

The Project Manual is bound in three separate volumes as follows:

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VOLUME 1

PROCUREMENT AND CONTRACTING REQUIREMENTS GROUP

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PART 1 - GENERAL

1.1 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and the Supplementary Conditions of the Contract;
 - .2 Division 1 requirements and documents referred to therein.

1.2 INFORMATION AVAILABLE TO BIDDERS

- .1 The following information is available to Bidders and is bound in specifications appended to this document.
- .2 The Following reports are for information only. Neither the Consultant nor the Owner assume any liability for items extracted from or contained in the reports.

1.3 GEOTECHNICAL AND ENVIRONMENTAL INVESTIGATION REPORT(S):

- .1 A copy of the following geotechnical and environmental investigation reports and related letters, prepared by the Owner's geotechnical consultant for the Place of the Work, are bound herein:
 - .1 Geotechnical Investigation Proposed Helicopter Hangar, Project 44148, dated August 30, 2024, by Patriot Engineering Ltd.
 - .2 Partial Site Plan Showing the Approximate Borehole Locations, Project 44148, dated August 2024, by Patriot Engineering Ltd.
- .2 Geotechnical investigation documents are not guaranteed to be representative of actual subsurface conditions of the Place of the Work.
- .3 When calculating soil volumes for bidding purposes, Bidders should assume flat plane geometric layers formed by straight lines drawn between subgrade elevations, for each material identified in the soils report.
- .4 This soils report shall not form part of the Contract Documents. The geotechnical report is provided for information purposes only and the Owner assumes no responsibility for their correctness or completeness.
- .5 Bidders shall ensure the Estimated Contract Price in their Bid includes and accounts for any work that is implied in, or reasonably inferable from, the soils report.

1.4 TRAINING CENTRE REFERENCE DRAWINGS

- .1 The following Drawings are issued with this Contract for reference only. Be responsible for properly assessing the information contained in these reference Drawings which has affect on the Work of this Contract. Consultant and Owner assumes no responsibility about their accuracy and/or completeness:
 - .1 Training Electrical Site Plan E-001
 - .2 Training Centre Site Plan Details E-901
 - .3 Training Centre Grading Plan C-102
 - .4 Training Centre Grading Plan C-103
 - .5 Training Centre Servicing Plan C-100

END OF DOCUMENT

PART 1 - GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
- .1 the General Conditions and Supplementary Conditions of the Contract.
 - .2 Division 1 requirements and documents referred to therein.

1.3 CASH ALLOWANCES

- .1 Disbursements from cash allowances are intended for Work not shown or described in the Contract Documents and shall be authorized by the Owner, through the Consultant, in writing, as applicable.
- .2 Extend to the Owner refunds and trade and quantity discounts which may be received from purchasing under cash allowances, except cash discounts for prompt payment.
- .3 In submitting final adjustments of cash allowances, include duplicate, summary statements and copies of receipted invoices substantiating purchases under cash allowances.
- .4 Provide cash allowances as noted on the Bid Form.

1.4 LIST OF CASH ALLOWANCES

- .1 Provide the cash allowances as follows:

No.	Description	Amount
1.	<u>Inspection and Testing: For inspection and testing services provided by independent inspection and testing companies and consultants.</u>	<u>\$ 150,000.00</u>
2.	<u>Commissioning of mechanical and electrical work by independent commissioning consultant in compliance with specified requirements. Normal commissioning by mechanical and electrical trades shall be included in Total Bid Price and excluded from this cash allowance item.</u>	<u>\$ 100,000.00</u>
3.	<u>Electrical Municipal Utilities connection charges. All Work shown on the Drawings shall be included as part of Total Bid Price and excluded from this cash allowance.</u>	<u>\$ 50,000.00</u>
4.	<u>Supply and installation of security system and equipment (excluding empty conduit which shall be included in Total Bid Price).</u>	<u>\$ 75,000.00</u>
5.	<u>Supply and installation of Fuel Tank including the fuel tank equipment and its components, layout, testing, and engineering fees. The empty conduit shall be included in Total Bid Price and excluded from this cash allowance.</u>	<u>\$ 150,000.00</u>
<u>Total Of Cash Allowances</u>		<u>\$ 525,000.00</u>

.4—

END OF SECTION

PART 1 - GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL

- .1 Read and conform to:
 - .1 the General Conditions and Supplementary Conditions of the Contract.
 - .2 Division 1 requirements and documents referred to therein.
- .2 Provide any permit necessary for temporary facilities and controls. Provide and maintain all temporary facilities and controls specified in the Contract Documents. Remove them when directed and/or when no longer required. Payment for temporary facilities and controls shall be made by the Contractor unless specified otherwise in the Contract Documents.
- .3 Provide and maintain adequate temporary supports, structures, light, power and water in accordance with GC 3.1 – CONTROL OF THE WORK and GC 3.3 – TEMPORARY SUPPORTS, STRUCTURES AND FACILITIES of the General Conditions of the Contract, as required by all trades and to facilitate the Work to proceed without delay at all times of the year. The cost of temporary light, power and water shall be included in the Contract Price. The Contractor shall pay for installation, light, power and water used, its maintenance and removal.

1.3 TEMPORARY UTILITIES

- .1 Temporary Water Supply:
 - .1 Arrange and pay for the supply of water required for construction purposes.
 - .2 Provide connections, piping and fittings for distribution of water and remove such temporary distribution upon completion of the Work.
- .2 Temporary Power:
 - .1 Provide continuous temporary power and lighting service. If necessary, arrange and coordinate off-Site power source for continuous temporary power and lighting service. Arrange and pay for energy charges and include costs in the Contract Price for connection and provision of a separate meter.
- .3 Temporary Heating, Ventilation and Air Conditioning:
 - .1 Provide temporary heating, ventilation and air conditioning for enclosed building until Substantial Performance of the Work to ensure adequate protection of the Work under way and of completed Work. Temporary heating, ventilation and air conditioning without limitation includes heating, cooling and desiccant de-humidification equipment, associated power cables, gas lines, temporary duct work and accessories.
 - .2 Provide also temporary heating, ventilation and air conditioning for portions of the Work where exposed to atmospheric elements during construction.
- .4 Temporary Controlled Environment:
 - .1 Provide a controlled environment and dehumidifier for the drying and curing of construction Work to prevent the growth of mold and to speed up the drying of concrete to meet moisture emission levels required by finish flooring installation. Conform to the following performance

requirements, except where more stringent requirements are required by the work of other Sections and Contract Documents:

- .1 Supply Air: Minimum 1 air change every 120 minutes.
 - .2 Filtration of out air - 100%.
 - .3 Temperatures - minimum between 15°C (59°F) and 27°C (80°F).
 - .4 Relative humidity - maintain at or below 50%.
 - .5 Ensure moisture content in wood and hardwood materials is stabilized to maximum percentage recommended by AWI/AWMAC requirements.
 - .6 Control condensation and maintain environmental conditions, including air and surface temperatures suitable for surface preparation, application and curing of paints and coatings.
 - .7 Conform to noise criteria requirements specified in the Contract Documents.
 - .2 Provide proper heating for drying out of new work. Maintain the minimum temperature specified in this Section. Uniformly distribute heat to avoid hot or cool areas or excessive drying. Protect concrete, masonry, excavations, backfilling and other work from frost during construction.
 - .3 Dehumidify interior spaces continuously during installation and curing periods required for moisture emitting work to maintain the required relative humidity levels, including without limitation work involving:
 - .1 joint compounds, skim coating, gypsum board work and plaster;
 - .2 cementitious materials;
 - .3 paints; and
 - .4 finish carpentry, casework, wood paneling, wood flooring and other millwork.
 - .4 As soon as construction is sufficiently advanced, and in order to prevent delays in the progress of the Work, enclose the building using necessary tarpaulins, plastic sheeting or glazing and temporary doors, with locks to doors.
 - .5 Construction heaters used inside the building must be vented to outside or be flameless type. Do not use direct fired space heaters and propane, salamander type heaters. Ventilate heated areas and keep the building free of exhaust and combustion gases.
 - .6 Maintain supervision of the operation of temporary heating and ventilation equipment. Maintain temporary climate control equipment in service until the completion of building commissioning or when use of the equipment is no longer required as directed by the Consultant.
 - .7 Remove climate control equipment from the Site after the successful commissioning of new HVAC equipment.
 - .8 Do not use any of the permanent facilities and controls without obtaining written permission from Consultant.
- .5 Use of Building HVAC System:
- .1 Before any portion of the heating system can be considered by the Consultant for use by Contractor, the Contractor shall verify the following requirements:
 - .1 equipment must be properly commissioned with safety and operating devices operational.
 - .2 proper electrical power requirements and equipment operating within nameplate ratings.
 - .3 flow rates of equipment verified to be within design tolerances.
 - .4 submission of operating and maintenance manuals.
 - .5 service and maintain systems and equipment in accordance with operating and maintenance manuals.

- .2 On completion of the work for which permanent heating system was used, the Contractor shall replace filters, inspect and replace defective bearings and lubricate all bearings and clean strainer baskets. This includes, without limitations, painting of equipment if required, repacking of pumps, and cleaning out of ductwork (all as instructed by the Consultant).
- .3 Warranties for the heating system shall not commence until the entire system is in as near original condition as possible and is so certified by the Consultant. Warranties shall not commence earlier than the date that Substantial Performance of the Work is achieved.
- .4 Pay costs for providing and maintaining temporary heat.
- .5 Be responsible for any damage to the Work due to failure in providing adequate heat and protection during construction.
- .6 Temporary Drainage:
 - .1 Protect excavation, trenches and building from damage by rainwater, ground water, backing up of drains or sewers and other water, frost and other weather conditions. Provide sheeting, piling, shoring, pumps, equipment, temporary drainage, protective covering and enclosures. Provide necessary pumps including spare pump for keeping the Work free of water throughout the construction period.
 - .2 Keep Site properly and efficiently drained during construction and until completion. Be responsible for disturbances, dirt and damage which may be caused by or result from water backing up or flowing over, though, from or along any part of the Work or due to operations which may cause water to flow elsewhere. Drain water away from Site without causing any danger to public health.
- .7 Temporary Protection:
 - .1 Provide and maintain the following temporary protection at all times:
 - .1 at window openings, provide translucent, weatherproof protection until windows and glazing are installed;
 - .2 for door openings, provide minimum wood doors, frames, hinges, locks and bolts to exterior and interior to existing areas;
 - .3 at air intakes, provide protection against infiltration of dirt, dust and other deleterious matter; and
 - .4 Provide temporary stair treads and landings.
 - .2 Provide scaffolding enclosures to enable the Work to continue during inclement weather and winter conditions.
 - .3 Notify the Fire Department and Consultant immediately should a fire of any nature occur regardless of whether the fire has been extinguished or not. Notify the Fire Department and Consultant of any fire alarm shutdowns and also provide notice once the fire alarm has been recertified and is operational.
 - .4 Establish a log book maintained by the Contractor which records all activity affecting the Owner's fire alarm system. The log book shall record date, time, trade, worker's name, nature and location of work performed, zone or zones affected, status of system while work was performed, time and date of completion of operation, and status of system upon completion of work. At the end of each Working Day, Contractor shall review the log and sign indicating the system is fully operational, except as recorded otherwise in the log. Inform the Owner of the system status and which zones may be affected daily prior to commencement of any new operation that affects the fire alarm system.

1.4 CONSTRUCTION FACILITIES

- .1 Temporary Support Structure and Facilities

- .1 Design, erect, operate, maintain and remove temporary structural and other temporary facilities. Engage and pay professional engineers licensed to practice in Province of Ontario and skilled in the appropriate disciplines to perform these functions where required by law or by Contract Documents and in cases where such temporary facilities and their methods of construction are of such a nature that professional engineering skill is required to produce safe and satisfactory results.
 - .2 Design metal guards and walls-acting-as-guards in accordance with the requirements of the OBC, "Loads on Guards" and "Loads on Walls Acting as Guards". Provide guards for the work of various trades such as masonry, structural steel stud framing system, metal siding system, curtain wall, and gypsum board, as applicable.
 - .3 Provide and maintain temporary ladders, ramps, walks and hand rails as necessary during construction in compliance with the requirements of the *Ontario Occupational Health and Safety Act* (Ontario), in particular paragraphs 4.1.10.1 and 4.1.10.3
- .2 Contractor's Field Offices and Sheds:**
- .1 Provide Contractor's field offices and storage sheds within the Place of the Work only. Provide offices and sheds properly painted and maintained.
 - .2 Provide the following field office facilities:
 - .1 A room to accommodate 12 persons for Site conference and job meetings, heated and air conditioned to maintain a temperature of 21° C (70° F) ± 2° C (4° F);
 - .2 One photocopy machine;
 - .3 "No Smoking" signs; and
 - .4 Proper flammable and explosive materials storage.
- .3 Sanitary Facilities**
- .1 Provide and maintain temporary facilities for use by workers in compliance with the *Occupational Health and Safety Act* (Ontario), and applicable by-laws. Provide portable, weatherproof toilets, serviced at least weekly.
- .4 Garbage Removal**
- .1 Do not use institutional garbage bin facilities for the removal of construction rubbish and debris. Provide garbage bins and schedule the pick-up of garbage.

1.5 CONSTRUCTION HOISTS AND SCAFFOLDING

- .1 Provide, maintain and locate where directed by the Consultant, the required hoisting equipment. Equipment shall be positioned so as not to interfere with the Work. Do not block public roads, or impede traffic during operation. If required to temporarily block traffic, control and flag person shall direct traffic in a manner acceptable to municipal authorities. The equipment shall be operated by a qualified hoist operator along with well-trained flag and signal persons. Coordinate and make required arrangements for the use of hoists by Subcontractors and Suppliers. Provide concrete pads for hoisting equipment and remove when no longer required. Restore area to its pre-construction condition.

1.6 VEHICULAR ACCESS AND PARKING

- .1 Provide access roads as may be necessary to provide safe and adequate access for materials, Products and other supplies to the Site. Provide and maintain access sidewalks, roadways and similar facilities as may be required for access to the Work. Do not block public roads or impede traffic during the progress of the Work. If required to temporarily block traffic, provide a flag person to direct traffic in a manner acceptable to municipal authorities. Remove accumulations

of ice and snow from areas providing access to Site. Ensure access to Site is available for emergency vehicles and comply with the fire plan for vehicular traffic.

1.7 TEMPORARY BARRIERS AND ENCLOSURES

.1 ~~Hoarding and Boardwalk~~Enclosures:

.1 Provide ~~enclosures~~~~hoarding~~ and gates in accordance with the requirements of the Local Municipality, the *Occupational Health and Safety Act* (Ontario), Regulations for Construction Projects and applicable requirements of other Authorities Having Jurisdiction to:

- .1 protect public, Owner's occupants, personnel and property from injury and damage; and
- .2 exclude non-construction personnel and public from parts of the Place of the Work under construction.

~~.2 Framing, sheathing and decking shall be in accordance with the details indicated on the Contract Drawings and materials listed herein are minimum requirements which may be exceeded by the Contractor's design.~~

~~.3 Wood Hoarding and Boardwalk Framing: National Lumber Grades Authority No. 1 Grade SPF.~~

~~.4 Wire Mesh: 50 mm x 50 mm x 3.4 mm (2" x 2" x 1/8") galvanized.~~

~~.5~~.2 The limit of the Place of the Work shall be as indicated on the Contract Drawings.

~~.6~~.3 Prohibit the use of roads outside of the Place of the Work except for construction purposes and as required for access to the Place of the Work.

~~.7~~.4 Maintain ~~hoarding~~~~enclosures~~ in a clean condition, free of unauthorized bills, signs and defacement.

~~.8~~.5 Remove and dispose of ~~hoarding~~~~enclosures~~ upon completion of the parts of the Work.

.2 Temporary Heated Enclosures

- .1 Conform to the requirements of the *Occupational Health and Safety Act* (Ontario).
- .2 Take precautions and provide temporary protection to prevent damage to the Work affected by temperature, water, weather and other environmental conditions.
- .3 Provide temporary heated enclosures in advance of cold weather to continue full operations through cold climatic temperature and weather throughout the Work.
- .4 Provide heating to maintain the recommended Product storage, mixing, substrate, ambient air, placement, Product installation and curing temperatures recommended by the respective Product manufacturers.
- .5 Provide temporary enclosures and heating as required by the Contract Documents.

.3 Existing Trees:

- .1 Remove trees indicated to be removed on the Drawings in a manner to prevent hazard to persons and property. Employ an expert woodsmen for tree removal over 150 mm (6") caliper.

1.8 PROJECT IDENTIFICATION

- .1 Provide a sign approved by the Consultant that identifies the Contract Work as detailed 2400 mm x 3600 mm (8'x12'), including wood frame support and minimum 19 mm (3/4") exterior grade plywood with reinforced resin facing and wood trim at the perimeter.

- .1 Mount at location and height as directed by the Consultant.

END OF SECTION

PART 1 - GENERAL

1.1 PRICING

- .1 All costs associated with the work required by this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and Supplementary Conditions of the Contract.
 - .2 Division 1 requirements and documents referred to therein.

1.3 SUMMARY

- .1 Work Included: Provide labour, materials, products, equipment and services to complete the exterior enclosure performance and testing work specified herein. This includes, but is not necessarily limited, to:
 - .1 Below-grade construction, including foundation walls and slabs-on-grade.
 - .2 Above-grade construction, including:
 - .1 exterior opaque wall materials and assemblies;
 - .2 roofing systems, including steep-slope and low-slope roofing;
 - ~~.3 outdoor plazas, planters and plaza paving systems and assemblies over occupied spaces; and~~
 - ~~.4.3 openings and glazed assemblies including windows, doors, curtain wall and sloped glazing systems skylights.~~
 - .3 Interface and penetration conditions (flashings, expansion joints and sealants) between each of the materials, components and systems that comprise the above and below-grade building exterior enclosure.
- .2 This Section includes the general design and performance requirements for the work of Sections which comprise the building enclosure portion of the Work. The requirements specified in this Section shall be read in conjunction with other requirements specified in Contract Documents.
- .3 This Section also outlines the process for independent, third-party verification that the installed performance of the building enclosure meets or exceeds the minimum performance requirements stipulated in the Contract Documents for this Project.
 - .1 Provision of inspection and testing services do not relieve Contractor of responsibility for compliance with Contract Document requirements.
 - .2 Specified inspections, tests, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with Contract Document requirements.
 - .3 Use of testing to discover deficiencies will not be permitted where Contractor's quality-control procedures would make these tests unnecessary.

1.4 REFERENCES

- .1 The following definitions apply to this Section:

- .1 "Post-Disaster Building": means a building that is essential to provision of services in event of a disaster. This facility is classified as post disaster as defined in the OBC.
- ~~.2 "Operational and Functional Component" and "OFC": means components within building which are directly associated with the function and operation of the facility. OFCs consist of architectural components, building services components, and building contents. Items specified herein may be designated as OFCs and may need to be designed in accordance with performance requirements specified herein and in Section 13 48 50.~~
- ~~.3.2~~ "Building Envelope" and "Building Enclosure": means the part of the building that physically separates the exterior environment from the interior environment. It includes above-grade walls and openings, below-grade walls, roofs, and the various components and accessories used to achieve continuity and physical connections and transitions between various assemblies.
- ~~.4.3~~ "Air Barrier Assembly": means a collection of Air Barrier Materials (i.e. self-adhered sheet air barriers, liquid applied membranes, medium density sprayed polyurethane foam, mechanically fastened commercial building wraps and boardstock air barriers) and Air Barrier Accessories (i.e. sealants, tapes and transition membranes) assembled together to form a continuous barrier to air infiltration into the environmental separator.
- ~~.5 "Air Barrier Material": means a primary material that controls the movement of air into and out of a building.~~
- ~~.6 "Air Barrier Accessory": means the materials or products which are used to connect different Air Barrier Materials to form a continuous air barrier assembly.~~
- ~~.7 "Vapour Barrier": means material or system within the building construction assembly that impedes water vapour transmission to less than 72 ng/(s-sq.m-Pa) when tested in accordance with ASTM E96 to prevent the accumulation of moisture having potential to cause deterioration of the Building Enclosure.~~
- ~~.8.4~~ "Testing with Sealed Openings": means testing with intentional openings sealed means that mechanical openings are purposely closed off. Mechanical systems that are intended to be sealed with dampers are only be sealed by closing the damper, with no additional sealing provided. Windows and doors are left in the closed and locked position.
- ~~.9.5~~ "Enclosure-Only Testing": similar to sealed openings approach, except all mechanical penetrations are temporarily masked to completely prevent air leakage through them.
- .2 Reference Standards: Latest published editions of reference standards listed in this Section in effect as of the closing date and time of the Request for Tenders for the Contract, including any amendments adopted, are applicable unless otherwise indicated.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings: arrange pre-installation meetings attended by third-party inspection and testing company, Consultant, and Subcontractors whose work is directly associated with or impacted by Building Enclosure activities prior to starting work on the Building Enclosure.
- .1 Quality Management Plan: review Contractor's quality control plan, and confirm that approaches to quality control and quality assurance procedures are coordinated with third-party inspection and testing company monitoring and testing requirements.
- .2 Document and Product Review: review Contract Documents and confirm compatibility between overlapping and adjacent components supplied and installed by multiple parties who are contributing different Products associated with the assembly of the Building Enclosure.

- .2 Scheduling: Schedule construction of sample panels and mock-ups, and associated pre-construction testing thereof to account for site-specific installation conditions. Ensure sufficient time is accounted for to permit corrections to proposed construction methods without negatively impacting the Construction Schedule.
- .3 Role of the Consultant: Consultant is the registered professional of record and is responsible for responding to the Owner's stated project requirements and providing statements of compliance to the Authorities Having Jurisdiction indicating that the objectives of building code functional statements for Building Enclosure performance are met.
 - .1 Consultant will rely on third-party inspection and testing company reports in conjunction with the Contractor's field quality control reports to provide opinion on Building Enclosure performance.
- .4 Role of the third-party inspection and testing company: Owner will engage third-party inspection and testing company acceptable to Owner and Consultant that specializes in Building Enclosure testing, and that has documented experience with construction of similar extent and complexity as that required for the Project.
 - .1 Third-party inspection and testing company will schedule and arrange testing during construction of the Building Enclosure and provide observation during installation of Building Enclosure components in accordance with their contract with Owner.
 - .2 Third-party inspection and testing company must assist in establishing best-practice installation procedures for Products forming the Building Enclosure.
 - .3 Third-party inspection and testing company must assist in establishing methods for corrective action where site conditions or actual installation result in non-conforming Building Enclosure performance.
 - .4 Third-party inspection and testing company will perform testing as directed by the Owner and Consultant, and will schedule with Contractor mutually agreed timing for access to site and performance of their activities.
 - .1 Third-party inspection and testing company will make recommendations for correction to observed deficiencies to Consultant. Consultant will make final recommendation for any assembly modifications to Contractor.
- .5 Role of the Contractor:
 - .1 Provision and coordination of trades, and sequence of construction to ensure total performance of Building Enclosure from substructure to walls and to roof, including proper insulation depths, continuity of air barrier system joints, junctures and transitions between materials, assemblies of materials, and products.
 - .2 Organize preconstruction meetings between trades involved in entire Building Enclosure system to discuss where each trade scope begins and ends, responsibility and sequence of installation for proper insulation, waterproofing, air-tight joints, junctures, and transitions between materials, products and assemblies of products specified in different sections.
 - .3 Build mock-ups satisfactory to Consultant and third-party inspection and testing company of each assembly type including, junctures, and transitions between products, materials and assemblies.
 - .4 Cooperate with agencies performing required inspections, tests, and similar services, and provide reasonable auxiliary services as requested. Notify third-party inspection and testing company sufficiently in advance of operations to permit assignment of personnel. Auxiliary services required include, but are not limited to, following:
 - .1 Provision of access to the Work.

- .2 Provision of incidental labour and facilities necessary to facilitate inspections and tests.
- .3 Provision of adequate quantities of representative samples of materials that require testing or assistance in taking samples.
- .4 Delivery of samples to testing laboratories.
- .5 Provision of security and protection of samples and test equipment at Project Site.

1.6 ACTION SUBMITTALS

- .1 Product Data: Submit in accordance with Division 01 for the following:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for the exterior enclosure commissioning work and include product characteristics, performance criteria, physical size, finish and limitations.
 - .2 Include recommendations for product application and use.
 - .3 Include test data substantiating that products comply with requirements.
- .2 Shop Drawings: Submit Shop Drawings indicating material characteristics, details of construction, connections, and relationship with adjacent construction.
 - ~~.1 — Energy Simulation: Submit energy simulation data conforming to the following:-~~
 - ~~.1 — Performance of Glazing: simulated using WINDOW (latest edition) software by Lawrence Berkley Laboratories ("LBL").~~
 - ~~.2 — Performance of Framing (opaque and glazed assemblies): simulated using THERM software by LBL.~~
 - ~~.2 — Simulations must be carried out by a qualified simulator and summary reports must bear seal of a Professional Engineer and clearly demonstrate materials used to reduce thermal bridging in the field and at the interfaces of Building Enclosure assemblies.~~
 - ~~.3 — Alternatively test results based on testing in accordance with AAMA 1503.1 may be submitted in lieu of energy simulation to verify performance.~~

1.7 INFORMATIONAL SUBMITTALS

- .1 Contractor's Quality Control Plan: submit quality control plan before pre-construction conference, describing approach to maintaining material and installation quality including the following:
 - .1 Lists of third-party standards, guidelines or reference documents forming part of proposed construction best-practices used to achieve specified performance requirements;
 - .2 Substrate preparation and installation of air barrier and vapour retarding membranes;
 - .3 Treatment of transitions between Building Enclosure components and their penetrations (including doors, frames, glazing, flashings, louvers and other penetrations);
 - .4 Confirmation of compatibility between Building Enclosure components;
 - .5 Proposed list of observations and tests forming a part of Contractor's quality assurance and quality control activities;
 - .6 Methods for addressing corrective action plans and addressing deficient or incompatible installation procedures;
 - .7 Format and frequency of reports, records of pre-construction meetings and site modifications; and

- .8 Proposed construction schedule indicating stages of Building Enclosure construction and potential dates for Consultant's, and third-party inspection and testing company's review activities.
- .2 Manufacturer's Certificates: Submit third-party verification stating conformance with Project requirements, including any material compatibility or limitations specific to Project conditions.
- .3 Test and Evaluation Reports: Submit reports indicating test methods and results, and stating specifically which attributes apply to the products supplied to the Project.
- .4 Manufacturer's Installation Instructions: Submit written installation requirements stating required workmanship practices to achieve assembly performance required for the Project.

1.8 CLOSEOUT SUBMITTALS

- .1 Maintenance Schedule: Submit summary table that indexes Building Enclosure components requiring maintenance and indicates frequency at which each component requires repair or replacement (i.e. replacement of sealants, gaskets, glazing units, paints or coatings and similar components).
- .2 Operation and Maintenance Data: Submit operation and maintenance data for each component listed in aforementioned schedule including the following as a minimum:
 - .1 Product Data Sheets as specified in this Section.
 - .2 Extended Warranty Information: Include warranties for products, equipment, components, and sub-components whose duration exceeds one year. Include warranties on components with the system they are a part of. Reference all specific operation and maintenance procedures that must be performed to keep warranty valid.
 - .3 Sources of Material: Include reference to contact information where specific materials can be obtained.
 - .4 Installation and Maintenance Instructions: Submit information for each material, component or system.

1.9 QUALITY ASSURANCE

- .1 Mock-Ups: Construct mock-ups of each assembly as specified in this Section, including junctures, transitions and interfaces to establish baseline quality for installation and workmanship, and to evaluate enclosure-related constructability and performance, with a specific emphasis on required coordination of Subcontractors and sequencing necessary to ensure that performance of enclosure materials, components, systems, assemblies, and interfaces meets or exceeds requirements of Contract Documents.
 - .1 Required Mock-ups: Provide "first installation" in-situ or on site mock-up (as determined by Consultant) of each major Building Enclosure system, including:
 - .1 Each below grade underslab and vertical waterproofing system.
 - .2 Each type of horizontal waterproofing system enclosing occupied space below.
 - .3 Each substantially different type of vertical enclosure assembly (including associated air barriers, insulation, and support materials) including, but not limited to precast concrete assemblies, masonry assemblies, curtain wall and glazed assemblies, and rain screen cladding assemblies.
 - .4 Each low-slope and each steep-slope roofing assembly.
 - .5 Each expansion joint assembly.

- ~~.2 — Extent of Mock-ups: Ensure extent of each mock-up includes interface of various materials and systems, both between various major assemblies (e.g. foundation waterproofing connection to wall assembly) and between various materials in the same assembly (e.g. interface between window and wall).~~
 - ~~.1 — Wall mock-ups must be minimum of 10 sq. m (100 sq. ft.) and extend one full structural bay wide by one full story high plus additional height as required to connect to assemblies below and above. Ensure mock-up includes typical exterior wall-to-interior floor slab connection. In addition, conform to the following:~~
 - ~~.1 — Curtain Wall Systems, Entrances and Windows: minimum of one full sized unit within rough opening demonstrating installation of transition membranes, sealants and flashings.~~
 - ~~.2 — Masonry Unit Panels: assemble a test panel including placement of a single opening (window and/or door) demonstrating installation of joint sealants and flashings, and placement of vents and weeps.~~
 - ~~.3 — Air Barrier Membranes: apply air barrier membrane to minimum area of 36 sq.m (390 sq. ft), including placement of a single opening (window and/or door) demonstrating overlaps, adhesion to substrates, and compatibility with adjacent materials.~~
 - ~~.4 — Cladding Panels (each type): assemble a test panel including placement of a single opening (window and/or door) demonstrating progressive installation, attachment to substrate, installation of insulation, joint sealants, and placement of flashings and closure strips.~~
 - ~~.2 — Roof mock-ups must be minimum of 10 sq. m (100 sq. ft.) and include parapet or roof edge conditions, as well as typical pipe, supports, and similar penetrations.~~
 - ~~.3 — Horizontal below-grade waterproofing or slab-on-grade vapour retarder mock-ups must be minimum of 10 sq. m (100 sq. ft.) and include edge conditions and typical penetration details.~~
 - ~~.4 — Vertical below-grade waterproofing (foundation wall waterproofing) mock-ups must include typical edge, termination, and penetration details.~~
- ~~.3 — Sequencing Requirements: Stage each component within mock-ups so that each layer of construction can be reviewed and tested as required to verify performance before succeeding layers of materials are applied.~~
- .4.2 Post Mock-Up Debrief: arrange for post mock-up debrief meetings attended by Contractor, Owner, third-party inspection and testing company, Consultant, and Subcontractors whose work is directly associated or impacted by Building Enclosure activities.
 - .1 Schedule debrief meeting immediately after testing results and observations of the mock-ups is completed.
 - .2 Incorporate lessons-learned arising from observed conditions and testing into Contractor's quality control plan.
- .5.3 Modifications to Mock-Ups: mock-ups may require modifications to account for site conditions and compatibility between adjacent materials and assemblies.
 - .1 Provide corrective actions as required to obtain acceptance. Repair mock-ups which are permitted to form a part of the final construction that have been damaged or that failed testing.
- ~~.2 — Mandatory Qualifications:-~~
 - ~~.1 — Mandatory Passive House Certification:-~~

- ~~.1 — Prior to commencement of building envelope work for this project, the Project Manager, site superintendent, building envelope coordinator and mechanical and electrical coordinators from the Contractor's team assigned to Project shall have received formal training in the Passive House Trades Course (minimum 3-day workshop) as offered by Peel Passive; <https://www.peelpassivehouse.ca> or similar. All costs are Contractor's responsibility. Proof of certification to be submitted upon request. Proposed replacements for any of these positions by the Contractor will require the same certification prior to commencing work on the project.~~
- ~~.2 — Mandatory Passive House Training:~~
 - ~~.1 — At least one senior on-site member (site foreman) from all sub trades performing work which forms part of the building envelope and the mechanical and electrical sub trades will be required to attend a mandatory one-day passive house training course. Duration of training shall be not less than 8 hours. Instructor shall be provided and paid for by Owner. Contractor to assume all other costs, including provision of on-site facilities to administer the course and required compensation to Contractor's team members for attending training.~~
 - ~~.2 — Owner and Consultant will schedule with Contractor mutually agreed timing for delivery of training to avoid delays to the Work.~~

PART 2 - PRODUCTS

2.1 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 Statement of Building Enclosure Design Intent: The design intent of this building's enclosure is to provide exterior floor, wall, and roof assemblies which prevent uncontrolled air and vapour infiltration into the building; eliminate water infiltration (including condensation) into conditioned spaces; and provide thermal insulation continuity to minimize cold bridging. Products and assemblies used to perform these functions must be technically sound, durable and serviceable.
 - .1 Design Assumptions:
 - .1 Exterior Air Temperature:
 - .1 Summer: 30 deg C dry bulb, 23 deg C wet bulb
 - .2 Winter: - 24 deg C
 - .2 Ambient Interior Air Temperature (Design (for all spaces within the building, except for mechanical and electrical rooms and the garage):
 - .1 Summer: 24 deg C dry bulb
 - .2 Winter: 22 deg C
 - .3 Interior Relative Humidity: 55 percent +/- 5 percent
 - .2 General Assembly Performance:
 - .1 Assemblies described in Contract Documents are expected to achieve the minimum performance requirements specified in this Section as verified by inspection and testing. Performance criteria identified in this Section shall supersede other criteria identified in other parts of Contract Documents.
 - .2 Comply with applicable building code, and other regulations and requirements of Authorities Having Jurisdiction, in design, engineering, fabrication and installation of the Work.

- .3 Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.
- .4 When difficult-to-construct material connections occur within Building Enclosure construction, advise Consultant at once so that details can be reviewed and installation methodologies confirmed. Poor installation of a difficult-to-construct detail is not acceptable.
- .5 Design of Building Enclosure assemblies is based on "Rain Screen" principle. The definition of the rain screen principle for the purpose of these Specifications is "as advocated by National Research Council of Canada".
 - .1 This approach is founded on the premise that multiple-element protection is necessary in most situations to achieve effective control, by means of
 - .1 a first line of defense that minimizes rainwater passage into wall by minimizing number and size of holes and managing driving forces acting on wall;
 - .2 a second line of defense that intercepts all water that gets past first line of defense and effectively dissipates it to exterior.
 - .2 All voids between assembly components as well as those between components and structure shall have:
 - .1 Gaskets, baffles, overlaps, seals and compartmentalization as required to provide a barrier "Rain Screen" to effectively prevent excessive rain water entry into any of Building Enclosure cavities but allow pressure moderation of cavity air spaces.
 - .2 Low permeability Vapour Barriers to minimize vapour diffusion, where required.
 - .3 Air barriers and seals as required to prevent entry of interior building air into Building Enclosure cavities, and exterior air into building. Air barriers and seals shall be able to withstand wind design pressures.
 - .4 Thermal separators, isolators and seals placed to eliminate direct contact between interior humid air and a cold surface or structural component to prevent condensation and ice build-up on surfaces during cold weather.
- .6 Air Barrier Continuity:
 - .1 This Project incorporates design principles of positive air and vapour leakage control at Building Enclosure line. Drawing details illustrate continuity of air barrier/vapour retarder at penetrating elements such as door, window and louver frames.
 - .1 In order to maintain continuity of Air Barrier Assemblies, interfacing of various building elements requires close coordination by all trades involved with exterior building elements.
 - .2 Air-barrier assembly extends nominally from foundation line, vertically along exterior walls and to positively contact with roof air barrier/vapour retarder or roofing membrane as applicable. Continuity also extends to waterproofing at podium areas, and to inner surface of glazing units. Provide a continuous, unbroken and non-perforated air and vapour seal to totally enclose Building Enclosure and to separate interior and exterior environments.
 - .3 Manufacturers of window and door frames must ensure correctly designed and positioned metallic legs, extensions or recesses are provided at thermal break line to facilitate connections of rigid or flexible transition materials prior to setting these elements in their allotted openings.

- .4 Penetrations of air barrier and paths of air infiltration / exfiltration must be sealed.
- .5 Air barrier system shall have following characteristics:
 - .1 It must be continuous, with all joints sealed.
 - .2 It must be structurally supported to withstand positive and negative air pressures applied to Building Enclosure.
 - .3 Connection shall be made between:
 - .1 Foundation and walls.
 - .2 Walls and windows or doors.
 - .3 Different wall systems.
 - .4 Wall and roof.
 - .5 Wall and roof over unconditioned space.
 - .6 Walls, floor and roof across construction, control and expansion joints.
 - .7 Walls, floors and roof to utility, pipe and duct penetrations.
 - .6 Materials: materials used for air barrier system in opaque wall assemblies shall comply with CAN/ULC S741 and shall have an air permeance not exceeding 0.02 L/(s·m²) (0.004 cfm/ft²) under a pressure differential of 75 Pa (1.57 psf) when tested in accordance with ASTM E2178.
- .3 Air Leakage Criteria (in-situ): The air leakage of the following assemblies must not exceed the following criteria when tested in the field in accordance with ASTM E783.
 - .1 Whole Building ('enclosure-only testing' and with 'sealed openings' testing results) for office area: less than 0.6 air changes per hour (ACH) under a pressure differential of 50 Pa (1.04 psf) and normalized leakage rate of 0.22 L/(s·m²) under a pressure differential of 50 Pa (1.04 psf).
 - .2 Opaque wall assemblies: less than 0.2 L/(s·m²) under a pressure differential of 75 Pa (0.04 cfm/ft² @ 1.57 psf)
 - .3 Fixed glazed assemblies: less than 0.01 L/(s·m²) under a pressure differential of 300 Pa (0.002 cfm/ft² @ 6 psf)
 - .4 Operable assemblies:
 - .1 Glazed ~~Windows, Sliding doors and~~ Swing Doors: less than less than 0.06 L/(s·m²) under a pressure differential of 75 Pa (0.01 cfm/ft² @ 1.57 psf)
 - .2 Sectional doors: less than 2.0 L/(s·m²) under a pressure differential of 75 Pa (0.4 cfm/ft² @ 1.57 psf)
 - ~~.3 Rolling doors: less than less than 5.0 L/(s·m²) under a pressure differential of 75 Pa (1 cfm/ft² @ 1.57 psf)~~
- .4 Thermal Performance Criteria: install insulation materials to maintain continuity of performance of the Building Enclosure meeting thermal resistance or thermal conductance ratings specified below:
 - .1 Roofing Assemblies:
 - .1 Nominal: Minimum ~~R60-R35 ci~~ sq.ft·h·deg F/BTU (RSI 10.59 sq.m·deg·K/W)
 - .2 Opaque Wall Assemblies Above-Grade:
 - .1 Nominal: Minimum ~~R40-R25 ci~~ sq.ft·h·deg F/BTU (RSI ~~7.064.4~~ sq.m·deg·K/W)
 - .3 ~~Curtain Wall and~~ Glazed Assemblies:
 - .1 Maximum U0.23 BTU/sq.ft·h·deg F (U1.30 W/sq.m·K)

- .2 Solar Heat Gain Coefficient: Maximum 0.4
- .4 Skylights:
 - .1 Maximum U0.22 BTU/sq.ft·h·deg F (U1.25 W/sq.m·K)
 - .2 Solar Heat Gain Coefficient: Maximum 0.4
- .5 Slabs-on-Grade:
 - .1 Nominal: Minimum ~~R40-R15~~ sq.ft·h·deg F/BTU (RSI ~~7.062.64~~ sq.m·deg·K/W)
- .5 Water Infiltration: There must be no uncontrolled water infiltration when following assemblies are tested in the field in accordance with the test method described in Part 3 of this Section.
- .6 Thermal Bridging: Ensure wall assembly and interface details are thermally broken and meet the OBC SB-10 requirements for continuous insulation to reduce structural connections which create thermal bridging.
 - .1 As a minimum, provide materials to minimize or prevent thermal bridging at the following locations and interfaces:
 - .1 Cladding and insulation attachment at opaque wall assemblies.
 - .2 At-grade transitions.
 - .3 Slab-edges and transitions.
 - .4 Glazing-to-wall transitions.
 - .5 Interior-to-exterior wall intersections.
 - .6 Assembly corners.
 - .7 Parapets.
 - .8 Roof penetrations and transitions.
 - .9 Exterior-to-interior structural components .
 - .2 Generally, select and install thermal break materials in accordance with "Building enclosure Thermal Bridging Guide, 2016 Ed." prepared by Morrison Hershfield to meet "EFFICIENT" Performance Categories in accordance with Chapter 4.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances, supports, and other conditions affecting performance of the Work.

3.2 PREPARATION

- .1 Protect construction from weather and other sources of moisture that are deleterious to the tested assemblies.
- .2 Repair or replace Building Enclosure components that are damaged as a consequence of exposure to weather conditions deleterious to the final construction.

3.3 WORKMANSHIP

- .1 Install materials and systems according to best-practices relating to quality of workmanship, and coordination and installation of specified Products to maintain continuity of the Building Enclosure.

- .1 Treatment of Penetrations: Use methods for making and sealing penetrations to maintain continuity of vapour, water and air control assemblies.
 - .1 Ensure mechanical and electrical work scheduled installed/modified within exterior Building Enclosure system is properly tied into Building Enclosure and does not compromise performance of Building Enclosure.
 - .2 Ensure mechanical and electrical penetrations through Building Enclosure are sealed against air leakage and water penetration and are designed to prevent condensation within exterior Building Enclosure system.
 - .3 Ensure mechanical water piping that is installed/modified within exterior wall system is free of leaks and protected from freezing.
- .2 Modification of Installation: Identify installation difficulties and make modification to installation to account for site conditions that differ from manufacturer's standard detailing or testing results. Make such modifications to reduce or eliminate potential for installation deficiencies.
- .3 Sequencing and Compatibility: Confirm compatibility between Products provided by different parties or that are used to join dissimilar components. Sequence such transitions and overlap materials to ensure they shed water to the exterior face of the Building Enclosure.
- .4 Workmanship: Train installers on Building Enclosure best-practices and provide them with update when modifications occur resulting from changes to site conditions and testing results.

3.4 FIELD QUALITY CONTROL (PERFORMANCE TESTING)

- .1 The objective of performance testing is to demonstrate that each Building Enclosure system, and system-to-system interface meets or exceeds the performance requirements of the Contract Documents and the Building Enclosure Design Intent specified in this Section.
 - .1 Unless otherwise indicated, costs associated with initial performance testing shall be paid by Owner through cash allowance.
 - .2 Costs associated with re-testing caused by failure of the Building Enclosure tests, during mock-up review or during the construction phase, shall be the responsibility of the Contractor.
- .2 Contractor's Collaboration: third-party inspection and testing company will coordinate with Contractor's schedule and make themselves aware of current work. Third-party inspection will bring to attention of the Consultant and Contractor any observation or testing requirement forming a part of their scope of auditing services, but not less than those listed in this Section.
 - .1 Access to Site: Contractor must provide reasonable access to the Project site, and any personnel to assist third-party inspection and testing company in performance of their service and maintain site safety.
 - .2 Services: Contractor must provide electrical, water or other utilities or services required by third-party inspection and testing company for performance of their work.
 - .3 Scheduling and Coordination:
 - .1 Contractor must coordinate sequence of testing activities to accommodate required inspection and testing services with minimum delay.
 - .2 Contractor must coordinate construction activities to avoid removing and replacing construction to accommodate observations and tests required by third-party inspection and testing company.

3.5 NON-CONFORMANCE

- .1 Non-conformance and deficiencies identified during periodic site visits or performance testing shall be resolved as follows:
 - .1 Third-party inspection and testing company will record the results of the performance test or its site visit observation in a report. All deficiencies or non-conformance issues shall be noted as action items on a punch-list and reported to Contractor through Consultant.
 - .2 Corrections of identified minor deficiencies may be made during the site visit at the discretion of third-party inspection and testing company. In such cases the deficiency and associated resolution will be documented in the field report.
 - .3 As site visits or tests progress and a deficiency is identified, the third-party inspection and testing company will discuss the issue with Contractor and Consultant for follow-up and resolution.
 - .1 Third-party inspection and testing company shall document deficiency and Contractor's response.
 - .2 Contractor shall correct the deficiency and notify third-party inspection and testing company and Consultant in writing that issue is resolved and/or product, material or assembly is ready to be retested.
 - .3 Contractor shall reschedule the test and the test shall be repeated. This process shall be repeated until test results meet or exceed requirements of Contract Documents.
 - .4 Contractor shall be responsible for costs associated with re-testing.

3.6 AIR INFILTRATION TESTING

- .1 Glazed Assemblies (curtain wall and punched windows):
 - .1 Test Method(s): pressurized chamber testing in accordance with ASTM E783.
 - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
 - .3 Frequency: As determined by third-party inspection and testing company.
 - .4 Success Criteria: As specified in this Section.
- .2 Opaque Wall Assemblies (including transitions to adjacent systems, field of air barrier and penetrations):
 - .1 Test Method(s):
 - .1 pressurized chamber testing in accordance with ASTM E783.
 - .2 smoke tracer testing in accordance with ASTM E1186.
 - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
 - .3 Frequency: As determined by third-party inspection and testing company.
 - .4 Success Criteria: As specified in this Section.
- .3 Whole Building Air Leakage Testing:
 - .1 Test Method(s):
 - .1 Fan pressurization testing in accordance with ASTM E779 or orifice blower door testing in accordance with ASTM E1827 or EN 13829 Method A (should Owner elect to pursue Passive House certification).

- .2 Smoke Tracer: third-party inspection and testing company may include observations using smoke tracer or theatrical fog in accordance with ASTM E1186 in conjunction with building pressurization to confirm anomalies identified using infrared scanning or to differentiate thermal bridging effects.
- .2 Frequency:
 - .1 At completion of air barrier work, and prior to installation of insulation ('enclosure-only testing').
 - .2 At completion of mechanical systems work, upon systems start-up ('sealed openings testing').
- .3 Success Criteria: As specified in this Section.

3.7 WATER PENETRATION TESTING

- .1 Glazed Assemblies (curtain wall and punched windows):
 - .1 Test Method(s): pressurized chamber testing in accordance with ASTM E1105
 - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
 - .3 Frequency: As determined by third-party inspection and testing company.
 - .4 Success Criteria: No leakage at 720 Pa (15 psf) pressure differential.
- .2 Roof Assemblies:
 - .1 Test Method(s):
 - .1 Water-spray test in accordance with AAMA 501.2 at transitions, corners, penetrations determined by Consultant.
 - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
 - .3 Frequency: As determined by third-party inspection and testing company.
 - .4 Success Criteria: No leakage.
- .3 Opaque Wall Assemblies including auxiliary components such as louvers, expansion joints and similar components:
 - .1 Test Method(s): Water-spray test in accordance with AAMA 501.2 at transitions, corners, penetrations determined by Consultant.
 - .2 Scope of Testing: Mock-up (first installation) and during construction phase.
 - .3 Frequency: As determined by third-party inspection and testing company.
 - .4 Success Criteria: No leakage.

3.8 THERMAL PERFORMANCE VERIFICATION

- .1 Wall Assemblies including openings and auxiliary components such as louvers, expansion joints and similar components:
 - .1 Test Method(s): Thermographic scan in accordance with ASTM C1060 or CAN/CGSB 149-GP-2MP.
 - .2 Frequency: As determined by third-party inspection and testing company.
 - .3 Success Criteria: Insulation is at full thickness and continuous in all cavities. No unacceptable thermal bridging.

- .2 Roof Assemblies:
 - .1 Test Method(s): Thermographic scan in accordance with ASTM C1153.
 - .2 Frequency: As determined by third-party inspection and testing company.
 - .3 Success Criteria: Insulation is at full thickness and continuous. No thermal anomalies associated with wet insulation.

3.9 ADHESION TESTING

- .1 Air Barrier Membrane Testing:
 - .1 Test Method(s): Pull-off testing in accordance with ASTM D4541
 - .2 Frequency: As determined by third-party inspection and testing company.
 - .3 Success Criteria: Pull-off strength of membrane conforms to manufacturer's published data.
- .2 Sealants Adhesion Tests:
 - .1 Test Method(s):
 - .1 Destructive: in accordance with Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C1193 or Method A, Tail Procedure, in ASTM C1521.
 - .2 Non-destructive: in accordance with ASTM C1521, using Nondestructive Spot Method.
 - .3 For joints with dissimilar substrates, verify adhesion to each substrate separately.
 - .2 Frequency: As determined by third-party inspection and testing company.
 - .3 Success Criteria: Sealant adhesion passes sealant manufacturer's field-adhesion hand-pull test published data.

3.10 REPAIR AND PROTECTION

- .1 Repair damaged construction and restore substrates and finishes following observation, testing, sample taking and similar services. Repair surfaces immediately after testing and sampling is completed to prevent damage to assemblies resulting from moisture diffusion or air leakage.
- .2 Protection of Installed Products: take necessary precautions to prevent puncturing, tearing, weakening or damaging of Building Enclosure membranes during construction; and immediately repair damage as directed by Consultant.

END OF SECTION

PART 1 -- GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and the Supplementary Conditions of the Contract.
 - .2 Division 01 requirements and documents referred to therein.

1.3 SUMMARY

- .1 Work Included: Provide labour, materials, products, equipment and services to complete the preformed metal cladding system work specified herein. This includes, but is not necessarily limited, to:
 - .1 preformed metal panels for rooftop screens and enclosures
 - .2 miscellaneous framing components,
 - .3 related trims and extrusions, including but not limited to flashings, splicers, end caps, trims and closures,
 - .4 transitions and connections between air barrier/vapour retarder membranes.
- .2 Related Requirements: Specifications throughout the entirety of Divisions of this Project are directly applicable to this Section, and this Section is directly applicable to them.

1.4 REFERENCES

- .1 Reference Standards: Unless otherwise stipulated by a specific publication date in this Section or the Ontario Building Code, the latest published editions of reference standards in force as of the Bid Closing Deadline for the Project, including adopted amendments, are applicable.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Prior to starting work of this Section, convene a pre-installation meeting at Project site to review Project requirements and site conditions with pertinent parties. Conform to requirements of Section 01 30 00.
 - .2 Review methods and procedures related to preformed metal panel installation, including manufacturer's written instructions.
 - .3 Examine support conditions for compliance with requirements of Contract Documents, including alignment between and attachment to structural members.
 - .4 Review flashings, special siding details, wall penetrations, openings, and condition of other construction that affect preformed metal panels.
 - .5 Review governing regulations and requirements for insurance, certificates, and tests and inspections if applicable.
 - .6 Review temporary protection requirements for preformed metal panel assembly during and after installation.

- .7 Review procedures for repair of panels damaged after installation.
- .8 Document proceedings, including corrective measures and actions required, and Supply copy of record to each participant.
- .2 Coordination:
 - .1 Coordinate metal panel assemblies with air barrier/vapour retarder, rain drainage work, flashing, trim, and construction of girts, soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
 - .2 Coordinate with related trades to maintain continuity of building air barrier/vapour retarder system at locations including but not limited to roofing, cladding and building openings.

1.6 SUBMITTALS

- .1 Product Data: Submit manufacturer's literature and data sheets for each type of material provided under this Section for Project in accordance with requirements of Section 01 30 00.
 - .1 Ensure data sheets provide required information including detailed instructions for installing as well as maintaining, preserving, and keeping materials in clean and safe conditions. Provide adequate warning of maintenance practices or cleaning agents detrimental to specified materials.
- .2 Safety Data Sheets (SDS): Submit SDS for inclusion in Operation and Maintenance Manual specified in Section 01 70 00, for adhesives, sealants and any other material designated by Consultant.
- .3 Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00.
 - .1 Ensure Shop Drawings show fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, supports and anchorages, attachment system, insulation type and thickness, trim, flashings, air seals, closures, and accessories; and special details including paths of pressure equalization and cavity drainage.
 - .2 Distinguish between factory, shop, and field-assembled work.
 - .3 Show provisions for structural and thermal movement between metal cladding and adjacent materials.
- .4 Samples: Submit samples in accordance with Section 01 30 00. Submit following samples:
 - .1 Manufacturer's colour charts or chips illustrating full range of colours, finishes and textures.
 - .2 300 mm x 300 mm (12 inch x 12 inch) aluminum composite panel in thickness specified, including clips, anchors, supports, fasteners, closures and other panel accessories necessary for assembly.
 - .3 300 mm (12 inch) each of extruded and formed trims.
- .5 Engineering Data:
 - .1 Submit engineering data substantiating that specified structural requirements of the metal cladding assembly meet minimum requirements of CSA S136.
 - .2 Submit design calculations signed and sealed by professional engineer registered in the province of Ontario, attesting to ability of preformed metal cladding system to withstand specified design loads including inward and outward pressures under fastenings to structure.
- .6 Sample Warranties: Submit samples of extend warranties specified in this Section.

- .7 Certificates:
 - .1 ~~Submit written certification from manufacturer that the Products, systems, and assemblies have been installed in accordance with manufacturer's requirements.~~
- .8 Maintenance Data:
 - .1 ~~Provide maintenance data for cleaning and maintenance of aluminum finishes for incorporation into manual specified in Section.~~
 - .2 ~~Submit instructions for touch-up, repair and removal of panels.~~
- .9 Extra Materials: ~~Submit sealed can of touch-up paint (minimum 1 l), properly identified for each panel colour provided.~~

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 ~~Manufacturers: Provide Products for Work of this Section by manufacturer with minimum 10 years' experience in the manufacture of such materials.~~
 - .2 ~~Installers: Provide work of this Section executed by competent installers with minimum 5 years' experience in the application of Products, systems and assemblies specified and with approval and training of the Product manufacturers.~~
- .2 Single Source Responsibility: ~~Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.~~
- .3 Welding: ~~Companies engaged in welding must be certified by Canadian Welding Bureau to CSA W47.1. Companies are to have welding procedures approved and welders qualified for base material types and thicknesses that are to be welded.~~
- .4 Mock-ups: ~~Provide Mock-ups in locations designated by Consultant and as required to demonstrate quality of workmanship. Maintain Mock-ups during construction in an undisturbed condition as a standard for judging the completed work.~~
 - .1 ~~Provide Mock-ups in locations designated by Consultant and as required to demonstrate quality of workmanship and displaying typical connections of the Project. Modify site mock-up detailing if necessary in accordance with Consultant's review.~~
 - .2 ~~Maintain Mock-ups during construction in an undisturbed condition as a standard for judging the completed work.~~
 - .3 ~~Reviewed Mock-ups may form part of finished Work if left undisturbed at time of Substantial Performance of the Work~~
- .5 Licensed Professionals: ~~Employ a professional structural engineer registered in the province of Ontario, carrying minimum of \$2,000,000.00 professional liability insurance to:~~
 - .1 ~~design the components of the work of this Section requiring structural performance and their attachments to building's structure,~~
 - .2 ~~be responsible for full assemblies and connections,~~
 - .3 ~~be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations,~~
 - .4 ~~be responsible for production and review of Shop Drawings,~~
 - .5 ~~inspect the work of this Section during fabrication and erection,~~

- .6 stamp and sign each shop drawing;
- .7 Provide site administration and inspection of this part of the Work.
- .8 ~~[Submit certificate validating seismic assessment and field review of this part of the Work].~~

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Comply with manufacturer's ordering instructions and lead time requirements to avoid construction delays.
- .2 Protect finish and edges using a plastic film adhered to panel in accordance with panel manufacturer's recommendations. Retain strippable protective covering on preformed metal panels during installation.
- .3 Deliver components, preformed metal panels, and other manufactured items so as not to be damaged or deformed. Package preformed metal panels for protection during transportation and handling.
- .4 Unload, store, and erect preformed metal panels in a manner to prevent bending, warping, twisting, and surface damage.
- .5 Stack preformed metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store preformed metal panels to ensure dryness, with positive slope for drainage of water. Do not store preformed metal panels in contact with other materials that might cause staining, denting, or other surface damage.

1.9 FIELD CONDITIONS

- .1 Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of preformed metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.10 WARRANTY

- .1 Warrant work of this Section against defects and/or deficiencies in accordance with General Conditions of the Contract. Promptly correct any defects or deficiencies which become apparent within warranty period, to satisfaction of Consultant and at no expense to Owner.
 - .1 Materials and Installation: for period of 5 years from date of Substantial Performance of the Work. Defects include but are not limited to; buckling, opening of seams, and structural failure.
 - .2 Panel Finish: for period of 30 years from date of Substantial Performance of the Work. Defects include but are not limited to: discoloration, finish peeling, bond failure and extensive colour fading.

PART 2 -- PRODUCTS

2.1 MANUFACTURERS

- .1 Products of following manufacturers may be acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
 - .1 Agway Metals Inc.;
 - .2 Morin; a Kingspan Group company;

- .3 Vicwest;
- .4 West-Form Metals;
- .2 Substitution Limitations: This Specification is based on Vicwest's Products.
- .3 Comparable Products from manufacturers listed herein offering functionally and aesthetically equivalent products in Consultant's opinion, and subject to Consultant's review, will be considered provided they meet the requirements of this Specification.

2.2 REGULATORY REQUIREMENTS

- .1 System Fire Propagation Characteristics: Provide preformed metal panel system tested in accordance with CAN/ULC-S134 by an independent testing organization and approved for use in non-combustible construction.
- .2 Panel Fire Performance: Flame spread less than 25 and smoke developed less than 450, in accordance with CAN/ULC-S102/S102.2 (subject to approval by Authorities Having Jurisdiction).

2.3 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 Architectural Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.
- .2 Provide sheet steel cladding wall panels conforming to requirements of CSSBI 20M.
- .3 Design, fabricate and install cladding system to prevent excessive condensation interior of wall when mechanical systems are functioning under designed operating conditions.
- .4 Ensure systems provided include attachment, insulation, air barrier/vapour retarder systems, necessary framing and suspension systems to support and anchor panel systems from concrete and/or metal structural framework.
- .5 Rain Screen Principle:
 - .1 Design exterior envelope cladding systems based on Rain Screen Principle advocated by NRCC and Provide for drainage of water entering building envelope wall systems.
 - .2 Design for compartments at corners to achieve appropriate pressure equalization in exterior cladding system.
 - .3 Provide gaskets, baffles, overlaps, seals and compartmentalization where required to achieve appropriate pressure equalization in exterior envelope cavity wall design. Maintain integrity of continuous air barrier/vapour retarder system with adjacent surrounding air barrier/vapour retarder.
 - .4 Incorporate means of draining moisture to exterior. Design drainage system to provide clear, internal paths of drainage of any trapped moisture within construction to exterior. Ensure weep water discharges in a manner that avoids staining of architectural finishes, collecting in puddles or formation of icicles.
- .6 Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads in accordance with requirements of Ontario Building Code, and CAN/CSA-S136:
 - .1 Determine specified loads, principal and companion load factors, building importance category, and load distributions in accordance with requirements of Ontario Building Code.
 - .1 Wind Loads: Determined in accordance with OBC requirements for geographical location of project, with 1 in 50 year return probability, but not less than 0.9 kPa (20 psf) positive, and 0.5 kPa (12 psf) negative.

- .2 ~~Design steel cladding components to be adequately interconnected and adequately fastened to structural supports to sustain loads.~~
- .3 ~~Design expansion joints to accommodate movement in cladding and between cladding and structure to prevent permanent distortion or damage to the cladding.~~
- .4 ~~Design wall system to maintain the following erection tolerances.~~
 - .1 ~~Maximum variation from plane or location shown on shop drawings: 20 mm in 10 m (3/4 inch in 30 feet).~~
 - .2 ~~Maximum offset from true alignment between two adjacent members abutting end to end in line: 1 mm (0.04 inches).~~
- .5 ~~Deflection of sheet steel cladding components due to uniformly distributed specified loads (eg. wind, snow) shall not exceed L/180.~~
- .6 ~~Wherever structural framing permits, and subject to reasonable limitations for handling, design and fabricate cladding to span continuously over at least four structural supports (three spans).~~
- .7 ~~Design cladding to accommodate thermal movement caused by ambient temperature range in accordance with OBC requirements and to suit Project location, without causing noise, buckling, failure of joint sealants, undue stress on metal members and fasteners, of operating units, reduction of performance, and other detrimental effects.~~
 - .1 ~~Thermal Movements: Provide assemblies that allow for thermal movements resulting from following maximum changes (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components and other detrimental effects:~~
 - .1 ~~Temperature Change (range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.~~
- .8 ~~Seismic Performance: Design work of this Section to withstand seismic motions determined in accordance with requirements of OBC and CAN/CSA S832.~~

2.4 MATERIALS

- .1 ~~Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet; minimum Grade 230 complying with ASTM A653/A 653M, Z275 (G90) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A792/A 792M, Class AZM150 (Class AZ50) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A755/A 755M.~~

2.5 PREFORMED METAL WALL PANELS - CONCEALED FASTENERS (MP-#)

- .1 ~~Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.~~
- .2 ~~Provide flush-profile, concealed-fastener metal wall panels with following characteristics:~~
 - .1 ~~Location: Rooftop Mechanical Screens and Equipment Enclosures~~
 - .2 ~~Panel Coverage: 300 mm (11-13/16 inches)~~
 - .3 ~~Panel Height: 40 mm (19/16 inch)~~
 - .4 ~~Nominal Thickness: As determined by Project-specified loadings, not less than 0.86 mm (22 ga - 0.034 inch)~~

- .5 Steel Structure Supports: Refer to Structural.
- .6 Acceptable Products:
 - .1 "AD300R — Perforated" by Vicwest; or approved equivalent.
 - .2 "HF-12 (Ribbed)" by Agway Metals.
 - .3 Approved Equivalent.
- .3 Exterior Finish: Siliconized Polyester system consisting of epoxy primer and silicone-modified, polyester-enamel topcoat; with a dry film thickness of not less than 0.005 mm (0.2 mil) for primer and 0.02 mm (0.8 mil) for topcoat.
 - .1 Basis-of-Design: "WeatherXL" by Vicwest or approved equivalent.
 - .2 Colour: Minimum of two colours to be selected by Consultant from manufacturer's full range.

2.6 AUXILIARY MATERIALS

- .1 Miscellaneous Metal Subframing and Furring: Sub-Girts, Z-bars etc., ASTM C645, Manufacturer's standard C- or Z-shaped sections, conforming to ASTM A653M, Grade A Zinc coating to Z275 (G90) designation. Transfer grid may be hat bars, Z-bars, adjustable Z-bars or combination of clip and Z-bar.
 - .1 Minimum thickness: 1.219 mm (18 ga.).
 - .2 Material visible after assembly of panel shall be finished to match panels.
- .2 Miscellaneous Steel Shapes including Plate and Hollow Sections: CSA G40.21, Grade 300W, or ASTM A36M complete with shop applied primer of either CPMA/CISC 1-73 or CGSB 1-GP-140M.
- .3 Extrusions and extrusion clips for attaching panels to substructure: purpose made aluminum. Install a separator between extrusions and sub-girts.
- .4 Thermally-Broken Sub-framing: Low conductivity thermally-broken, intermittent structural attachment insulation clips designed maintain insulation effectiveness, with adjustable depth and suitable for vertical and horizontal sub-girts.
 - .1 Acceptable Products:
 - .1 "ISO Clip" by Northern Facades Ltd.—
 - .2 "Cascadia Clip" by Cascadia Windows
 - .3 "TClip Thermally Broken Façade Substructure" by Engineered Assemblies
 - .4 "NVELOPE NV1 Cladding Attachment System" by SFS Group.
 - .5 Approved equivalent.
- .5 Panel Accessories:
 - .1 Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of preformed metal panels unless otherwise indicated.
 - .2 Provide flashing and trim formed from same material as preformed metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent preformed metal panels.

- .3 Match material, gauge thickness and finish of metal panels, unless otherwise indicated.
- .6 Field Touch-Up Paint: of same colour as exterior panel and as recommended by manufacturer.
- .7 Isolation Coating: Bituminous paint, alkali-resistant bituminous paint or epoxy resin solution to Provide dielectric separation which will dry to be tack-free and withstand high temperatures. Cold-applied asphalt mastic complying with SSPC-Paint 12, except containing no asbestos fibers.
- .8 Sealants: ASTM C920, conforming to Section 07 92 00 as recommend by manufacturer.
- .9 Fasteners: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten miscellaneous metal framing members to substrates.
 - .1 Exposed fasteners: Series 300 stainless steel and nylon colour coated head to match substrate colour.
 - .2 Concealed fasteners: stainless steel Type 304 screws in accordance with manufacturer's recommendations.
- .10 Miscellaneous Splicers, End Caps, Trims and Closures:
 - .1 Provide components required for a complete metal panel assembly including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items.
 - .2 Provide flashing and trim as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers.
 - .3 Match material, gauge thickness and finish of metal wall panels, unless otherwise indicated.
 - .4 Ensure items are galvanized in accordance with ASTM A653/A653M with minimum Z275 (G90) coating.

2.7 FABRICATION

- .1 Prior to commencement of fabrication, obtain Consultant's final approval of colours. Fabricate to manufacturer's standard assembly line production methods, incorporating unique conditions of this Project.
- .2 Fabricate metal panels for designated façade and trim sections to profiles and patterns indicated. Manufacture panels from sufficiently thick material in combination with backing and/or reinforcing to produce metal cladding required to suit design requirements indicated on Drawings. Fabricate all components of system in factory and ready for field installation.
- .3 Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- .4 Carry out complete fabrication including welding, grinding, punching and like to finish Work. Make welds clean, sound and solid, free from defects. Grind smooth, free from marks.
- .5 Finished cladding shall be free from visible defects and accurately manufactured to dimensions of reviewed Shop Drawings.
- .6 Fabricate metal panels in a manner that eliminates condensation on interior side of panel and with joints between panels designed to form weathertight seals.
- .7 Make connections rigid and fail-safe wherever practicable, and make completely concealed.
- .8 Fabricate all flashing pieces associated with and in contact with wall panel system. Use same sheet stock as exposed face sheets, pre-finished to match.

- .9 ~~Include cold rolled framing, furring, brackets, clips, hangers and incidental components as required for secure fastening and Provide weathertight installation including non-corrosive fasteners.~~
- .10 ~~Consider condensation and allow for inner wall drainage at sill members and other shapes which would otherwise tend to trap water.~~

2.8 FINISHES

- .1 ~~Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.~~
- .2 ~~Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.~~
- .3 ~~Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.013 mm (0.5 mil).~~

PART 3 – EXECUTION

3.1 EXAMINATION

- .1 ~~Site Verification of Conditions:~~
 - .1 ~~Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.~~
 - .2 ~~Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by preformed metal wall panel manufacturer.~~
 - .3 ~~Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by preformed metal wall panel manufacturer.~~
 - .4 ~~Notify Consultant in writing of any conditions which would be detrimental to the installation.~~
 - .5 ~~Coordinate and verify job site dimensions affecting this Work. Submit in writing dimensions or conditions which vary from those on reviewed Shop Drawings or detrimental to installation. Obtain corrective measures from Consultant prior to installation.~~
 - .6 ~~Verify that air barriers/vapour retarders have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.~~
 - .7 ~~Examine roughing-in for components and assemblies penetrating preformed metal panels to verify actual locations of penetrations relative to seam locations of preformed metal panels before installation.~~
 - .8 ~~Commencement of Work implies acceptance of previously completed Work.~~

3.2 PREPARATION

- .1 ~~Framing: Install subgirts, base angles, sills, furring, and other miscellaneous panel support members and anchorages according to reviewed Shop Drawings, erection drawings, and manufacturer's installation instructions.~~

- .1 ~~Secure sub-girt units to structural supports with stainless steel or galvanized self-tapping screws. Install Work rigidly and securely.~~
- .2 ~~Fasten thermally broken structural clips through air barrier/vapour retarder to supporting structure in accordance with manufacturer's installation details and instructions.~~
- .3 ~~Weld all connections, unless otherwise permitted. For hot dipped galvanized items and where not possible, bolt or secure connections in a manner acceptable to Consultant.~~
- .4 ~~Erect Work true to dimensions, square, plumb, level and free from distortion or defects detrimental to appearance and performance.~~
- .2 Insulation
 - .1 ~~Install insulation to maintain continuity of thermal protection to building elements and spaces. Extend insulation in thickness indicated to cover entire wall. Comply with installation requirements in Section 07 21 00.~~
 - .2 ~~Install insulation with adhesive and/or stick clips as specified in Section 07 21 00 to prevent movement of insulation in finished wall.~~
 - .3 ~~Butt each insulation board against adjacent boards with joints staggered. Fit neatly with tight joints around obstructions, openings and corners. Fill voids behind flashings and trim with loose mineral wool insulation.~~

3.3 INSTALLATION

- .1 ~~Install preformed metal panels, fasteners, trims and related items according to manufacturer's written instructions and reviewed Shop Drawings in orientation, sizes, and locations indicated on Drawings.~~
- .2 ~~Install panels perpendicular to girts and subgirts unless otherwise indicated. Bring each unit to bear evenly on framing. Ensure complete nesting of flange frames.~~
- .3 ~~Anchor metal wall panels and other components of the Work securely in place, with provisions for thermal and structural movement.~~
- .4 ~~Shim or otherwise plumb substrates receiving metal wall panels.~~
- .5 ~~Prepare openings for louvers, doors, windows where applicable as detailed. Install necessary formed closures and trim as applicable at openings and penetrations. Make cut-outs neatly by saw cutting.~~
- .6 ~~Flash and seal metal wall panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air barrier/vapour retarder and flashings that will be concealed by metal wall panels are installed. Install flashing and trim as metal wall panel work proceeds.~~
- .7 ~~Install screw fasteners in predrilled holes.~~
- .8 ~~Locate and space fastenings in uniform vertical and horizontal alignment in accordance with manufacturer's instructions.~~
- .9 ~~Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.~~
- .10 ~~Apply elastomeric sealant continuously between metal base channel (sill angle) and concrete and elsewhere as indicated or, if not indicated, as necessary for waterproofing.~~
- .11 ~~Align bottom of metal wall panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.~~
- .12 ~~Provide weathertight escutcheons for pipe and conduit penetrating exterior.~~

- .13 ~~Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.~~
- .14 ~~Joint sealing: Install gaskets, joint fillers, and sealants where indicated and where required for weathertight performance of metal wall panel assemblies. Provide types of gaskets, fillers, and sealants indicated or, if not indicated, types recommended by metal wall panel manufacturer.~~

3.4 FIELD QUALITY CONTROL

- .1 ~~Manufacturer's Field Service: Engage a factory-authorized service representative to provide training and supervision of Contractor's personnel in installation of panel system at commencement of installation. Factory-authorized service representative must also:~~
 - .1 ~~meet and discuss installation procedures and unique conditions at the Place of the Work.~~
 - .2 ~~inspect substrate surfaces and recommend solutions to accommodate adverse conditions.~~
 - .3 ~~periodically visit and inspect the installation and report unsatisfactory conditions to Consultant.~~
 - .4 ~~attend final inspection and submit written certification that Products, systems and assemblies have been installed in accordance with manufacturer's requirements.~~

3.5 CLEANING AND PROTECTION

- .1 ~~Remove temporary protective coverings and strippable films, if any, as preformed metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions.~~
- .2 ~~On completion of preformed metal panel installation, clean finished surfaces as recommended by preformed metal panel manufacturer. Maintain a clean condition during construction.~~
- .3 ~~After preformed metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.~~
- .4 ~~Replace preformed metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.~~

END OF SECTION

GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and the Supplementary Conditions of the Contract;
 - .2 Division 1 requirements and documents referred to therein.

1.3 SUMMARY

- .1 Work Included: Pre-finished, thermally broken, aluminum glazed curtain wall and cladding systems complete with vision units and entrances ~~and spandrel panels~~ including but not limited to the following:
 - .1 4-sided structural sealant glazed curtain wall systems ~~with aluminum perimeter caps.~~ and entrances.
 - .2 materials related to work of this Section which are to be installed by those performing the work of other Sections including but not limited to:
 - .1 inserts, anchors and support items required for connection or support of assemblies specified in this Section
 - .2 entrance doors and framing, including hardware, stripping and thresholds
 - .3 automatic door operator components installed in door and frame openings
 - .4 sealing joints within work of this Section and at abutting joints of this work and work of adjacent trades.
- .2 Related Requirements: Specifications throughout the entirety of the Divisions of this Project are directly applicable to this Section, and this Section is directly applicable to them

1.4 REFERENCES

- .1 Reference Standards: Latest published editions of reference standards listed in this Section in effect as of the closing date and time of the Request for Tenders for the Contract, including any amendments adopted, are applicable unless otherwise indicated.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Sequencing: Coordinate installation required herein with the installation and work required to be performed under related Sections that are referenced herein.
 - .1 Pre-construction Site Meeting:
 - .1 Prior to the start of the work, arrange for a Project site meeting of the parties associated with work of this Section, including without limitation, the Subcontractor(s) performing the work of this Section, testing company's representative and other contractors and consultants of disciplines applicable to this Section. The Consultant may attend.

- .2 Review the Contract Documents to ensure the work specified in this Section can proceed, and ensure complete understanding of requirements and responsibilities relative to:
 - .1 work included,
 - .2 materials to be used,
 - .3 storage and handling of materials,
 - .4 installation of materials,
 - .5 sequence and quality control,
 - .6 Project staffing, and
 - .7 restrictions on areas of work and other matters affecting construction.
- .2 Coordination:
 - .1 Notify relevant and concerned trades of items required to be incorporated into the work of other Sections. Certain components specified under this Section include items which are closely integrated with air barrier/vapour retarder transitions, entrances, glazing components, flashing pieces, and architectural metalwork specified under separate Sections, and consequently require close coordination with such allied trades. Perform total coordination required to ensure correct installation procedures and results.
 - .2 Coordinate and cooperate with trades providing metal panel systems by installing closures and trims supplied by such trades to be installed directly into the curtain wall system.
- .3 Scheduling:
 - .1 Prior to commencing work of this Section, arrange for the manufacturer's technical representative to review, with the Contractor and Consultant, procedures to be adopted and conditions under which the work shall be performed. Inspect surfaces to determine adequacy of existing and proposed conditions.
 - .2 Cooperate fully with other Subcontractors performing the Work and promptly proceed with the work of this Section as rapidly as job conditions permit.
 - .3 Cooperate with those performing work of other Sections for application of all miscellaneous specialties.
 - .4 Supply items to be built-in in ample time to be incorporated into the work of Subcontractors performing work of other Sections, together with measurements and other information required for the location of such items.

1.6 SUBMITTALS

- .1 Product Data: Submit manufacturer's literature and data sheets for each type of material provided under this Section for the Project in accordance with requirements of Section 01 30 00. Ensure data sheets provide required information including detailed instructions for installing as well as maintaining, preserving and keeping materials in clean and safe conditions. Provide adequate warning of maintenance practices or cleaning agents detrimental to specified materials.
- .2 Safety Data Sheets (SDS): Submit SDS for inclusion in Operation and Maintenance Manual specified in Section 01 70 00, for adhesives, sealants and any other material designated by Consultant.
- .3 Shop Drawings: Submit Shop Drawings for work of this Section in accordance with Section 01 30 00. In addition to the minimum requirements indicate the following:
 - .1 Indicate with plans, sections, elevations and sufficient full size details to indicate all components and methods of assembly, materials and their characteristics relative to their purpose and all other fabrication information.

- .2 Indicate details of field connections, anchorage, and the relationship of the work under this Section to the work required to be performed under other Sections so as to facilitate the coordination with such scopes of work.
- .3 Ensure Shop Drawings are stamped by Professional Engineer registered in Province of Ontario as specified herein.
- .4 Do not fabricate Work until Shop Drawings have been reviewed by the Consultant for fabrication.
- .5 Field Measurements: Verify dimensions of supporting structure by field measurements before fabrication so that the curtain wall work will be accurately designed, fabricated and fitted to the structure. Indicate measurements on Shop Drawings. Coordinate the fabrication schedule with construction progress to avoid delaying the Work.
- .4 Design Calculations:
 - .1 Submit for information only, and under seal, calculations prepared by a structural Professional Engineer registered in the Province of Ontario, providing design assumptions regarding loadings related to the OBC, standards referenced in this Section and requirements of Authorities Having Jurisdiction.
- .5 Test and Evaluation Reports:
 - .1 Prior to fabrication of curtain wall, submit recent certified test data performed by an independent laboratory approved by Standards Council of Canada or AAMA displaying results of testing program carried out on typical curtain wall systems proposed for this Project.
 - .2 Submit test reports for insulating glass units indicating compliance with requirements of CAN/CGSB-12.8.
- .6 Samples: Submit samples in accordance with Section 01 30 00.
 - .1 Submit two 75 mm x 140 mm (3" x 5-1/2") samples for each exposed metal finish required (extrusion and sheet).
 - .1 Ensure samples are of specified alloy, temper, and thickness of metal required for the Work. Where finishes involve colour and texture variations, include sample sets showing full range of variations expected.
 - .2 Mark direction of metal grain and rolling and paint application on back of control samples.
- .7 Closeout Submittals:
 - .1 Maintenance Instructions: Submit copies of the manufacturer's written instructions in accordance with Section 01 70 00 for adjustment, operation and maintenance of operating components forming part of curtain wall system.

1.7 QUALITY ASSURANCE

- .1 Qualifications:
 - .1 Manufacturer Qualifications: firm producing and executing work of this Section must have a minimum of ten (10) consecutive years experience in work of similar scope and nature to that specified herein.
 - .2 Insulating glass unit fabricators: membership and certification in the Insulating Glass Manufacturer's Alliance (IGMA). IGMA members must participate in the certification program and successfully pass a Compliance Audit within the last 6 months.

- .2 Licensed Professionals: Employ a full time structural Professional Engineer registered in the Province of Ontario, carrying a minimum \$2,000,000.00 professional liability insurance, to:
 - .1 design the components of the Work of this Section requiring structural performance,
 - .2 be responsible for full assemblies and connections
 - .3 be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with OBC and standards referenced in this Section,
 - .4 be responsible for the production and review of Shop Drawings,
 - .5 inspect the Work of this Section during fabrication and erection,
 - .6 stamp and sign each Shop Drawing,
 - .7 Provide site administration and inspection of this part of the Work.
 - .8 submit certificate validating seismic assessment and field review of this part of the Work
- .3 Field Mock-Ups:
 - .1 Provide Mock-ups, minimum 1 bay in width, and of sufficient height to include 2 vision panels and 1 spandrel panel, in locations designated by the Consultant and as required to demonstrate quality of workmanship.
 - .2 Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work. Adjust non-compliant mock-ups at no extra cost to Owner as required to obtain acceptance. Once accepted, mock-up becomes part of completed work, and becomes the standard for the remainder of the work under this Section.
- .4 Single Source Responsibility: Ensure primary materials provided in this Section are obtained from 1 source by a single manufacturer and secondary materials are obtained from sources recommended by primary materials manufacturers.

1.8 DELIVERY, STORAGE AND HANDLING

- .1 Delivery and Acceptance Requirements: Comply with the applicable provisions of AAMA "Curtain Wall Manual #10" for the care and handling of curtain wall work from shop to site.

1.9 WARRANTY

- .1 The Contractor warrants the following work of this Section against defects and/or deficiencies in accordance with General Conditions of Contract. Promptly correct any defects or deficiencies which become apparent within the warranty period, to the satisfaction of the Consultant and at no expense to the Owner.
 - .1 Curtain Wall System:
 - .1 Warranty Period: 10 years from the date of Substantial Performance of The Work.
 - .2 Aluminum Finishes:
 - .1 Warranty Period: 20 years from the date of Substantial Performance of The Work.
 - .3 Factory Sealed Insulating Units:
 - .1 Warranty Period: 10 years from the date of Substantial Performance of The Work.
 - .4 Sealants:
 - .1 Guarantee Period: 20 years from the date of Substantial Performance of The Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Curtain Wall: Products of following manufacturers may be acceptable subject to conformance to requirements of Drawings, schedules and Specifications:
 - .1 Alumicor Limited
 - .2 Kawneer Canada Limited
 - .3 Oldcastle Building Envelope
 - .4 Wicona,
 - .5 Windspec
- .2 Substitution Limitations:
 - .1 Design for work of this Section is based on "ThermaWall 2600" with "Thermaporte 7700 Entrance" by Alumicor Limited with glazing units as fabricated by Guardian Industries as specified herein. Equivalent Products from manufacturers listed herein offering functionally, aesthetically equivalent Products in the Consultant's opinion and subject to the Consultant's review will be considered provided they meet the requirements of this Specification.

2.2 DESCRIPTION

- .1 Regulatory Requirements
 - .1 Comply with the more stringent requirements of the OBC, applicable laws, bylaws, fire regulations, health and safety regulations, and requirements of Authorities Having Jurisdiction or requirements of this Specification. The standards specified herein to be used for the work of this Section are considered a minimum.
- .2 Design and Performance Requirements:
 - .1 Drawings and details are diagrammatic and are intended to show design concept, configuration, components and arrangements; they are not intended to identify nor solve completely problems of thermal and structural movements, air pressure equalization, air and vapour barriers, assembly framing, fixings and anchorages, moisture disposal, water penetration and problems at the glass line associated with glazing installation, movements, pressure fracture or thermal shock and weather seal.
 - .2 Glass thicknesses and heat treatments indicated are minimum requirements. Glazing details shown are for convenience of detailing only and are to be confirmed by relative to cited standards and final framing details. Confirm glass thicknesses and heat treatments, verified by analysis and engineering design, as required to meet performance and testing requirements specified in this Section. Increase glazing thicknesses as required to meet project-specific loadings.
 - .3 Utilize Limit States Design in sizing of glass and employ a safety factor for glass to statistical probability of failure of 8 glass lites per 1000. Comply with requirements of CAN/CGSB-12.20-M and ASTM E1300 for design of glass. Design units to accommodate live, dead, lateral, wind, handling, transportation and erection loads.
 - .4 Structural Performance: Ensure aluminum system has passed testing in accordance with ASTM E330. Design building envelope assemblies, members and their connections to withstand, within acceptable deflection limitations as specified, their own weight, loads imposed by the motion of operable elements, and the maximum design loads and combination of loads due to snow, rain, ice, seismic loads, the pressure and suction of wind and internal pressure.

- .1 Wind loads:
 - .1 Design glazed assembly to withstand, without detrimental effects to appearance and performance, wind loads and temperature ranges expected in the geographical location of this Project based on the OBC requirements, based on a minimum 50 year probability factor for the Project location.
- .2 Loads on guards: In locations where glazed curtain wall assemblies are acting as guards pursuant to the requirements of the OBC Article 3.3.1.17, assemblies must be designed in accordance with minimum interior load impact as required for guards (Loads on Guards, and Loads for Walls Acting as Guards) under the OBC and the requirements of the CSA A500. Provide internal mullion reinforcing if required.
- .3 Seismic Performance: Design the work of this Section to withstand seismic motions determined in accordance with the requirements of the OBC.
- .4 Deflection of framing members:
 - .1 Deflection Limits:
 - .1 Limit deflection of framing members normal to wall plane to $1/175$ of clear span or an amount that restricts edge deflection of individual glazing lites to 19 mm (3/4"), whichever is less.
 - .2 Limit deflection of framing members parallel to glazing plane to $L/360$ of clear span or 3 mm (1/8"), whichever is smaller.
 - .3 Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to 2 times length of cantilevered member, divided by 175.
 - .2 Do not include glass, sealants and interior finishes to contribute to framing member strength, stiffness or lateral stability.
 - .3 Do not permit permanent deformation (set) in metal framing work. Ensure permanent deformation, fastener, weld, or gasket failure, component breakage or disengagement does not occur under wind loading equal to 1.5 times design wind loads (positive or negative). Permanent deformation to be taken as deflection without recovery exceeding $1/1000$ times span.
- .5 Design light gauge aluminum structural members in accordance with CSA S157/S157.1
- .6 Design light gauge steel structural members in accordance with CAN/CSA S136-07 and CSA S136.1-07 under direct supervision of a Professional Engineer experienced in design of this work and licensed in Ontario.
- .7 Design anchors, fasteners, bracing and framing fastened directly to structure in accordance with requirements of CSA S16 using Limit States Design. Design structural details and connections not shown on Drawings in accordance with CAN/CSA S16 and CSA S 136.1.
- .8 Design expansion joints within assemblies to be permanently watertight and airtight under all conditions.
- .9 Provide curtain wall systems that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 - .1 Thermal Expansion Allowance: Ensure system is able to withstand temperature differential of 85 deg C for materials and surfaces without putting

stresses on members or sealants. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

.5 Thermal Design and Performance:

.1 Energy Performance: Structural-sealant-glazed curtain walls must have certified and labeled energy performance ratings according to NFRC.

- .1 Thermal Transmittance (U-Factor for entire assemblies): Fixed glazing and framing areas shall have U-factor of not more than 1.30 W/sq. m x K (0.23 Btu/sq. ft. x h x deg F) as determined according to NFRC 100.
- .2 Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a Solar Heat Gain Coefficient (SHGC) of no greater than 0.35 as determined according to NFRC 200.
- .3 Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 0.2 L/s per sq. m (0.04 cfm/sq. ft.) of fixed wall area as determined according to ASTM E283 at a minimum static-air-pressure differential of 300 Pa (6.24 lbf/sq. ft.).
- .4 Provide thermal breaks between exterior and interior components and sufficient metal on interior side of glass to provide total absence of condensation on interior metal surfaces under specified design conditions. Avoid thermal bridges while securing system with concealed fastening devices.

.2 Condensation Resistance: Design fixed glazing and framing areas to prevent accumulation of condensation on interior side of curtain wall framing with condensation resistance rating of no less than 66_{frame} and 60_{glass} in accordance with AAMA 1503 under winter design conditions indicated herein for location of Project.

.3 Maximum Water Leakage:

- .1 No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E331 at a minimum static-air-pressure differential of 20% of positive wind-load design pressure, but not less than 730 Pa (15.2 lbf/sq. ft.) and when tested in accordance with AAMA 501.1 for dynamic pressure.
- .2 No uncontrolled water penetrating curtain or water appearing on systems' normally exposed interior surfaces from sources other than condensation is permitted. Water leakage does not include water controlled by flashing and gutters that is drained to exterior and water that cannot damage adjacent materials or finishes.

.4 Rain Screen Design Requirements:

- .1 Design aluminium framing system based on NRC recommended "Rain Screen" principle with provisions for pressure equalization and draining. Maintain integrity of continuous air barrier/vapour retarder system with adjacent surrounding air barrier/vapour retarder.

.6 Acoustic Performance:

- .1 Ensure no vibration harmonics, wind whistles, noises caused by thermal movement, loosening, weakening or fracturing of attachments or components of system occur after system has been installed.

.7 Sealants Performance:

- .1 Provide all glazing sealants and seals from a single manufacturer.

- .2 Ensure sealants are non-bleeding, non-staining and capable of supporting their own weight and capable of supporting specified loads associated with glazing systems.
- .3 Ensure materials used for edge seals are compatible with other materials they come in contact within glazing system. If required, perform compatibility tests to ASTM C510, ASTM C794 and ASTM C1087, or others as applicable.
- .4 Use sealants and other materials in glazing system which are unaffected by long term UV light exposure.

2.3 MATERIALS

- .1 Aluminum extrusions, channels, bars, rods, and wire: ASTM B211 and ANSI H35.1/H35 AA6063 alloy, T6 temper.
- .2 Aluminum sheet and panels: ASTM B209-07 and ANSI H35.1/H35.1M-06 AA I 100 aluminum alloy, H 14 temper, minimum 3 mm for formed sheet cladding and soffit panels, 1.5 mm thick for formed window panning. Exposed sheet: machine flattened free of distortions.
- .3 Light Gauge Sheet Metal: Commercial quality galvanized sheet steel to ASTM A653M, Designation Z275 unless otherwise specified in Contract Documents.
- .4 Miscellaneous and Sub-Frame Steel: CSA G40.21, Grade 300W, hot dipped galvanized after fabrication to ASTM A123/A123M, with additional zinc chromate coating to CAN/CGSB-1.132-M after fabrication. Provide internal reinforcing steel channel minimum 6 mm (1/4") thick nested in curtain wall mullions where required to meet design requirements.
- .5 Gaskets and Sealants: Ensure compatibility with edge seal of glazing units and other adjacent materials.
- .6 Glass: Conforming to requirements of Section 08 80 00.
 - .1 Tempered Glass: conforming to ASTM C1048, Kind FT or Equivalent to CAN/CGSB-12.1 and meeting requirements of ANSI Z97.1. Ensure surface compression is equal to or greater than 69 MPa (10 000 psi).
 - .2 Unless indicated otherwise, Provide ~~heat strengthened glass. Provide~~ fully tempered glass, ~~where safety glazing is required for code compliance and where heat strengthened glass is verified as inadequate to resist local peak wind loads or interior guard loads.~~
 - .3 Edges of glass to be straight cut, free from nicks and other imperfections conducive to breakage, arrissed where visible, without metal edge banding.

2.4 COMPONENTS

- .1 Framing Members: Manufacturer's standard extruded-aluminum framing members of thickness required and reinforced as required to support imposed loads and to suit design requirements.
- .2 Factory-Sealed Insulated Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E2190, IGCC or equivalent to CAN/CGSB-12.8, and complying with other requirements specified in this Section.
 - .1 Sealing System: Dual seal, with polyisobutylene and silicone primary and secondary.
 - .2 Ensure low 'E' coating is edge-deleted over depth of primary and secondary edge seal at units where glass edges are visible.
 - .3 Edge spacer core to be straight and evenly set into glass units with maximum variation in line of spacer core of +/- 2 mm (0.08 inch) and ensure primary seal does not extend past inside edge of spacer core by more than 1.5 mm (1/16 inch).
 - .4 All units to have IGMA certification.

- .5 Spacer: Plastic-covered stainless steel in colour selected by Consultant.
- .6 Low Emissivity Glass Coating (Low 'E'): Provide triple silver sputtered vacuum deposited Low 'E' coating to surfaces of sealed insulating glass unit to meet criteria specified herein. Uniformly apply Low 'E' coating to glass.
 - .1 Ensure low 'E' coating is edge-deleted over depth of primary and secondary edge seal at units where glass edges are visible.
 - .2 Clear Units, and unless indicated otherwise:
 - .1 Basis-of-Design: "SunGuard® SN 68" or equivalent meeting aesthetic and performance criteria by one of the following:
 - .1 Vitro Architectural Glass (formerly PPG)
 - .2 AGC Glass Industries
 - .3 Cardinal Glass Industries
 - .4 Viracon
- .7 Safety / Security Window Film (FILM-S) - at all exterior glazing units up to 3 m above grade: Optically clear microlayered polyester film, with abrasion-resistant acrylic coating over one surface and a pressure sensitive adhesive on the other. Apply to surface no. 6 of triple glazed units and surface no. 4 of double glazed units.
 - .1 Colour: Clear.
 - .2 Thickness: Minimum 0.2 mm (8 mils)
 - .3 Impact Resistance:
 - .1 complying with testing requirements in ANSI Z97.1, Class A and 16 CFR 1201 for Category II.
 - .2 Complying with testing requirements in ASTM E1996 for "Large-Missile Test" when tested at +/- 3.6 kPa (75 psf) according to ASTM E1886; with film applied to 6.0 mm (1/4 inch) thick tempered glass.
 - .4 Accessories: Provide manufacturer's recommended weatherable, UV-resistant, structural sealant attachment system "3M Impact Protection Film Attachment System" by 3M Canada or Equivalent.
 - .5 Basis-of-Design: "3M Scotchshield Ultra S800 Safety and Security Window Film" by 3M Canada or equivalent.

2.5 ASSEMBLIES

- .1 Curtain Wall Systems:
 - .1 ~~SSG-system~~: Provide prefabricated ~~structural-sealant full capped~~ glazed aluminum framed curtain wall system complete vision units, spandrel panels, metal air barrier/vapour retarders, seals, perimeter trims, stools, accessories, shims, anchors and miscellaneous framing components meeting or exceeding performance requirements indicated herein.
 - .1 Glazing System: ~~Retained with structural sealant on two sides with perimeter caps. Refer to Drawings for locations. Retained on 4 sides.~~
 - .2 Mullion depth: as indicated on Drawings.
 - .3 Finish: Clear anodized
 - .4 Fabrication Method: Factory-fabricated system

- .5 Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
- .6 Steel Reinforcement: As required by manufacturer.
- .7 Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.
- .8 Basis-of-Design: "Thermawall 2600" by Alumicor or equivalent.
- .2 Glazing Units:
 - .4 ~~Vision Glass – Type VG1: Low-E-coated, clear triple insulating glass. [TBD]~~
 - .1 ~~Overall Unit Thickness: 44 mm (1-3/4 inch)~~
 - .2 ~~Outdoor Lite: 6 mm thick clear tempered glass.~~
 - .3 ~~Glazing cavity 1 – Content: 90% Argon; 10% Air~~
 - .4 ~~Glazing Cavity 1 – Thickness: 13 mm (1/2 inch)~~
 - .5 ~~Middle Lite: 6 mm thick clear heat-strengthened glass~~
 - .6 ~~Glazing cavity 2 – Content: 90% Argon; 10% Air~~
 - .7 ~~Glazing Cavity 2 – Thickness: 13 mm (1/2 inch)~~
 - .8 ~~Indoor Lite: 6 mm thick clear tempered glass.~~
 - .9 ~~Low-E Coating: triple-silver as specified in this Section, sputtered on surfaces no. 2 and no. 5.~~
 - .10 ~~Bird-friendly frit: Provide ceramic frit applied by acid etching on surface no. 1 of glazing.~~
 - .1 ~~Pattern: Provide 6 mm (1/4 inch) diameter dots at 100 mm (4 inches) on center spacing, applied to glass units, with 100% coverage of glass unit.~~
 - .2 ~~Basis-of-Design: Walker Glass or approved Equivalent.~~
 - .11 ~~Performance Requirements:~~
 - .1 ~~Winter U-Value: 0.13 — Maximum~~
 - .2 ~~SHGC: 0.33 Maximum~~
 - .3 ~~Visible Light Transmittance (VLT): Not less than 52%.~~
 - .2 Vision Glass - Type VG12: Low-E-coated, clear double insulating glass. [TBD]
 - .1 Overall Unit Thickness: 25 mm (1 inch)
 - .2 Outdoor Lite: 6 mm thick clear tempered glass.
 - .3 Glazing cavity: 90% Argon; 10% Air
 - .4 Indoor Lite: 6 mm thick clear tempered glass.
 - .5 Low-E Coating: triple-silver as specified in this Section, sputtered on surfaces no. 2
 - .6 Bird-friendly frit: Provide ceramic frit applied by acid etching on surface no. 1 of glazing.
 - .1 Pattern: Provide 6 mm (1/4 inch) diameter dots at 100 mm (4 inches) on center spacing, applied to glass units, with 100% coverage of glass unit.
 - .2 Basis-of-Design: Walker Glass or approved Equivalent.

- .7 Performance Requirements:
 - .1 Winter U-Value: 0.25 Maximum
 - .2 SHGC: 0.37 Maximum
 - .3 Visible Light Transmittance (VLT): Not less than 60%.
- .3 Operable Aluminum Swing Doors and Entrances
 - .1 Manufacturer's standard glazed entrance doors for manual-swing operation.
 - .2 Door Construction: 57.2-mm (2-1/4-inch) overall thickness, with minimum 3.2-mm- (0.125-inch-) thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
 - .3 Thermally-Broken Construction: High-performance plastic connectors separate aluminum members exposed to exterior from members exposed to interior.
 - .4 Door Design: As indicated on Drawings.
 - .5 Glazing for Doors:
 - .1 At exterior doors forming part of the building envelope, Provide glazing matching curtain wall in every respect (VG-2 1) as noted on Drawings.
 - .2 At interior vestibule doors, single fully tempered glazing (TGL) as specified in Section 08 80 00 is acceptable.
 - .6 Glazing Stops and Gaskets: Beveled or square, snap-on, extruded-aluminum stops and preformed gaskets.
 - .7 Provide nonremovable glazing stops on outside of door.
 - .8 Door Hardware: Provide entrance door hardware and entrance door hardware sets indicated in Door And Frame Schedule for each entrance door to comply with requirements in this Section.
 - .9 Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
 - .10 Opening-Force Requirements:
 - .1 Egress Doors: Not more than 67 N (15 lbf) to release the latch and not more than 133 N (30 lbf) to set the door in motion.
 - .2 Accessible Interior Doors: Not more than 22.2 N (5 lbf) to fully open door.
 - .11 Weather Stripping: Manufacturer's standard replaceable components.
 - .12 Compression Type: Made of ASTM D2000, molded neoprene, or ASTM D2287, molded PVC.
 - .13 Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
 - .14 Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.
 - .15 Basis-of-Design: "ThermaPorte 7700" by Alumicor or equivalent.

2.6 FABRICATION

- .1 Curtain Wall:

- .1 Fabricate glazed aluminum framing systems for curtain wall to designs, shapes, and sizes shown using materials specified and shown to produce assemblies which meet or exceed performance requirements. To greatest extent possible complete fabrication, assembly, finishing, hardware applications and other work before shipment to Project site.
- .2 Ensure exposed work is carefully fitted and matched to produce continuity of line and design, with joints, being accurately fitted for hairline contact and rigidly secured. Where additional rigidity or strength is required to satisfy performance requirements reinforce aluminum framing system components with aluminum or carbon steel shapes, bars, and plates.
- .3 Provide vents, weepholes and internal water passages in glazing framing recesses as recommended by respective glass and framing manufacturers to conduct infiltrating water to exterior, and to avoid condensation at unit air spaces. Provide weep baffles secured to inside of frame behind vents and weepholes. Make provisions for reglazing from interior for vision glass.
- .4 Brace frames to maintain squareness and rigidity during shipment and installation. Galvanize steel clips and reinforcement with 380 g/m² zinc coating to ASTM A123/A123M
- .5 Ensure aluminum framing system frames are installed with factory or site installed air and vapour barrier for sealing to building air and vapour barrier. Ensure compatibility with air and vapour barrier materials of building envelope assembly. Ensure materials provide required air tightness and vapour diffusion seal to building.
- .6 Flashing and Trim:
 - .1 Provide metal flashing members, trim and accessories in contact with framing members. Fabricate exposed, concealed or semi-concealed flashing and closure sections from finish-matching 3 mm (1/8") thick aluminum from stock as previously specified.

2.7 FINISHES

- .1 Finish of Exposed Aluminum Components: in accordance with the appropriate AAMA voluntary guide specification as follows:
- .2 Building Exterior: AA M10 C21 or C22 A41; AAMA 611 Class I Clear Anodizing
- .3 Building Interior: AA M10 C21 or C22 A31; AAMA 611 Class II Clear Anodizing
- .4 Finishes on exposed metal parts of windows and doors specified in this Section or adjacent to work of this Section, excluding hardware, must be same finish as that specified for the curtain wall framing.
- .5 Finish of Unexposed Aluminum Components: provided with pre-treatment, flash anodize or organic paint finish to improve sealant adhesion.
- .6 Dissimilar Material Protection: Where aluminum or carbon steel surfaces are to be in contact with each other or in contact with dissimilar materials such as masonry or concrete, and where hot dip galvanizing of carbon steel is incompatible with component parts because of galvanic action or component fabrication tolerances provide one of the following:
 - .1 Bituminous Paint: Cold-applied, non-sagging, asphalt-mastic paint complying with SSPC-Paint 12 requirements, except containing no asbestos. Apply in two coats for an overall minimum dry film thickness of 25 mils.
 - .2 Zinc Rich Primer: Organic zinc-rich primer, complying with SSPC-Paint 20.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Before commencing installation, examine the work of other Sections to which work of this Section will be attached.
- .2 Report immediately in writing to the Consultant all discrepancies in accuracy and suitability which will adversely affect the work of this Section. Report surfaces left unacceptable by other trades to the Consultant before commencing installation.
- .3 Ensure that openings and recesses to receive work of this Section are within acceptable tolerances.
- .4 Commencement of installation shall indicate acceptance of work of other Sections upon which work of this Section depends.

3.2 PREPARATION

- .1 Supply anchorage devices and inserts to appropriate trades where required for building in or casting-in-place and instruct such trades as to the proper location and position.
- .2 Ensure that masonry and concrete surfaces to receive adhesives and sealants are dry, firm, sound, smooth, suitable for bond, and free from loose material, projections, ice, frost, slick, grease, oil and other matter detrimental to bond.
- .3 Remove dust and other loose material from openings.
- .4 Preconstruction Adhesion and Compatibility Testing: Submit to the structural glazing sealant manufacturer, for testing indicated below, samples of each glazing material type, tape sealant, gasket, glazing accessory, and glass-framing member that is in close proximity to or is touching the structural or nonstructural sealants of a structural glazed system.

3.3 INSTALLATION

- .1 Erect all work plumb and true and in proper alignment and relationship to established lines and grades. Comply with manufacturer's written instructions.
- .2 Fit joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints.
- .3 Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints. Weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding. Seal joints watertight, unless otherwise indicated.
- .4 Ensure devices for anchoring frame assemblies have sufficient adjustment to permit correct and accurate alignment. After alignment, positively secure anchorage devices to prevent movement other than those designed for expansion and contraction. Take into consideration climatic conditions prevailing at the time of installation.
- .5 Site located fixings shall be subject to the Consultant's review. Perform welding and drilling of steel and drilling of concrete as required to Install fixings. Repair concrete chipped by drilling or fixing operations.
- .6 Install aluminium framing system (complete with fixed and operable panes) in accordance with manufacturer's instructions. Install materials with continuous thermal breaks located on exterior side of glazing as designed. Fill frame extrusion on warm side of thermal break with insulation.

- .7 Isolate metal surfaces in contact with incompatible materials, including wood, by painting contact surfaces with bituminous coating or primer, or by applying sealant or tape recommended by the manufacturer.
- .8 Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.
- .9 Set continuous sill members and flashing in full sealant bed as specified in Section 07 92 00 to produce weathertight installation.
- .10 Erection Tolerances:
 - .1 Limit variations from plumb, level or dimensioned angle to the following:
 - .1 3mm (1/8") maximum deviation in storey height, or in 3m (10') vertical run, or in 6m (20') horizontal run.
 - .2 6mm (1/4") maximum deviation in 12m (40') in any direction.
 - .2 Limit variations from location (theoretical calculated positions in plan or elevation based on established floor lines and column lines), including variations from plumb and level, to following:
 - .1 9mm (3/8") total maximum deviation for member at any location.
 - .2 3mm (1/8") maximum change in deviation for member for 3m (10') run, any direction.
 - .3 Limit offsets in end-to-end and edge-to-edge alignment of adjoining and consecutive members, which form planes, continuous runs and profiles to 1.5mm (1/16") maximum offset in flush alignment, including those which are to be 13mm (1/2") or less out-of-flush, and including those which are separated 50mm (2") or less by a reveal or protrusion in plane or wall.
- .11 Ensure a uniform, continuous thermal and vapour barrier effect. Where adjacent insulation and vapour barriers are to be provided under other Sections, coordinate the work such that thermal and vapour barrier continuity is achieved.
- .12 Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.
- .13 Install glazing as specified in Section 08 80 00. Prepare surfaces that will contact structural sealant according to the sealant manufacturer's written instructions to ensure compatibility and adhesion. Preparation includes, but is not limited to, cleaning and priming surfaces.
- .14 Install weatherseal sealant according to Section 07 92 00 and according to the sealant manufacturer's written instructions to produce weatherproof joints. Install joint filler behind the sealant as recommended by the sealant manufacturer.

3.4 SITE QUALITY CONTROL

- .1 Site Tests and Inspections:
 - .1 Curtain wall systems will be subject to tests to confirm performance criteria specified herein and in Sections 01 45 00 and Section 01 83 16. The Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.
 - .2 Before concealing window and curtain wall work obtain required inspections from an independent testing and inspection agency. As a minimum, the following tests will be required:

- .1 Water Leakage Tests: ASTM E1105 at a minimum cyclic static-air-pressure differential as specified in Section 01 83 16, and shall not evidence water penetration.
- .3 In event that the curtain wall system does not pass tests performed by the inspection and testing company, take remedial action, approved by the Consultant, as necessary to correct deficiencies observed as a result of tests. Perform retesting at own expense until tests indicate satisfactory results.

3.5 CLEANING

- .1 Clean work of this Section in accordance with "Cleaning Procedure" as recommended by Aluminum Company of Canada in publication D.I. 650, 1962 "Care During Construction" and as recommended by the finish applicator.
- .2 Clean and polish glass on exterior and interior and remove markings indicating presence of glass.

END OF SECTION

PART 1 - GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and the Supplementary Conditions of the Contract;
 - .2 Division 1 requirements and documents referred to therein.

1.3 SUMMARY

- .1 Work Included: Provide labour, materials, products, equipment and services to complete the decorative metal screens work specified herein. This includes, but is not necessarily limited, to:
 - .1 Rooftop fixed decorative metal screens.
 - .2 Auxiliary materials required for complete installation.
- .2 Related Requirements: Specifications throughout the entirety of Divisions of this Project are directly applicable to this Section, and this Section is directly applicable to them.

1.4 REFERENCES

- .1 Reference Standards: Unless otherwise stipulated by a specific publication date in this Section or the Ontario Building Code, the latest published editions of reference standards in force as of the Bid Closing Deadline for the Project, including adopted amendments, are applicable.

1.5 SUBMITTALS

- .1 Product Data: Submit product data in accordance with Section 01 33 00 for the following:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for the decorative metal screens work and include product characteristics, performance criteria, physical size, finish and limitations.
- .2 Safety Data Sheets (SDS): Submit SDS for inclusion in Operation and Maintenance Manual specified in Section 01 78 00, for adhesives, sealants and any other material designated by Consultant.
- .3 Shop Drawings: Submit Shop Drawings in accordance with Section 01 33 00, for decorative metal screens and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
 - .1 Show mullion profiles and locations.
- .4 Samples: Submit samples in accordance with Division 01 for each type of metal finish required.
- .5 Professional Engineer's Stamped Shop Drawings and Submittals: For decorative metal screens indicated to comply with structural performance requirements and design criteria, including analysis data signed and sealed by the qualified Professional Engineer responsible for their preparation.

1.6 QUALITY ASSURANCE

- .1 Welding Qualifications:

- .1 Provide welding in accordance with CSA W59-M performed by a fabricator and mechanics fully approved by the Canadian Welding Bureau as specified herein.
- .2 Ensure fabricator is fully certified by Canadian Welding Bureau for fusion welding of steel structures to CSA W47.1 and for fusion welding of aluminum to CSA W47.2.
- .2 Fabricator qualifications. A firm experienced in producing fencing/infill/gate products similar to those indicated for the Project and with a record of successful in-service performance.
- .3 Source Limitations: Obtain fixed decorative metal screens from single source from a single manufacturer where indicated to be of same type, design, or factory-applied colour finish.

1.7 FIELD CONDITIONS

- .1 Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.8 WARRANTY

- .1 Extended Warranty for Finishes: Repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
 - .1 Deterioration includes, but is not limited to, the following:
 - .1 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
 - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - .2 Warranty Period: 10 years from date of Substantial Performance of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Products of following manufacturers may be acceptable subject to conformance to requirements of Drawings, Schedules and Specifications:
 - .1 Dowco
 - .2 Construction Specialties
 - .3 Equivalent.

2.2 DESIGN AND PERFORMANCE REQUIREMENTS

- .1 Professional Engineering Design and Certification: Design decorative metal screens, including comprehensive engineering analysis by a Professional Engineer licensed to practice in the Province of Ontario, using structural performance requirements and design criteria indicated.
- .2 Structural Performance: Decorative metal screens shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of louvre components, noise or metal fatigue caused by louvre-blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - .1 Wind Loads: Determine loads based on pressures as indicated on Drawings.
 - .2 Provide additional structural supports as required to adequately secure decorative metal screens within openings.

- .3 Vibration Control: Ensure louvre members do not vibrate when subjected to above wind loading. Provide integral bosses as required.

2.3 MATERIALS

- .1 Steel Plates, Shapes, and Bars: ASTM A 36/A 36M or equivalent to CSA G40.20/G40.21, Grade 300W.
- .2 Aluminum Extrusions: ASTM B 221M (ASTM B 221), Alloy 6063-T5, T-52, or T6.
- .3 Aluminum Sheet: ASTM B 209M (ASTM B 209), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.
- .4 Fasteners: Use types and sizes to suit unit installation conditions.
 - .1 Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.
 - .2 For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.
 - .3 For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
 - .4 For fastening stainless steel, use 300 series stainless-steel fasteners.
 - .5 For color-finished decorative metal screens, use fasteners with heads that match colour of decorative metal screens.
- .5 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.
- .6 Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing additives.

2.4 DECORATIVE METAL SCREENS

- .1 Description: decorative screen systems fabricated using durable aluminum with hidden supports and frames. Blade sizes, spacing, and configuration to be as selected by the Consultant to meet sight cutoff and aesthetic requirements.
- .2 Finish: Kynar to match aluminum panels.
- .3 Basis-of-Design: "Dowco with 4 in blades at 5 in o/c" or Construction Specialties VAC-301

2.5 ACCESSORIES

- .1 Mounting Hardware: Provide necessary fasteners, anchors, and brackets for proper installation of screen system. Hardware to be non-corrosive, and compatible with aluminum to prevent galvanic action; conceal from view.
- .2 Roof Penetration Sealing System: sealing system composed of precast modular polyester curbs, polyester adhesive and 1-part moisture-cure, self-levelling, pourable sealer.
 - .1 Acceptable Products: "ChemCurb System" by Chem Link Inc.,

2.6 FABRICATION

- .1 Factory assemble decorative metal screens to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
- .2 Maintain equal louvre blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.
- .3 Include supports, anchorages, and accessories required for complete assembly.

- .4 Join frame members to each other and to fixed louvre blades with fillet welds concealed from view unless otherwise indicated or size of louvre assembly makes bolted connections between frame members necessary.

PART 3 - EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

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

3.2 EXAMINATION

- .1 Site Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to installation. Commencement of work implies acceptance of previously completed work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 PREPARATION

- .1 Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.4 INSTALLATION

- .1 Install the decorative screen system in accordance with the manufacturer's written instructions and as indicated on Drawings. Ensure components are securely fastened and aligned, with hidden supports and frames.
- .2 Locate and place decorative metal screens level, plumb, and at indicated alignment with adjacent work. Use concealed anchorages where possible.
- .3 Form closely fitted joints with exposed connections accurately located and secured.
- .4 Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.
- .5 Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.
- .6 Install concealed gaskets, flashings, joint fillers, and insulation as louvre installation progresses, where weathertight louvre joints are required. Comply with Section 07 92 00, Joint Sealants for sealants applied during louvre installation.
- .7 Use roof penetration sealant systems at all penetrations.

3.5 FIELD QUALITY CONTROL

- .1 Manufacturer Services: Arrange for Product manufacturer's technical representative to:
 - .1 meet and discuss installation procedures and unique conditions at the Place of the Work.
 - .2 inspect substrate surfaces and recommend solutions to accommodate adverse conditions.
 - .3 periodically visit and inspect installation and report unsatisfactory conditions to Contractor.
 - .4 attend final inspection and to submit written certification that Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

3.6 ADJUSTING AND CLEANING

- .1 Clean exposed louvre surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.
- .2 Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.
- .3 Restore decorative metal screens damaged during installation and construction so no evidence remains of corrective work. If the results of restoration are unsuccessful, as determined by Consultant, remove damaged units and replace with new units.
 - .1 Touch up minor abrasions in finishes with air-dried coating that matches colour and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

PART 1 - GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and the Supplementary Conditions of the Contract;
 - .2 Division 1 requirements and documents referred to therein.

1.3 SUMMARY

- .1 Provide labour, materials, products, equipment and services to complete the sun control devices work specified herein. This includes, but is not necessarily limited to:
 - .1 Exterior sun shades a building exterior.
 - .2 Framing and associated anchorage.
 - .3 Auxiliary materials required for complete installation.
- .2 Related Requirements: Specifications throughout the entirety of Divisions of this Project are directly applicable to this Section, and this Section is directly applicable to them.

1.4 REFERENCES

- .1 Definitions: the following definitions shall apply to this Section:
 - .1 "Post-Disaster Building": means a building that is essential to provision of services in event of a disaster. This facility is classified as post disaster as defined in the OBC.
 - .2 "Operational and Functional Component" and "OFC": means components within building which are directly associated with the function and operation of the facility. OFCs consist of architectural components, building services components, and building contents. Items specified herein may be designated as OFCs and may need to be designed in accordance with performance requirements specified herein and in Section 13 48 50.
- .2 Reference Standards: Latest published editions of reference standards listed in this Section in effect as of the closing date and time of the Request for Tenders for the Contract, including any amendments adopted, are applicable unless otherwise indicated.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Prior to starting work of this Section, convene a pre-installation meeting at the Project site to review the Project requirements and site conditions with pertinent parties. Conform to requirements of Section 01 30 00.

1.6 ACTION SUBMITTALS

- .1 Product Data: Submit in accordance with Division 01 for the following:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for the sun control devices work and include product characteristics, performance criteria, physical size, finish and limitations.

- .2 Shop Drawings: Submit in accordance with Division 01 for sun control devices and accessories. Include plans, elevations, sections, details, and attachments to other work. Show frame profiles and blade profiles, angles, and spacing.
- .3 Samples: Submit samples in accordance with Division 01 for each type of metal finish required.

1.7 QUALITY ASSURANCE

- .1 Welding Qualifications:
 - .1 Provide welding in accordance with CSA W59-M performed by a fabricator and mechanics fully approved by the Canadian Welding Bureau as specified herein.
 - .2 Ensure fabricator is fully certified by Canadian Welding Bureau for fusion welding of steel structures to CSA W47.1 and for fusion welding of aluminum to CSA W47.2.
- .2 Fabricator qualifications: A firm experienced in producing fencing/infill/gate products similar to those indicated for the Project and with a record of successful in-service performance.
- .3 Source Limitations: Obtain sun control devices from single source from a single manufacturer where indicated to be of same type, design, or factory-applied colour finish.
- .4 Licensed Professionals: Employ a full time structural Professional Engineer registered in the Province of Ontario, carrying minimum \$2,000,000.00 professional liability insurance, to:
 - .1 design the components of the work of this Section requiring structural performance,
 - .2 be responsible for full assemblies and connections,
 - .3 be responsible for determining sizes, yield strengths, gauge thicknesses and joint spacing to allow thermal movement and loading of components in accordance with applicable codes and regulations,
 - .4 be responsible for production and review of Shop Drawings,
 - .5 inspect the Work of this Section during fabrication and erection,
 - .6 stamp and sign each Shop Drawing, and
 - .7 provide site administration and inspection of this part of the Work.
- .5 Mock-ups: Provide mock-ups in locations designated by Consultant and as required to demonstrate quality of workmanship. Maintain mock-ups during construction in an undisturbed condition as a standard for judging the completed work.

1.8 FIELD CONDITIONS

- .1 Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.9 WARRANTY

- .1 Extended Warranty for Finishes: Repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
 - .1 Deterioration includes, but is not limited to, the following:
 - .1 Colour fading more than 5 Hunter units when tested according to ASTM D2244.
 - .2 Chalking in excess of a No. 8 rating when tested according to ASTM D4214.
 - .3 Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 - .2 Warranty Period: 10 years from date of Substantial Performance of the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Products of following manufacturers (or Equivalent) may be acceptable subject to conformance to requirements of Drawings, schedules and Specifications.
 - .1 Levolux;
 - .2 Construction Specialties
 - .3 TenPlus Architectural Products
 - .4 or Equivalent to the above.
- .2 Substitution Limitations: This Specification is based on "Infiniti System" by Levolux. Equivalent Products from manufacturers listed herein offering functionally and aesthetically equivalent Products in Consultant's opinion and subject to Consultant's review, will be considered provided they meet the requirements of this Specification.

2.2 DESCRIPTION

- .1 Regulatory Requirements:
 - .1 Design shall be based on Limit States Design principles using factored loads and resistance. Resistance and resistance factors shall be determined in accordance with the OBC and CSA S136 requirements.
- .2 Design and Performance Requirements:
 - .1 Professional Engineering Design and Certification: Design sun control devices, including comprehensive engineering analysis by a Professional Engineer licensed to practice in the Province of Ontario, using structural performance requirements and design criteria indicated.
 - .2 Structural Performance: Sun control devices shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated without permanent deformation of sun control device components, noise or metal fatigue caused by sun control device blade rattle or flutter, or permanent damage to fasteners and anchors. Wind pressures shall be considered to act normal to the face of the building.
 - .1 Wind Loads: Determine loads based on pressures as indicated on Drawings.
 - .2 Limit deflection of members and framing to L/360.
 - .3 Vibration Control: Ensure sun control device members do not vibrate when subjected to above wind loading.
 - .4 Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
 - .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
 - .5 SMACNA Standard: Comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" for fabrication, construction details, and installation procedures.

2.3 MATERIALS

- .1 Steel Plates, Shapes, and Bars: ASTM A 36/A 36M or equivalent to CSA G40.20/G40.21, Grade 300W.
- .2 Aluminum Extrusions: ASTM B 221M (ASTM B 221), Alloy 6063-T5, T-52, or T-6.

- ~~.3 Aluminum Sheet: ASTM B 209M (ASTM B 209), Alloy 3003 or 5005 with temper as required for forming, or as otherwise recommended by metal producer for required finish.~~
- ~~.4 Fasteners: Use types and sizes to suit unit installation conditions.~~
 - ~~.1 Use hex-head or Phillips pan-head screws for exposed fasteners unless otherwise indicated.~~
 - ~~.2 For fastening aluminum, use aluminum or 300 series stainless-steel fasteners.~~
 - ~~.3 For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.~~
 - ~~.4 For fastening stainless steel, use 300 series stainless-steel fasteners.~~
 - ~~.5 For color-finished sun control devices, use fasteners with heads that match colour of sun control devices.~~
- ~~.5 Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187.~~
- ~~.6 Grout: Non-shrink type, pre-mixed compound consisting of non-metallic aggregate, cement, and water-reducing and plasticizing additives.~~

2.4 MANUFACTURED UNITS

- ~~.1 Sun Control Devices: Provide ornamental system consisting vertical fixed shading blades, fabricated with extruded aluminum framing bars and supported by extruded aluminum posts with following characteristics:~~
 - ~~.1 Fin Bracket: Stainless Steel.~~
 - ~~.2 Support arm and support fixing: stainless steel.~~
 - ~~.3 Fin: fixed extruded aluminum shading blades bars, spaced as required to provide solar shading. Size and angle: as indicated on reviewed Shop Drawings.~~
 - ~~.4 Carrier Arm: Provide aluminum extruded tubular aluminum sections with solid aluminum caps sized as required to carry blade loadings.~~
 - ~~.5 Basis of Design: "Infiniti System" by Levolux or Equivalent.~~

2.5 FABRICATION

- ~~.1 Factory assemble sun control devices to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.~~
- ~~.2 Maintain equal sun control device blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.~~
- ~~.3 Include supports, anchorages, and accessories required for complete assembly.~~
- ~~.4 Join frame members to each other and to sun control device blades with fillet welds concealed from view unless otherwise indicated or size of sun control device assembly makes bolted connections between frame members necessary.~~

2.6 ALUMINUM FINISHES

- ~~.1 Finish sun control devices after assembly.~~
- ~~.2 High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70percent PVDF resin by weight in both colour coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.~~

- .1 Colour and Gloss: "Wood Look" colour or pattern as selected by Consultant from manufacturer's full range.
- .2 Manufacturer's standard powder coating of performance equivalent to AAMA 2605 is acceptable in lieu of high-performance organic finish specified in this Section.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Site Verification of Conditions: Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify the Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.
- .2 Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- .1 Coordinate setting drawings, diagrams, templates, instructions, and directions for installation of anchorages that are to be embedded in concrete or masonry construction. Coordinate delivery of such items to Project site.

3.3 INSTALLATION

- .1 Comply with manufacturer's written recommendations or specifications, including product technical bulletins, handling, storage and installation instructions, and datasheets.
- .2 Locate and place sun control devices level, plumb, and at indicated alignment with adjacent work.
- .3 Use concealed anchorages where possible.
- .4 Form closely fitted joints with exposed connections accurately located and secured.
- .5 Provide perimeter reveals and openings of uniform width for sealants and joint fillers.
- .6 Protect unpainted galvanized and nonferrous metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

3.4 FIELD QUALITY CONTROL

- .1 Manufacturer Services: Arrange for Product manufacturer's technical representative to:
 - .1 meet and discuss installation procedures and unique conditions at the Place of the Work.
 - .2 inspect substrate surfaces and recommend solutions to accommodate adverse conditions.
 - .3 periodically visit and inspect installation and report unsatisfactory conditions to Contractor.
 - .4 attend final inspection and to submit written certification that Products, systems and assemblies have been installed in accordance with manufacturer's requirements.

3.5 ADJUSTING AND CLEANING

- .1 Clean exposed sun control device surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

- .2 Restore sun control devices damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, remove damaged units and replace with new units.
- .3 Touch up minor abrasions in finishes with air-dried coating that matches colour and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION

PART 1 - GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and the Supplementary Conditions of the Contract.
 - .2 Division 01 requirements and documents referred to therein.

1.3 SUMMARY

- .1 Provide labour, materials, Products, equipment and services to complete the pre-engineered building work specified herein. This includes all structural steel components above grade including, but is not necessarily limited, to:
 - .1 Primary structural steel: Welded plate section columns and beams for bolted field assembly.
 - .2 Secondary structural steel: Roof purlins and wall girts, cross bracing, hoist beam and supports, and lateral support for masonry walls.
 - .3 Support beams for cantilevered components and conventional framing interface.
 - .4 Standing seam roof cladding and gutter assembly.
 - .5 Insulated wall assembly.
 - .6 Eave overhangs, internal gutters, seals, metal flashings, copings, and closures.
 - .7 Rigid frame and miscellaneous framing, rough opening frame.
 - .8 Auxiliary materials required for a complete installation.
- .2 Related Requirements: Specifications throughout all Divisions of the Project shall be read as a whole, and may be directly applicable to this Section. Related requirements provided below are for convenience purposes only:
 - .1 Section 07 21 00 - Building Insulation.
 - .2 Section 07 42 46 - Insulated-Core Metal Wall Panels

1.4 REFERENCES

- .1 Definitions:
 - .1 "Post-Disaster Building": means a building that is essential to provision of services in event of a disaster. This facility is classified as post disaster as defined in the OBC.
 - .2 "Operational and Functional Component" and "OFC": means components within building which are directly associated with the function and operation of the facility. OFCs consist of architectural components, building services components, and building contents. Items specified herein may be designated as OFCs and may need to be designed in accordance with performance requirements specified herein and in Section 13 48 50.

- .2 Reference Standards: Latest published editions of reference standards listed in this Section in effect as of the closing date and time of the Request for Tenders for the Contract, including any amendments adopted, are applicable unless otherwise indicated.

1.5 DEFINITIONS

- .1 The following definitions per CSSBI 30 apply to this Section:
- .2 Pre-Engineered Metal Building System: means an integrated assembly of manufactured steel structural components and cladding components specifically designed by the manufacturer to support and transfer loads and provide a complete or partial building shell
- .3 Structural Framing: means the steel framework consisting of primary members (rigid frames, beams, girders, trusses, arches, rafters, columns), secondary members (purlins, joists, struts, bracing, tension rods, girts, eave struts, base angle and channel, header, jambs, sills and other structural items) and all necessary hardware.
- .4 Cladding: means the exposed exterior wall and roof skin of any material type and combination including fasteners and attachments, weather sealants, trim, flashing, fascia, and closures, as applicable.

1.6 PREINSTALLATION MEETINGS

- .1 Pre-installation Meetings: Schedule and hold a pre-installation meeting at the Project site at least one week before beginning work on this Section to coordinate activities with related Subcontractors.
 - .1 Required Attendance: Subcontractor performing work of this Section, representatives from manufacturers and fabricators involved in or affected by installation.
 - .2 Notification: Notify Consultant and Owner of scheduled meeting dates in advance; minimum 72 hour notice required.
 - .3 Agenda:
 - .2 Review progress of related construction activities and preparations for particular activity under consideration.
 - .3 Make note of required sequencing and coordination with materials and activities that have preceded or will follow.
 - .1 Reporting: Record significant discussions, agreements, and disagreements, including required corrective measures and actions.
 - .2 Distribution: Distribute minutes of the meeting to each party present and to other parties requiring information not more than 72 hours after meeting.

1.7 SEQUENCING

- .1 Coordinate installation with other related Sections.
- .2 Supply items to be installed by other Sections in ample time to avoid delays.
- .3 Supply necessary measurements, templates, and instructions to ensure smooth progression of construction activities.
- .4 Arrange for manufacturer's technical representative to review procedures and conditions prior to commencing work.

1.8 SUBMITTALS

- .1 Product Data: Submit manufacturer's product characteristics, catalogue cuts, installation instructions and other relevant information for each material and product used for pre-engineered building work specified in this Section.
- .2 Shop Drawings: Submit Shop Drawings indicating material layouts, details of construction, connections, and relationship with adjacent construction. As a minimum indicate following:
 - .1 Include plans, elevations, sections and details as applicable.
 - .2 Show size, location, projection of anchor bolts, grid lines, structural members, connection details, and related elements.
 - .3 Clearly mark components and parts, and provide erection Drawings for identification and parts assembly.
 - .4 Indicate field-measured dimensions on Shop Drawings.
- .3 Delegated Design Submittals:
 - .1 Engineering design completion of pre-engineered building work is delegated to Contractor based on structural design criteria indicated in Contract Documents.
 - .2 Submit Shop Drawings for work of this Section that bear the stamp of a Professional Engineer registered in Province of Ontario.
 - .3 Submit copy of structural calculations upon request by Consultant.
- .4 Embodied Carbon / Environmental Product Declarations (EPDs): When available, submit product-specific or industry-wide EPDs conforming to ISO 14025 or other recognized environmental Product declaration framework meeting following criteria:
 - .1 EPD Scope: Must cover Cradle-to-Gate (A1 to A3) as a minimum.
 - .2 EPD Impact Categories: Must report Global Warming Potential (GWP) in form of unit of kgCO₂e/declared unit as a minimum.
 - .3 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- .5 Material Ingredient Disclosure: When available, submit documentation disclosing chemical inventory of materials to at least 0.1% (1000ppm) meeting following criteria:
 - .1 Standard: Health Product Declaration (HPD) Open Standard, Cradle to Cradle v2 (Basic level) or Cradle to Cradle v3 (Bronze level), International Living Future Institute (ILFI) Declare, or other approved material ingredient declaration framework.
 - .2 Product Options: Give preference to Products with compliant documentation when choice is at Contractor's option.
- .6 Welding Certificate: Submit certification for welding firms and welders to verify compliance with welding qualifications specified in this section.

1.9 CLOSEOUT SUBMITTALS

- .1 Operating and Maintenance Data: Submit care and maintenance instructions for pre-engineered building to be included in building operation and maintenance manual.
- .2 Warranty Documentation: Submit copy of extended warranties specified in this Section.

1.10 QUALITY ASSURANCE

- .1 Manufacturer Qualifications: Provide Products for work of this Section by manufacturer with at least 10 years' experience manufacturing such materials.
 - .1 Steel building system manufacturer must be certified to CSA A660.
 - .2 Provide on-site supervision by a qualified technical representative during erection.
- .2 Installer Qualifications: Engage an entity with at least five years' experience installing, erecting, or assembling work similar in material, design, and extent to that shown on Drawings and Schedules, and whose work has resulted in construction with a track record of successful in-service performance.
- .3 Welding Qualifications: Qualify procedures and personnel in accordance with the following:
 - .1 Steel: to CSA W47.1 and CSA W59
 - .2 Aluminum: to CSA W47.2 and CSA W59.2
 - .3 Stainless Steel: to CSA W47.1 (Annex K) and CSA W59.
- .4 Professional Engineer's Qualifications: Employ Professional Engineer licensed to practice in Province of Ontario who carries professional liability insurance and has at least five years' experience providing engineering services of similar kind, scope, and complexity.
 - .1 Professional Engineer's Responsibility:
 - .5 production and review of Shop Drawings,
 - .6 design and certification of pre-engineered building, including attachments for foundation, in accordance with applicable codes and regulations,
 - .7 stamping and signing of each Shop Drawing and associated calculations
- .8 Single Source Responsibility: Obtain primary materials for this Section from a single source by a single manufacturer, and secondary materials from sources recommended by manufacturers of primary materials.

1.11 DELIVERY, STORAGE AND HANDLING

- .1 Deliver, store and handle pre-engineered building materials in accordance with manufacturer's written instructions.
- .2 Protect pre-finished sheet steel during handling and storage as per CSSBI Bulletin No. 9.

1.12 FIELD CONDITIONS

- .1 Field Measurements: Verify actual dimensions of construction contiguous with pre-engineered building by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Provided requirements of Contract Documents are satisfied, the following manufacturers may supply Products for work this Section:
 - .1 Butler Manufacturing Company;
 - .2 Robertson Building Systems
 - .3 Steelway Building Systems

- .4 Behlen Industries
- .5 Varco Pruden

2.2 PERFORMANCE / DESIGN CRITERIA

- .1 Design Intent: Architectural Drawings and details are diagrammatic and are only intended to show design concept, aesthetics, interfacing requirements, configuration, components and arrangements. They are not intended to identify or solve completely problems of thermal and structural movements, assembly framing, engineering design, fixings and anchorages.
- .2 Structural Performance: Provide pre-engineered building capable of withstanding the effects of the following loads in accordance with requirements of Ontario Building Code (Part 4, Structural Design) (geographical location - Newmarket):
 - .1 Wind Loads: Determined in accordance with OBC requirements for the project's geographical location, with a 1 in 50-year return probability.
 - .2 Roof Snow Loads: Determined in accordance with OBC requirements for the project's geographical location.
 - .3 Seismic Loads: Determined in accordance with OBC requirements for the project's geographical location.
 - .4 Dead Loads: Account for loads attributable to weight of building system construction, including roof, framing, and covering materials.
 - .5 Collateral Loads: Include additional imposed loads required by Contract Documents, such as sprinklers, mechanical, electrical, and ceiling systems.
 - .6 Design cold-formed metal framing used for the work of this Section to CAN/CSA S136.
 - .7 Design structural steel framing used for the work of this Section to CAN/CSA S16.
- .3 Deflections:
 - .1 Calculate deflections using only bare frame method. Do not use reductions based on engineering judgment unless actual calculations for the stiffness are included in the design for the specific project.
 - .2 Design frame bases assuming "pinned" connections to prevent moment transfer to foundations.
 - .3 Limit lateral deflections due to wind and gravity loads to $H/500$, where H is the building height at the eaves.
 - .4 Limit deflections of roof purlins to $[L/180]$ under snow and wind loading.
 - .5 Limit lateral deflections of wall girts to $[L/180]$ where girts brace metal siding and $[L/720]$ where girts brace masonry walls.
- .4 Rain Screen Principle:
 - .1 Design exterior envelope cladding systems based on Rain Screen Principle advocated by NRCC and Provide for drainage of water entering building envelope wall systems.
 - .2 Provide gaskets, baffles, overlaps, seals and compartmentalization where required to achieve appropriate pressure equalization in exterior envelope cavity wall design. Maintain integrity of continuous air barrier/vapour retarder system with adjacent surrounding air barrier/vapour retarder.
 - .3 Incorporate means of draining moisture to exterior. Design drainage system to provide clear, internal paths of drainage of any trapped moisture within construction to exterior.

Ensure weep water discharges in a manner that avoids staining of architectural finishes, collecting in puddles or formation of icicles.

- .5 Thermal Movements: Ensure roof and wall framing allow for thermal movement without causing buckling, joint seal failure, undue stress on fasteners, or other detrimental effects.
 - .1 Temperature Change (Range): 67 deg C (120 deg F), ambient; 100 deg C (180 deg F), material surfaces.
- .6 Condensation Control: Ensure no condensation on interior surfaces under the following conditions:
 - .1 Interior: 22 degrees C, 30% relative humidity (RH), still air.
 - .2 Exterior: Determined according to OBC Climatic Design Conditions for the project's geographical location (assume January Temperature at 1% return).
- .7 Accommodate structural movement with expansion joints and clips without causing permanent distortion, damage to infills, joint racking, seal breakage, water penetration, or glass breakage.

2.3 MATERIALS

- .1 Steel: to CAN/CSA G40.21, with a minimum yield strength of 350 MPa. Steel must be shop primed with a 30-day primer.
- .2 Bolts: to ASTM A325M, complete with nuts and washers. Provide heavy, hexagon head high strength structural bolts, of standard size and required lengths for the thickness of members joined and the type of connection.
- .3 Welded Materials: in accordance with CSA W59 standards.
- .4 Shop-Applied Zinc-Rich Primer Paint: As recommended by manufacturer.
- .5 Galvanized Steel Sheet: to ASTM A792, structural quality grade A, with AZ165 coating, regular spangle surface, and passivated for unpainted finish. For paint finish, use AZ150 unpassivated coating.
- .6 Pre-Finished System for Steel Sheet Exposed to the Exterior: zinc-coated material with a factory-applied paint system conforming to CSSBI Technical Bulletin No. 7.
- .7 Screws: corrosion-resistant, purpose-made, concealed screws.

2.4 INSULATION

- .1 Refer to Section 07 21 00 - Building Insulation.

2.5 METAL ROOFING SYSTEM Roof type R-2, basis of design Robertson Thermal Systems (RST)

- .1 Exterior sheet-roof: factory preformed steel sheet aluminum zinc alloy coated factory preformed steel sheet, prefinished from manufacturer's standard profiles and colours. Minimum core thickness 0.61 mm (24 Ga), standing seam roof panels with locking seam formed around concealed sliding panel clip and sealant. Include closures, gaskets, caulking, flashing and fasteners to effect weathertight installation.
- .2 Roof Panel: Provide minimum 24 gauge roof panel assembly. Colour and Finish to be selected at a later date. Basis-of-Design: "Double-Lok Panel" by Robertson.
- .2.3 Roof Guard: Provide metal roof snow retention system at bottom of sloped roofs. Basis-of-Design: "ColorGard – Metal Roof Snow Bar" By S-5!
- .3.4 Roof liner: factory preformed steel sheet, zinc coated, prefinished from manufacturer's standard profiles and colours. Minimum core thickness 0.61 mm (24 Gauge) and prefinished to 5000

paint series. Install roof liner on top of roof purlins, caulked and sealed to Provide roof vapour barrier.

4.5 Install thermal spacers, hat bar and continuous 9mm rigid insulation thermal break over roof liner to accommodate thickness of insulation and attachment of panel clips and exterior roof sheet. Sealants as recommended by manufacturer.

6 Provide components required for a complete metal roof panel assembly including copings, fasciae, corner units, ridge closures, clips, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal roof panels unless otherwise indicated.

2.6 METAL CLADDING SYSTEM

.1 Insulated metal panel system as specified in Section 07 42 46 - Insulated-Core Metal Wall Panels.

2.7 ACCESSORIES

.1 Provide accessories as standard with metal building system manufacturer and as specified. Fabricate and finish accessories at the factory to greatest extent possible, by manufacturer's standard procedures and processes. Comply with indicated profiles and with dimensional and structural requirements.

2.8 FABRICATION

- .1 Fabricate structural members according to Shop Drawings and CAN/CSA S16.1.
- .2 Construct frames from welded plate section columns and roof beams, including necessary splice plates for bolted field assembly. Provide high-strength bolts for frame member assembly.
- .3 Reinforce openings to maintain the design strength of structure.
- .4 Factory weld base plates, cap plates, compression splice plates, and stiffener plates with shop-fabricated connection holes.
- .5 Fabricate columns and roof beams with pre-drilled holes for attachment of secondary structural members and bracing, except as noted for field work on the manufacturer's erection Drawings.
- .6 Use welded "H" sections or cold-formed "C" sections for exterior columns.
- .7 Fabricate beams and posts with pre-drilled holes for secondary structural member attachment, except as specified for field work.
- .8 Shop-fabricate splice plates and base clips with bolt connection holes. Factory weld base plates, cap plates, compression splice plates, and stiffener plates with shop-fabricated connection holes.
- .9 Substitute intermediate frames for end-wall roof beams and corner posts as required.
- .10 Ensure necessary endwall posts and connection holes to the intermediate frame are shop-fabricated.
- .11 Design secondary structures, including purlins and girts, to support specified design loads. Place bracing as indicated on reviewed Shop Drawings.
- .12 Attach diagonal bracing, consisting of hot-rolled rod, to columns and roof beams.
- .13 Install cold-formed flange braces, purlin braces, and similar components as indicated on Drawings.
- .14 Cladding Accessories: Brake or bend accessories to shape, using material and finish that matches the roof cladding or wall cladding.

2.9 TOLERANCES

- .1 Ensure tolerances comply with CSSBI 30M.
- .2 Provide holes for the attachment of other work as indicated on the Drawings.

2.10 SHOP FINISHING

- .1 Clean, prepare surfaces, and shop prime structural steel in accordance with CAN/CSA S16.1, except where members are zinc-coated, zinc-aluminum alloy coated, or to be encased in concrete.
 - .1 Commercially blast clean frames and end structures to SSPC-SP2, SSPC-SP3 or SSPC-SP6 before painting with manufacturer's standard zinc-rich primer.
- .2 Purlins and Girts: Cold form for galvanized coil.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify actual site conditions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

3.2 INSTALLATION

- .1 Installation, generally: Install work of this Section in strict accordance with manufacturer's written installation instructions and reviewed Shop Drawings. Supplement manufacturer's installation instructions with additional installation requirements specified in this Section to produce specified work results.

3.3 ERECTION

- .1 Do work in accordance with CSSBI 30M except where specified otherwise.
- .2 Erect structural frame in accordance with shop drawings and to CAN/CSA-S16
- .3 Connect major structural members using high-tensile bolts through pre-punched or predrilled holes for precise alignment.
- .4 Do not field cut, drill, or alter structural members without written approval from the metal building system manufacturer's professional engineer.
- .5 Include support for adjacent structural members as indicated on Structural Drawings. Set structural framing accurately in locations and to elevations indicated in accordance with CSA and CSSBI standards referenced in this section. Maintain structural stability of the frame during erection.
- .6 Base and Bearing Plates
 - .1 Preparation: Clean concrete and masonry bearing surfaces of materials that may impair bond, and roughen surfaces before setting plates. Clean the bottom surface of plates.
 - .2 Setting Plates: Set plates for structural members on wedges, shims, or setting nuts as required.
 - .3 Alignment and Adjustment: Align and adjust structural framing before permanently fastening. Clean bearing surfaces and other surfaces that will be in permanent contact with framing before assembly. Perform necessary adjustments to compensate for

discrepancies in elevations and alignment. Level and plumb individual members of the structure. Allow for temperature differences between the time of erection and the mean temperature when the structure will be completed and in service.

- .7 Primary Framing and End Walls: Erect framing level, plumb, rigid, secure, and true to line. Level baseplates to a true even plane with full bearing to supporting structures, set with double-nutted anchor bolts. Use grout to obtain uniform bearing and maintain a level base-line elevation. Moist-cure grout for at least seven days after placement. Make field connections using high-strength bolts installed according to manufacturer's instructions.
- .8 Secondary Framing: Erect framing level, plumb, rigid, secure, and true to line. Field bolt secondary framing to clips attached to primary framing.
 - .1 Provide rake or gable purlins with tight-fitting closure channels and fasciae.
 - .2 Locate and space wall girts to suit openings such as doors and windows.
 - .3 Provide supplemental framing at the entire perimeter of openings, including doors, windows, ventilators, and other roof and wall penetrations.
- .9 Bracing
 - .1 Install bracing in roof and sidewalls where indicated on erection drawings.
 - .2 Tighten rod and cable bracing to avoid sag.
 - .3 Locate interior end-bay bracing only where indicated.
- .10 Framing for Openings: Provide shapes of proper design and size to reinforce openings and carry loads and vibrations imposed, including equipment furnished under mechanical and electrical work. Securely attach to structural framing.

3.4 PROTECTION

- .1 Protect pre-engineered building from damage, soiling and contaminating substances resulting from construction activities or caused by work of other trades.
- .2 Where soiling or spills have occurred, remove spills and soiling from adjacent surfaces using cleaning procedures recommended in writing by affected material's manufacturer. Do not use materials or process that can damage finishes, surfaces, or construction.
- .3 Promptly replace pre-engineered building work damaged during construction that cannot be satisfactorily repaired.

3.5 CLEANING AND WASTE MANAGEMENT

- .1 Cleaning: Maintain clean construction area at the end of each day. When activities of this Section are complete, remove materials, tools, equipment and rubbish.
- .2 Waste Management and Disposal: sort waste for reuse, recycling, or disposal, as specified. Remove recycling bins and containers from site and dispose of contents at the appropriate waste disposal facilities.

END OF SECTION

PART 1 - GENERAL

1.1 SUBMITTALS

- .1 Submit shop drawings/product data sheets for all products specified in this section, except piping and valves.

1.2 CLOSEOUT SUBMITTALS

- .1 Submit a letter from compressor manufacturer/supplier to certify proper compressor set installation as specified in Part 3 of this section.
- .2 Training attendance records.

1.3 QUALITY ASSURANCE

- .1 Compressed air piping system work is to be in accordance with the following:
 - .1 CSA B51, Boiler, Pressure Vessel, and Pressure Piping Code;
 - .2 ASME B31, Standards of Pressure Piping;
 - .1 ASME-B31.1 – Power Piping.
 - .3 ASME/ANSI B16 - Standards for Pipes and Fittings.
 - .4 and governing Provincial and/or Municipal Codes and Regulations.
 - .1 O.Reg. 220/01 - Boiler and Pressure Piping Regulation.

PART 2 - PRODUCTS

2.1 PIPE, FITTINGS AND JOINTS

- .1 Galvanized Steel
 - .1 Schedule 40 mild steel, galvanized, ASTM A53, screwed, complete with Class 125 galvanized cast iron screwed fittings and screwed joints.
- .2 Copper
 - .1 Type "L" hard drawn seamless copper to ASTM B88, complete with forged solder type fittings to suit pipe, and soldered joints using 95% tin / 5% Antimony solder.

2.2 PIPING UNIONS

- .1 Screwed Steel Piping
 - .1 Malleable iron, galvanized, ground joint, brass to iron or bronze to bronze seat unions and union elbows with a minimum pressure rating of 1725 kPa (250 psi) steam at 260°C (500°F).
- .2 Soldered Copper Piping
 - .1 Solder-on forged copper or bronze screwed unions suitable in all respects for the application.

2.3 LOW PRESSURE SHUT-OFF VALVES

- .1 Class 600, 4140 kPa (600 psi) WOG rated full port ball valves, each complete with a forged brass or bronze body with solder joint or screwed joint ends as required, forged brass cap and blowout-proof stem, forged brass chrome plated ball, "Teflon" or "PTFE" seat, and a removable lever handle.
- .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 5049A solder or Fig. 5044A screwed;
 - .2 Watts Industries (Canada) Ltd. #FBV-3 or #FBVS-3;
 - .3 Kitz Corporation Code 59 solder or Code 58 screwed;
 - .4 Apollo Valves #70-100 screwed or #70-200 solder.

2.4 HIGH PRESSURE SHUT-OFF VALVES

- .1 Equal to Apollo Valves #70-100-27, 4140 kPa (600 psi) rated Class 600, screwed bronze ball valve with a PTFE seat, automatic relief vent, and removable lever handle.

2.5 DRAIN VALVES

- .1 Minimum 2070 kPa (300 psi) water rated, 20 mm ($\frac{3}{4}$ ") dia. straight pattern full port bronze ball valves, each complete with a threaded outlet suitable for coupling connection of 20 mm ($\frac{3}{4}$ ") dia. garden hose, and a cap and chain.
- .2 Manufacturers:
 - .1 Toyo Valve Co. Fig. 5046;
 - .2 Kitz Corporation Code 58CC;
 - .3 Apollo Valves #78-100 or #78-200;
 - .4 Watts Industries (Canada) Ltd. #B6000-CC.

2.6 AIR COMPRESSOR SET (TO BE SUPPLIED BY OWNER)

- .1 "Campbell Hausfeld", CE5002 compressor features a cast iron, oil lubricated 2 stage pumps. 175 PSI max pressure, 7.6 SCFM @ 90 PSI. 60-gallon ASME vertical tank design. Induction engine. ASME, UL, CSA certified.
- .2 Compressor set model number, performance and electrical characteristics as follows:
 - .1 model number: WBB2764020
 - .2 motor characteristics: 3.7 HP, 230 volts, 1 phase;
 - .3 tank capacity: 60 GAL
- .3 Each compressor complete with:
 - .1 cast iron cylinders, heads, crankcase, and cast iron connecting roads with replaceable automotive type insert bearings;
 - .2 cast iron crankshaft supported on both ends by oversized tapered roller bearings;
 - .3 pressure type oil lubrication with oil sight gauge;
 - .4 steel inlet and discharge valves, and a high efficiency intercooler with steel fins on copper tubes;
 - .5 heavy-duty dry type inlet filter-silencer;

- .6 high volume, statically balanced flywheel/cooing fan;
- .7 motor conforming to requirements specified in Section 20 05 00 – Common Work Results for Mechanical, on an adjustable support base, and V-belt drive with OHSA type steel belt guard, also as specified in Basic Mechanical Materials and Methods.
- .4 Welded steel receiver including an ASME rated tank in accordance with CSA B51 and TSSA requirements, complete with welded steel support feet, and following:
 - .1 ASME rated safety relief valve;
 - .2 positive seating ball type outlet valve, a screwed union, and a length of braided metallic flexible connection;
 - .3 pressure gauge with gauge cock;
 - .4 adjustable pressure switch for automatic start-stop operation of the compressors;
 - .5 valved manual tank drain, and an automatic tank drain;
 - .6 properly sized neoprene-steel-neoprene vibration isolating mounting pads;
 - .7 braided stainless steel flexible pipe connectors supplied loose.
- .5 Surface wall mounting power and control panel in a NEMA 1 (NEMA 2 if room is sprinklered) enamelled steel enclosure with a hinged (piano hinge) lockable front door, door interlock disconnect switch, and following:
 - .1 overload protected across-the-line, non-reversing magnetic starter, and a door mounted H-O-A switch for each motor, in accordance with Section 20 05 00 – Common Work Results for Mechanical;
 - .2 fused control transformer;
 - .3 electronic alternator to automatically alternate lead compressor after each start cycle, and to automatically start lag compressor should the lead compressor fail to start;
 - .4 door mounted "power on" LED for panel and door mounted "run" LED for each compressor;
 - .5 terminal block and strips for power and control wiring connections, including control wiring from receiver mounted pressure switch.
- .6 Manufacturers:
 - .1 CompAir Kellog;
 - .2 Atlas Copco Compressors Canada;
 - .3 DeVair Systems.
 - .4 Campbell Hausfeld.

PART 3 - EXECUTION

3.1 INSTALLATION OF AIR COMPRESSOR SET

- .1 Provide an air compressor set.
- .2 Secure set in place on vibration isolation on a concrete housekeeping pad.
- .3 Ensure housekeeping pad is keyed to structure, and compressor assembly is secured to structure by slack cable restraints. Refer to Section 20 05 48.16 - Seismic Controls for Mechanical Systems.
- .4 Install accessories shipped loose with set, except power and control panel.

- .5 Extend type DWV soldered hard copper drainage piping from tank drain assemblies to nearest floor drain.
- .6 Hand power and control panel to electrical trade at site for mounting and power wiring connections as part of electrical work.
- .7 Connect receiver pressure switch to starter and control panel with wiring in conduit to the standards of the electrical work and in accordance with panel supplier's instructions.
- .8 Touch-up paint any damage to the factory finish.

3.2 INSTALLATION OF PIPING AND PIPING SYSTEM COMPONENTS

- .1 Provide required compressed air piping. Unless otherwise specified, install horizontal piping to outlets 1.5 m (5 feet) above finished floor level.
- .2 Pipe is to be Schedule 40 mild galvanized steel, screwed, or type "L" hard copper, soldered.
- .3 Support and secure piping generally as specified in Section 20 05 00 – Common Work Results for Mechanical, but with extra support and securing hardware as required to prevent drumming. Provide rigid supports at each side of outlets.
- .4 Arrange piping so condensate will drain from mains and branches into drip legs. Provide drip legs at bottom of risers, every 30 m (100') of pipe run, and at the end of each branch piping run, whether indicated on drawings or not.
- .5 Drip legs are to extend down from bottom of pipe and consist of a piping tee and 250 mm (10") long pipe nipple same size as main or branch pipe, then a reducing fitting (if required) and 12 mm (½") dia. piping extended down to floor level and terminated with a ball valve. Ensure drain points are easily accessible and identified.
- .6 Extend branch piping to outlets and/or equipment off the top of the main(s).
- .7 Provide shut-off valves in piping at all equipment connections, to isolate piping components for removal or maintenance, and wherever else specified or shown. Provide vented type valves between air compressor set and pressure reducing stations.
- .8 Provide unions in piping at connections to equipment.
- .9 When piping is complete and has been pressure tested, but before connection of outlets, blowout piping to remove oil and foreign matter.
- .10 Provide adjustable pressure regulators, filters, compressed air outlets, etc. Unless otherwise indicated locate outlets 1.5 m (5 feet) above floor and properly secured in place. Provide a hose hanger at each outlet location. Confirm exact location of piping components prior to roughing-in.

3.3 SYSTEM STARTUP

- .1 For equipment/system start-up requirements, refer to Section 20 05 00 – Common Work Results for Mechanical.
- .2 For equipment/system manufacturer certification requirements, refer to Section 20 05 00 – Common Work Results for Mechanical. Submit a copy of the letter prior to Substantial Performance of the Work.

3.4 CLOSEOUT ACTIVITIES

- .1 Include for 4 hours of on-site training for 2 groups of 6 people. Training is to be a full review of all components including but not limited to a full operation and maintenance demonstration, with abnormal events.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Factory assembled packaged gas-engine generator set equipment with digital (microprocessor-based) electronic generator set controls, digital governor, and digital voltage regulator.
- .2 Exhaust silencer and fittings.
- .3 Fuel fittings.
- .4 Remote control panel.
- .5 Battery and charger.
- .6 Weatherproof skin-tight enclosure.
- .7 Accessories.

1.2 RELATED REQUIREMENTS

- .1 Section 03 30 00 – Cast-in-Place Concrete.
- .2 Section 23 11 23 – Facility Natural-Gas Piping.
- .3 Section 26 08 32.16 – Performance Checklist for Natural-Gas Generators.
- .4 Section 26 36 23.13 – Bypass-Isolation Automatic Transfer Switches.
- .5 Section 26 36 23.16 – One-Way Bypass-Isolation Automatic Transfer Switches.
- .6 Section 26 52 13.13 – Emergency Lighting.
- .7 Section 28 46 13 – Fire-Alarm Systems.

1.3 ALTERNATIVES

- .1 Not used

1.4 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No. 5-16 – Molded-Case Circuit Breakers: Molded case switches and circuit breaker enclosures (Tri-National standard, with UL 489 and NMX-J-266-ANCE).
 - .4 CSA C22.2 No. 100-14 – Motors and Generators.
 - .5 CSA C22.2 No. 141-15 (R2020) – Emergency Lighting Equipment.
 - .6 CSA B149.1:20 – Natural Gas and Propane Code.
 - .7 CSA Z245.1-18, Steel pipe.
- .2 Ontario Fire Code, latest edition.
- .3 O.Reg. 524/98, Environmental Compliance Approvals – Exemptions for Section 9 of the Act.
- .4 National Fire Code of Canada 2010.
- .5 Technical Standards & Safety Authority (TSSA) of Ontario:

- .1 FS-255-21 – Gaseous Fuels Code Adoption Document Amendment: Ontario amendments to CSA B149:20 series.
- .6 Underwriters' Laboratories of Canada:
 - .1 CAN/ULC-S524-14 – Standard for Installation of Fire Alarm Systems.
 - .2 CAN/ULC-S1001-11, Integrated Systems Testing of Fire Protection and Life Safety Systems.

1.5 SUBMITTALS

- .1 To Section 01 33 00.
- .2 Work of this Section is to be submitted for review after Consultant's review of Coordination Study per Section 26 05 73.16 is completed.
- .3 Shop Drawings:
 - .1 Indicate electrical characteristics and connection requirements. Show plan and elevation views with overall and interconnection point dimensions, fuel consumption rate curves at various loads, ventilation and combustion air requirements, and electrical diagrams, including schematic and interconnection diagrams.
 - .2 Outline drawings of assembly, including sound attenuated weatherproof enclosure and accessories.
 - .3 Weight of complete assembly, including fuel.
 - .4 One line diagrams and wiring diagrams for assembly and components.
 - .5 Interconnection wiring diagrams.
- .4 Product data:
 - .1 Provide data showing dimensions, weights, ratings, interconnection points, and internal wiring diagrams for engine, generator, control panel, battery, battery rack, battery charger, exhaust silencer, vibration isolators, and remote radiator.
 - .2 Technical data on all major components. Technical data must include an alternator thermal damage curve, description and operating characteristics of the alternator protection device, and an alternator reactive capability curve. Alternator data demonstrating compliance to section.
 - .3 Certification of the emissions performance of the generator set engine by the engine manufacturer.
 - .4 Acoustical information of enclosure.
- .5 Line-by-line compliance statement that demonstrates compliance with this Section.
- .6 Test Reports: Indicate results of performance testing.
- .7 Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- .8 Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- .9 Manufacturer's Field Reports: Indicate procedures and findings.
- .10 Data for Ministry of Environment Environmental Activity and Sector Registry (Certificate of Approval).
 - .1 The maximum electrical output rating of the generator set (kW).

- .2 Manufacturer's combustion contaminant emissions data or U.S. EPA emissions standard certification sheet.
- .3 Layout drawing showing engine exhaust stack orientation, for generator sets installed in outdoor enclosures.
- .4 Enclosure layout drawing.
- .5 Manufacturer's enclosure noise emissions data.
- .11 Colour samples for custom enclosure colour.
- .12 Project information:
 - .1 Test reports and certifications.
 - .2 Factory test procedures.

1.6 CLOSEOUT SUBMITTALS

- .1 Startup reports:
 - .1 Manufacturer's startup reports.
 - .2 Section 26 08 32.16 – Performance Checklist for Natural-Gas Generators.
- .2 AHJ inspection documentation:
 - .1 Fuelling compliance certificate.
 - .2 Variance approval correspondence, as applicable.
- .3 Maintenance Contracts:
 - .1 Manufacturer to maintain model and serial number records of each generator set provided for at least 20 years.
 - .2 The manufacturer shall itemize the complete offering of preventative and full-service maintenance contracts for the generator with submission, as described for each maintenance period described below.
 - .3 Maintenance service as part of base bid submission:
 - .1 Provide 7 x 24 x 365 service and maintenance of Generator for 2 years from Date of Substantial Completion. Price is to include two (2) full service maintenance program visits per each year.
 - .4 Additional maintenance service offers:
 - .1 Provide a separate price to extend 7 x 24 x 365 service and maintenance of generator for year three to year five.
- .4 Operation and Maintenance Data:
 - .1 Operation Data: Include instructions for normal operation.
 - .2 Maintenance Data: Include instructions for routine maintenance requirements, service manuals for engine, oil sampling and analysis for engine wear, and emergency maintenance procedures.
 - .3 Provide electronic copies of all documents, test data, shop drawings, etc.
- .5 Training records including attendance sheet, date, and training syllabus.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- .1 Provide three copies of maintenance materials.
- .2 Spare Parts:
 - .1 Provide two of each of the following:
 - .1 Fuel oil filter element.
 - .2 Lube oil filter element.
 - .3 Air filter element.
 - .4 Fuel water separator.
- .3 Tools: provide one set of tools required for preventative maintenance of the engine generator system. Package tools in adequately sized metal tool box.
- .4 Keys.

1.8 MANUFACTURER'S QUALIFICATIONS

- .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 The manufacturer shall maintain model and serial number records of each generator set provided for at least 20 years.
- .4 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.
- .5 The manufacturer of this equipment shall have produced similar equipment for a minimum period of ten years. When requested by the Consultant, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.
- .6 Manufacturer: Company specializing in manufacturing the products specified in this section with minimum 2 years documented experience, and with service facilities within 160 km of project.
- .7 Supplier: Authorized or franchised distributor of specified manufacturer with minimum 3 years documented experience.

1.9 DELIVERY, STORAGE, AND HANDLING

- .1 Store equipment in original, undamaged package.
- .2 Deliver to the project site in manufacturer's original wrapping and containers, labelled with manufacturer's name, product information, etc.
- .3 Coordinate delivery date and time with the Owner and equipment supplier.
- .4 Installing contractor to accept unit on site, inspect for damage, provide craning complete with spreader bars, and install equipment.

1.10 WARRANTY

- .1 Warrant the material and workmanship of the generator set and associated equipment for a minimum of [two] years from registered commissioning and start-up, or 30 months from date of arrival on site.
- .2 The warranty shall be comprehensive. No deductibles shall be allowed for travel time, service hours, repair parts cost, etc.
- .3 Warrant all equipment provided under this section, whether or not is manufactured by the generator set manufacturer, so that there is one source for warranty and product service. Service of the generators sets to be performed by technicians specifically trained and certified by the manufacturer to support the product and employed by the generator set supplier.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 Manufacturer List:
 - .1 Paramount Power Systems Ltd.
 - .2 Cummins Power Generation.
 - .3 Caterpillar.
 - [.4 Kohler Power Systems.](#)
 - [.5 LMR Power Systems Inc.](#)
 - [.6 Generac Power Systems by Total Power Ltd.](#)
- .2 Substitution Limitations: Only those manufacturers listed above shall supply equipment provided under this contract. Proposals must include a line-by-line compliance statement based on this specification.

2.2 REGULATORY REQUIREMENTS

- .1 Generator set to be listed and labelled by a certification organization accredited by the Standards Council of Canada.
- .2 Comply with all applicable EPA emissions standards at the date of installation.
- .3 Conform to requirements of CSA C22.1, the Ontario Electrical Safety Code, and other requirements of the Electrical Safety Authority (ESA).

2.3 GENERATOR SET

- .1 Ratings
 - .1 The generator set shall operate at 1800 rpm and at a voltage of: 347/600 volts AC, three phase, 4-wire, 60 Hz.
 - .2 The generator set shall be rated per ISO 8528 at (per drawing) kW] at 0.8 PF, standby rating, based on site conditions of:
 - .1 Altitude: 914 m (3000 ft).
 - .2 Ambient temperatures up to 40°C (104°F)
- .3 Emissions:

- .1 25 kW to 300 kW – EPA Tier 3 certified.
- .2 350 kW to 2250 kW – EPA Tier 3 certified.
- .4 Standby rating, based on site conditions of: Altitude 400 m above sea level, ambient temperatures of 40°C, based on temperature measured at the control for indoor installations, and measured at the air inlet closest to the alternator for outdoor equipment.
- .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 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 Motor starting capability shall be a minimum of [64 kVA]. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
 - .5 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 40.
 - .6 The generator set shall be certified by the engine manufacturer to be suitable for use at the installed location and rating, and shall meet all applicable exhaust emission requirements at the time of commissioning.
 - .7 The time required to automatically start, accelerate to rated speed and voltage, synchronize, to the system bus on a normal power failure shall not exceed 15 seconds, assuming that the generator sets are in an ambient temperature of 15 degrees C or greater, and water jacket heaters are operating properly.
 - .8 The generator set, complete with sound attenuated enclosure, shall be tested by the generator set manufacturer per ANSI S1.13. Data documenting performance shall be provided with submittal documentation.
- .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 V.
- .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 described in this specification. Sufficient lug space shall be provided for use with cables.
 - .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.

2.4 ENGINE AND ENGINE EQUIPMENT

- .1 The engine shall be natural gas fueled, 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. Engine accessories and features shall include:
 - .1 Complete engine fuel system, including all pressure regulators, strainers, and control valves. The fuel system shall be plumbed to the generator set skid for ease of site connections to the generator set.
 - .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 40°C (104°F) ambient as measured at the generator air inlet, based on 0.5 in H₂O external static head. Radiator shall be sized based on a core temperature that is 20°F 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 equipment manufacturer shall fill the cooling system with a 50/50-ethylene glycol/water mixture. 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 Replaceable dry element air cleaner with restriction indicator.
 - .8 Flexible fuel lines.
 - .9 Engine mounted battery charging alternator, 40 A minimum, and solid-state voltage regulator.
- .2 Coolant Heater
 - .1 Engine mounted, thermostatically controlled, coolant heater(s) for each engine. Heater voltage shall be as shown on the project drawings. The coolant heater shall be UL499 listed and labeled.
 - .2 The coolant heater shall be installed on the engine with SAEJ20 compliant materials. Steel tubing shall be used for connections into the engine coolant system wherever the length of pipe run exceeds 300 mm (12 in). The coolant heater installation shall be specifically designed to provide proper venting of the system. The coolant heaters shall be installed using isolation valves to isolate the heater for replacement of the heater element. The design 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 24 VDC thermostat, installed at the engine thermostat housing. An AC power connection shall be provided for a single AC power connection to the coolant heater system.

- .4 Coolant heater(s) sized as recommended by the engine manufacturer to warm the engine to a minimum of 40°C in a 15°C ambient, in compliance with CSA C282 requirements, as a minimum, or the temperature required for starting and load pickup requirements of this section.
- .3 Provide vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.
- .4 Starting and Control Batteries: lead acid type, 24 VDC, sized as recommended by the engine manufacturer for compliance to CSA C282 starting requirements, complete with battery cables and connectors.
- .5 Exhaust Silencer:
 - .1 Provide exhaust silencer for each engine of size and type as recommended by the generator set manufacturer and approved by the engine manufacturer.
 - .2 The silencer shall be selected by the manufacturer to suit the overall noise rating of the enclosed unit in Part 2 Article "Weatherproof Skin-Tight Enclosure".
 - .3 Exhaust system shall be installed according to the engine manufacturer's recommendations and applicable codes and standards.
 - .4 Complete exhaust system to be installed within the enclosure, with vertical exhaust discharge.
 - .1 Vertical exhaust discharge extends a minimum of 1.2 m (4 ft) above the roof of the enclosure to ensure the following:
 - .1 Hot air does not recirculate in the air intake and overheat the engine.
 - .2 In case any snow builds up on the enclosure roof, the exhaust discharge is not covered which could prevent operation of the unit.
 - .2 Vertical exhaust discharge be complete with rain cap.
 - .5 Includes provisions for draining moisture that condenses in the exhaust system that could lead to corrosion.
 - .6 Provide Stainless Steel exhaust flex connector to suit engine outlet connection, minimum 610 mm (24") length.
- .6 Provide a minimum 10 A battery charger for each generator set battery bank. The charger shall include the following capabilities:
 - .1 Chargers shall be UL 1236-BBHH listed and CSA or CUL certified for use in emergency applications.
 - .2 The charger shall be compliant with UL 991 requirements for vibration resistance.
 - .3 The charger shall comply with the requirements of EN61000-4-5 for voltage surge resistance; EN50082-2 for immunity; EN61000-4-2 for ESD; EN61000-4-3 for radiated immunity; ANSI/IEEE C62.41 category B and EN61000-4-4 for electrically fast transient; EN61000-4-6 for conducted emissions; and FCC Part 15 Class A for radiated emissions.
 - .4 The charger shall be capable of charging a fully discharged battery without damage to the charger. It shall be capable of returning a fully discharged battery to fully charged condition within 24 hours. The charger shall be UL-labeled with the maximum battery amp-hour rating that can be recharged within 24 hours.
 - .5 The charger shall incorporate a 4-state charging algorithm, to provide trickle charge rate to restore fully discharged batteries, a bulk charge rate to provide fastest possible recharge

after normal discharge, an absorption state to return the battery to 100 percent of charge, and a float stage to maintain a fully charge battery and supply battery loads when the generator set is not operating. In addition, the charger shall include an equalization timer. Charge rates shall be temperature compensated based on the temperature directly sensed at the battery.

- .6 The DC output voltage regulation shall be within plus or minus 1%. The DC output ripple current shall not exceed 1 A at rated output current level.
- .7 The charger shall include the following features:
 - .1 Two line alphanumeric display with programming keys to allow display of DC output ammeter and voltmeters (5% accuracy or better), display alarm messages, and perform programming;
 - .2 LED indicating lamp(s) to indicating normal charging condition (green), equalize charge state (amber), and fault condition (red);
 - .3 AC input overcurrent, over voltage, and undervoltage protection;
 - .4 DC output overcurrent protection;
 - .5 Alarm output relay;
 - .6 Corrosion resistant aluminum enclosure
- .7 Emissions Requirements
 - .1 NOx not to exceed 9.2 g NOx per kWh.
 - .2 Engine exhaust to be complete with catalytic converter for units over 80 kWe.

2.5 AC ALTERNATOR

- .1 The AC alternator shall be; synchronous, four pole, 2/3 pitch, brushless, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc. The alternator design shall prevent shaft current from flowing and eliminate the need for insulated bearings. All insulation system components shall meet NEMA MG1 requirements for Class H insulation systems. Actual temperature rise measured by resistance method at full load shall not exceed 105°C in a 40°C ambient.
- .2 The alternator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage up to 5 percent above or below rated voltage.
- .3 A 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 alternator shall be supplied with a dedicated, independent power source for the voltage regulation system, which provides sufficient excitation for the alternator to supply 300 per cent of rated output current for 10 seconds.
- .5 The subtransient reactance of the alternator to not exceed 15 per cent, based on the standby rating of the generator set.
- .6 Provide an anti-condensation heater for the alternator for generator sets installed outdoors or in unheated environments.

- .7 Provide two embedded resistance temperature detectors per phase and temperature indication equipment. The control system shall annunciate high alternator temperature as a fault condition.
- .8 The alternator shall be capable of operation with reverse kVAR of 0.15 per unit.

2.6 GENERATOR SET CONTROL

- .1 The generator set shall be provided with a microprocessor-based control system that is designed to provide automatic starting, monitoring, protection, 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.
- .2 The control shall be mounted on the generator set in an accessible location. 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 Control Switches
 - .1 Mode Select Switch.
 - .1 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.
 - .1 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. The switch shall include a lockout provision for use in safely disabling the generator set for necessary service.
 - .2 Locate inside Generator enclosure.
 - .3 RESET switch.
 - .1 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.
 - .1 Operating 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 operated, or after the switch is operated a second time.
 - .5 Voltage and Frequency Adjustment. The genset mounted control shall include digital raise/lower switches for adjustment of voltage and frequency.
 - .2 Generator Set AC Output Metering. The generator set shall be provided with a metering set including the following features and functions:
 - .1 Digital metering set, 1% accuracy, to indicate generator RMS voltage and current, frequency, output current, output kW, kWh, 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.
- .2 Analog voltmeter, ammeter, frequency meter, power factor meter, and kilowatt (kW) meter. Voltmeter and ammeter shall display all three phases. Meter scales shall be colour coded in the following fashion: green shall indicate normal operating condition, amber shall indicate operation in ranges that indicate potential failure, and red shall indicate failure impending. Metering accuracy shall be within 1% at rated output. Both analog and digital metering are required.
 - .3 The control system shall monitor the total load on the generator set, and maintain data logs of total operating hours at specific load levels ranging from 0 to 110% of rated load, in 10% increments. The control shall display hours of operation at less than 30% load and total hours of operation at more than 90% of rated load.
 - .4 The control system shall log total number of operating hours, total kWh, and total control on hours, as well as total values since reset.
- .3 Generator Set Alarm and Status Display.
- .1 The generator set control shall include LED alarm and status indication lamps. The lamps shall be high intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. Functions indicated by the lamps shall include:
 - .2 The control shall include five configurable alarm-indicating lamps. The lamps shall be field adjustable for any status, warning, or shutdown function monitored by the genset. They shall also be configurable for colour, and control action (status, warning, or shutdown).
 - .3 The control shall include green lamps to indicate that the generator set is running at rated frequency and voltage, and that a remote start signal has been received at the generator set. The running signal shall be based on actual sensed voltage and frequency on the output terminals of the generator set.
 - .4 The control shall include a flashing red lamp to indicate that the control is not in automatic state, and red common shutdown lamp.
 - .5 The control shall include an amber common warning indication lamp.
 - .6 The generator set control shall indicate the existence of the warning and shutdown conditions on the control panel. All conditions indicated below for warning shall be field-configurable for shutdown. Conditions required to be annunciated shall include:
 - .1 low oil pressure (warning).
 - .2 low oil pressure (shutdown).
 - .3 oil pressure sender failure (warning).
 - .4 low coolant temperature (warning).
 - .5 high coolant temperature (warning).
 - .6 high coolant temperature (shutdown).
 - .7 high oil temperature (warning).
 - .8 engine temperature sender failure (warning).
 - .9 low coolant level (warning).

- .10 fail to crank (shutdown).
 - .11 fail to start/overcrank (shutdown).
 - .12 overspeed (shutdown).
 - .13 low DC voltage (warning).
 - .14 high DC voltage (warning).
 - .15 weak battery (warning).
 - .16 low gas pressure (warning).
 - .17 high AC voltage (shutdown).
 - .18 low AC voltage (shutdown).
 - .19 under frequency (shutdown).
 - .20 over current (warning).
 - .21 over current (shutdown).
 - .22 short circuit (shutdown).
 - .23 over load (warning).
 - .24 emergency stop (shutdown).
 - .25 natural gas supply valve(s) closed.
 - .26 (4) configurable conditions
- .7 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.
- .4 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.
- .5 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.
- .6 Alternator Control Functions:
 - .1 The generator set shall include a full wave rectified 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 line to neutral 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 an adjustable frequency threshold. Torque matching characteristic shall be adjustable for roll-off frequency and rate, and be capable of being curve-matched to the engine torque curve with adjustments in the field. 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 NFPA 70 article 445. The protection for this function shall be 3rd party certified to very performance.
 - .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 NFPA 70 article 445. The protection for this function shall be 3rd party certified to very performance.
 - .4 Controls shall be provided to monitor the kW load on the generator set, and initiate an alarm condition (over load) when total load on the generator set exceeds the generator set rating for in excess of 5 seconds. Controls shall include a load shed control, to operate a set of dry contacts (for use in shedding customer load devices) when the generator set is overloaded.

- .5 A line to neutral sensing 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.
- .6 The generator set control shall include a 120 VAC control heater.
- .7 Other Control Functions
 - .1 The generator set shall be provided with a network communication module to allow LonMark compliant communication with the generator set control by remote devices. The control shall communicate all engine and alternator data, and allow starting and stopping of the generator set via the network in both test and emergency modes.
 - .2 A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25 VDC or more than 32 VDC. During engine cranking (starter engaged), the low voltage limit shall be disabled, and DC voltage shall be monitored as load is applied to the battery, to detect impending battery failure or deteriorated battery condition.

2.7 OTHER EQUIPMENT TO BE PROVIDED WITH THE GENERATOR SET

- .1 Control Interfaces for Remote Monitoring:
 - .1 The control system shall provide four programmable output relays. These relay outputs shall be configurable for any alarm, shutdown, or status condition monitored by the control. The relays shall be configured to indicate: (1) generator set operating at rated voltage and frequency, (2) common warning, (3) common shutdown, (4) load shed command.
 - .2 A fused 10 A switched 24 VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
 - .3 A fused 10 A, 24 VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
 - .4 The control shall be provided with a direct serial communication link for the LonWorks communication network interface as described elsewhere in this specification and shown on the drawings.
- .2 Provide and install a 20-light LED type remote alarm annunciator with horn, located as shown on the drawings or in a location that can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 for level 1 systems for the local generator control panel. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable, and indicating lamp colour shall be capable of changes needed for specific application requirements. Alarm horn shall be switchable for all annunciation points. Alarm horn (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA 110 3-5.6.2. The interconnecting wiring between the annunciator and other system components shall be monitored and failure of the interconnection between components shall be displayed on the annunciator panel.
- .3 The annunciator shall include the following alarm labels, audible annunciation features, and lamp colours:

Condition	Lamp Colour	Audible Alarm
Normal Power (to Loads)	Green	No
Genset Supplying Load	Amber	No
Genset Running	Green	No
Not in Auto	Red (Flashing)	Yes
High Battery Voltage	Red	Yes
Low Battery Voltage	Red	Yes
Charger AC Failure	Red	Yes
Fail to Start	Red	Yes
Low Engine Temperature	Amber	Yes
Pre-High Engine Temperature	Amber	Yes
High Engine Temperature	Red	Yes
Pre-Low Oil Pressure	Amber	Yes
Low Oil Pressure	Red	Yes
Overspeed	Red	Yes
Low Coolant Level	Amber	Yes
Low Fuel Pressure	Amber	Yes
Network OK	Green	Yes
Natural gas supply valve closed	Red	Yes
(4) Spares	Configurable	Configurable

- .4 Low battery voltage lamp shall also be lighted for low cranking voltage or weak battery alarm.
- .5 The generator set shall be provided with a mounted main line circuit breaker, sized to carry the rated output current of the generator set. The circuit breaker shall incorporate an electronic trip unit that operates to protect the alternator under all overcurrent conditions, or a thermal-magnetic trip with other overcurrent protection devices that 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.

2.8 CIRCUIT BREAKERS

- .1 CSA C22.2 No. 5, molded case circuit breakers on generator output with integral thermal and instantaneous magnetic trip in each pole, sized to CSA C22.1. Include battery-voltage operated shunt trip, connected to open circuit breakers on engine failure. Unit mount in enclosure to meet CSA C22.2 No. 100, Type 1 requirements.
- .2 Bolt-on, molded case, temperature compensated for 40°C ambient, dual thermal-magnetic trip. Electronic trip type with adjustments for long-time, instantaneous, and short-time functions.
- .3 Interrupting capacity: To suit available fault current from Generator set alternator.

- .1 Minimum 25 kA IC.
- .2 The emergency generator main overcurrent device shall be coordinated with the overcurrent devices of feeders and branch circuits downstream and in accordance with the Coordination Study specified in Section 26 05 73.16.
- .4 Schedule of generator output circuit breakers:
 - .1 Generator Output Breaker to feed emergency terminals of Automatic Transfer Switches.
 - .2 Load Bank Breaker
 - .1 Rating and ampacity of load bank breaker to match generator output breaker.
 - .2 Equipped with shunt trip capability to ensure that the breaker will be tripped during testing upon receiving engine start signal from Automatic Transfer Switch. Electrical contractor to provide cables from each Automatic Transfer Switch to breaker to suit manufacturer's instructions.
 - .3 Provide lugs allowing ease of connection for load bank cables.

2.9 REMOTE ANNUNCIATION AND MONITORING

- .1 Provide remote annunciator panel for field installation by installing Contractor.
- .2 Provide BACnet/BACnet-IP and other interface required in order to connect the generator control panel to the Building Automation System. The BAS must be able to read all the monitoring and operation signals from genset. Provide all the conduit and wires to the BAS panel and coordinate with Division 25 for final connection. At a minimum, include the following:
 - .1 ON/OFF status.
 - .2 Oil Pressure.
 - .3 Coolant Level.
 - .4 Coolant temperature.
 - .5 Oil Temperature.
 - .6 Up to 10 additional points should be allowed to be programmable for Generator on the BAS.
- .3 The Generator graphics should also be included on the BAS with the points listed above.
- .4 Coordinate with Division 25 to ensure necessary critical alarm parameters are programmed to allow alarms to be sent to relevant stakeholders via email.

2.10 WEATHERPROOF SKIN-TIGHT ENCLOSURE

- .1 Sound attenuating enclosure with sound attenuation to provide sound levels of no greater than 75 dB(A) at 7 m perimeter.
- .2 To suit conduit entry from below grade.
- .3 Access doors with key locks, welded hinges, and door lock port hole to keep door open during maintenance. Maximum access door width 1000 mm.
- .4 Primed for corrosion protection and finish painted in a custom colour to be selected by the Owner and confirmed at submittal review.
- .5 Interior of enclosure to consist of high reflectance materials to improve light levels when servicing or maintaining unit.

2.11 ACCESSORIES

- .1 Factory provided accessories in the generator enclosure prewired to a panelboard in the generator enclosure:
 - .1 Heating:
 - .1 Battery thermal wrap, 120 V, minimum 75 W per battery to maintain battery temperature of 27°C (80°F), and complete with thermostat to eliminate batter damage caused by overheating or acid spill.
 - .2 Motorized intake dampers, 5 kW 208 V 3-phase forced flow heater in enclosure complete with reverse acting thermostat for control to maintain 10°C at all times.
 - .3 Engine block circulating coolant heater with thermostat, sized to engine manufacturer's recommendations].
 - .4 Regulator heater.
 - .2 Lighting:
 - .1 Two LED strip luminaires 4100 lumen nominal, 3500 K CCT, standard driver, frosted lens, wire guard, and control.
 - .1 Signify FluxStream series.
 - .2 Substitution by Acuity Brands, Cree, Cooper Lighting Solutions, Hubbell, Visioneering.
 - .2 Control for luminaires: white decorator style switch installed in surface mount utility box, complete with galvanized steel cover plate with rounded corners.
 - .3 Emergency lighting battery unit complete with 2 hours runtime on loss of utility power and complete with two MR16 LED heads, light output equivalent to two 20 W MR16 incandescent lamps, in accordance with CSA C282 clause 6.11.1.
 - .1 Minimum illumination: 50 lx (5 fc).
 - .2 Battery units shall include automatic self-diagnostic circuitry, and a transient voltage surge suppressor on the supply site of power to the unit.
 - .3 Battery unit to be complete with CSA 5-15 plug and plugged into a dedicated emergency lighting receptacle installed immediately adjacent to the battery unit.
 - .3 Minimum one 5-15R GFI duplex receptacle on generator (in addition to the battery unit receptacle).
 - .4 If spring isolators are to be used, provide generator frame-bottom metal sealing plate to maintain heat inside enclosure, proper directionality of airflow, maintain noise rating, and prevent animal ingress.
 - .5 Other accessories as indicated on the generator enclosure layout drawing, and as required for a complete operating system, and as recommended by the generator manufacturer.
 - .6 Accessories to be fed from a panelboard pre-installed within the generator enclosure, rated 100 A 120/208 V, 3-Ph, 4W, 10 kA IC, complete with main breaker, and complete with full size, bolt-on breakers, installed with vibration isolation from the generator enclosure.
 - .1 Plug-on breaker panelboard, or use of tandem circuit breakers will be rejected and field replaced at manufacturer's expense.

- .2 Acceptable panelboard and circuit breaker manufacturers:
 - .1 Eaton PRL1 series.
 - .2 Schneider Electric NQ series.
 - .3 Siemens equal.
- .3 Provide a minimum of one (1) spare 15 A single pole breaker.
- .2 Supplier to include an inspection for unit enclosure and generator accessories by the Electrical Authority Having Jurisdiction (ESA in Ontario) prior to shipment to site. Submit ESA inspection report to the Consultant.

2.12 SEQUENCE OF OPERATION

- .1 Start generator set on receipt of a start signal from remote equipment (automatic transfer switch). 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:
 - .1 The control system shall verify that the engine is rotating when the starter is signalled to operate. If the engine does not rotate after three attempts, the control system shall shut down and lock out the generator set, and indicate "fail to crank" shutdown.
 - .2 The engine shall start 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".
 - .3 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.
- .4 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.
- .5 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.
- .6 On completion of the time delay stop period, 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.

2.13 SOURCE QUALITY CONTROL

- .1 Provide factory test, start-up by a supplier authorized by the equipment manufacturer(s), and on-site testing of the system.
- .2 The generator set manufacturer shall perform a complete operational test on the generator set prior to shipping from the factory. A certified test report shall be provided to the Consultant. All testing shall be performed with calibrated metering.

- .3 Factory testing may be witnessed by the Owner and the Consultant. Costs for travel expenses will be the responsibility of the Owner and the Consultant. Supplier is responsible to provide two weeks notice for testing.
- .4 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:
 - .1 4 hour run at full load.
 - .2 Maximum power.
 - .3 Voltage regulation.
 - .4 Transient and steady-state governing.
 - .5 Single step load pickup:
 - .1 Zero to 100% to zero.
 - .2 Zero to 75% to zero.
 - .3 Zero to 50% to zero.
 - .4 Zero to 25% to zero.
 - .6 Function of safety shutdowns.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 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 final testing of the system.
- .2 Remove battery from emergency lighting equipment and store indoors in a climate controlled area prior to installation of the generator set.

3.2 PREPARATION

- .1 Location of generator in accordance with the National Fire Code of Canada:
 - .1 Locate at a minimum distance of 1 m to a building on the same property.
 - .2 Locate at a minimum distance of 1 m to a property line.
 - .3 Located such that the exhaust vent or chimney is minimum 3 m (10 ft) from any building.

3.3 INSTALLATION

- .1 Install equipment in accordance with final submittals and contract documents. Comply with applicable provincial and 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 CSA listed products.
- .2 Perform Work to CSA C22.1.
- .3 Conform to CSA B149.1.
- .4 Concrete housekeeping pad:

- .1 Install generator on concrete housekeeping pads [designed by Structural Engineer] to Section 03 30 00.
- .2 Cast-in-place concrete housekeeping pad to extend a minimum of 1 m beyond footprint of generator.
- .3 Coordinate exact conduit entry point with equipment submittals prior to fabricating pad.
- .4 Sleeve conduit stubs and caulk conduits after concrete pour.
- .5 Permanently fasten equipment to the pad in accordance with manufacturer's instructions and seismic requirements of the site.
- .5 Provide all interconnecting wiring between all major equipment provided for the on-site power system. Provide interconnecting wiring between equipment sections (when required), under the supervision of the equipment supplier.
- .6 Provide a minimum 60 A, 2-wire plus neutral plus ground feeder, fed from a 60A/2P breaker in the local 120/208 V emergency receptacle panel to feed generator accessory panel, unless noted otherwise by the manufacturer.
- .7 Install remote annunciator adjacent to the automatic transfer switch, or as noted on drawings.

3.4 GROUNDING AND BONDING (3-POLE ATS)

- .1 Ground and bond to Electrical Code requirements, and Section 26 05 26.
- .2 Remove bonding jumper from generator neutral to suit 3-pole ATS.
- .3 For 3-pole transfer switches utilized on 4-wire systems with unswitched neutrals, provide warning sign at the generator to clearly indicate the use of a floating neutral and that the generator neutral is not separately grounded.

3.5 NOT USED

3.6 FIELD QUALITY CONTROL

- .1 Inspect equipment for physical damage. Repair scratches and other installation damage prior to final system testing. Thoroughly clean equipment to remove all dirt and construction debris prior to initial operation and final testing of the system.
- .2 Manufacturer Services:
 - .1 On completion of the installation, conduct a site evaluation to verify that the equipment is installed per manufacturer's recommended practice.
 - .2 Equipment shall be initially started and operated by representatives of the manufacturer. All protective settings shall be adjusted as instructed by the Consultant.
- .3 Inspections
 - .1 Complete all verifications, inspections, and reports prior to scheduling TSSA inspection.
 - .2 Carry for the cost of all inspections by authorities having jurisdiction, including, but not limited to, the Electrical Safety Authority (ESA), and Technical Standards Safety Authority (TSSA).
 - .3 Carry the cost of all TSSA variances, or as detailed in CSA B149.1.
 - .4 Confirm the emergency lighting unit is fully operational.
- .4 On Site Acceptance Test

- .1 The complete installation shall be tested to verify compliance with the performance requirements of this specification following completion of all site work. Testing shall be conducted by representatives of the manufacturer. Notify the Consultant in advance of the test for the option to witness the tests. The generator set manufacturer shall provide a site test specification covering the entire system.
- .2 Prior to start of active testing, all field connections for wiring, power conductors, and bus bar connections shall be checked for proper tightening torque.
- .3 Installation acceptance tests to be conducted on-site shall include a "cold start" test, a 4 hour full load (resistive) test, and a one step rated load pickup test in accordance with CSA C282. Provide a resistive load bank and make temporary connections for full load test, if necessary.
- .4 Perform a power failure test on the entire installed system. This test shall be conducted by opening the power supply from the utility service, and observing proper operation of the system for at least 2 hours. Coordinate timing and obtain approval for start of test with site personnel.
- .5 The generator set supplier shall issue a test report documenting the results of testing, and including a complete list of all settings in the control system.
- .5 Provide labour and material to conduct the integrated systems testing of interconnected life safety systems in accordance with CAN/ULC-S1001-11.

3.7 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 and the class size shall be limited to 5 persons. Training date shall be coordinated with the Owner.
- .2 Familiarize the Owner's Representative in the testing and maintenance requirements prescribed by Ontario Regulations, O.Reg 524/98:
 - .1 The system shall be used and operated for the purpose of testing or performing maintenance for a maximum of 60 hours in any 12 month period.
 - .2 The system shall be used and operated for the purpose of testing or performing maintenance only between the hours of 7 a.m. and 7 p.m.
 - .3 When the system is used and operated for the purpose of testing or performing maintenance, the air intakes, doors and windows of any buildings or structures located on the same site as the system shall be closed, if doing so would reduce the likelihood of emissions from the system entering the building or structure.
 - .4 If more than one generator unit is part of the system, only one unit shall be used and operated at any time for the purpose of testing or performing maintenance.
 - .5 If the Ministry of the Environment issues a smog advisory that identifies an area in which the system is located, the system shall not be used or operated for the purpose of testing or performing maintenance until a termination notice with respect to the advisory has been issued for that area.

3.8 MAINTENANCE

- .1 Perform equipment maintenance as described in PART 1 of this section.

END OF SECTION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- .1 Provide complete factory assembled power transfer equipment with field programmable digital electronic controls designed for fully automatic operation and including, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts for both sources.
- .2 The Automatic Transfer Switch will transfer the load in delayed transition (break and delay-before-make) mode.
- .3 Automatic transfer switches are to be electrically operated, mechanically held open contact type, without integral overcurrent protection. Transfer switches utilizing automatic or non-automatic molded case circuit breakers as switching mechanisms are not acceptable.
- .4 The transfer switch shall feature a double-sided bypass isolation mechanism.

1.2 RELATED REQUIREMENTS

- .1 Section 26 08 36 – Performance Checklist for Automatic Transfer Switches.
- .2 Section 26 32 13.13 – Diesel-Engine-Driven Generator Sets.
- .3 Section 26 32 13.16 – Gas-Engine-Driven Generator Sets.
- .4 Section 28 46 13 – Fire-Alarm Systems.

1.3 REFERENCES

- .1 CSA Group:
 - .1 CSA C22.1:21, Canadian Electrical Code, Part 1 (25th Edition), Safety Standard for Electrical Installations.
 - .2 Ontario Electrical Safety Code (28th edition/2021).
 - .3 CSA C22.2 No.5:16 (R2021), Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, NMX-J-266-ANCE-2010).
 - .4 CSA C22.2 No. 178.1-14 (R2019), Transfer Switch Equipment.
 - .5 CSA C282:19, Emergency Electrical Power Supply for Buildings.
 - .6 CAN/CSA C60044-1-07 (R2011), Instrument Transformers.
- .2 IEEE
 - .1 IEEE 446, Recommended Practice for Emergency and Standby Power Systems for Commercial and Industrial Applications.
- .3 National Electrical Manufacturers Association (NEMA)
 - .1 ANSI/NEMA ICS 2-1996(R2009), Controllers, Contactors, and Overload Relays, Rated Not More Than 2000 Volts AC or 750 Volts DC, Part 8: Disconnect Devices for Use in Industrial Control Equipment.
 - .2 NEMA ICS 1 - General Standards for Industrial Control and Systems.
 - .3 NEMA ICS 2 -Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
 - .4 NEMA ICS 6 - Industrial Controls and Systems: Enclosures.

- .5 NEMA ICS 10-1993, AC Automatic Transfer Switches.

1.4 ACTION SUBMITTALS

- .1 Within ten days after award of contract, provide electronic copies of the following information for review:
- .2 Product Data:
 - .1 Submit manufacturer's instructions, printed product literature and data sheets for transfer switches and include product characteristics, performance criteria, physical size, finish and limitations, including voltage, switch size, ratings and size of switching and overcurrent protective devices, operating logic, short circuit ratings, dimensions, weights, and enclosure details.
 - .2 A copy of the markings that are to appear on the transfer switches when installed.
 - .3 Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.
 - .4 Interconnection wiring diagrams showing all external connections required; with field wiring terminals marked in a consistent point-to-point manner.
 - .5 Manufacturer's certification of prototype testing.
 - .6 Manufacturer's published warranty documents.
- .3 Shop Drawings:
 - .1 Indicate on drawings:
 - .1 Make, model and type.
 - .2 Single line diagram showing controls and relays.
 - .3 Description of equipment operation including:
 - .1 Automatic starting and transfer to standby unit and back to normal power.
 - .2 Test control.
 - .3 Manual control.
 - .4 Automatic shutdown.
 - .2 Submit drawing of the engraved phenolic equipment nameplate.

1.5 CLOSEOUT SUBMITTALS

- .1 Provide operation and maintenance data for automatic load transfer equipment for incorporation into manual specified in Section 01 78 00. Make prints of electronic submittals.
- .2 Operation and Maintenance Data: submit operation and maintenance data for transfer switches for incorporation into manual.
- .3 Detailed instructions to permit effective operation, maintenance, and repair.
- .4 Technical data:
 - .1 Schematic diagram of components, controls and relays.
 - .2 Illustrated parts lists with parts catalogue numbers.

- .3 Certified copy of factory test results.
- .5 On-site commissioning and functional testing reports.
- .6 Warranty card, specifying the warranties for all ATS's.

1.6 OPERATIONS AND MAINTENANCE DATA

- .1 Operation Data: Include instructions for operating equipment. Include instructions for operating equipment under emergency conditions.
- .2 Maintenance Materials:
 - .1 Include routine preventative maintenance and lubrication schedule.
 - .2 List special tools, maintenance materials, and replacement parts, or indicate if there are no special tools or user serviceable parts.
 - .3 Provide two of each special tool required for maintenance, if applicable.

1.7 QUALITY ASSURANCE

- .1 Manufacturer Qualifications
 - .1 Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience, and with service facilities to respond in timely manner.
 - .2 Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.
 - .3 The manufacturer of the transfer switch shall maintain service parts inventory at a central location which is accessible to the service location 24 hours/day, 365 days/year.
 - .4 The transfer switch shall be serviced by a local service organization that is trained and factory certified in transfer switch 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/day, 365 days/year.
 - .5 Manufacturer 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.
- .2 Regulatory Requirements
 - .1 Provide products listed and classified by CSA or testing firm acceptable to authority having jurisdiction as suitable for purpose specified and indicated.
 - .2 CSA listed and labeled.
 - .3 Meet all requirements as described in CSA C282.

1.8 DELIVERY, STORAGE, AND HANDLING

- .1 Delivery and Acceptance Requirements: deliver materials to site in original factory packaging, labelled with manufacturer's name and address.
- .2 Storage and Handling Requirements:
 - .1 Store materials indoors in dry location and in accordance with manufacturer's recommendations in clean, dry, well-ventilated area.
 - .2 Store and protect transfer switches from nicks, scratches, and blemishes.

- .3 Replace defective or damaged materials with new.

1.9 FIELD MEASUREMENTS

- .1 Verify that field measurements are as indicated on shop drawings.

1.10 MAINTENANCE SERVICE

- .1 Provide service and maintenance of transfer switch for one year from date of Substantial Completion.

1.11 WARRANTY

- .1 Minimum one year from the date of commissioning, warranted against defects in materials and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- .1 ASCO 7000 Series automatic transfer and bypass isolation switch (basis of design).
.2 Cummins Power Generation.
.3 Caterpillar.
.4 Eaton.
.5 Kohler Power Systems.
.6 [LMR Power Systems Inc.](#)

2.2 RATINGS

- .1 As indicated on single line diagram.
.2 Minimum interrupting capacity per the following table, unless a higher value is indicated on the drawings:

Switch Rating (amps)	AIC Rating (kA)
70 - 225	25
250	25
400	35
600, 800	65
1000, 1200	65
1600, 2000	65 [100 Optional]
2500, 3000	100
4000	100

2.3 SYSTEM DESCRIPTION

- .1 Automatic load transfer equipment to:
 - .1 Monitor voltage on all phases of normal (utility) and emergency (generator) power sources.
 - .2 Initiate cranking of standby generator unit on normal power failure or abnormal voltage on any one phase below preset adjustable limits for adjustable period of time.
 - .3 Transfer load from normal supply to standby unit when standby unit reaches rated frequency and voltage pre-set adjustable limits.
 - .4 Transfer load from standby unit to normal power supply when normal power restored, confirmed by sensing of voltage on phases above adjustable pre-set limit for adjustable time period.
 - .5 Shut down standby unit after running unloaded to cool down using adjustable time delay relay.

2.4 AUTOMATIC TRANSFER AND BYPASS/ISOLATION SWITCH

- .1 Description: NEMA ICS 2, automatic transfer switch with manual bypass switch suitable for continuous operation.
- .2 Configuration: Draw-out type electrically-operated, mechanically-held transfer switch with manually-operated CONNECTED, TEST, AND DISCONNECTED draw-out positions, and with mechanically-operated, mechanically-held transfer switch connected to bypass automatic switch in both NORMAL and EMERGENCY positions.
- .3 The transfer switch shall feature a double sided bypass-isolation mechanism to allow power transfer switches to be inspected, tested, and maintained without any interruption of power to the load.
- .4 The isolate and bypass procedure shall not exceed 15 seconds.
- .5 Transfer switch shall permit bypass of the load to either source without load interruption.
- .6 Bypass Switch Ratings: Match automatic transfer switch for electrical ratings.
- .7 Transition: Delayed.

2.5 CONSTRUCTION

- .1 Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in the source 1 and source 2 positions. The transfer switch shall be specifically designed to transfer to the best available source if it inadvertently stops in a neutral position.
- .2 Transfer switches shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms.
- .3 Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishing. Arc chutes shall have insulating covers to prevent inter-phase flashover.
- .4 Transfer switch internal wiring shall be composed of pre-manufactured harnesses that are permanently marked for source and destination. Harnesses shall be connected to the control system by means of locking disconnect plugs, to allow the control system to be easily disconnected and serviced without disconnecting power from the transfer switch mechanism.

- .5 Power transfer switch shall be provided with flame retardant transparent covers to allow viewing of switch contact operation but prevent direct contact with components that could be operating at line voltage levels.
- .6 Transfer switches shall be provided with a neutral bus and lugs. The neutral bus shall be sized to carry 100% of the current designated on the switch rating.

2.6 ENCLOSURE

- .1 Enclosure: ICS 6, Type 1.
- .2 Finish: Manufacturer's standard gray enamel.
- .3 Maximum dimensions and space restrictions: refer to drawings.
 - .1 Ensure adequate space is available at sides and rear of the equipment as required to allow access during installation.
- .4 Enclosures shall be UL listed. The enclosure shall provide wire bend space in compliance to the latest version of CSA standards. The cabinet door shall include permanently mounted key type latches.
- .5 Transfer switch equipment shall be provided in a minimum NEMA 1 sprinklerproof enclosure.
- .6 Enclosures shall be the NEMA type specified. The cabinet shall provide code-required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door. Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.
- .7 Enclosure shall be complete with wireway as required to accept top, side, or bottom cable entry.

2.7 CONNECTIONS

- .1 Field control connections shall be made on a common terminal block that is clearly and permanently labeled.
- .2 Transfer switch shall be provided with mechanical lugs suitable for copper conductors and sized to accept the full output rating of the switch.
- .3 Lugs suitable for multiple parallel runs of conductors.
- .4 Contractor to field verify exact size and quantity of existing conductors.

2.8 SERVICE CONDITIONS

- .1 Transfer switches rated to carry 100 per cent of rated current continuously in the enclosure supplied, in ambient temperatures of -40°C to +60°C, relative humidity up to 95 per cent non-condensing, and altitudes up to 3000 m (10 000 feet).

2.9 MATERIALS

- .1 Instrument transformers: to CAN/CSA C60044-1.
- .2 Contactors: to NEMA ICS2.

2.10 CONTROLS AND INDICATORS

- .1 Selector switches:
 - .1 2 position for system test with load "Test", "Auto"
 - .2 3 position for generator control "Auto", "Manual", "Engine Start"
 - .3 Test position - normal power failure simulated. Engine starts and transfer takes place. Return switch to "Auto" to stop engine.
 - .4 Auto position - normal operation of transfer switch on failure of normal power; retransfers on return of normal voltage and shuts down engine.
 - .5 Manual position - transfer switch may be operated by manual handle but transfer switch will not operate automatically and engine will not start.
 - .6 Engine start position - engine starts but unit will not transfer unless normal power supply fails. Switch must be returned to "Auto" to stop engine.
- .2 Control transformers: dry type with 120 V secondary to isolate control circuits from:
 - .1 Normal power supply.
 - .2 Emergency power supply.
- .3 Relays: continuous duty, industrial control type, with wiping action contacts rated 10 A minimum:
 - .1 Voltage sensing: 3 phase for normal power and on three phases for emergency, solid state type, adjustable drop out and pick up, close differential, 2 V minimum undervoltage and over voltage protection.
 - .2 Time delays as indicated in the Sequence of Operation section
 - .3 Frequency sensing, to prevent transfer from normal power supply until frequency of standby unit reaches preset adjustable values.
- .4 Product Options and Features
 - .1 Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION, NORMAL BYPASS, ALTERNATE SOURCE BYPASS.
 - .2 Test Switch: Mount in cover of enclosure to simulate failure of normal source.
 - .3 Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.
 - .4 Transfer Switch Auxiliary Contacts: two normally open; two normally closed.
 - .5 Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 85 percent or frequency varies more than 3 percent from rated nominal value.
 - .6 Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 85 percent or frequency varies more than 3 percent from rated nominal value.
- .5 Operator Panel. Each transfer switch shall be provided with a control panel to allow the operator to view the status and control operation of the transfer switch. The operator panel shall be a sealed membrane panel rated NEMA 3R/IP53 or better that is permanently labeled for switch and control functions. The operator panel shall be provided with the following features and capabilities.

- .1 High intensity LED lamps to indicate the source that the load is connected to (source 1 or source 2); and which sources are available. Source available LED indicators shall operate from the control microprocessor to indicate the true condition of the sources as sensed by the control.
- .2 High intensity LED lamps to indicate that the transfer switch is “not in auto” (due to control being disabled or due to bypass switch enabled or in operation) and “Test/Exercise Active” to indicate that the control system is testing or exercising the generator set.
- .3 “OVERRIDE” pushbutton to cause the transfer switch to bypass any active time delays for start, transfer, and retransfer and immediately proceed with its next logical operation.
- .4 “TEST” pushbutton to initiate a pre-programmed test sequence for the generator set and transfer switch. The transfer switch shall be programmable for test with load or test without load.
- .5 “LAMP TEST” pushbutton(s) to test all lamps on the panel by lighting them, either simultaneously from one control, or individually.
- .6 The control system shall continuously log information on the number of hours each source has been connected to the load, the number of times transferred, and the total number of times each source has failed. This information shall be available via a PC-based service tool or an operator display panel.
- .7 Security Key Switch or password on control panel to allow the user to inhibit adjustments.
- .8 Key operated test operator switch to prevent manual operation or testing of the transfer switch unless key is in place and operated.
- .9 Digital AC meter display panel, to display 3-phase AC Volts, Hz, kW load level, and load power factor. The display shall be colour-coded, with green scale indicating normal or acceptable operating level, yellow indicating conditions nearing a fault, and red indicating operation in excess of rated conditions for the transfer switch.
- .10 Vacuum fluorescent or LCD alphanumeric display panel with push-button navigation switches. The display shall be clearly visible in both bright (sunlight) and no light conditions. It shall be visible over an angle of at least 120 degrees. The Alphanumeric display panel shall be capable of providing the following functions and capabilities:
 - .1 Display source condition information, including AC voltage for each phase of normal and emergency source, frequency of each source. Voltage for all three phases shall be displayed on a single screen for easy viewing of voltage balance.
 - .2 Display source status, to indicate source is connected or not connected.
 - .3 Display load data, including 3-phase AC voltage, 3-phase AC current, frequency, kW, kVA, and power factor. Voltage and current data for all phases shall be displayed on a single screen.
 - .4 The display panel shall allow the operator to view and make the following adjustments in the control system, after entering an access code:
 - .1 Adjust voltage and frequency sensor operation set points.
 - .2 Set up time clock functions.
 - .3 Set up load sequence functions.
 - .4 Enable or disable control functions in the transfer switch, including program transition.

- .5 Set up exercise and load test operation conditions, as well as normal system time delays for transfer time, time delay start, stop, transfer, and retransfer.
- .5 Display Real time Clock data, including date, and time in hours, minutes, and seconds. The real time clock shall incorporate provisions for automatic daylight savings time and leap year adjustments. The control shall also log total operating hours for the control system.
- .6 Display service history for the transfer switch. Display source connected hours, to indicate the total number of hours connected to each source. Display number of times transferred, and total number of times each source has failed.
- .7 Display fault history on the transfer switch, including condition, date/time of fault. Faults to include controller checksum error, low controller DC voltage, ATS fail to close on transfer, ATS fail to close on retransfer, battery charger malfunction, network battery voltage low, network communications error.
- .6 Internal Controls
 - .1 Provide RMS voltage sensing and metering that is accurate to within plus or minus 1% of nominal voltage level. Frequency sensing shall be accurate to within plus or minus 0.2%. Voltage sensing shall be monitored based on the normal voltage at the site. Systems that utilize voltage monitoring based on standard voltage conditions that are not field configurable are not acceptable.
 - .2 Transfer switch voltage sensors shall be close differential type, providing source availability information to the control system based on the following functions:
 - .1 Monitoring all phases of the normal service (source 1) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of normal voltage level).
 - .2 Monitoring all phases of the emergency service (source 2) for under voltage conditions (adjustable for pickup in a range of 85 to 98% of the normal voltage level and dropout in a range of 75 to 98% of pickup voltage level).
 - .3 Monitoring all phases of the normal service (source 1) and emergency service (source 2) for voltage imbalance.
 - .4 Monitoring all phases of the normal service (source 1) and emergency service (source 2) for loss of a single phase.
 - .5 Monitoring all phases of the normal service (source 1) and emergency service (source 2) for phase rotation.
 - .6 Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over voltage conditions (adjustable for dropout over a range of 105 to 135% of normal voltage, and pickup at 95-99% of dropout voltage level).
 - .7 Monitoring all phases of the normal service (source 1) and emergency service (source 2) for over or under frequency conditions.
 - .8 Monitoring the neutral current flow in the load side of the transfer switch. The control shall initiate an alarm when the neutral current exceeds a preset adjustable value in the range of 100-150% of rated phase current for more than an adjustable time period of 10 to 60 seconds.
 - .3 All transfer switch sensing shall be configurable from the Transfer Switch or a Remote PC-based service tool, to allow setting of levels, and enabling or disabling of features and

functions. Selected functions including voltage sensing levels and time delays shall be configurable using the operator panel. Designs utilizing DIP switches or other electromechanical devices are not acceptable. The transfer control shall incorporate a series of diagnostic LED lamps.

- .4 The transfer switch shall be configurable to control the operation time from source to source (program transition operation). The control system shall be capable of enabling or disabling this feature, and adjusting the time period to a specific value. A phase band monitor or similar device is not acceptable.
- .5 The transfer switch shall incorporate adjustable time delays for generator set start (adjustable in a range from 0-15 seconds); transfer (adjustable in a range from 0-120 seconds); retransfer (adjustable in a range from 0-30 minutes); and generator stop (cool-down) (adjustable in a range of 0-30 minutes).
- .6 The transfer switch shall be configurable to accept a relay contact signal and a network signal from an external device to prevent transfer to the generator service.
- .7 The control system shall be designed and prototype tested for operation in ambient temperatures from -40°C to +70°C. It shall be designed and tested to comply with the requirements of the noted voltage and RFI/EMI standards.
- .8 The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs, to provide optimum protection from line voltage surges, RFI and EMI.

2.11 ACCESSORIES

- .1 Ensure pilot lights indicate power availability normal and standby, switch position, green for normal, red for standby, mounted in panel.
- .2 Plant exerciser.
- .3 Auxiliary Relays:
 - .1 Auxiliary relays to provide normally open (NO) and normally closed (NC) contacts for remote alarms.
 - .2 The transfer switch will provide the following dry contact monitoring points to determine status of the ATS remotely:
 - .1 Normal power available
 - .2 Emergency power available
 - .3 ATS in "Normal" position
 - .4 ATS in "Emergency" position
 - .5 ATS "Not in Auto"
 - .6 Pre-transfer
 - .7 Failure to Synchronize
 - .8 Extended Parallel Alarm
- .4 Instruments:
 - .1 Digital true RMS, indicating type 2 per cent accuracy, flush panel mounting:
 - .1 Voltmeter: AC, scale 0 to nominal system voltage +10%.

- .2 Ammeter: ac, scale 0 to 10% above continuous rating.
- .3 Frequency meter: scale 55 Hz to 65 Hz.
- .4 Voltmeter selector switch: rotary, maintained contacts, panel mounting type, round notched handle, four position, labelled "OFF-Phase A-Phase B-Phase C".
- .5 Ammeter selector switch: rotary, maintained contacts, panel mounting type, designed to prevent opening of current circuits, round notched handle, four position labelled "OFF - Phase A - Phase B - Phase C".
- .6 Bypass and Isolator
 - .1 A two-way bypass-isolation switch shall provide manual bypass of the load to either source and permit isolation of the automatic transfer switch from all source and load power conductors. All main contacts shall be manually driven.
 - .2 Power interconnections shall be silver-plated copper bus bar. The only field installed power connections shall be at the service and load terminals of the bypass-isolation switch. All control interwiring shall be provided with disconnect plugs.
 - .3 Separate bypass and isolation handles shall be utilized to provide clear distinction between the functions. Handles shall be permanently affixed and operable without opening the enclosure door. Designs requiring insertion of loose operating handles or opening of the enclosure door to operate are not acceptable.
 - .4 Bypass to the load-carrying source shall be accomplished with no interruption of power to the load (make before break contacts). Designs that disconnect the load when bypassing are not acceptable. The bypass handle shall have three operating modes: "Bypass to Normal," "Automatic," and "Bypass to Emergency." The operating speed of the bypass contacts shall be the same as the associated transfer switch and shall be independent of the speed at which the manual handle is operated. In the "Automatic" mode, the bypass contacts shall be out of the power circuit so that they will not be subjected to fault currents to which the system may be subjected.
 - .5 The isolation handle shall provide three operating modes: "Closed," "Test," and "Open." The "Test" mode shall permit testing of the entire emergency power system, including the automatic transfer switches with no interruption of power to the load. The "Open" mode shall completely isolate the automatic transfer switch from all source and load power conductors. When in the "Open" mode, it shall be possible to completely withdraw the automatic transfer switch for inspection or maintenance to conform to code requirements without removal of power conductors or the use of any tools.
 - .6 When the isolation switch is in the "Test" or "Open" mode, the bypass switch shall function as a manual transfer switch.
 - .7 Designs requiring operation of key interlocks for bypass isolation or ATs which cannot be completely withdrawn when isolated are not acceptable.
- .7 Communications Module
 - .1 The communications shall be capable of connecting to the Ethernet TCP/IP network with BacNet card for BAS communication. This module shall allow for the seamless integration of communication transfer devices.
 - .2 Allow remote viewing of transfer switch information from a PC, including transfer switch name, real time load in kW on the transfer switch, current source condition, and current operating mode.

2.12 EQUIPMENT IDENTIFICATION

- .1 Identify equipment in accordance with Section 26 05 53.
- .2 Control panel:
 - .1 For selector switch and manual switch: size 4 nameplates.
 - .2 For meters, indicating lights, minor controls: use size 3 nameplates.
- .3 Warning labels:
 - .1 For 3-pole transfer switches utilized on 4-wire systems with unswitched neutrals, provide warning sign on transfer switch to clearly indicate the use of a floating neutral and that the generator neutral is not separately grounded.
 - .2 For 4-pole transfer switches utilized on a 4-wire system with a switch neutral, provide warning sign on transfer switch to clearly indicate that each source is separately grounded.
- .4 Nameplates:
 - .1 Engraved phenolic nameplate, 3 mm (1/8 in) thick plastic engraved sheet.
 - .2 Red face, white core unless noted otherwise.
 - .3 To be mechanically attached with self-tapping screws.
 - .4 White letters, 12 mm (1/2 in.) high unless otherwise noted below.
 - .5 To include:
 - .1 Identity of equipment (i.e. ATS-1), 20 mm (3/4 in.) high letters.
 - .2 Voltage.
 - .3 Ampacity.
 - .4 Number of phases.
 - .5 Identity, switchboard section (if applicable), circuit number, and size of Normal Power source.
 - .6 Identity, switchboard section (if applicable), circuit number, and size of Emergency Power source.
 - .7 Identity of device or panelboard on the Load side of the transfer switch.
 - .8 Date of installation.
 - .9 If upstream or downstream device is located in a separate room from ATS, indicate the room name and number.
 - .6 Confirm exact colours and text with the engineer prior to fabrication.
 - .7 Example of nameplate:

AUTOMATIC TRANSFER AND BYPASS ISOLATION SWITCH

ATS-1

800 A-4P, SWITCHED NEUTRAL, 347/600 V, 3PH, 4W
NORMAL FED FROM 800 A-3P BREAKER IN MAIN SWITCHBOARD
EMERGENCY FED FROM 450 kW STANDBY GENERATOR OUTSIDE
CONTROLS 450 kW GENERATOR FOR DATA CENTRE
FEEDING PANEL DPSP6A
INSTALLED APRIL 2013

2.13 SOURCE QUALITY CONTROL

- .1 Complete equipment, including transfer mechanism, controls, relays, and accessories factory assembled and tested in presence of the Consultant.
- .2 Notify Consultant 5 days minimum in advance of date of factory test.
- .3 Tests:
 - .1 Operate equipment both mechanically and electrically to ensure proper performance.
 - .2 Check selector switch, in modes of operation Test, Auto, Manual, Engine Start and record results.
 - .3 Check voltage sensing and time delay relay settings.
 - .4 Check:
 - .1 Automatic starting and transfer of load on failure of normal power.
 - .2 Retransfer of load when normal power supply resumed.
 - .3 Automatic shutdown.
- .5 Provide copy of test reports and include with Commissioning Manual.

2.14 SEQUENCE OF OPERATION

- .1 The automatic and manual control of an emergency electrical power supply system, including the starting of a generator set or generator sets, and actuation of automatic transfer switches to connect a load to the emergency supply and reconnect it to the normal supply, shall be in the following sequence:
 - .1 Confirm initial set points with the Consultant prior to start up and commissioning.
 - .2 The generator sets shall be started when the normal supply at the transfer switch on one or more phase has been interrupted or is at a voltage that is less than 70 per cent of the nominal system voltage for 3 seconds.
 - .1 Initiate time delay to start alternate source engine generator: Upon initiation by normal source monitor.
 - .2 Time delay to start alternate source engine generator: 0 to 3 seconds, adjustable. Initial set point 3 seconds.

- .3 Initiate transfer load to alternate source: Upon initiation by normal source monitor and permission by alternate source monitor.
- .4 Time delay before transfer to alternate power source: 0 to 60 minutes, adjustable.
 - .1 Initial set point for "Non-Life Safety" transfer switches: 30 seconds.
- .5 The set points for the items above shall be configured such that the generator is connected to and powering life safety equipment within 15 seconds of the loss of normal power.
- .3 Where delayed emergency loads are arranged to be connected to the emergency supply later than the emergency loads, all of the delayed emergency loads and any other loads that have been arranged for connection at the same time.
- .4 On restoration of the normal supply, and after nominal voltage and frequency have been maintained at nominal levels on all phases of the transfer switch for a period of 1 to 30 minutes, the automatic transfer switches shall transfer the loads back to the normal supply, except that the transfer shall occur without delay when an emergency supply fails.
 - .1 Initiate retransfer load to normal source: upon permission by normal source monitor.
 - .2 Time delay before transfer to normal power: 0 to 60 minutes, adjustable; bypass time delay in event of alternate source failure. Initial set point 10 minutes.
 - .3 Delayed transition duration: 0.5 to 3 seconds. Initial set point 0.5 seconds.
- .5 After the transfer of loads back to the normal supply, the automatic shutdown of the generator set shall be delayed for 5 minutes or a reasonable length of time to stabilize the operating temperature under no-load conditions.
 - .1 Time delay before engine shut down: 0 to 60 minutes, adjustable, of unloaded operation. Initial set point 5 minutes.
- .2 Automatic engine exerciser:
 - .1 Engine Exerciser: Start engine every 7 days; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.
 - .2 Alternate System Exerciser: Transfer load to alternate source during engine exercising period.
 - .3 Initial set point: turn off automatic engine exerciser.
- .3 Generator Set Exercise (Test) With Load Mode. The control system shall be configurable to test the generator set under load. In this mode, the transfer switch shall control the generator set in the following sequence:
 - .1 Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - .2 The transfer switch shall issue a compatible start command to the generator set, and cause the generator set to start and run at idle until it has reached normal operating temperature.
 - .3 When the generator set has reached normal operating temperature or after an adjustable time period (whichever is shorter), the control system shall accelerate the generator set to rated voltage and frequency.
 - .4 When the control systems senses the generator set at rated voltage and frequency, it shall operate to connect the loads to the generator set by opening the normal source contacts, and closing the alternate source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.

- .5 The generator set shall operate connected to the load for the duration of the exercise period. If the generator set fails during this period, the transfer switch shall automatically reconnect the generator set to the normal service.
- .6 On completion of the exercise period, the transfer switch shall operate to connect the loads to the normal source by opening the alternate source contacts, and closing the normal source contacts a predetermined time period later. The timing sequence for the contact operation shall be programmable in the controller.
- .7 The transfer switch shall operate the generator set unloaded for a cool-down period, and then remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.
- .4 Generator Set Exercise (Test) Without Load Mode. The control system shall be configurable to test the generator set without transfer switch load connected. In this mode, the transfer switch shall control the generator set in the following sequence:
 - .1 Transfer switch shall initiate the exercise sequence at a time indicated in the exercise timer program, or when manually initiated by the operator.
 - .2 When the control systems senses the generator set at rated voltage and frequency, it shall operate the generator set unloaded for the duration of the exercise period.
 - .3 At the completion of the exercise period, the transfer switch shall remove the start signal from the generator set. If the normal power fails at any time when the generator set is running, the transfer switch shall immediately connect the system loads to the generator set.

2.15 SOURCE QUALITY CONTROL

- .1 The transfer switch manufacturer shall perform a complete operational test on the transfer switch prior to shipping from the factory. Tests shall be conducted as per CSA standards. A certified test report shall be included in each copy of the Operations Manual. Test process shall include calibration of voltage sensors. The following factory tests shall be performed:
 - .1 Visual inspection to verify that each ATS is in accordance with the specifications.
 - .2 Mechanical test to verify that ATS sections are free of mechanical hindrances.
 - .3 Insulation resistance test to ensure integrity and continuity of entire system.
 - .4 Main switch contact resistance test.
 - .5 Electrical tests to verify complete system electrical operation and to set up time delays and voltage sensing settings.
- .2 Provide for the Owner and Consultant to witness factory testing.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Verify existing conditions, including restrictions for moving equipment into position and ensure equipment can suit these limitations.
- .2 Coordinate disassembly and field assembly of equipment with the manufacturer.

3.2 INSTALLATION

- .1 Install transfer switches to in accordance with codes, as shown on the drawings, and as recommended by manufacturer's instructions.
- .2 Provide engraved plastic nameplates.
- .3 Locate, install and connect transfer equipment as indicated.
- .4 Check relays and solid state monitors and adjust as required to ensure correct operation.
- .5 Install and connect remote alarms and IP based monitoring.
- .6 Connect generator control wiring.
 - .1 Provide one pair of stranded conductors from the ATS "start-stop" signal contacts to the generator.
 - .2 Provide one-pair of conductors from the ATS "on generator source" contacts to the load bank shunt trip breaker.
- .7 Set field-adjustable intervals and delays, relays, and engine exerciser. Verify exact set points with the Consultant.

3.3 MANUFACTURER'S FIELD SERVICES

- .1 The manufacturer shall provide disassembly, field assembly, and field certification services to suit restrictions of moving equipment into place.
- .2 A factory-authorized service representative is to perform start-up and testing of the ATS in the presence of the commissioning authority.

3.4 FIELD QUALITY CONTROL

- .1 Perform tests in accordance with Section 26 05 00, and Section 26 08 00.
- .2 Energize transfer equipment from normal power supply.
- .3 Set selector switch in "Test" position to ensure proper standby start, running, transfer, retransfer. Return selector switch to "Auto" position to ensure standby shuts down.
- .4 Set selector switch in "Manual" position and check to ensure proper performance.
- .5 Set selector switch in "Engine start" position and check to ensure proper performance. Return switch to "Auto" to stop engine.
- .6 Set selector switch in "Auto" position and open normal power supply disconnect. Standby should start, come up to rated voltage and frequency, and then load should transfer to standby. Allow to operate for 10 minutes, then close main power supply disconnect. Load should transfer back to normal power supply and standby should shutdown. Repeat, at 1 hour intervals, 4 times, complete test with selector switch in each position, for each test.

3.5 SITE TESTS AND INSPECTIONS

- .1 Submit commissioning reports to the Consultant.
- .2 A factory-authorized service representative is required to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
- .3 Following completion of automatic transfer switch installation and after making proper adjustments and settings, site tests shall be performed by the manufacturer's representative in accordance with manufacturer's written instructions to demonstrate that each automatic transfer

switch functions satisfactorily and as specified. Advise the Consultant of the site testing within five days prior to its scheduled date, and provide certified field test reports within 14 days following successful completion of the site tests. Test reports shall describe adjustments and settings made and site tests performed. Minimum operational tests shall include the following:

- .1 Insulation resistance shall be tested, both phase-to-phase and phase-to-ground.
- .2 Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.
- .3 Verify that manual transfer warnings are properly placed.
- .4 Perform manual transfer operation.
- .5 After energizing circuits, demonstrate the interlocking sequence and operational function.
- .6 Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.
- .7 Simulate loss of phase-to-ground voltage for each phase of normal source.
- .4 Verify time-delay settings.
- .5 Verify pickup and dropout voltages by data readout or inspection of control settings.
- .6 Verify proper sequence and correct timing of automatic engine starting, transfer time delay, re-transfer time delay on restoration of normal power, and engine cool-down and shut-down.
- .7 Test bypass/isolation unit functional modes and related automatic transfer-switch operations.
- .8 Power failure of normal source shall be simulated by opening upstream protective device. This test shall be performed a minimum of five times.
- .9 Power failure of emergency source with normal source available shall be simulated by opening upstream protective device for emergency source. This test shall be performed a minimum of five times.
- .10 Low phase-to-ground voltage shall be simulated for each phase of normal source.
- .11 Operation and settings shall be verified for specified automatic transfer switch operational feature, such as override time delay, transfer time delay, return time delay, engine shutdown time delay, exerciser, auxiliary contacts, and supplemental features.
- .12 Manual and automatic transfer and bypass isolation functions shall be verified.

3.6 CLEANING

- .1 Progress Cleaning: clean in accordance with Section 01 74 00. 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 00.

3.7 DEMONSTRATION

- .1 At the final inspection in the presence of the Consultant, demonstrate that the complete auxiliary electrical power system operates properly in every respect.
- .2 Coordinate this demonstration with the demonstration of the engine-generator.
- .3 Demonstrate operation of transfer switch in bypass, normal, and emergency modes.
- .4 Demonstrate operation of IP based monitoring and configuration.

3.8 TRAINING

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

END OF SECTION

PART 1 - GENERAL

1.1 PRICING

- .1 All costs associated with the work required by and associated with this Section shall be included as part of the Contract Price and in the price listed in item #1 of the Bid Form.

1.2 GENERAL INSTRUCTIONS

- .1 Read and conform to:
 - .1 the General Conditions and the Supplementary Conditions of the Contract.
 - .2 Division 01 requirements and documents referred to therein.

1.3 SUMMARY

- .1 Work Included: Provide labour, materials, products, consumables and equipment for the fencing work specified herein.
- .2 Related Requirements: Specifications throughout the entirety of Divisions of this Project are directly applicable to this Section, and this Section is directly applicable to them.

1.4 REFERENCES

- .1 Reference Standards: Latest published editions of reference standards listed in this Section in effect as of the closing date and time of the Request for Tenders for the Contract, including any amendments adopted, are applicable unless otherwise indicated.

1.5 ADMINISTRATIVE REQUIREMENTS

- .1 Pre-Installation Meetings:
 - .1 Prior to starting work of this Section, convene a pre-installation meeting at Project site to review Project requirements and site conditions with pertinent parties. Conform to requirements of Section 01 30 00.

1.6 SUBMITTALS

- .1 Product Data: Product Data: Submit manufacturer's literature and data sheets for each type of material provided under this Section for the Project in accordance with requirements of Division 01.
- .2 Safety Data Sheets (SDS): Submit SDS for inclusion in Operation and Maintenance Manual specified in Section 01 70 00, for adhesives, sealants and any other material designated by Consultant.
- .3 Shop Drawings: Submit Shop Drawings in accordance with Section 01 30 00.

PART 2 - PRODUCTS

2.1 MATERIAL

- .1 Fencing, unless specified otherwise in Drawings and Shop Drawings, shall comply with the following requirements:
 - .1 All chain link fencing to be heavy-duty hot dipped galvanized finish to municipal standards and in conformance with the detailed Drawings.

- .2 Refer to Shop Drawings and detail Drawings for specific requirements of fencing and chain link fencing. Refer to plans for fencing locations.
- .2 Concrete mixes and materials: to Section 03 30 00 - Cast-in-Place Concrete and as per detail Drawings. Concrete strength to be 3000 psi after 28 Days, unless specified otherwise in Section 03 30 00 – Cast-in-Place Concrete.
- .3 Chain link fence fabric: to CAN/CGSB-138.1-M80, as per detail Drawings and to a minimum of:
 - .1 Mesh to be hot dipped galvanized after waving and knuckled finish top and bottom selvage edges. Galvanized fabric to have a minimum zinc application of 490 g/m2 of surface area or as illustrated on the Drawings.
- .4 All items to be as per detail Drawings and Shop Drawings.

2.2 FINISHES

- .1 Galvanizing:
 - .1 For chain link fabric: to CAN/CGSB-138.1-M80 Grade 2.
 - .2 For pipe: 550 g/m2 minimum to ASTM A90-81.
 - .3 For other fittings: to CSA G164-M1981.
- ~~.3.2~~ Finish: to be black vinyl coated.

PART 3 - EXECUTION

3.1 EXAMINATION

- .1 Site Verification of Conditions:
 - .1 Verify actual site dimensions and location of adjacent materials prior to commencing work. Notify Consultant in writing of any conditions which would be detrimental to the installation. Commencement of work implies acceptance of previously completed work.

3.2 GRADING

- .1 Remove debris and correct ground undulations along fence line to obtain smooth uniform gradient between posts. Provide clearance between bottom of fence and ground surface as specified on drawings.

3.3 GENERAL INSTALLATION

- .1 Ensure Drawings and/or on-site instructions clearly indicate which side of fence line the fabric and overhang are to be installed.
- .2 Erect fence along lines indicated and in accordance with CAN/CGSB-138.3-M80 and manufacturer's specifications.
- .3 Excavate post holes to dimensions indicated.
- .4 Space line posts as indicated, measured parallel to ground surface.
- .5 Install additional bracing as indicated in detailed Drawings.
- .6 Install corner post where change in alignment exceeds 10 degrees, unless otherwise specified on the Drawings.
- .7 Install end posts at end of fence and at buildings. Install gate posts on both sides of gate openings.

- .8 Place concrete/grout in post holes then embed posts into concrete to depths indicated. Concrete to drain away from posts. Brace to hold posts in plumb position and true to alignment and elevation until concrete has set.
- .9 Do not install fence fabric until concrete has cured a minimum of 5 Days.
- .10 Unless otherwise indicated, install brace between end and gate posts and nearest line post, placed in centre of panel and parallel to ground surface. Where indicated, install braces on both sides of corner and straining posts in similar manner.
- .11 Install overhang tops and caps where required.
- .12 Install top rail between posts, fasten securely to posts and secure waterproof caps and overhang tops.
- .13 Install middle and bottom rails between posts and fasten securely, as per the detail Drawings.
- .14 Lay out fence fabric. Stretch tightly to tension recommended by manufacturer and fasten to end, corner, gate and straining posts with tension bar secured to post with tension bar bands spaced as per details. Knuckled selvage at bottom; twisted selvage at top, unless otherwise indicated on details and Shop Drawings.
- .15 Secure fabric to top rails, line posts and bottom rails with 6-gauge tie wires as per detail and Shop Drawings. Give tie wires minimum three twists.

3.4 INSTALLATION OF CHAIN LINK GATES

- .1 Install gates as indicated on detail plans and Shop Drawings.
- .2 Determine position of centre gate rest for double gate. Cast gate rest in concrete as directed. Dome concrete above ground level to shed water.
- .3 Install gate stops where indicated.

3.5 TOUCH UP

.1 Touch up as required.

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

3.6 RESTORATION

- .1 Clean and trim areas disturbed by operations to satisfaction of the Consultant. Dispose of surplus material off site.

3.7 WARRANTY

- .1 The Contractor shall provide a warranty, with a warranty period that is a minimum of five (5) years starting on Substantial Performance of the Work, for all fence and gate components including workmanship.

END OF SECTION