint often enough during application to keep pigment in suspension and composition uniform.

.4 Do not mix or keep paint in suspension by means of air bubbling through paint.

.5 Thin paint for spraying according to manufacturer's instructions. If directions are not on container, obtain instructions in writing from manufacturer and provide a copy of instructions to Engineer.

3.5 APPLYING PAINT

.1 Apply paint by brushing, spraying or a combination of both. Use sheepskins or daubers only when no other method is practical in places of difficult access.

.2 Use dipping or roller coating method of application only when specifically authorized by Engineer in writing.

.3 Caulk open seams at contact surfaces of built up members with red lead paste, or other approved material. Apply second coat of primer to caulked areas.

.4 Where surface to be painted is not under cover, do not apply paint when:

.1 Air temperature is below 5EC or when temperature is expected to drop to 0EC before paint has dried.

.2 Temperature of surface is over 50EC unless paint is specifically formulated for application at high temperatures.

.3 Fog or mist occur at site; it is raining or snowing; there is a danger of rain or snow; relative humidity is above 85%.

.4 Surface to be painted is wet, damp or frosted.

.5 Previous coats are not dry.

.5 When paint must be applied in damp or cold weather apply paint under cover. Protect, shelter, or heat surface and surrounding air to comply with temperature and humidity conditions specified in 3.9.4. Protect until paint is dry or until weather conditions permit.

.6 Permit drying of applied paint which has been exposed to freezing, excess humidity, rain, snow or condensation. Remove paint from damaged areas, prepare surface again and repaint same as undamaged areas.

.7 Apply each coat of paint as a continuous film of uniform thickness. Repaint thin spots or bare areas before next coat of paint is applied.

.8 Brush Application

.1 Work paint into cracks, crevices and corners and paint surfaces not accessible to brushes by spray, daubers or sheepskins.

.2 Brush out runs and sags.

.3 Leave a minimum of brush marks in finished paint surfaces.

.4 Remove runs and sags from finished work and repaint.

.9 Spray Application

.1 Provide and maintain equipment that is suitable for intended purpose, capable of properly atomizing paint to be applied, and equipped with suitable pressure regulators and gauges.

.2 Provide traps or separators to remove oil and water from compressed air and drain periodically during operations.

.3 Keep paint ingredients properly mixed in spray pots or containers during paint application either by continuous mechanical agitation or by intermittent agitation as frequently as necessary.

.4 Apply paint in a uniform layer, with overlapping at edges of spray pattern.

.5 Brush out immediately all runs and sags.

.6 Use brushes to work paint into cracks, crevices and places which are not adequately painted by spray. In areas not accessible to spray gun, use brushes, daubers or sheepskins.

.7 Remove runs and sags from finished work and repaint.

.10 Shop Painting

.1 Do shop painting after fabrication and before any damage to surface occurs from weather or other exposure.

.2 Spray paint contact surfaces of field assembled, bolted, friction type joints with primer coat only. Do not brush primer after spraying.

.3 Do not paint metal surfaces which will be embedded in concrete.

.4 Paint metal surfaces to be in contact with wood with either full paint coats specified or three shop coats of specified primer.

.5 Do not paint metal within 50 mm of edge to be welded. Give unprotected steel one coat of boiled linseed oil or other approved protective coating after shop fabrication is completed.

.6 Remove weld spatter before painting. Remove weld slag and flux.

.11 Field Painting

.1 Paint steel structures as soon as possible.

.2 Touch up metal which has been shop coated with same type of paint and to same thickness as shop coat. This touch-up to include cleaning and painting of field connections, welds, rivets, nuts, washers, bolts and damaged or defective paint and rusted areas.

.3 Field paint surfaces (other than joint contact surfaces) which are accessible before erection but which will not be accessible after erection.

.4 If possible do not apply final coat of paint until concrete work is completed. If concreting or other operations damage any paint, clean and repaint damaged area. Remove concrete spatter and droppings before paint is applied.

.5 Where painting does not meet with requirements of specifications, and when so directed by Engineer, remove all defective pain, thoroughly clean affected surfaces and repaint in accordance with these specifications.

3.6 PIPE IDENTIFICATION SYSTEM

.1 All piping shall be identified and painted in accordance with the following requirements:

.1 Flammable: For piping systems containing flammable gases or liquids - gasoline, fuel oil, digester gas, acetylene, propane, etc.

.2 Colour: Yellow-Orange; Canadian General Standards Board (CGSB) 508-103, plus identification labels consisting of black lettering and arrows on a yellow-orange background.

.3 Method

.1 Complete painting of all piping, valves and fittings plus labelling every linear 3 meters maximum identifying the contents and the direction of flow (comply with Occupational Health and Safety Act (OHSA) 66(1)(a), (b) and (c);

.2 Firefighting: For piping system containing firefighting substances - water, carbon dioxide, etc.

Colour: Red; CGSB 509-102 plus identification labels consisting of white lettering and arrows on a red background.

Method: Identical to piping systems containing flammable gases or liquids.

.3 Dangerous Substances: For other piping systems containing dangerous (highly hazardous) substances - chlorine gas, fluosilicic acid, other concentrated acids or caustics, etc. - i.e. - strongly corrosive, strongly toxic, temperature greater than 80EC (175EF) including steam, pressure greater than 700 kPa (100 psi).

Colour: Yellow; CGSB 505 110 plus identification labels consisting of black lettering and arrows on a yellow background.

Method: Identical to piping systems containing flammable gases or liquids.

.4 Other Chemical Substances: For other piping systems containing chemical substances (not highly dangerous) - chlorine solutions, sodium hypochlorite, alum, polyelectrdolytes, lime solutions, fluoride solutions, etc. - i.e. - mildly corrosive, mildly toxic, temperature less than 80EC (175EF), pressure less than 700 kPa (100 psi).

Colour: Neutral or Background (colour of wall); identification labels consisting of black lettering and arrows on a white background.

Method: Label every 10 meters maximum identifying the contents and the direction of flow (comply with OHSA 66(1)(a), (b) and (c) - i.e. - colour coded painting or banding not required, only labelling to identify contents and direction.

.5 Process & Drainage: For process and drainage, etc. piping systems, one colour for water being protected, one for sludges and one for other water and drainage systems. Within each group colour gradations to reflect the degree of contamination, as follows:

Description of Contents	**Colour**	**CGSB Code**
Raw Water	Dark Blue	502-103
Settled Water	Mid Blue	502-208
Finished or Potable Water	Light Blue	502-106
Raw Sewage, Sanitary Waste	Mid Grey	501-103
Non-potable Water (heating system), drainage, effluent water, final effluent	Light Grey	501-108
WTP Sludges	Dark Brown	504-102
WTP settled backwash	Light Brown	505-206

Method: Identical to piping systems containing flammable gases and liquids except labelling should occur at 10 meter rather than 3 meter intervals and should consist of white lettering and arrows on a background colour which matches the colour code for the pipe.

.6 Identification Labels: For simplicity, identification labels can be purchased with the standard CGSB background colours and paint can be purchased locally to match a sample of the identification label (see Appendix I Paint Specifications and Samples).

There are several types of identification label materials available. The pipe size, material of pipe and/or insulation surface, working temperature range and environment (indoors, outdoors, etc.) lettering and arrow size should be specified when ordering labels.

Pipe/Label Letter Sizes

Outside Pipe Diameter	**Letter Size**
Less than or equal to 25 mm	12 mm
Greater than 25 mm - less than 100 mm	25 mm
Equal or greater than 100 mm	50 mm

It is suggested that lettering and arrows be on separate labels.

Examples of identification labels available are:

a) Vinyl Cloth - General purpose pressure sensitive adhesive of high tensile strength - service temperature –40 deg. C to 60 deg. C.
b) Perma-Code Markers - for problem pipes - insulated or rough surface - pressure sensitive - thin film - conformable - temperature –40 deg. to 100 deg. C.
c) Pressure Sensitive Film - printed with weather resistant inks for outdoor durability - temperature – 40 deg. to 80 deg. C.

The above identification labels are available from W.H. Brady Inc. (labels from other suppliers should be of equal quality).

END OF SECTION

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PART 1 GENERAL

1.1 WORK INCLUDED

.1 Labour, Products, equipment and services necessary for ceramic tile Work in accordance with the Contract Documents.

1.2 REFERENCE STANDARDS

.1 ANSI A118.3, Latex – Chemical Resistant, Water Cleanable Tile-Setting and Grout Epoxy and Water Cleanable Tile-Setting Epoxy Adhesive.

.2 ANSI A118.4, Latex - Portland Cement Mortar.

.3 ANSI A118.6, Latex – Standard Ceramic Tile grouts for Tile Installation.

.4 ANSI A118.7, Latex – Polymer Modified Cement Grout for Tile Installation.

.5 ANSI A118.10, Latex – Load Bearing, Bonded, Waterproof Membranes for Thin-Set Ceramic Tile and Dimensional Stone Installation.

.6 ANSI A118.11, EGP (Exterior Glue Plywood) Latex - Portland Cement Mortar.

.7 ASTM C144, Specification for Aggregate for Masonry Mortar.

.8 ASTM C1028, Standard Test Method for Determining the Coefficient of Friction of Ceramic Tile and Other Like Surfaces by the Horizontal Dynamometer Pull-Meter Method.

.9 CAN/CGSB-75.1-M, Tile, Ceramic.

.10 CAN/CSA A5/A8/A362, Portland Cement / Masonry Cement / Blended Hydraulic Cement.

.11 CAN/CGSB-19.13-M, Sealing Compound, One Component, Elastomeric, Chemical Curing.

.12 CAN/CGSB-19.22-M, Mildew Resistant Sealing Compounds for Tubs and Tiles.

.13 CAN/CGSB-19.24-M, Multi-Component, Chemical Curing, Sealing Compound.

.14 CGSB 71-GP-22M, Organic Adhesive for Installation of Ceramic Wall Tile.

.15 TTMAC Specification Guide 09300 Tile Installation Manual.

.16 TTMAC, Maintenance Guide.

1.3 SUBMITTALS

.1 Submit sample panels in accordance with Section 01340 Submittals for each colour, texture, size, and pattern of tile.

.2 Certificates:

.1 Submit manufacturer's installation procedures.

.2 Submit installers proof of membership in good standing with Terrazzo, Tile and Marble Association of Canada.

1.4 QUALITY ASSURANCE

.1 Perform Work of this Section by member in good standing of the Terrazzo, Tile and Marble Association of Canada with proven, minimum two years' experience on installations of similar complexity and scope.

1.5 SITE CONDITIONS

.1 Do not install Work of this Section outside of following environmental ranges without the Engineer's and Product manufacturer's written acceptance:

.1 Ambient air and surface temperature: 12 ^{0}C to 38 ^{0}C.

.2 Precipitation: None.

.2 Install temporary protection and facilities to maintain Product manufacturer's, and specified, environmental requirements for 7 days before, during, and 7 days after installation.

1.6 SPARE PRODUCTS

.1 Supply extra ceramic tile, amounting to 5% of gross area covered, allow proportionately for each pattern and type specified and part of same production run as installed Products. Store maintenance Products as directed by the Engineer.

PART 2 PRODUCTS

2.1 MATERIALS

.1 Floor Tiles

.1 Porcelain tile: CAN/CGSB-75.1-M, Type 4, Class MR1:

.1 Surface hardness: MOHS 7 minimum.
.2 Colour: As selected by Owner.
.3 Finish: Slip resistant: coefficient of friction 0.60 minimum testing to ASTM C1028-M modified to include rubber and leather in accordance with CAN/CGSB 75.1-M.
.4 Dimensions: 300 X 300 x 9 mm.
.5 Cove base: match tile.
.6 Accessories: Available accessory trim pieces as required to complete installation.
.7 Grout joint width: 3 mm.
.8 Grout colour: As selected by Owner.
.9 Mortar: Pre-mixed thinset mortar.

.2 Wall Tiles

.1 Porcelain tile: CAN/CGSB-75.1-M, Type 2 Class:

.1 Surface hardness: MOHS 7 minimum
.2 Colour: As selected by Owner.
.3 Finish: Unglazed.
.4 Dimensions: 300 X 300 x 7 mm.

.5 Accessories: Available accessory trim pieces as required to complete installation.
.6 Grout joint width: 3 mm.
.7 Grout colour: As selected by Owner.
.8 Mortar: Adhesive type.

.3 Setting Materials

.1 Surface Preparation:

.1 Cement: CAN/CSA A5/A8/A362, Type 10.
.2 Sand: ASTM C144.
.3 Water: potable and free of minerals, detrimental to mortar and grout mixes.
.4 Mud bed and repair topping fast curing cement: Mapecem by Mapei Inc.
.5 Additive to cement and sand: ANSI A118.4,
.1 Keralastic by Mapei Inc.
.2 Primer and Patch Additive TA 861 by TEC Inc.

.6 Waterproofing membrane: ANSI A118.10,
.1 Elastomeric latex compound with reinforcing fabric: WP-980 by Flextile Ltd.
.2 Liquid rubber and reinforcing fabric: Laticrete 9235 by Laticrete International Inc. Canada.
.3 Two component synthetic latex cement based, trowel applied mortar with fibre glass mesh: Mapelastic PRP 315 by Mapei Inc.
.4 Elastomeric cementitous mortar, trowel applied with reinforcing fabric: Triple Flex TA 324 by TEC Inc.

.2 Mortar Systems:

.1 #50 Multi-Purpose Medium Bed/Thin-set Mortar by Flextile Ltd.
.2 Laticrete 317 with Laticrete 3701 mortar admixture by Laticrete International Inc. Canada.
.3 Kerabond thin-set mortar mixed with Keralastic latex additive by Mapei Inc.
.4 TEC Medium Bed TA 372 with Full Bond Additive TA867 by TEC Inc.

.3 Organic adhesive: CGSB 71-GP-22M, Type 1.

.4 Grouts and Sealants

.1 Grout (floors, bases): ANSI A118.7:

.1 600 Polymer Modified Floor Grout by Flextile Ltd.
.2 Sanded Ker-200 dry-polymer modified Floor Grout by Mapei Inc.
.3 TEC TA 650 with TA 869 additive by TEC Inc.

.2 Grout (walls) ANSI A118.6; 1.5 mm to 3 mm joint width:

.1 500 Polymer Modified Wall Grout by Flextile Ltd.
.2 Ker 800 dry-polymer modified Wall by Mapei Inc.
.3 Accucolor – Premium Unsanded Grout, TA 620 by TEC Inc.

.3 Grout colour: As selected by Owner from manufacturer's full colour range.

.4 Joint backing: Round, closed cell, foam rod, oversized by 30% to 50%, Shore A hardness of 20, tensile strength 140 to 200 kPa.

.5 Tile sealant horizontal expansion/control floor joints: CAN/CGSB-19.24-M; Multi component polyurethane sealant, THC 900 and primer by Tremco Ltd.

.6 Tile sealant remainder of Work: CAN/CGSB-19.22-M; One-part mildew-resistant silicone; FDA Regulation 21 CFR 177.2600, in standard colours selected.

.1 786 Mildew Resistant Silicone Sealant by Dow Corning Inc.
.2 Tremsil 200 silicone sealant by Tremco Ltd.

.5 Mixes

.1 Cement levelling bed mix:

.1 1 part Portland cement.
.2 4 parts sand.
.3 1 part water (including polymer additive), adjusted for water content of sand.
.4 1/10 part polymer additive.

.2 Mapecem levelling bed mix:

.1 1 part Mapecern Premix.
.2 Water as per manufacturer's specifications.
.3 Sand or gravel as per manufacturer's specifications.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Verify condition and dimensions of previously installed Work upon which this Section depends. Report defects to Engineer. Commencement of Work means acceptance of existing conditions.

3.2 SURFACE PREPARATION

.1 Clean and dry surfaces thoroughly. Remove oil, wax, grease, dust, dirt, paint, tar, primers, form release agents, curing compound, and other foreign material from substrate surfaces which may prevent or reduce adhesion.

.2 Neutralize any trace of strong acids or alkali from substrate.

3.3 CONTROL JOINTS

.1 Continue control, construction, and cold joints in structural substrate up through tile finish, and align with mortar joints where possible. Review joint locations on Site with the Engineer.

.2 Install joint widths to match grout joint widths, except where minimum width indicated.

.3 Install control joints in following typical locations:

.1 At restraining perimeters such as walls and columns.

.2 As indicated on the Contract Drawings.

.4 Seal control joints in accordance with Section 07900.

3.4 LEVELLING BED

.1 Install leveling bed on uneven substrate surfaces, level and plumb substrates in accordance with following tolerances:

.1 Vertical surfaces: 3 mm in 2.4 m maximum.

.2 Horizontal surfaces: 6 mm in 3 m from finished levels of surface, or better.

.2 Clean structural substrate control joints and blow-clean with compressed air. Grout fill control joints flush to slab with levelling bed.

3.5 GENERAL TILE INSTALLATION REQUIREMENTS

.1 Mix and install thin set mortar, adhesive, and grout components in accordance with manufacturer's recommended proportions and methods, to achieve maximum bond strength.

.2 Install tiles in accordance with manufacturer's instructions and TTMAC, Installation Manual, Ceramic Tile. Manufacturer's installation instructions govern over TTMAC Installation Manual.

.3 Lay out Work to produce symmetrical pattern with minimum amount of cutting. Ensure cut tile at room perimeter not less than 1/2 full size.

.4 Set tiles in place and rap or beat with beating block as necessary to ensure proper bond and to level surface of tile. Align tile for uniform joints and allow to set until firm. Clean excess mortar from surface of tile with wet cloth or sponge while mortar fresh.

.5 Adjust joints between tile uniform, plumb, straight, even, and true, with adjacent tile flush. Align grout joints in both directions unless indicated otherwise.

.6 Align floor, base and wall tile grout joints.

.7 Install tile accessory fittings for complete and fully coordinated tile assembly.

.8 Install wall tile full height unless indicated otherwise.

.9 Cut and fit tile neatly around piping, fittings, projections and around recesses items e.g. washroom accessories. Where surface mounted equipment and accessories installed on tiled surfaces, extend tile over surfaces. Cut edges smooth, even, and free from chipping; chipped and broken edges not acceptable.

.10 Do not proceed with grouting until minimum 48 hours after tile has set, to prevent displacement of tiles.

.11 Apply grout in accordance with grout manufacturer's directions to produce watertight, filled joints without voids, cracks and excess grout. Thoroughly compact and tool floor grout. Finish grout flush to edge thickness of tile and remove excess grout with soft burlap or sponge moistened with clean water.

3.6 CLEANING

.1 Clean and polish floor and wall tile after grout has cured in accordance with TTMAC recommendations in Maintenance Guide; do not use acid for cleaning.

.2 Re-point joints after cleaning as required to eliminate imperfections, then re-clean as necessary. Avoid scratching tile surfaces.

3.7 JOINT BACKING AND TILE SEALANT

.1 Install joint backing under sealant as necessary.

.2 Install tile sealant around piping and fittings extending through tiled surfaces.

.3 Seal tile control joints.

.4 Seal internal tile to tile junctions. Tool to smooth, flush surface, free from air bubbles and contamination.

3.8 FIELD QUALITY CONTROL

.1 Field testing: Conduct slip resistance testing in accordance with ASTM C1028.

.2 Submit written inspection report to Engineer.

3.9 PROTECTION

.1 Prevent traffic over tiled areas, and protect tiled assemblies from weather, freezing, and water immersion, for 72 hours minimum, after final installation.

.2 Prevent direct impact, vibration and heavy hammering on adjacent and opposite walls for 24 hours minimum, after final installation.

END OF SECTION

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PART 1 GENERAL

1.1 WORK INCLUDED

.1 Supply and install Rubber Tile

1.2 RELATED WORK

.1 Concrete finishing

1.3 ENVIRONMENTAL CONDITIONS

.1 Install rubber tile only when base surfaces and air temperature have been maintained above 20 deg. C. for 72 hours preceding installation and maintained during and after installation for three days.

1.4 DELIVERY AND STORAGE

.1 Material shall be delivered to site and checked by flooring trade for completeness and shipping damage prior to job start.

.2 Material shall be stored in a dry, enclosed area protected from exposure to moisture. Temperature of storage area shall be maintained between 15 deg. C. and 30 deg. C.

1.5 SPECIAL PROTECTION

.1 Prevent traffic and work on newly laid floors by barricading until work has set. Avoid static loading during the first seven days after installation. Provide adequate ventilation and fire protection when adhesives are being used.

1.6 SUBMITTALS

.1 Supply one sample of each material to be installed.

1.7 MAINTENANCE MATERIALS

.1 Provide maintenance manual which gives clear instructions as to the maintenance and care of each flooring material.

.2 Leave on site one full box of tile.

1.8 GUARANTEE

.1 Provide written guarantees for each flooring materials.

PART 2 PRODUCTS

2.1 MATERIALS

.1 All Rubber Flooring shall be the product of one manufacturer and shall, to the maximum extent possible, be of a single batch number.

.2 Rubber Tile: CSA A126.4 – Amtico, Marathon Square 3.5 mm or approved equal.

.3 Adhesives: as recommended by the floor material manufacture.

.4 Cleaner: neutral compound that will not damage flooring or effect its colour.

.5 Colour Selection shall be made at a later date.

PART 3 EXECUTION

3.1 EXAMINATION

.1 Before proceeding, examine surface material carefully. Fill any small holes and cracks. DO NOT PROCEED if the base surface is unacceptable and cannot be made good.

3.2 INSTALLATION

.1 Spread compatible adhesive evenly using a notched trowel. Lay tile in designated pattern with all seams straight and tight.

END OF SECTION

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1 GENERAL

1.1 SCOPE

.1 Provide complete factory assembled generator set equipment with digital electronic controls.

.2 Provide factory test, startup by a supplier authorized by the manufacturer, and on-site testing of the system.

.3 The generator set manufacturer shall warrant all equipment provided under this section so that there is one source for warranty and product service. Technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier shall service the generator sets.

1.2 CODES AND STANDARDS

.1 The generator set and its installation and on-site testing shall conform to the requirements of the following codes and standards:

- .1 CSA C-282-15, 2015 Emergency Electrical Power Supply for Buildings
- .2 IEC8528 part 4. Control Systems for Generator Sets
- .3 IEEE446 – Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications
- .4 NEMA ICS 10-2015 – Guide to Application of Low-voltage Automatic Transfer Switch Equipment
- .5 NEMA MG1 – Motors and Generators
- .6 NFPA 70 – National Electrical Code. Equipment shall be suitable for use in systems in compliance to Article 700, 701, and 702.
- .7 NFPA 110 – Emergency and Standby Power Systems. The generator set shall meet all requirements for Level 1 systems. Level 1 prototype tests required by this standard shall have been performed on a complete and functional unit, component level type tests will not substitute for this requirement.
- .8 UL2200. The genset shall be listed to UL2200 or submit to an independent third party certification process to verify compliance as installed.
- .9 Any other applicable regulation or standard.

.2 The generator set manufacturer shall be certified to ISO 9001 International Quality Standard and shall have third party certification verifying quality assurance in design/development, production, installation, and service, in accordance with ISO 9001.

1.3 ACCEPTABLE MANUFACTURERS

.1 Only approved suppliers shall supply equipment provided under this contract.

.2 Suppliers must be manufacturers of generators or their authorized distributor in Ontario. Approved manufacturers of generator are Cummins and CAT (Toromont).

2 PRODUCTS

2.1 GENERATOR SET

.1 Ratings

.1 The generator sets shall operate at 1800 rpm and at a voltage of: 600 Volts AC, Three phase, Four-wire, 60 hertz.

.2 The generator set shall be rated as follows:

.1 300 kW, 375 kVA at 0.8 PF, standby rating, based on site conditions of ambient temperatures ranging from -40 degrees C to 40 degrees C.

.3 The generator set rating shall be based on emergency/standby service.

.2 Performance

.1 Voltage regulation shall be plus or minus 0.5 percent for any constant load between no load and rated load for both parallel and non-parallel applications. Random voltage variation with any steady load from no load to full load shall not exceed plus or minus 0.5 percent.

.2 Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no load to full load shall not exceed plus or minus 0.25%.

.3 The diesel engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable derating factors, with the engine-generator set at operating temperature.

.4 The alternator shall produce a clean AC voltage waveform, with not more than 5% total harmonic distortion at full linear load, when measured from line to neutral, and with not more than 3% in any single harmonic. Telephone influence factor shall be less than 50.

.3 Construction

.1 The engine-generator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails

.2 All switches, lamps, and meters in the control system shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts.

.4 Connections

.1 The generator set load connections shall be composed of silver or tin plated copper bus bars, drilled to accept mechanical or compression terminations of the number and type as shown on the drawings. Sufficient lug space shall be provided for use with cables of the number and size as shown on the drawings.

.2 Power connections to auxiliary devices shall be made at the devices, with required protection located at a wall-mounted common distribution panel.

.3 Generator set control interfaces to other system components shall be made on a common, permanently labeled terminal block assembly.

2.2 ENGINE AND ENGINE EQUIPMENT

.1 The engine shall be diesel, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories.

.2 An electronic governor system shall provide automatic isochronous frequency regulation. The governing system dynamic capabilities shall be controlled as a function of engine coolant temperature to provide fast, stable operation at varying engine operating temperature conditions. The control system shall actively control the fuel rate and excitation as appropriate to the state of the generator set. Fuel rate shall be regulated as a function of starting, accelerating to start disconnect speed, accelerating to rated speed, and operating in various isochronous or parallel states.

.3 Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet, based on 0.5 in H_2O external static head. Radiator shall be sized based on a core temperature which is 20F higher than the rated operation temperature, or prototype tested to verify cooling performance of the engine/radiator/fan operation in a controlled environment. Radiator shall be provided with a duct adapter flange. The cooling system shall be filled with a 50/50-ethylene glycol/water mixture by the equipment manufacturer. Rotating parts shall be guarded against accidental contact.

.4 Electric starter(s) capable of three complete cranking cycles without overheating.

.5 Positive displacement, mechanical, full pressure, lubrication oil pump.

.6 Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.

.7 An engine driven, mechanical, positive displacement fuel pump. Fuel filter with replaceable spin-on canister element. Fuel cooler, suitable for operation of the generator set at full rated load in the ambient temperature specified shall be provided if required for operation due to the design of the engine and the installation

.8 Replaceable dry element air cleaner with restriction indicator.

.9 Flexible supply and return fuel lines.

.10 Engine mounted battery charging alternator, 40-ampere minimum, and solid-state voltage regulator.

.11 Coolant heater

.1 Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage to be 240V. The coolant heater shall be UL499 listed and labeled.

.2 The coolant heater shall be installed on the engine with silicone hose connections. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 12 inches. The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using quick disconnect couplers to isolate the heater for replacement of the heater element. The quick disconnect/automatic sealing couplers shall allow the heater element to be replaced without draining the engine cooling system or significant coolant loss.

.3 The coolant heater shall be provided with a 24VDC thermostat, installed at the engine thermostat housing. An AC power connection box shall be provided for a single AC power connection to the coolant heater system.

.4 The coolant heater(s) shall be sized as recommended by the engine manufacturer to warm the engine to a minimum of 100F (40C) in a 40F ambient,

in compliance with NFPA110 requirements, or the temperature required for starting and load pickup requirements of this specification.

.12 Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer.

.13 Starting and Control Batteries shall be calcium/lead antimony type, 24 volt DC, sized as recommended by the engine manufacturer, complete with battery cables and connectors.

.14 Provide an outdoor rated sound attenuated enclosure combined with a critical engine silencer that provides a noise reduction of 70dbA at 7 meters. Silencer to have condensate plug and ASA flanges. The silencers must be designed, so that the backpressure on engine at 110 percent load shall not exceed engine maker's recommendation. Insertion losses in 1/1 octave frequency bands to be equivalent to or better than the following:

Centre Frequency (Hz)	125	250	500	1000	2000	4000
Insertion Loss (dB)	23	29	30	28	22	21

.15 Provide an exhaust silencer as specified in Division 15, Division 11 or as specified elsewhere in the specifications and contract drawings.

.16 Provide stainless steel exhaust flex connector for engine of size and type as recommended by the generator set manufacturer. Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.

.17 A UL listed/CSA certified 10 amp voltage regulated battery charger shall be provided for each engine-generator set. The charger is to be wall mounted. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:

.1 Loss of AC power - red light

.2 Low battery voltage - red light

.3 High battery voltage - red light

.4 Power ON - green light (no relay contact) Charger shall include an Analog DC voltmeter and ammeter, 12 hour equalize charge timer, and AC and DC fuses

2.3 AC GENERATOR

.1 The AC generator shall be; synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single prelubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.

.2 The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.

.3 Permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase

or three phase fault at approximately 300% of rated current for not more than 10 seconds.

.4 The subtransient reactance of the alternator shall not exceed 12 percent, based on the standby rating of the generator set.

2.4 GENERATOR SET CONTROL

.1 The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also be designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control system should control the cool down time of the generator once the start signal drops out from the transfer scheme. The cool down time is to be set as per manufacturers recommendations.

.2 The control shall be mounted on the generator set. The control shall be vibration isolated and prototype tested to verify the durability of all components in the system under the vibration conditions encountered.

.3 The generator set mounted control shall include the following features and functions:

.1 Mode Select Switch. The mode select switch shall initiate the following control modes. When in the RUN or Manual position the generator set shall start, and accelerate to rated speed and voltage as directed by the operator. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.

.2 EMERGENCY STOP switch. Switch shall be Red "mushroom-head" push-button. Depressing the emergency stop switch shall cause the generator set to immediately shut down, and be locked out from automatic restarting.

.3 RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.

.4 PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

.5 Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:

.1 Analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. Voltmeter and ammeter shall display all three phases. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; readings from 90-100% of standby rating: amber; readings in excess of 100%: red.

.2 Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages, and shall display all three phase voltages (line to neutral or line to line) simultaneously.

.3 Both analog and digital metering are required. The analog and digital metering equipment shall be driven by a single microprocessor, to provide consistent readings and performance.

2.5 GENERATOR SET ALARM AND STATUS DISPLAY

.1 The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing warning and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on an alphanumeric digital display panel:

- .1 low oil pressure (alarm)
- .2 low oil pressure (shutdown)
- .3 oil pressure sender failure (alarm)
- .4 low coolant temperature (alarm)
- .5 high coolant temperature (alarm)
- .6 high coolant temperature (shutdown)
- .7 engine temperature sender failure (alarm)
- .8 low coolant level (alarm or shutdown--selectable)
- .9 fail to crank (shutdown)
- .10 fail to start/overcrank (shutdown)
- .11 overspeed (shutdown)
- .12 low DC voltage (alarm)
- .13 high DC voltage (alarm)
- .14 weak battery (alarm)
- .15 low fuel-sub-base fuel tank (alarm)
- .16 high AC voltage (shutdown)
- .17 low AC voltage (shutdown)
- .18 under frequency (shutdown)
- .19 over current (warning)
- .20 over current (shutdown)
- .21 short circuit (shutdown)
- .22 over load (alarm)
- .23 emergency stop (shutdown)

.2 Provisions shall be made for indication of four customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red, and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

2.6 ENGINE STATUS MONITORING

.1 The following information shall be available from a digital status panel on the generator set control :

- .1 engine oil pressure (psi or kPA)
- .2 engine coolant temperature (degrees F or C)
- .3 engine oil temperature (degrees F or C)
- .4 engine speed (rpm)
- .5 number of hours of operation (hours)

.6 number of start attempts

.7 battery voltage (DC volts)

.2 The control system shall also incorporate a data logging and display provision to allow logging of the last 10 warning or shutdown indications on the generator set, as well as total time of operation at various loads, as a percent of the standby rating of the generator set.

.3 The following status and alarms are to be available from a set of relay contacts to be used as inputs to the site RPU:

.1 Generator Mode
.2 Generator Running
.3 Generator Hi Temp
.4 Generator Lo Oil
.5 Generator Overcrank
.6 Generator Overspeed.
.7 Generator General Alarm.

2.7 ENGINE CONTROL FUNCTIONS

.1 The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15-second rest period between cranking periods.

.2 The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.

.3 The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting.

.4 The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.

.5 The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.

2.8 ALTERNATOR CONTROL FUNCTION

.1 The generator set shall include an automatic digital voltage regulation system that is matched and prototype tested by the engine manufacturer with the governing system provided. It shall be immune from misoperation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alphanumeric LED

readout to indicate setting level. Rotary potentiometers for system adjustments are not acceptable.

.2 Controls shall be provided to monitor the output current of the generator set and initiate an alarm (over current warning) when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (over current shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445

.3 Controls shall be provided to individually monitor all three phases of the output current for short circuit conditions. The control/protection system shall monitor the current level and voltage. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator (short circuit shutdown). The protective functions provided shall be in compliance to the requirements of NFPA70 article 445.

.4 An AC over/under voltage monitoring system that responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

.5 A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds a "weak battery" alarm shall be initiated.

.6 The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set on a continuous basis. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that positively protect the alternator under overcurrent conditions. The supplier shall submit time overcurrent characteristic curves and thermal damage curve for the alternator, demonstrating the effectiveness of the protection provided.

2.9 FUEL TANK

.1 Provide as a minimum 24 hour rated 600 gallon sub-base diesel fuel tank or as specified elsewhere in the specifications and contract drawings.

.2 Provide an electric low vacuum switch and alarm, with audible annunciator at alarm panel and remote alarm contacts for connection to customer alarm system

.3 Provide an electric high fuel level switch and fuel supplier fill alarm with audible annunciator at alarm panel and remote alarm contacts for connection to customer alarm system. The audible alarm is to have a silencer pushbutton.

.4 Provide an electric low fuel level switch with audible annunciator at alarm panel and remote alarm contacts for connection to customer alarm system.

.5 All alarms for fuel system to be wired to the RPU. Supply, install, test, and commission all wiring and conduits as necessary to the RPU. Co-ordinate with RPU panel fabricator.

2.10 OPERATION

.1 Sequence of Operation

.1 Generator set shall start on receipt of a start signal from remote equipment. The start signal shall be via hardwired connection to the generator set control and a redundant signal over the required network connection.

.2 The generator set shall complete a time delay start period as programmed into the control.

.3 The generator set control shall initiate the starting sequence for the generator set. The starting sequence shall include the following functions:

.2 The control system shall verify that the engine is rotating when the starter is signaled to operate. If the engine does not rotate after two attempts, the control system shall shut down and lock out the generator set, and indicate “fail to crank” shutdown.

.3 The engine shall fire and accelerate as quickly as practical to start disconnect speed. If the engine does not start, it shall complete a cycle cranking process as described elsewhere in this specification. If the engine has not started by the completion of the cycle cranking sequence, it shall be shut down and locked out, and the control system shall indicate “fail to start”.

.4 The engine shall accelerate to rated speed and the alternator to rated voltage. Excitation shall be disabled until the engine has exceeded programmed idle speed, and regulated to prevent over voltage conditions and oscillation as the engine accelerates and the alternator builds to rated voltage.

.5 On reaching rated speed and voltage, the generator set shall operate as dictated by the control system in isochronous, synchronize, load share, load demand, or load govern state.

.6 When all start signals have been removed from the generator set, it shall complete a time delay stop sequence. The duration of the time delay stop period shall be adjustable by the operator.

.7 On completion of the time delay stop period (cool down time set as per the manufacturers recommendations), the generator set control shall switch off the excitation system and shall shut down.

.1 Any start signal received after the time stop sequence has begun shall immediately terminate the stopping sequence and return the generator set to isochronous operation.

2.11 OTHER REQUIREMENTS

.1 The generator shall be equipped with a disconnect breaker mounted on the generator set that is capable of being locked in the open position with a pad lock.

.2 Submittals. In accordance with Division 01000, provide six sets of the following information for review:

.1 Manufacturer's product literature and performance data, sufficient to verify compliance to specification requirements.

.2 A paragraph by paragraph specification compliance statement, describing the differences between the specified and the proposed equipment.

.3 Manufacturer's certification of prototype testing.

.4 Manufacturer's published warranty documents.

.5 Shop drawings showing plan and elevation views with certified overall dimensions, as well as wiring interconnection details.

.6 Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.

.7 Manufacturer's installation instructions.

2.12 FACTORY TESTING

.1 The generator set manufacturer shall perform a 4 Hour complete operational test on the generator set prior to shipping to the site. A certified test report shall be provided. Equipment supplied shall be fully tested for function and performance.

.2 Factory testing may be witnessed by the owner and consulting engineer. If the factory test is to occur a distance further than 200 km from the site, costs for travel expenses will be the responsibility of the owner and consulting engineer. Factory testing must be undertaken at a site within Canada. Supplier is responsible to provide two weeks notice for testing.

.3 Generator set factory tests on the equipment shall be performed at rated load and rated power factor. Generator sets that have not been factory tested at rated power factor will not be acceptable. Tests shall include: run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and function of safety shutdowns.

2.13 SPARE PARTS

.1 Provide the following spare parts:

.1 Provide engine oil drip tray, 1.5mm minimum, galvanized steel with 50mm lip suitable for location on the concrete pad. The tray shall extend completely under the generator set, between the vibration isolators and easily removable without disturbing any components.

.2 Provide one wall mounted steel cabinet. Cabinet shall be provided with front hinged doors(s), padlock and hasp. Cabinet to accommodate tools, spare and one set of manuals.

.3 Special tools, spare parts shall be provided by the supplier, which are non-standard off the shelf items.

.4 Provide three sets of fuel oil filter elements and gaskets.

.5 Provide three lubricating oil filter elements and gaskets.

.6 Provide one air cleaner filter element.

.7 Provide two sets V-belts for fan and pump drives.

3 EXECUTION

3.1 INSTALLTION

.1 Equipment shall be installed by the contractor in accordance with final submittals and contract documents. Installation shall comply with applicable local codes as required by the authority having jurisdiction. Install equipment in accordance with manufacturer's instructions and instructions included in the listing or labeling of UL listed products.

.2 Installation of equipment shall include furnishing and installing all interconnecting wiring between all major equipment provided for the on-site power system. The contractor shall also perform interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.

.3 Equipment shall be installed on concrete housekeeping pads. Equipment shall be permanently fastened to the pad in accordance with manufacturer's instructions and seismic requirements of the site.

.4 Equipment shall be initially started and operated by representatives of the manufacturer.

.5 All equipment shall be physically inspected for damage. Scratches and other installation damage shall be repaired prior to final system testing. Equipment shall be thoroughly cleaned to remove all dirt and construction debris prior to initial operation and final testing of the system.

3.2 ON-SITE ACCEPTANCE TEST

.1 The complete installation shall be tested under full load for 4 Hours to CSA C282-15 standards for compliance with the specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer, with required fuel supplied by Contractor. The Engineer/Owner shall be notified in advance and shall have the option to witness the tests.

.2 Provide all fuel as necessary in order to complete testing and repeat as necessary until testing is acceptable. Upon completion of testing fill fuel tank for the owners use.

.3 Co-ordinate all commissioning with automatic transfer switch supplier.

3.3 TRAINING

.1 The equipment supplier shall provide training for the facility operating personnel covering operation and maintenance of the equipment provided. The training program shall be not less than 4 hours in duration. Training date shall be coordinated with the facility owner.

3.4 SERVICE AND SUPPORT

.1 The manufacturer of the generator set shall maintain service parts inventory at a central location which is accessible to the service location 24 hours per day, 365 days per year.

.2 . The generator set shall be serviced by a local service organization that is trained and factory certified in generator set service. The supplier shall maintain an inventory of critical replacement parts at the local service organization, and in service vehicles. The service organization shall be on call 24 hours per day, 365 days per year.

3.5 WARRANTY

.1 The generator set and associated equipment shall be warranted for a period of not less than 2 years from the date of commissioning against defects in materials and workmanship.

END OF SECTION

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