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NHRC GENERATOR REPLACEMENT

AT

NATIONAL HYDROLOGY RESEARCH CENTRE

SPECIFICATIONS

**REAL PROPERTY MANAGEMENT DIVISION, TECHNICAL SERVICES
11 INNOVATION BLVD.
SASKATOON, SK S7N 3H5**

**PROJECT: NHRC-005-J1301
DATE: JUNE 21, 2016
ISSUED FOR TENDER**

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1. SUMMARY OF WORK

1. The Contractor shall provide all labour and materials required to complete the replacement of the Emergency generator at the National Hydrology Research Centre, 11 Innovation Blvd. Saskatoon, SK as described in the attached plans and specifications.
2. The work on this contract includes coordination and cooperation with other contractors and building personnel working on the site.
3. Work to be performed under this Contract includes, but is not limited to, the following items covered further in the Contract Documents, items below summarize major equipment, refer to full Contract Documents for complete listing.
 - .1 Supply, install and connect new equipment and all associated connectors
 1. Removal of existing standby generator, fuel tank and housekeeping pad
 2. 1x Emergency Closed Transition Transfer Switch c/w Manual Bypass
 3. 1x Exterior Generator and concrete slab
4. The scope of the electrical work is as follows:
 1. Install new concrete pad for generator.
 2. Run new feeders as required for the project. This will prepare the installation for the new layout. These feeders include:
 1. Feeders from switch/fuse in MCC-1 to new transfer switch location
 2. Feeders from new transfer switch to MCC-1A
 3. Feeders from the emergency generator to the new E-CDP
 4. Feeders from the E-CDP to the new transfer switch location.
 3. Set into place the new closed transition transfer switch as shown on the plans.
 4. Terminate the following feeds onto the new transfer switch
 1. Utility power from MCC 1.
 2. Emergency power from E-CDP
 5. Take over existing temporary generator contract.
 6. Install new emergency generator outside on new concrete slab.
 7. Run new mechanical piping to new generator location
 8. Terminate the following feeders
 1. Feeder from the new generator to E-CDP
 2. Feeder from E-CDP to the new transfer switch.
 3. Feeder associated with the new load bank to the generator exterior splitter.

9. Request a shutdown of MCC-1
 1. Start temporary generator
 2. Terminate all feeders associated with the normal power feeders from MCC-1 to transfer switch
10. Test/commission the emergency generator to ensure that the new generator control panel functions properly, via loading from the permanent 400kw load bank.
11. Test/commission the new emergency transfer switch to ensure that it functions properly. Testing shall include the following and shall be conducted in the presence of the consultant:
 1. Testing the transfer switch while the generator is 'on' to ensure that the transfer switch carries the load seamlessly under test conditions between utility power and emergency and back to utility power again.
 2. Testing the transfer switch while the generator is off by opening up the switch/fuse located in MCC-1 to ensure that the generator starts and the transfer switch switches the load to emergency power. The switch in MCC-1 shall then be switch back 'on' to ensure that the generator switches back to utility power seamlessly.
 3. The transfer switch shall be tested in manual bypass mode.
12. Confirm that a shutdown of MCC-1A is required.
13. Remove the conductors from the temporary generator to MCC-1A and tie in the permanent feeders from E-CDP.
14. Test the transfer switch function again under the load conditions of MCC-1A .
15. Remove old generator and associated components.

2. TIME OF COMPLETION

1. Commence work in accordance with notification of acceptance of your tender submission and complete the work including rectification of deficiencies within twenty-four (24) weeks of commencement.

3. HOURS OF WORK

1. Work shall be carried out Monday to Friday from 08:00hrs to 16:15hrs.
2. Shutdown, bypassing or isolating any parts effecting the electrical shall be undertaken after hours, Monday through Friday from 17:30hrs to 06:00hrs and/or on weekends from 06:00hrs to 18:00hrs.

3. Lock-Out / Tag-Out (LOTO) work shall be completed off-hours Monday through Friday from 17:30hrs to 07:00hrs and and/or on weekends from 06:00hrs to 18:00hrs. All Internal & External LOTO permits will be required to commence work.
4. Live Work procedures will not be permitted on this site.
5. The Contractor shall not permit his personnel to work alone on this project when the following activities are undertaken:
 1. Work assessment determined that the potential health & safety risk is high;
 2. Work requiring entry into or work within a Confined Space;
 3. Work requiring Lock-Out / Tag-Out (LOTO);
 4. Work requiring use of fall arrest equipment;
 5. Work on scaffolding;
 6. Work requiring supplied air respirators or similar equipment;
 7. Hot Work and/or Hot Tap activities;
 8. Work involving cranes or hoisting;
 9. Work or work situations identified by the Engineer.
6. Work affecting laboratory operations shall be carried out after normal hours as defined in 3.1 above. Any shut down of service effecting laboratory operations requires a minimum of 48 hours notice.

4. SCHEDULING

1. On award of contract submit a bar chart construction schedule for the work, indicating anticipated progress stages within time of completion. Minimum stages include, mobilization, shop drawing, product data MSDS sheets and samples submittal, order and delivery of major components and equipment, major approvals stages, interim and final inspection times, commissioning timeframes, final deficiency corrections, training, demobilization and manuals submission. When schedule has been reviewed and approved by the Engineer take necessary measures to complete work within scheduled times. Do not change schedule without written approvals from the Engineer.

5. CONTRACT DOCUMENTS

1. Drawings and specifications are complementary, items shown or mentioned in one and not in the other are deemed to be included in the contract work.
2. Any questions that arise in relation to the design shall be brought to the attention of the Engineer. Failure to comply with this procedure may necessitate amendments and other layout modifications as required to complete the Work, costs of which shall be solely the responsibility of the Contractor.
3. Study all documents, which describe, or are related to any operation before commencement of that operation. Report discrepancies discovered between existing conditions and documentation. Obtain ruling on required interpretation before commencing work.

4. Any changes to the scope of work are to be confirmed in writing by the Engineer and Contract value changes approved, prior to start of said work.
5. The cost of any additional work to the Owner shall be the actual cost of the work plus ten percent (10%) overhead and ten percent (10%) profit on the actual cost of the work.

6. CONTRACTOR'S USE OF SITE

1. Do not unreasonably encumber site, with material or equipment.
2. Execute the work with the least possible interference or disturbance to the normal use of the exiting premises. Make arrangements with the Engineer to facilitate the work as stated.
3. Maintain existing services to the building and provide for personnel and vehicle access.
4. Maintain a proper solid or chain link security fence c/w suitable locks around work and storage areas at all times.
5. Where security is reduced by the work, provide temporary means to maintain security.
6. Contractor to supply their own site trailer (if required) phone, fax, and storage box. No storage will be provided within the building. Accommodation will be made for limited on-site storage at the discretion of the Engineer in area designated by the Engineer.
7. Maintain 1 copy of each of the following at the job site:
 - .1 Contract drawings
 - .2 Contract specifications
 - .3 Addenda to contract documents
 - .4 Copy of approved work schedule
 - .5 Reviewed/approved shop drawings
 - .6 Change orders
 - .7 Other modifications to contract
 - .8 Field test reports
 - .9 Reviewed/approved samples
 - .10 Manufacturers' installation and application instructions
 - .11 One set of record drawings and specifications for "as-built" purposes
 - .12 National Building Code of Canada 2010
 - .13 Current construction standards of workmanship listed in technical Sections
 - .14 Project Safety Plan – Including emergency contact names and directions to the nearest hospital.

7. CONTRACTOR PROJECT SUPERINTENDENT

1. The Contractor shall, upon award of contract, designate a Project Superintendent. The Contractor shall provide the name, cellular phone number to the Engineer at the preconstruction meeting. The Project Superintendent shall have full responsibility for the project and shall be authorized to accept and act upon any notice or direction provided by

the Engineer. Project Superintendent shall be available on site at all times that work is being performed under this contract.

2. Supervise and direct all persons engaged in the work, including all tradesmen and suppliers. Become familiar with the requirements of each trade. Coordinate delivery and work operations. Examine the work of all trades during work operations to ensure compliance with the contract requirements. Expedite all work to maintain the contract schedule.
3. Cooperate with all other contractors working on site in parallel or related projects.
4. Attend coordination and project meetings at the direction of the Engineer.

8. CONTRACTOR and SUB CONTRACTORS

1. The Contractor agrees to employ those sub-contractors proposed by him in writing as listed in the Contractor's tender submission.
2. Do not change or substitute approved contractor for sub-contractors without prior authorization from the design authority.
3. Contractor and sub-contractor personnel shall be qualified as per definitions under the Trades Qualification and Apprenticeship Acts and as required by regulatory agencies in Saskatchewan.
4. Electrical work shall be carried out by qualified and licensed electrical contractors as per Saskatchewan regulations.

9. WORKMANSHIP

1. Workmanship shall be the best quality, executed by workers experienced and skilled in the respective duties for which they are employed. Immediately notify the Engineer, if required, if work is such as to make it impractical to produce required results.
2. Do not employ any person unfit or unskilled in their required duties. The Engineer reserves the right to require the dismissal from the site, workers deemed incompetent, careless, insubordinate or otherwise objectionable.
3. The Work as covered by the tender documents is intended to comply exactly with the latest rules and regulations of the inspection authorities, and these rules are to be considered an integral part of the tender documents. In case of conflict, any ruling by the Inspection Authority shall be final. All changes and alterations to the Contractor's work required by an authorized inspector or any authority having jurisdiction shall be carried out at the expense of the Contractor.
4. Decisions as to the quality or fitness of workmanship in cases of dispute rest solely with the Engineer, whose decision is final.

10. RECORD DRAWINGS

1. As work progresses, maintain accurate records to show deviations from the contract drawings. Just prior to completion of work, supply to the Engineer one set of white prints with all deviations neatly inked in. Contractor to show actual layouts for underground services including elevations, all mechanical piping and ductwork and all electrical wiring diagrams, locations and sizes of electrical conduits, pull boxes and wiring, circuits etc.

11. SHOP DRAWINGS

1. Provide four (4) copies of the shop drawings as listed in the specifications and/or drawings to the Engineer prior to ordering materials. Shop drawings to illustrate details of portion of work specific to the project requirements. Information to clearly indicate the items to be reviewed. Generic drawings and faxed copies are not acceptable.
2. Allow five (5) working days for Engineer's review of each shop drawing submission.

12. CODES AND STANDARDS

1. The following codes and Standards are in place for work under this contract. The latest edition applicable at the time to be utilized.
 1. The National Building Code of Canada (NBC) 2010
 2. Saskatchewan Fire Code
 3. Canadian Electric Code
 4. Canada Labour Code Part II and Federal Occupational Health and Safety Policies
 5. Construction Standards and/or any other Code or bylaw of local application.
2. Comply with applicable local bylaws, rules and regulations enforced at the location concerned.
3. Meet or exceed requirements of Contract documents, specified standards, codes and referenced documents.
4. In any case of conflict or discrepancy, the most stringent requirements shall apply

13. FEES AND CERTIFICATES

1. Submit a completed Notice of Project Form to WCB as required by the notification requirements under the Regulations for Construction Projects made pursuant to the WCB. Provide copy to the Departmental Representative.
2. Obtain and pay for – Building Permit required, Certificates, Licenses and other permits required by regulatory municipal, provincial or federal authorities to complete the work.
3. Provide inspection authorities with plans and information required for issue of acceptance certificates.
4. Furnish inspection certificates in evidence that the work installed conforms with the

requirements of the authority having jurisdiction.

5. Submit to the Electrical Inspection Authority the necessary number of working drawings and specifications for examination and approval prior to commencement of work and pay all associated fees.
 - .1 Obtain and pay for all electrical inspection fees.
 - .2 On completion of the work provide copies of the Electrical Inspection Authority inspection approval certificates.

14. CONSTRUCTION SAFETY MEASURES

1. Observe and enforce construction safety measures required by the Canada Labour Code Part II, Occupational Health and Safety, Workers' Compensation Board, Saskatchewan WCB and municipal statutes and authorities and site specific Health and Safety Policies and Directives
2. In the event of conflict between any provisions of above authorities, the most stringent will apply.
3. Provide and maintain guardrails, fences, barricades, lights, signs and other devices required for protection of workmen and public in accordance with the requirements of the Canada Labour Code Part II, Occupational Health and Safety, WCB and Safety Act and Regulations for Construction Projects and Local by-laws. All signs shall be bilingual or CSA universal pictograms.
4. Ensure the safety of building personnel at all times when performing work.
5. Refer to Specifications Section 01 35 30 for additional requirements

15. FIRE SAFETY REQUIREMENTS

1. Comply with the National Building Code of Canada for fire safety in construction and the National Fire Code of Canada for fire prevention, fire fighting and life safety in building in use.
2. Comply with Human Resources Development Canada (HRDC), Fire Commissioner of Canada (FCC) Standards;
 - .1 No. 301: Standard for Construction Operations
 - .2 No. 302: Standard for Welding and Cutting
 - .3 No. 374: Fire Protection Standard for General Storage (Indoor and Outdoor)
 - .4 Available from Fire protection Engineering Services, Labour program, HRDC or following internet site: <http://www.labour.gc.ca/eng/home.shtml>
 - .5 Retains all fire safety documents on site.
3. Refer to Section 01 35 30 of this document for further information on Health and Safety

16. WORKPLACE SAFETY AND INSURANCE BOARD

1. Prior to commencing the work, throughout the total performance of the work when requesting payments and prior to receiving final payment, the Contractor shall provide evidence of good standing with Workplace Safety and WCB.

17. UTILITIES

1. Water supply is available on site and will be provided for construction usage at no cost. Facility Supervisor reserves the right to limit volume of water utilized.
2. Existing electrical services to a maximum of 15 kVA required for the work may be used by the Contractor without charge. Ensure capacity is adequate prior to connecting and imposing additional loads. Connect and disconnect at own expense and responsibility.

18. PROTECTION

1. Protect finished work against damage until take-over.
2. Protect the work and all surrounding equipment, landscape, structures, floors, ceilings, walls, etc., from damage.
2. Make good, at no cost to the Owner, any damage caused.
3. Protect any services, which are uncovered during work.
4. Protect all areas adjacent to the construction areas from dust and debris produced during construction. Use hoarding, solid walls, drop cloths, sealed dust screens and tarps and clean up and vacuum up all debris daily.

19. PRODUCT HANDLING AND STORAGE

1. Deliver materials in original and unopened containers or wrappings with Manufacturers' seals and labels intact and legible.
2. Deliver materials in sufficient quantity to allow continuity of the work. Do not encumber site with unnecessary materials.
3. All unused materials at the end of any working day shall be properly protected from damage.
4. All materials, equipment, etc. to be handled and stored as not to interfere with the operation of the building.
5. All material and equipment to be new unless specified otherwise.
6. Contractors who use controlled products must ensure that their workers are properly trained in the safe use and handling of such products in compliance with the Workplace Hazardous Materials Information System (WHMIS).

7. Comply with all requirements with respect to Controlled products labeling and Material Safety Data Sheets (MSDSs) according to the requirements of WHMIS and the Hazardous Products Act.

20. PRODUCT AVAILABILITY

1. Upon award of contract immediately review product delivery requirements and advise the design authority of any foreseeable delays.
2. In the event of failure to notify the Engineer at commencement of the work, the Departmental Representative reserves the right to require the supply of substitute products of equivalent quality at no increase in contract price to ensure adherence to project schedule.

21. MATERIALS STANDARDS

1. Materials shall be new and work shall conform to the minimum applicable standards of the Canadian General Standards Board, the Canadian Standards Association, the National Building Code of Canada and all applicable Provincial and Municipal codes. In the case of conflict or discrepancy the most stringent requirements shall apply.
2. Products (materials, equipment and articles) incorporated in work shall be new, not damaged or defective and of best quality compatible with specifications for purpose intended. If requested by the design authorities, furnish evidence as type, source, and quality of product.
3. Defective products will be rejected, regardless of previous inspections. Inspection does not relieve responsibility but is a precaution against oversight or error. Remove and replace defective products at own expense and be responsible for delays and expenses caused by rejection.
4. Should any dispute arise as to the quality of fitness of products, the decision shall rest with the Engineer based upon requirements of Contract Documents. The Engineer's decision shall be final.
5. Ensure that materials, equipment, services and labour are brought to site in sufficient quantity and in accordance with requirements of the work schedule.
6. Use materials/products containing highest percentage of recycled and recovered materials practicable – consistent with maintaining cost effective satisfactory levels of completion. Adhere to waste reduction requirements for reuse or recycling of waste materials, thus diverting materials from landfill

22. MATERIALS OTHER THAN SPECIFIED

1. Secure in writing, permission from the engineer to use any materials other than those specified.
2. The listed suppliers/manufacturers are acceptable for their ability to meet the general design intent, quality and performance characteristics of the specified product. The listed

equipment/materials does not endorse the acceptability of all products available from the listed manufacturers/suppliers.

3. It remains the responsibility of the contractor to ensure the products supplied are equal to the specified products in every aspect, operate as intended, and meet the performance specifications and physical dimensions of the specified product.
4. The contractor shall be fully responsible for any additional materials, to accommodate the use of equipment from the acceptable manufacturer and suppliers list.

23. HAZARDOUS MATERIALS

1. Comply with the requirements of the Workplace Hazardous Materials Information System (WHMIS) regarding use, handling, storage, and disposal of hazardous materials: and regarding labeling and the provision of Material Safety Data Sheets (MSDS) acceptable to Human Resources Development Canada, Labour Program.

24. REMOVED MATERIALS

1. Unless otherwise specified, materials for removal become the Contractor's property and shall be taken from the site.

25. PROJECT CLEANLINESS

1. Remove waste materials and debris from the site at the end of each day. Leave the work area unencumbered upon completion of each work shift. Store materials and equipment.
2. Ensure site is clean, orderly and neat at all times during the work shift. Provide additional cleaning as requested by the design authority, facility supervisor.
3. At the end of the project, remove dirt, dust and other disfigurations from all surfaces affected by the project including, but not limited to ceilings, walls, floors, fixtures and lights. Clean by dusting, damp wiping, washing, waxing and polishing to the satisfaction of the design authority, facility supervisor.
4. Upon completion, remove scaffolding, temporary protections and surplus materials. Make good any defects noted at this stage.
5. Clean areas affected under contract, to a condition at least equal to that previously existing and to satisfaction of the design authority, facility supervisor.
6. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

26. WASTE MANAGEMENT

1. Comply with the Environmental Protection Act and the Saskatchewan Waste Management Act for waste management programs on construction and demolition projects.

27. EXISTING SERVICES

1. Where work involves breaking into or connecting to existing services, Carry out work at times directed by the Engineer. Connection to existing services shall be after hours and/or on weekends.
2. Before commencing Work, establish location and extent of service lines in area of Work and notify the Engineer of findings.
3. Submit schedule to and obtain approval from the Engineer for any shutdown or closure of active service or Facility. Adhere to approved schedule and provide notice to affected parties. Do not alter schedule without prior written consent of the Engineer.
4. Give the Engineer 48 hours notice related to each necessary interruption of any mechanical or electrical service throughout the course of the work. Obtain written authorization from the Engineer prior to any interruption. Keep duration of those interruptions to a minimum.
5. Where unknown services are encountered, immediately advise Engineer and confirm findings in writing.

28. CUTTING, PATCHING AND MAKING GOOD

1. Cut existing surfaces as required to accommodate new work. Openings shall be neatly cut and dimensioned to fit electrical conduits, mechanical pipes and/or ductwork passing through the surfaces. Obtain the Engineer's approval before cutting into structure. Cutting torches shall not be permitted.
2. Patch and make good cut on both sides of surfaces, damaged or disturbed to match or better existing conditions to the satisfaction of the Engineer.
Note: The Contractor shall patch and make good existing openings when Contractor utilizes the existing openings for his work.
3. Fill voids left around all electrical conduits, mechanical pipes and/or ductwork with appropriate fire-proofing material to maintain fire stop integrity. Finish patching with finishing compounds to the satisfaction of the Engineer.

29. DEMOLITION

1. Except if expressly stated otherwise, materials indicated for removal, become the Contractor's property and shall be promptly taken from the site.

30. EQUIPMENT

1. Provide and maintain equipment such as temporary stairs, ladders, ramps, scaffolds, swing stages, runways, chutes and the like, as required for execution of work
2. Provide and maintain conveying equipment such as cranes, hoists, derricks and the like, as required for execution of work.

3. Assume complete responsibility for construction strength, placing, anchoring and operation of derricks, cranes, hoists and other mechanical contrivances used for work; and ensure that loads carried thereon can be safely supported and be free from accidents to all persons.
4. Comply with all governing safety regulations in force at the time of construction.
5. Remove immediately such equipment when not required for work.
6. Provide and maintain, on site, suitable fire extinguishers in sufficient quantities, as required by the Safety Code.

31. LOADING

1. Take precautions to prevent the overloading of any part of the structure during the progress of the work. Make good, at no expense to Owner, any damage resulting from such overloading.

32. HOISTING

1. All crane operations are restricted to the following:
 - .1 All craning of materials and equipment must be done outside normal building operating hours, ensure interior areas below are kept unoccupied.

33. POWDER ACTUATED GUNS

1. Do not employ powder-actuated guns using explosives, unless expressly permitted by the Engineer. If permitted, comply with requirements of CAN3-Z166.2-M85 (Use and Handling of Powder Actuated Tools).

34. TAXES

1. Pay all taxes properly levied by law (including Federal, Provincial and Municipal)
2. The Provincial Sales Tax (PST) is NOT to be considered an applicable tax for the purposes of this bid. The bidder shall therefore include separately any amount in his bid price for the said PST. In the event the PST does apply, the successful Contractor will indicate on each application for payment as a separate amount the appropriate PST the Owner is legally obliged to pay. The Contractor's PST registration number must be shown on all invoices. This amount will be paid to the Contractor in addition to the amount certified for payment under the contract and will therefore not affect the contract price.

35. SIGNS – ADVERTISING

1. No advertising and/or posting of company signs shall be permitted.
2. Provide common-use signs as related to traffic control, information, instruction, health and safety, use of equipment, public safety devices, in both official languages or by the use of commonly understood graphic symbols to the Engineer's approval.

36. SECURITY CLEARANCES

1. All personnel employed on this project shall be escorted while inside the building.

37. BUILDING SMOKING ENVIRONMENT

1. Smoking is prohibited in the building and on the roofs. Smoking is prohibited within a 6 metres of the building. Obey smoking restrictions on building property as directed by the Engineer.

38. GUARANTEE

1. Provide written one (1) year guarantee for all materials and labour provided as part of this Contract. Effective start date shall be date of final completion.
2. The contractor, at own expense, shall correct any defects in the work due to faulty products and/or workmanship appearing within the extended guarantee/warranty periods set out in the individual sections from date of final completion.

39. TRAINING AND DEMONSTRATION

1. Upon completion of the mechanical, electrical and controls installations provide qualified personnel to train and demonstrate the installations to the site's operations and maintenance personnel.
2. Contractor to review sources of power for newly installed equipment and demonstrate the start/stop and control functions of the installed equipment. Training and demonstration to be for a duration of four (4) hours. Training date and time to be coordinated with and approved by the Engineer.

40. EQUIVALENT EQUIPMENT

1. Where equivalent equipment has been submitted without specifics, it is the contractor's responsibility to provide detailed specifications highlighting differences to the specified unit prior to requesting for acceptance as equal. Requests without inclusion of sufficient details will automatically be rejected. Provide differences and clear quantifiable characteristics why, how and where the unit meets performance and other requirements. Requests for substitution must be made to the Engineer.
2. Equipment specified serves to set minimum standard. Substituted equipment shall meet performance requirements and physical limitations, including fitting within space constraints.
3. Access to equipment for servicing will by the substitution not be compromised, nor will access to other equipment/services within the mechanical room.

41 UNIT PRICING

1. Within the contract the contractor shall be responsible for all costs including fuel and loadbanks associated with testing of the emergency generator. In addition, the contractor shall be responsible for all costs associated with a temporary generator within the base contract for a period of 3 weeks including rental, fuel, connection costs, etc. The contractor shall provide a unit cost for each additional week for the emergency generator if required.

OPERATIONS AND MAINTENANCE MANUALS

42.

1. Provide two (2) sets of operations and maintenance data detailed in 01 78 00. Data to include detailed technical information, documents and records describing operation and maintenance of individual components.

END OF SECTION

PART 1 - GENERAL

1.1 ACCESS AND EGRESS

- .1 Design, construct and maintain temporary "access to" and "egress from" work areas, including stairs, runways, ramps or ladders [and scaffolding], independent of finished surfaces and in accordance with relevant municipal, provincial and other regulations.

1.2 USE OF SITE AND FACILITIES

- .1 Execute work with least possible interference or disturbance to normal use of premises. Make arrangements with Departmental Representative to facilitate work as stated.
- .2 Maintain existing services to building and provide for personnel and vehicle access.
- .3 Where security is reduced by work provide temporary means to maintain security.
- .4 Departmental Representative will assign sanitary facilities for use by Contractor's personnel. Keep facilities clean.
- .5 Closures: protect work temporarily until permanent enclosures are completed.

1.3 ALTERATIONS, ADDITIONS OR REPAIRS TO EXISTING BUILDING

- .1 Execute work with least possible interference or disturbance to occupants, and normal use of premises. Arrange with Departmental Representative to facilitate execution of work.

1.4 EXISTING SERVICES

- .1 Notify, Departmental Representative utility companies of intended interruption of services and obtain required permission.
- .2 Where Work involves breaking into or connecting to existing services, give Departmental Representative [48] hours of notice for necessary interruption of mechanical or electrical service throughout course of work. Keep duration of interruptions minimum. Carry out interruptions after normal working hours of occupants, preferably on weekends.

1.5 SPECIAL REQUIREMENTS

- .1 Carry out noise generating Work Monday to Friday from 18:00 to 07:00 hours and on Saturdays.
- .2 Submit schedule in accordance with Section 01 11 55 - Construction Progress Schedule - Bar (GANTT) Chart.
- .4 Ensure Contractor's personnel employed on site become familiar with and obey regulations including safety, fire, traffic and security regulations.
- .5 Keep within limits of work and avenues of ingress and egress.

- .6 Deliver materials outside of peak traffic hours 17:00 to 07:00 and 13:00 to 15:00 unless otherwise approved by Departmental Representative.
- .7 Prior to cutting or drilling horizontal or vertical surfaces including concrete, concrete block or other structural substrate, determine location of reinforcing, service lines, pipes, conduits or other items by x-ray, ground penetrating radar or other appropriate method. Submit findings to Departmental Representative prior to cutting or drilling.

1.6 SECURITY

- .1 Where security has been reduced by Work of Contract, provide temporary means to maintain security.
- .2 Security clearances:
 - .1 Obtain requisite clearance, as instructed, for each individual required to enter premises.
 - .2 Personnel will be checked daily at start of work shift and provided with pass which must be worn at all times. Pass must be returned at end of work shift and personnel checked out.

1.7 BUILDING SMOKING ENVIRONMENT

- .1 Comply with smoking restrictions. Smoking is not permitted within 6m of a door, window or fresh air intake.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

3.1 NOT USED

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL

1.1 Section Includes

- .1 Shop drawings and product data.
- .2 Samples.
- .3 Certificates and transcripts.

1.3 Related Sections

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 01 78 00 - Closeout Submittals.

1.4 References

- .1 Canadian Construction Documents Committee (CCDC)
- .2 CCDC 2-[94], Stipulated Price Contract.

1.5 Administrative

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

**1.6 Shop Drawings
and Product Data**

- .10 Keep one reviewed copy of each submission on site.
- .1 The term "shop drawings" means drawings, diagrams, illustrations, schedules, performance charts, brochures and other data which are to be provided by Contractor to illustrate details of a portion of Work.
- .2 Indicate materials, methods of construction and attachment or anchorage, erection diagrams, connections, explanatory notes and other information necessary for completion of Work. Where articles or equipment attach or connect to other articles or equipment, indicate that such items have been coordinated, regardless of Section under which adjacent items will be supplied and installed. Indicate cross references to design drawings and specifications.
- .3 Allow 5 business days for Engineer's review of each submission.
- .4 Adjustments made on shop drawings by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
- .5 Make changes in shop drawings as Engineer may require, consistent with Contract Documents. When resubmitting, notify Engineer in writing of any revisions other than those requested.
- .6 Accompany submissions with transmittal letter, containing:
 - .1 Date.
 - .2 Project title and number.
 - .3 Contractor's name and address.
 - .4 Identification and quantity of each shop drawing, product data and sample.
 - .5 Other pertinent data.
- .7 Submissions shall include:
 - .1 Date and revision dates.
 - .2 Project title and number.
 - .3 Name and address of:
 - .1 Subcontractor.
 - .2 Supplier.
 - .3 Manufacturer.
 - .4 Contractor's stamp, signed by Contractor's authorized representative certifying approval of submissions, verification of field measurements and compliance with Contract Documents.
 - .5 Details of appropriate portions of Work as applicable:
 - .1 Fabrication.
 - .2 Layout, showing dimensions, including identified field dimensions, and clearances.

- .3 Setting or erection details.
- .4 Capacities.
- .5 Performance characteristics.
- .6 Standards.
- .7 Operating weight.
- .8 Wiring diagrams.
- .9 Single line and schematic diagrams.
- .10 Relationship to adjacent work.

- .8 After Engineer's review, distribute copies.
- .9 Submit (4) prints and an electronic copy of shop drawings for each requirement requested in specification Sections and as consultant may reasonably request.
- .11 Submit (4) copies and an electronic copy of product data sheets or brochures for requirements requested in specification Sections and as requested by Engineer where shop drawings will not be prepared due to standardized manufacture of product.
- .12 Delete information not applicable to project.
- .13 Supplement standard information to provide details applicable to project.
- .14 If upon review by Engineer, no errors or omissions are discovered or if only minor corrections are made, copies will be returned and fabrication and installation of Work may proceed. If shop drawings are rejected, noted copy will be returned and resubmission of corrected shop drawings, through same procedure indicated above, must be performed before fabrication and installation of Work may proceed.

1.7 Samples

- .1 Submit for review samples in duplicate as requested in respective specification Sections. Label samples with origin and intended use.
- .2 Deliver samples prepaid to Engineer's business address.
- .3 Notify Engineer in writing, at time of submission of deviations in samples from requirements of Contract Documents.
- .4 Where colour, pattern or texture is criterion, submit full range of samples.
- .5 Adjustments made on samples by Engineer are not intended to change Contract Price. If adjustments affect value of Work, state such in writing to Engineer prior to proceeding with Work.
- .6 Make changes in samples which Engineer may require, consistent with Contract Documents.

- .7 Reviewed and accepted samples will become standard of workmanship and material against which installed Work will be verified.

1.8 Mock-ups

- .1 Not Used.

**1.9 Progress
Photographs**

- .1 Submit progress photographs in accordance with Section 01 33 00 - Submittal Procedures.

**1.10 Certificates
and Transcripts**

- .1 Immediately after award of Contract, submit Workers' Compensation Board status.

END OF SECTION

1. SUBMITTALS

- 1.1 Make Submittals in accordance with Section 01 11 55 "General Instructions".
- 1.2 Submit a site-specific Health and Safety Plan, within 7 days after Notice to Proceed and prior to commencement of Work. The Health and Safety Plan must include:
 - 1.2.0 Site-specific safety hazard assessment.
 - 1.2.1 Safety and health risk or hazard analysis for site risks and operation.
- 1.3 Submit Construction Safety Checklists after completion.
- 1.4 Submit copies of reports or directions issued by Federal and Provincial health and safety inspectors.
- 1.5 Submit copies of incident and accident reports.
- 1.6 Submit to Engineer with Material Safety Data Sheets (MSDS).
- 1.7 Personal training requirements including as follows:
 - 1.7.1 Names of personnel and alternates responsible for site safety and health, hazards present on site, and use of personal protective equipment.
- 1.8 The Engineer will review the Contractor's site-specific Health and Safety Plan and provide comments to the Contractor within 7 days after receipt of the plan. Revise the plan as appropriate and resubmit plan to the Engineer within 3 days after receipt of comments from the Engineer.
- 1.9 Medical Surveillance: Within 7 days after date of the Notice to Proceed and prior to mobilization to the site, submit certification of medical surveillance for site personnel, and submit additional certifications as personnel are sent to the site.
- 1.10 On-site Contingency and Emergency Response Plan: Address the standard operating procedures to be implemented during emergency situations.

2. FILING OF NOTICE

- 2.1 File Notice with Provincial authorities prior to commencement of Work.

3. SAFETY ASSESSMENT

- 3.1 Perform a site-specific safety hazard assessment related to the project.

4. MEETINGS

- 1.1. Pre-construction meetings: The Contractor shall attend a Pre-Construction Meeting.

5. REGULATORY REQUIREMENTS

- 5.1 The Contractor shall comply with the specified standards and regulations to ensure safe operations. The latest editions are applicable.
- 5.5.1. Canada Labour Code Part II
 - 5.5.2. Canada Occupational Safety and Health Regulations
 - 5.5.3. National Building Code Part 8 – Safety Measures at Construction & Demolition Sites
 - 5.5.4. National Fire Code Part 4 – Flammable and Combustible Liquids
 - 5.5.5. National Fire Code Part 5 – Hazardous Process and Operations
 - 5.5.6. Provincial Health and Safety Act and Regulations including;

6. CONTRACTOR RESPONSIBILITY

- 6.1 The Contractor shall be responsible for the Health and Safety of persons on site, safety of property on site and for the protection of persons adjacent to the site and environment to the extent that they may be affected by the conduct of Work.
- 6.2 The Contractor shall comply with and enforce compliance by their employees with the safety requirements of the Contract Documents, applicable federal, provincial, local statutes, regulations, ordinances, and site-specific Health and Safety Plan.
(i.e. Occupational Health and Safety Acts and Regulations for Construction Projects, Canada Labour Code Part II)

7. CONTRACTOR ACCIDENT AND INCIDENT REPORT

- 7.1 The Contractor shall advise the Engineer of any accident, injury, near-miss incident, fire, explosion or chemical spill occurring at the Work site and any visit to the site by a governmental enforcement official.

8. UNFORSEEN HAZARDS

- 8.1 Should any unforeseen or peculiar safety-related factor, hazard, or condition become evident during performance of Work, the Contractor shall immediately stop work and advise the Engineer verbally and in writing.

9. WORK STOPPAGE

- 9.1 The Engineer and/or designated Health and Safety personnel may stop work for health and safety considerations.

10. CORRECTION OF NON-COMPLIANCE

- 10.1 The Contractor shall immediately address health and safety non-compliance issues identified by the Engineer and/or other designated Health and Safety personnel.
The Engineer may stop Work if non-compliance of health and safety regulations is not corrected by the Contractor.

11. DISCIPLINARY ACTIONS

- 11.1 The Contractor's disregard and/or lack of compliance to health and safety measures, procedures and policies shall lead to disciplinary action by the Engineer.

12. SITE HEALTH AND SAFETY POLICIES AND DIRECTIVES

- 12.1 The Contractor shall comply and follow all prescribed site Health and Safety Policies and Directives including but not limited to the following;

12.1.1 Worker Profile Sheet: The Contractor shall submit to the Engineer a completed Worker Profile Sheet c/w all attachments including copies of licenses, certificates and permits for supporting qualifications to perform required work for a given project for each individual worker requiring access to the site. The completed Worker Profile Sheets are required for each individual worker prior to working on site.

12.1.2 Hot Work Permit: The Contractor shall submit a completed Hot Work Permit to the Engineer for review and approval. The Engineer's approval is required prior to initiating hot work.

12.1.3 Hot Tap Permit: The Contractor shall submit a completed Hot Tap Permit to the Engineer for review and approval. Approval by the Engineer is required prior to initiating hot tap work.

12.1.4 Lock Out and Tag Out (LOTO) – Isolation Procedures: The Contractor shall submit a completed LOTO Isolation Form (Zero Energy) to the Engineer for review and approval for all work requiring LOTO. The Engineer's approval of isolation form is required prior to initiating LOTO work.

12.1.5 Live Work Procedure: The Contractor shall submit a completed Live Work Procedure Form to the Engineer for review and approval for all work requiring Live Work procedures. The Engineer's approval of the Live Work Form is required prior to initiating Live Work.

12.1.6 Emergency and Fire Evacuation Route: The Contractor shall obtain training on procedures of evacuating the site under emergency and/or fire situations. Contractor training and sign-off is required prior to initiating site work.

12.1.7 Trades Qualifications and Apprenticeship Act: The Contractor shall sign-off confirming that the Trades Qualifications and Apprenticeship Act shall be observed and followed. Contractor sign-off is required prior to initiating site work.

END OF SECTION

PART 1 - GENERAL

1.1 CONSTRUCTION & DEMOLITION WASTE

- .1 Carefully deconstruct and source separate materials/equipment and divert, from D&C waste destined for landfill to maximum extent possible. Target for this project is 75% diversion from landfill. Reuse, recycle, compost, anaerobic digest or sell material for reuse except where indicated otherwise. On site sales are not permitted.
- .2 Source separate waste and maintain waste audits in accordance with the Environmental Protection Act,
 - .1 Provide facilities for collection, handling and storage of source separated wastes.
 - .2 Source separate the following waste:
 - .1 Brick and portland cement concrete.
 - .2 Corrugated cardboard.
 - .3 Wood, not including painted or treated wood or laminated wood.
 - .4 Gypsum board, unpainted.
 - .5 Steel.
 - .6 Items indicated in a Deconstruction and Waste Products Workplan Summary.
- .3 Submit a waste reduction workplan indicating the materials and quantities of material that will be recycled and diverted from landfill.
 - .1 Indicate how material being removed from the site will be reused, recycled, composted or anaerobically digested in a Deconstruction and Waste Products Workplan Summary.
- .4 Submit proof that all waste is being disposed of at a licensed land fill site or waste transfer site. A copy of the disposal/waste transfer site's license and a letter verifying that said landfill site will accept the waste must be supplied to Departmental Representative prior to removal of waste from the demolition site.

PART 2 - PRODUCTS

2.1 NOT USED

- .1 Not Used.

PART 3 - EXECUTION

- .1 Not Used.

END OF SECTION

PART 1 - GENERAL

- | | | |
|----------------------|----|---|
| 1.1 Section Includes | .1 | As-built, samples, and specifications. |
| | .2 | Equipment and systems. |
| | .3 | Product data, materials and finishes, and related information. |
| | .4 | Operation and maintenance data. |
| | .5 | Spare parts, special tools and maintenance materials. |
| | .6 | Warranties and bonds. |
| | .7 | Final site survey. |
| 1.2 Precedence | .1 | Not Used |
| 1.3 Related Sections | .1 | Section 01 11 55 - General Instructions. |
| | .2 | Section 01 91 00 - Commissioning |
| 1.4 Submission | .1 | Prepare instructions and data using personnel experienced in maintenance and operation of described products. |
| | .2 | Copy will be returned after final inspection, with Engineer's comments. |
| | .3 | Revise content of documents as required prior to final submittal. |
| | .4 | Two weeks prior to Substantial Performance of the Work, submit to the Engineer, two final copies of operating and maintenance manuals in English. |
| | .5 | Ensure spare parts, maintenance materials and special tools provided are new, undamaged or defective, and of same quality and manufacture as products provided in Work. |
| | .6 | If requested, furnish evidence as to type, source and quality of products provided. |
| | .7 | Defective products will be rejected, regardless of previous inspections. Replace products at own expense. |
| | .8 | Pay costs of transportation. |
| 1.5 Format | .1 | Organize data in the form of an instructional manual. |
| | .2 | Binders: vinyl, hard covered, 3 'D' ring, loose leaf with spine and face pockets. |
| | .3 | When multiple binders are used, correlate data into related consistent groupings. Identify contents of each binder on spine. |
| | .4 | Cover: Identify each binder with type or printed title 'Project Record Documents'; list title of project and identify subject matter of contents. |
| | .5 | Arrange content by systems, under Section numbers and sequence of Table of Contents. |
| | .6 | Provide tabbed fly leaf for each separate product and system, with typed description of product and major component parts of equipment. |
| | .7 | Text: Manufacturer's printed data, or typewritten data. Data in tables are to be entered in MS-Excel format. Include PDF's |

- and spreadsheet on CD/DVD.
- .8 Drawings: provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.
 - .9 Provide 1:1 scaled CAD files in DWG-format and in PDF-format on CD/DVD.
- 1.6 Contents - Each Volume
- .1 Table of Contents: provide title of project;
 - .1 date of submission; names,
 - .2 addresses, and telephone numbers of Consultant and Contractor with name of responsible parties;
 - .3 schedule of products and systems, indexed to content of volume.
 - .2 For each product or system:
 - .1 list names, addresses and telephone numbers of subcontractors and suppliers, including local source of supplies and replacement parts.
 - .3 Product Data: mark each sheet to clearly identify specific products and component parts, and data applicable to installation; delete inapplicable information.
 - .4 Drawings: supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams.
 - .5 Typewritten Text: as required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions.
- 1.7 As-builts and Samples
- .1 In addition to requirements in General Instructions, maintain at the site for Engineer one record copy of:
 - .1 Contract Drawings.
 - .2 Specifications.
 - .3 Addenda.
 - .4 Change Orders and other modifications to the Contract.
 - .5 Reviewed shop drawings, product data, and samples.
 - .6 Field test records.
 - .7 Inspection certificates.
 - .8 Manufacturer's certificates.
 - .2 Store record documents and samples in field office apart from documents used for construction. Provide files, racks, and secure storage.
 - .3 Label record documents and file in accordance with Section number listings in List of Contents of this Project Manual. Label each document "PROJECT RECORD" in neat, large, printed letters.
 - .4 Maintain record documents in clean, dry and legible condition. Do not use record documents for construction purposes.
 - .5 Keep record documents and samples available for inspection by Engineer.
- 1.8 Recording Actual Site
- .1 Record information on set of black line opaque drawings, and in copy of Project Manual, provided by Engineer.

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|----------------------------|--|
| Conditions | <ul style="list-style-type: none"> .2 Provide felt tip marking pens, maintaining separate colours for each major system, for recording information. .3 Record information concurrently with construction progress. Do not conceal Work until required information is recorded. .4 Contract Drawings and shop drawings: legibly mark each item to record actual construction, including: <ul style="list-style-type: none"> .1 Measured depths of elements of foundation in relation to finish first floor datum. .2 Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements. .3 Measured locations of internal utilities and appurtenances, referenced to visible and accessible features of construction. .4 Field changes of dimension and detail. .5 Changes made by change orders. .6 Details not on original Contract Drawings. .7 References to related shop drawings and modifications. .5 Specifications: legibly mark each item to record actual construction, including: <ul style="list-style-type: none"> .1 Manufacturer, trade name, and catalogue number of each product actually installed, particularly optional items and substitute items. .2 Changes made by Addenda and change orders. .6 Other Documents: maintain manufacturer's certifications, inspection certifications, field test records, required by individual specifications sections. |
| 1.9 Final Equipment Layout | <ul style="list-style-type: none"> .1 Submit final as-built equipment layout, certifying that elevations and locations of completed Work are in conformance, or non-conformance with Contract Documents. |
| 1.10 Equipment and Systems | <ul style="list-style-type: none"> .1 Each Item of Equipment and Each System: include description of unit or system, and component parts. Give function, normal operation characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and commercial number of replaceable parts. .2 Panel board circuit directories: provide electrical service characteristics, controls, and communications. .3 Include installed colour coded wiring diagrams. .4 Operating Procedures: include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions. .5 Maintenance Requirements: include routine procedures and guide for trouble-shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions. |

- .6 Provide servicing and lubrication schedule, and list of lubricants required.
- .7 Include manufacturer's printed operation and maintenance instructions.
- .8 Include sequence of operation by controls manufacturer.
- .9 Provide original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.
- .10 Provide installed control diagrams by controls manufacturer.
- .11 Provide Contractor's coordination drawings, with installed colour coded piping diagrams.
- .12 Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.
- .13 Provide list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.
- .14 Include test and balancing reports as specified in Section 22 20 10 - Testing, Adjusting and Balancing – Pure Water System. Company performing TAB will sign off on commissioning sheets and performance verifications forms.
- .15 Additional requirements: As specified in individual specification sections.

1.11 Materials and Finishes

- .1 Building Products, Applied Materials, and Finishes: include product data, with catalogue number, size, composition, and colour and texture designations. Provide information for re-ordering custom manufactured products.
- .2 Instructions for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .3 Moisture-protection and Weather-exposed Products: include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.
- .4 Additional Requirements: as specified in individual specifications sections.

1.12 Spare Parts

- .1 Provide spare parts, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.
- .3 Deliver to site; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.

1.13 Maintenance Materials

- .1 Provide maintenance and extra materials, in quantities specified in individual specification sections.
- .2 Provide items of same manufacture and quality as items in Work.

- .3 Deliver to site; place and store.
- .4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- .5 Obtain receipt for delivered products and submit prior to final payment.
- 1.14 Special Tools
 - .1 Provide special tools, in quantities specified in individual specification section.
 - .2 Provide items with tags identifying their associated function and equipment.
 - .3 Deliver to site; place and store.
 - .4 Receive and catalogue all items. Submit inventory listing to Engineer. Include approved listings in Maintenance Manual.
- 1.15 Storage, Handling and Protection
 - .1 Store spare parts, maintenance materials, and special tools in manner to prevent damage or deterioration.
 - .2 Store in original and undamaged condition with manufacturer's seal and labels intact.
 - .3 Store components subject to damage from weather in weatherproof enclosures.
 - .4 Store paints and freezable materials in a heated and ventilated room.
 - .5 Remove and replace damaged products at own expense and to satisfaction of Engineer.
- 1.16 Warranties and Bonds
 - .1 Separate each warranty or bond with index tab sheets keyed to Table of Contents listing.
 - .2 List subcontractor, supplier, and manufacturer, with name, address, and telephone number of responsible principal.
 - .3 Obtain warranties and bonds, executed in duplicate by subcontractors, suppliers, and manufacturers, within ten days after completion of the applicable item of work.
 - .4 Except for items put into use with Owner's permission, leave date of beginning of time of warranty until the Date of Substantial Performance is determined.
 - .5 Verify that documents are in proper form, contain full information, and are notarized.
 - .6 Co-execute submittals when required.
 - .7 Retain warranties and bonds until time specified for submittal.

END OF SECTION

PART 1 - GENERAL

1.1 INCLUDED WORK

1. Develop appropriate verification forms and submit to Engineer for approval prior to use.
2. Commissioning Forms to be completed for equipment, system and integrated system.
3. Report Forms and Schematics
4. Training of O&M Personnel

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures
- .2 Section 01 35 30 - Health and Safety Requirements
- .3 Section 01 78 00 - Closeout Submittals
- .4 Section 26 05 28 – Grounding
- .5 Section 26 32 10 – Emergency Power Generator
- .6 Section 26 36 23 – Automatic Transfer Switches
- .7 Section 26 23 00 – Low Voltage Switchgear

1.2 INSTALLATION/START-UP CHECK LIST

- .1 Include the following data:
 - .1 Product manufacturer's installation instructions and recommended checks.
 - .2 Special procedures as specified in relevant technical sections.
 - .3 Items considered good installation and engineering industry practices deemed appropriate for proper and efficient operation.
- .2 Equipment manufacturer's installation/start-up check lists are acceptable for use. As deemed necessary Engineer supplemental additional data lists will be required for specific project conditions.
- .3 Use check lists for equipment installation. Document check list verifying checks have been made, indicate deficiencies and corrective action taken.
- .4 Installer to sign check lists upon completion, certifying stated checks and inspections have been performed. Return completed check lists to Engineer. Check lists will be required during Commissioning and will be included in Maintenance Manual at completion of project.
- .5 Use of check lists will not be considered part of commissioning process but will be stringently used for equipment pre-start and start-up procedures.
- .6 Co-ordinate decommissioning of the temp generator and transfer switch with commissioning of new emergency system ensuring minimal interruption of emergency power to building. Only after acceptable generator operation has been verified can connection be made to the building emergency distribution.

1.4 PERFORMANCE VERIFICATION

- .1 PV forms to be used for checks, running dynamic tests and adjustments carried out on equipment and systems to ensure correct operation, efficiently and function independently and interactively with other systems as intended with project requirements.
- .2 PV report forms include those developed by Contractor records measured data and readings taken during functional testing and Performance Verification procedures.
- .3 Prior to PV of integrated system, complete PV forms of related systems and obtain Engineer's approval.

1.5 COMMISSIONING FORMS

- .1 Use Commissioning Forms to verify installation and record performance when starting equipment and systems.
- .2 Strategy for Use:
 - .1 Develop Commissioning forms with Specification data included.
 - .2 Contractor will provide required shop drawings information and verify correct installation and operation of items indicated on these forms.
 - .3 Confirm operation as per design criteria and intent.
 - .4 Identify variances between design and operation and reasons for variances.
 - .5 Verify operation in specified normal and emergency modes and under specified load conditions.
 - .6 Record analytical and substantiating data.
 - .7 Verify reported results.
 - .8 Form to bear signatures of recording technician and reviewed and signed off by Engineer.
 - .9 Submit immediately after tests are performed.
 - .10 Reported results in true measured SI unit values. Contact the Engineer for clarification of acceptable units.
 - .11 Provide Engineer with originals of completed forms.
 - .12 Maintain copy on site during start-up, testing and commissioning period.
 - .13 Forms to be both hard copy and electronic format with typed written results in Maintenance Manual.

1.6 SUBMITTALS

- .1 Commissioning of system will be carried out by firm responsible for TAB and preparation of Maintenance Manual.
- .2 Prior to start of Work, submit name of organization proposed to perform services. Designate who has managerial responsibilities for coordination of entire testing, adjusting and balancing.
- .3 Submit documentation to confirm organization compliance with quality assurance provision.
- .4 Submit 3 preliminary specimen copies of each of report forms proposed for use.
- .5 Fifteen days prior to Substantial Performance, submit 3 copies of final reports on applicable forms.
- .6 Submit reports of testing, adjusting, and balancing postponed due to seasonal, climatic, occupancy, or other reasons beyond Contractor's control, promptly after execution of those services.

1.7 PROCEDURES - GENERAL

- .1 Comply with procedural standards of certifying association under whose standard services will be performed.
- .2 Report to Engineer any deficiencies or defects noted during performance of services. Include steps taken to bring performance of services with required services.

1.8 FINAL REPORTS

- .1 Organization having managerial responsibility shall make reports.
- .2 Ensure each form bears signature of recorder, and that of supervisor of reporting

- organization.
- .3 Identify each instrument used, and latest date of calibration of each.

1.9 CONTRACTOR RESPONSIBILITIES

- .1 Prepare each system for testing and balancing.
- .2 Cooperate with testing organization and provide access to equipment and systems.
- .3 Provide personnel and operate systems at designated times, and under conditions required for proper testing, adjusting, and balancing.
- .4 Notify testing organization 7 days prior to time project will be ready for testing, adjusting, and balancing.

1.10 PREPARATION

- .1 Provide instruments required for testing, adjusting, and balancing operations.
- .2 Make instruments available to Engineer to facilitate spot checks during testing.
- .3 Retain possession of instruments and remove at completion of services.
- .4 Verify systems installation is complete and in continuous operation.
- .5 Verify equipment such as computers, laboratory and electronic equipment are in full operation.

1.11 EXECUTION

- .1 Test equipment, balance distribution systems, and adjust devices for de-ionized and reverse-osmosis water systems.
- .2 Balance DI-water flows both at full building demand and at zero building demand. Systems to be operated at full capacity under various modes to determine if they function correctly and consistently at peak efficiency.

1.12 SCHEDULE OF SYSTEMS REQUIRING TESTING, ADJUSTING AND BALANCING SERVICES

- .1 Co-ordinate with Building Manager for convenient opportunity causing least interruption to normal operation of labs.

1.13 TRAINING

- .1 Objective is to ensure safe, reliable, cost-effective, energy-efficient operation of systems, effective on-going inspection, measurements of system performance, proper preventative maintenance, diagnosis and trouble-shooting. Clarify how to operate equipment and systems under emergency conditions until appropriate assistance arrives.
- .2 Provide instructions on start-up, operation, shut-down of equipment, components and systems. Include control features, implication on adjustment of set points, etc.
- .3 Instructors to be responsible for content and quality of training materials. Training materials to include:
 - .1 "As-Built" Contract Documents.
 - .2 Operating Manual.
 - .3 Maintenance Manual.
 - .4 Management Manual.
 - .5 TAB and PV Reports.

- .4 Project Manager will review training manuals.
- .5 Training materials to be in a format that permits future training procedures to same degree of detail.
- .6 Supplement training materials:
 - .1 Presentation material include MS Power Point and printed copies.
 - .2 Multimedia presentations.
 - .3 Manufacturer's training videos.
 - .4 Equipment models.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Cast-in-Place Concrete required for this project is to include:
 - .1 200mm thick concrete generator pad reinforced with 15M @ 300mm o.c. each way mid height over 0.15mm Poly vapour barrier, over 200mm thick base of type 33 granular fill. Refer to electrical drawings for extent of pad.

1.2 REFERENCE STANDARDS

- .1 CSA A23.1-14 - "Concrete Materials and Methods of Concrete Construction".
- .2 CSA A23.2-14 - "Test Methods and Standard Practices for Concrete".
- .3 CAN/CSA G30.18-09 (R2014) - "Carbon Steel Bars for Concrete Reinforcement".

1.3 QUALITY ASSURANCE

- .1 Provide at least one person who shall be present at all times during execution of this portion of the Work and who shall be thoroughly trained and experienced in placing the types of concrete specified and who shall direct all work performed under this Section.
- .2 For finishing of exposed surfaces of the concrete, use only thoroughly trained and experienced journeyman concrete finishers.
- .3 Perform cast-in-place concrete work to requirements of CSA A23.1-14 - "Concrete Materials and Methods of Concrete Construction".
- .4 The concrete supplier and plant shall be certified by the Saskatchewan Ready Mix Concrete Association.

1.4 PRODUCT HANDLING

- .1 Use all means necessary to protect cast-in-place concrete materials before, during and after installation and to protect the installed work and materials of all other trades.
- .2 In the event of damage, immediately make all repairs and replacements necessary to approval of the Consultant and at no additional cost to the Owner.

1.5 INSPECTION AND TESTING

- .1 Inspection and testing to be performed by a firm approved by the Consultant and is to be paid for by the contractor.
- .2 Provide free access to all portions of work and co-operate with appointed firm.

- .3 Compaction of base to be tested no earlier than 48hrs prior to concrete being placed.
- .4 Submit proposed mix design for each class of concrete to Consultant for approval two weeks prior to commencement of work.
- .5 Tests of cement and aggregates may be performed to ensure conformance with requirements stated herein.
- .6 One concrete test, consisting of three test cylinders shall be taken at the time of pour. One cylinder to be tested at 7 days, the remaining two cylinders to be tested at 28 days.
- .7 One (1) slump test and one (1) air content test is to be taken for each set of test cylinders taken.
- .8 Testing of concrete is to be performed in accordance with CSA A23.2-14 "Method of Test for Concrete".
- .9 Test results are to be issued to the Contractor, Consultant, and Owner. Test reports are to be numbered consecutively beginning with number one.
- .10 Required retesting will be paid for by the Contractor.

Part 2 Products

2.1 CONCRETE MATERIALS

- .1 Hydraulic Cement: General Use (GU) conforming to CSA A300.
- .2 Fine and coarse aggregates shall meet the requirements of CSA A23.1-14. Aggregates used in the concrete shall not react with alkalis or other elements in the concrete mix such that they produce excessive expansion and/or cracking of the concrete.
- .3 Water shall meet the requirements of CSA A23.1-14.
- .4 Supplementary cementing materials shall conform to the requirements of CSA A23.1-14 and CSA A3001.
- .5 Air entraining admixtures shall conform to the requirements of CSA A23.1-14 and ASTM C 494.
- .6 Chemical admixtures shall conform to the requirements of CSA A23.1-14 and ASTM C 494.

2.2 ACCESSORIES

- .1 Vapour Barrier: 0.15 mm polyethylene film, to CGSB 70-GP-1a, Type I - low permeance heavy duty.
- .2 200mm thick type 33 granular fill

- .3 All reinforcing steel, unless noted otherwise on the drawings or herein shall be deformed bars of new billet steel conforming to the current CAN/CSA-G.30.18 – 09 (R2014), Grade 400, plain finish for all bars. Minimum splice for 10M bars to be 450 mm. Minimum lap splice for all other bars to be 36 bar diameter or 675 mm, whichever is greater.

2.3 CONCRETE MIXES

- .1 Produce concrete mixes in accordance with the requirements of CSA A23.1-14 with 35 MPa strength and exposure class C-1.
- .2 Each load of ready-mixed or transit-mixed concrete delivered to the project site shall be accompanied by duplicate delivery slips providing the following information:
 - .1 Name of ready-mix batch plant
 - .2 Serial number of ticket
 - .3 Date and truck number
 - .4 Name of contractor
 - .5 Specific designation of project
 - .6 Specific class of concrete
 - .7 Amount of concrete in cubic metres
 - .8 Time of loading or first mixing of aggregate, cement and water
- .3 Use chemical admixtures only when approved by Consultant.

2.4 GRANULAR BASE

- .1 When tested according to the A.S.T.M. Designation C135, Method of Test for Sieve Analysis, the material shall meet the gradation requirements of Type 33 base material.

Part 3 Execution

3.1 INSPECTION

- .1 Prior to all work of this Section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
- .2 Verify that all items to be embedded in concrete are in place.

3.2 PREPARATION

- .1 Remove all wood scraps and debris from the formed areas in which concrete will be placed.
- .2 Thoroughly clean the forms to ensure proper placement and bonding of concrete.
- .3 Thoroughly clean all transporting and handling equipment.

3.3 GRANULAR BASE

- .1 Granular base to be compacted to 100% maximum dry density in accordance with the standard proctor test.

3.4 REINFORCING STEEL

- .1 Reinforcement to be placed accurately and in accordance with contract documents. Mid-height reinforcing steel to be placed within 5mm of mid-height of slab to ensure equal concrete cover above and below bars.

3.5 PLACING CONCRETE

- .1 Place concrete in accordance with requirements of CSA A23.1-14.
- .2 Notify Consultant, Inspection and Testing Firm a minimum of 24 hours prior to commencement of concreting operations.
- .3 Ensure all anchors, seats, plates and other items to be cast into concrete are placed, held securely and will not cause undue hardship in placing concrete.
- .4 Maintain accurate records of poured concrete items. Record date, location of pour, quantity, air temperature and test samples taken.
- .5 Ensure reinforcement, inserts, embedded parts, formed joints and fitments are not disturbed during concrete placement.
- .6 Approval to place concrete shall be contingent on the formwork and reinforcing steel placement and evidence that the Contractor can place the planned casting without stopping.
- .7 Convey concrete to the place of final deposit by methods which will prevent the segregation or loss of material.
- .8 Conveying and placing equipment to be free of hardened concrete and foreign material. Clean at frequent intervals.
- .9 Concrete to be deposited as close as practicable to final position. Avoid segregation due to rehandling or flowing. Place in horizontal lifts to maintain a level surface.
- .10 Vertical height of free fall of concrete not to exceed maximum required for good practice. If segregation occurs, chutes and spouts to be used.
- .11 Consolidate thoroughly and uniformly by tamping, hand tools, vibrators and finishing machines. Secure dense, homogeneous structure, close bond with reinforcement and smooth formed surfaces. Use internal vibrators wherever practicable. External-type vibrators only where satisfactory surfaces cannot be obtained with internal type.

- .12 Apply internal vibrators applied at the point of deposit in the areas of freshly placed concrete. Follow the requirements of CSA A23.1-14.
- .13 Excessive honeycomb or embedded debris in concrete is not acceptable. Remove and replace defective concrete. Excessive honeycomb is when eraser end of a pencil fits into cavity.

3.6 FINISHING CONCRETE

- .1 Finish concrete surfaces in accordance with CSA A23.1-14.
- .2 Uniformly spread, screed, and float concrete. Do not use grate tampers or mesh rollers. Do not spread by vibration.
- .3 Float concrete surface with one or more passes of a magnesium float to obtain a level finish free of ridges. Provide light broom finish and chamfer edge of slab 20mm on all sides.

3.7 CURING AND PROTECTION

- .1 Protection and curing of fresh concrete shall conform to the requirements of CSA A23.1-14, Clause 7.5 and Clause 7.7
- .2 Concrete surfaces shall be moist cured in accordance with the methods and regimes specified in CSA A23.1-14. Review curing and protection methodology with Consultant prior to construction.
- .3 Heated enclosures used for protection and curing shall meet the requirements of

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Equipment installation requirements common to equipment sections.
 - 2. Painting and finishing.
 - 3. Supports and anchorages.
- B. This section applies to Division 21, Division 22 and Division 23.

1.2 EXAMINATION OF WORK AND SITE

- A. Check local site conditions to determine difficulties in carrying out the work as shown and specified.
- B. Confirm inverts and locations of all services prior to commencing work on site. Advise Consultant of discrepancies between existing conditions and drawings.

1.3 DRAWINGS

- A. Drawings are essentially diagrammatic. Size and location of equipment are drawn to scale wherever possible, however, all data in the contract documents shall be verified for information involving accurate dimensions of the building. No claim shall be allowed on account of actual or estimated dimensions.
- B. Drawings indicate required size and points of termination of piping, ductwork, etc., and suggest proper routes to conform to the structure, avoid obstructions and preserve clearances. It is not intended that the drawings indicate all offsets. Piping, ductwork, etc., shall be installed as to conform to the structure, avoid obstructions, preserve headroom and keep openings and passageways clear.
- C. The mechanical drawings do not show all structural and architectural details. Information regarding actual dimension shall be obtained from the structural and architectural drawings or on site. No pipes, ducts and equipment shall be prefabricated without such checks of other drawings, and any changes to accommodate the structure shall be made at no additional cost.
- D. It is intended that all apparatus be located symmetrically with Architectural elements.

1.4 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, and tunnels.

- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.5 PERMITS, CODES, BYLAWS AND ABBREVIATIONS

- A. Codes and by-laws relating to the installation and the equipment shall have precedence over drawings and specifications.
- B. Obtain and pay for all permits and incidental charges for the execution of the work. Registration Certificates for all pressure vessels shall be framed behind glass, located as instructed.
- C. Tradesman shall be fully qualified under Provincial and Local Regulations.
- D. Abbreviations which may be used in this specification and on the drawings shall be interpreted as referred to in the American Society of Heating, Refrigeration and Air Conditioning Guide and Data Book; current edition. Abbreviations of which the Contractor is unsure shall be confirmed with the Consultant.

1.6 CONTRACTOR'S SUPERVISION

- A. Provide for services of a mechanical superintendent approved by the Consultant and General Contractor. The superintendent shall not be changed during the duration of the contract, unless he is unsatisfactory to the Consultant or General Contractor, or is no longer employed by the Contractor.
- B. The mechanical superintendent shall:
 - 1. Coordinate the efforts of the mechanical tradesmen of Divisions 21, 22 and 23.
 - 2. Coordinate the mechanical work with other divisions of the work in a proactive manner.
 - 3. Be the point of contact for the Consultant.
 - 4. Address Requests for Information (RFI's) from the mechanical tradesmen, and if further information is required, then submit written request through formal channels.
 - 5. Address all action items indicated in the Consultant's Site Visit Reports in writing on a line-by-line basis

1.7 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."
- B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
 - 1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
 - 2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.
- C. Welding qualifications :Registered Quality Control Program, Qualify procedures and personnel according to CSA standards and ASME standards. Cross reference the appropriate CSA and ASME standard for all American standards specified. As a minimum, welders will hold a level B Journeyman welders certificate, and Welder Licence from TSASK.
 - 1. Submit to mechanical consultant:
 - a. One copy - Quality control manual registered with TSASK. complete with certificate of registration.
 - b. One copy - Welding procedure registered with TSASK for review.
 - c. One copy of each -Welder qualifications,(welder licence from TSASK).
 - 2. Radiographic test Interpretation to be according to the criteria of ANSI/ASME B31.3 for appropriate service categories.
 - a. Provide one full circumference radiographic inspection for the first 2 welds made by every welder and at least one of every ten welded pipe to pipe and pipe and pipe to- fitting joints.
 - b. All sizes and types of pipe welds to be tested at locations identified by the engineer.
 - 3. Contractor shall pay for associated costs.
- D. For all structural work: Company & Welders must be CWB certified to CSA Standard W47.1 Certification of companies for Fusion Welding of Steel in Division 2.

1.8 INSPECTIONS AND TESTS

- A. Work shall not be concealed until examined and approved by the Consultant and required regulatory organizations.
- B. No pipe or fitting shall be concealed unless examined and approved by the Consultant and other required regulatory organizations.
- C. Give 48 hour written notice of date for tests and inspections.

1.9 TESTS

- A. Work shall pass all tests as indicated and as may be required by regulatory organizations, and shall be witnessed by the person requiring the tests. Upon

completion of tests, the work shall be cleaned out and put in a condition of readiness for operation.

- B. Give 48 hour written notice of date for tests.
- C. Insulate or conceal work only after testing and approval by Consultant.
- D. Conduct tests in presence of Consultant or authority having jurisdiction.
- E. Bear costs including retesting and making good.
- F. Piping: test as specified in relevant sections.
- G. Equipment: test as specified in relevant sections.
- H. Prior to tests, isolate all equipment or other parts which are not designed to withstand test pressures or test medium.

1.10 COORDINATION

- A. This Contractor shall check all contract drawings and specifications to determine any conflicts with other trades and shall immediately advise the Consultant of any conflicts.
- B. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for Mechanical installations.
- C. Coordinate requirements for access panels and doors for Mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Panels."
- D. Supply anchor bolts and templates for installation by other divisions.

1.11 PROGRESS CLAIM BREAKDOWN

- A. Refer to Section 23 05 01 for the Mechanical Progress claim Breakdown.
 - 1. The contractor shall completely fill out the Mechanical Progress Claim Price Breakdown Form and submit it to the Mechanical Engineer within 14 days of award of contract.
 - 2. Obtain all necessary price breakdowns from sub-contractors and suppliers as required to accurately complete the form.
 - 3. Fill in with zeros any items that do not apply to this project.
 - 4. This form to be completed to the satisfaction of the Engineer.
 - 5. Submit this form filled out in its entirety with each month's Progress Claim.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

PART 3 - EXECUTION

3.1 INSTALLATION AND EQUIPMENT REQUIREMENTS

- A. Be fully informed regarding peculiarities and limitations of the spaces involved for the installation of work and materials. Exercise due and particular caution to determine that all parts of work are made quickly and easily removable. Although locations of equipment and piping may be shown on drawings in certain positions be guided by details and conditions existing at the side.
- B. Provide all offsets requiring to produce a neat, workmanlike arrangement.
- C. Equipment such as valves, cleanouts, motors, drain points, shall be fully accessible by access doors or other approved means.
- D. Permit equipment maintenance and disassembly by use of unions or flanges to minimize disturbance to connecting piping and duct systems and without interference from building structure or other equipment.
- E. Pipe equipment drains and other drain lines to nearest floor drain.
- F. Line-up equipment, rectangular cleanouts and similar items with building walls wherever possible.

3.2 MECHANICAL DEMOLITION / INTERRUPTION OF EXISTING SERVICES

- A. Disconnect, demolish, and remove mechanical systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping at active main with same or compatible piping material. Dead-end branches no longer in service are to be removed, unless specifically noted.
 - 2. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 3. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 4. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
 - 5. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
- B. If pipe, duct, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

- C. Do not interrupt service to facilities occupied by Owner or others (for demolition or new tie-in) unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements of the owner indicated:
 - 1. Coordinate all mechanical system shut-downs as required for demolition or new tie-ins with the owner.
 - 2. Notify Consultant and Owner no fewer than two days in advance of proposed interruption of service.
 - 3. Do not proceed with interruption of service without Consultant's written permission.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.

END OF SECTION

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes diesel-fuel-oil distribution systems and the following:
 - 1. Pipes, tubes, and fittings.
 - 2. Piping and tubing joining materials.
 - 3. Piping specialties.
 - 4. Valves.

1.2 DEFINITIONS

- A. AST: Aboveground storage tank.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- E. FPM: Vinylidene fluoride-hexafluoropropylene copolymer rubber.

1.3 QUALITY ASSURANCE

- A. Brazing: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
- B. Steel Support Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."
- C. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.
- D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- E. Comply with ASME B31.9, "Building Services Piping," for fuel-oil piping materials, installation, testing, and inspecting.
- F. Comply with requirements of the EPA and of state and local authorities having jurisdiction. Include recording of fuel-oil storage tanks and monitoring of tanks and piping.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.
- B. Store pipes and tubes with protective PE coating to avoid damaging the coating and to protect from direct sunlight.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide a complete and fully operational system with facilities and services to meet requirements described herein and in accordance with FM Global, CSA cUL, and authorities having jurisdiction.

2.2 PIPES, TUBES, AND FITTINGS

- A. See Part 3 piping schedule articles for where pipes, tubes, fittings, and joining materials are applied in various services.
- B. Steel Pipe: ASTM A 53/A 53M, black steel, Schedule 40, Type E or S, Grade B.
 - 1. Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern.
 - 2. Wrought-Steel Welding Fittings: ASTM A 234/A 234M, for butt and socket welding.
 - 3. Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends.
- C. Stainless Steel Pipe: Schedule 40, ASTM A 312/A 312M, Grade TP316L, unless otherwise indicated; seamless pipe and ASTM A 403/A 403M, Class S, seamless fittings matching pipe thickness and grade, for welded joints.

2.3 PIPING SPECIALTIES

- A. Flexible Connectors: Comply with UL 567.
 - 1. Metallic Connectors:
 - a. Listed and labeled for aboveground and underground applications by an NRTL acceptable to authorities having jurisdiction.
 - b. Stainless-steel bellows with woven, flexible, bronze or stainless-steel, wire-reinforcing protective jacket.
 - c. Minimum Operating Pressure: 1035-kPa (150-psig).
 - d. End Connections: Socket, flanged, or threaded end to match connected piping.
 - e. Maximum Length: 750-mm (30-in.).
 - f. Swivel end, 345-kPa (50-psig) maximum operating pressure.
 - g. Factory-furnished anode.
- B. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
 2. End Connections: Threaded ends for DN 50 (NPS 2) and smaller; flanged ends for DN 65 (NPS 2-1/2) and larger.
 3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
 4. CWP Rating: 860-kPa (125-psig).
- C. Manual Air Vents:
1. Body: Bronze.
 2. Internal Parts: Nonferrous.
 3. Operator: Screwdriver or thumbscrew.
 4. Inlet Connection: DN 15 (NPS 1/2).
 5. Discharge Connection: DN 6 (NPS 1/8).
 6. CWP Rating: 1035-kPa (150-psig).
 7. Maximum Operating Temperature: 107°C (225°F).

2.4 JOINING MATERIALS

- A. Joint Compound and Tape: Suitable for fuel oil.
- B. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.5 MANUAL FUEL-OIL SHUTOFF VALVES

- A. General Requirements for Metallic Valves, DN 50 (NPS 2) and Smaller for Liquid Service: Comply with UL 842.
1. CWP Rating: 860-kPa (125-psig).
 2. Threaded Ends: Comply with ASME B1.20.1.
 3. Dryseal Threads on Flare Ends: Comply with ASME B1.20.3.
 4. Tamperproof Feature: Locking feature for valves indicated in the valve schedule.
 5. Service Mark: Initials "WOG" shall be permanently marked on valve body.
- B. Two-Piece, Regular-Port, Bronze Ball Valves with Bronze Trim: MSS SP-110.
1. Body: Bronze, complying with ASTM B 584.
 2. Ball: Chrome-plated bronze, solid.
 3. Stem: Bronze; blowout proof.
 4. Seats: Reinforced TFE; blowout proof.
 5. Packing: Threaded-body packnut design with adjustable-stem packing.
 6. Ends: Threaded, flared, or socket as indicated in the valve schedule.
 7. CWP Rating: 4140-kPa (600-psig).
 8. Service Mark: Initials "WOG" shall be permanently marked on valve body.

2.6 SPECIALTY VALVES

- A. Pressure Relief Valves: Comply with UL 842.
1. Listed and labeled for fuel-oil service by NRTL FM Global, CSA, and acceptable to authorities having jurisdiction.

2. Body: Brass, bronze, or cast steel.
3. Springs: Stainless steel, interchangeable.
4. Seat and Seal: Nitrile rubber.
5. Orifice: Stainless steel, interchangeable.
6. Factory-Applied Finish: Baked enamel.
7. Maximum Inlet Pressure: 1035-kPa (150-psig).
8. Relief Pressure Setting: 414-kPa (60-psig).

2.7 SLEEVES

- A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

2.8 ESCUTCHEONS

- A. General Requirements for Escutcheons: Manufactured wall and ceiling escutcheons and floor plates, with ID to fit around pipe or tube and with OD that completely covers opening.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine roughing-in for fuel oil piping system to verify actual locations of piping connections before equipment installation.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Close equipment shutoff valves before turning off fuel oil to premises or piping section.
- B. Comply with NFPA 30 and NFPA 31 requirements for prevention of accidental ignition.

3.3 OUTDOOR PIPING INSTALLATION

- A. Steel Piping with Protective Coating:
 1. Apply joint cover kits to pipe after joining, to cover, seal, and protect joints.
 2. Repair damage to PE coating on pipe as recommended in writing by protective coating manufacturer. Review protective coating damage with Architect prior to repair.
 3. Replace pipe having damaged PE coating with new pipe.
- B. Install vent pipe at a minimum slope of 2 percent downward toward fuel-oil storage tank sump.

- C. Assemble and install entry boots for pipe penetrations through sump sidewalls for liquid-tight joints.
- D. Install metal pipes and tubes, fittings, valves, and flexible connectors at piping connections to AST.
- E. Install fittings for changes in direction in rigid pipe.
- F. Install system components with pressure rating equal to or greater than system operating pressure.
- G. Install pressure gage on suction and discharge from each pump.

3.4 INDOOR PIPING INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Arrange for pipe spaces, chases, slots, sleeves, and openings in building structure during progress of construction, to allow for mechanical installations.
- C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping free of sags and bends.
- G. Install fittings for changes in direction and branch connections.
- H. Install escutcheons for penetrations of walls, ceilings, and floors.
- I. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems."
- J. Verify final equipment locations for roughing-in.
- K. Comply with requirements for equipment specifications in Division 23 Sections for roughing-in requirements.

- L. Conceal pipe installations in walls, pipe spaces, or utility spaces; above ceilings; below grade or floors; and in floor channels unless indicated to be exposed to view.
- M. Prohibited Locations:
 - 1. Do not install fuel-oil piping in or through circulating air ducts, clothes or trash chutes, chimneys or gas vents (flues), ventilating ducts, or dumbwaiter or elevator shafts.
 - 2. Do not install fuel-oil piping in solid walls or partitions.
- N. Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.
- O. Connect branch piping from top or side of horizontal piping.
- P. Install unions in pipes DN 50 (NPS 2) and smaller at final connection to each piece of equipment and elsewhere as indicated. Unions are not required on flanged devices.
- Q. Do not use fuel-oil piping as grounding electrode.
- R. Install Y-pattern strainer on inlet side of fuel-oil pump.

3.5 VALVE INSTALLATION

- A. Install manual fuel-oil shutoff valves on branch connections to fuel-oil appliance.
- B. Install valves in accessible locations.
- C. Protect valves from physical damage.
- D. Install metal tag attached with metal chain indicating fuel-oil piping systems.
- E. Install one-piece, bronze ball valve with hose end connection at low points in fuel-oil piping.
- F. Install manual air vents at high points in fuel-oil piping.

3.6 PIPING JOINT CONSTRUCTION

- A. Ream ends of pipes and tubes and remove burrs.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.

2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- D. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to "Quality Assurance" Article.
 1. Bevel plain ends of steel pipe.
- E. Patch factory-applied protective coating as recommended by manufacturer at field welds and where damage to coating occurs during construction.

3.7 HANGER AND SUPPORT INSTALLATION

- A. Pipe hanger and support and equipment support materials and installation requirements are specified in Division 23 Section "Hangers and Supports."
- B. Install hangers for horizontal steel piping with the following maximum spacing and minimum rod sizes:
 1. **DN 32 (NPS 1-1/4)** and Smaller: Maximum span, 2100-mm (**84-in.**); minimum rod size, 10-mm (**3/8-in.**).
 2. **DN 40 (NPS 1-1/2)**: Maximum span, 2700-mm (**108-in.**); minimum rod size, 10-mm (**3/8-in.**).
 3. **DN 50 (NPS 2)**: Maximum span, 3-m (**10-ft**); minimum rod size, 10-mm (**3/8-in.**).
 4. Support vertical steel pipe at each floor and at spacing not greater than 4.5-m (**15-ft.**).

3.8 CONNECTIONS

- A. Install piping adjacent to equipment to allow service and maintenance.
- B. Install unions, in piping DN 50 (NPS 2) and smaller, adjacent to each valve and at final connection to each piece of equipment having threaded pipe connection.
- C. Connect piping to equipment with ball valve and union. Install union between valve and equipment.
- D. Install flexible piping connectors at final connection to burners or oil-fired appliances that must be moved for maintenance access.

3.9 FIELD PAINTING OF ABOVEGROUND PIPING

- A. Comply with requirements in Division 9 painting Sections for painting interior and exterior fuel-oil piping.
- B. Paint exposed, exterior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.
 1. Alkyd System: MPI EXT 5.1D.
 - a. Prime Coat: Alkyd anticorrosive metal primer.

- b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
 - c. Topcoat: Exterior alkyd enamel flat.
 - d. Color: Black.
- C. Paint exposed, interior metal piping, valves, and piping specialties, except components with factory-applied paint or protective coating.
 - 1. Latex Over Alkyd Primer System: MPI INT 5.1Q.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior latex matching topcoat.
 - c. Topcoat: Interior latex flat.
 - d. Color: Black.
 - 2. Alkyd System: MPI INT 5.1E.
 - a. Prime Coat: Alkyd anticorrosive metal primer.
 - b. Intermediate Coat: Interior alkyd matching topcoat.
 - c. Topcoat: Interior alkyd flat.
 - d. Color: Black.
- D. Damage and Touchup: Repair marred and damaged factory-applied finishes with materials and by procedures to match original factory finish.

3.10 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Piping: Minimum hydrostatic or pneumatic test-pressures measured at highest point in system:
 - a. Suction Piping: Minimum 68-kPa (20-in. Hg) for minimum 30 minutes.
 - 1) Isolate storage tanks if test pressure in piping will cause pressure in storage tanks to exceed 69-kPa (10-psig).
 - 2. Inspect and test fuel-oil piping according to NFPA 31, "Tests of Piping" Paragraph; and according to requirements of authorities having jurisdiction.
 - 3. Test liquid-level gage for accuracy by manually measuring fuel-oil levels at not less than three different depths while filling tank and checking against gage indication.
 - 4. Test leak-detection and monitoring system for accuracy by manually operating sensors and checking against alarm panel indication.
 - 5. Start fuel-oil transfer pumps to verify for proper operation of pump and check for leaks.
 - 6. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
 - 7. Bleed air from fuel-oil piping using manual air vents.
- B. Fuel-oil piping and equipment will be considered defective if it does not pass tests and inspections.

3.11 OUTDOOR PIPING SCHEDULE

- A. Aboveground fuel-oil piping shall be the following:
 - 1. DN 50 (NPS 2) and Smaller: Steel pipe, steel welding fittings, and

- welded joints.
- 2. **NPS 2-1/2 (DN 65)** and Larger: Steel pipe, steel welding fittings, and welded joints.

3.12 INDOOR PIPING SCHEDULE

- A. Aboveground fuel-oil piping shall be the following:
 - 1. Steel pipe with wrought-steel fittings and welded joints.

3.13 ABOVEGROUND MANUAL FUEL-OIL SHUTOFF VALVE SCHEDULE

- A. Distribution piping valves for pipe DN 50 (NPS 2) and smaller shall be the following:
 - 1. Two-piece, regular-port, bronze ball valves with bronze trim.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Provide complete and fully operational electrical systems with facilities and services to meet requirements described herein, as shown on the drawings, and in complete accord with applicable codes and ordinances.
- .2 Only those items that are specifically indicated as not in contract (N.I.C.) will be omitted.
- .3 Contract documents of this Division are diagrammatic and approximately to scale, unless detailed otherwise. They establish scope, material and installation quality, and are not detailed installation instructions.
- .4 Follow manufacturers' recommended installation details and procedures for equipment supplemented by details given herein and on plans subject to approval of the Consultant.
- .5 Examine all drawings to ensure that work under this Division can be properly installed without interference.
- .6 Where discrepancies, ambiguities, obvious omissions or errors have been made in drawings and specifications, it shall be the responsibility of the contractor to clarify same prior to tender closing. No allowance will be made after contract award for any expense incurred by him for having to adjust his work to properly conform.
- .7 Provide labour and materials required to install, test and place into operation a complete electrical system. When necessary, in the opinion of the Consultant, provide additional material and labour to modify or correct job conflicts and unsatisfactory work.

1.2 CODES AND STANDARDS

- .1 Do complete installation in accordance with the 2015 Canadian Electrical Code and Saskatchewan supplements, Saskatchewan Human Rights Accessibility Standard, local by-laws and utility requirements. Work involving fire protection shall be in accordance with the Underwriter's Laboratory of Canada, National Building Code, and National Fire Protection Code.
- .2 The electrical installation shall comply with all SaskPower and SaskTel requirements and regulations.
- .3 In the event of any inspection authority requesting deviation from the design, notify the Consultant and obtain approval before proceeding with any change.
- .4 In no instance, shall the standard established by the drawings and specification be reduced by any code or ordinance.

- .5 All references to codes and standards shall be to the latest edition and any errata or addenda.

1.3 CARE, OPERATION AND START-UP

- .1 Instruct operating personnel in the operation, care and maintenance of systems, system equipment and components.
- .2 Connect to equipment furnished in other Divisions and by Owner including start-up and test.
- .3 Arrange and pay for services of manufacturer's factory service engineer to supervise start-up of installation, check, adjust, balance and calibrate components and instruct operating personnel.
- .4 Provide these services for such period, and for as many visits as necessary to put equipment in operation, and ensure that operating personnel are conversant with all aspects of its care and operation.
- .5 Provide labour and materials required to install, test and place into operation a complete electrical system. When necessary, in the opinion of the Consultant, provide additional materials and labour to modify or correct job conflicts and unsatisfactory work.

1.4 VOLTAGE RATINGS

- .1 Operating voltages: to CAN3-C235-83.
- .2 Motors, electric heating, control and distribution devices and equipment to operate satisfactorily at 60 Hz within normal operating limits established by above standard. Equipment to operate in extreme operating conditions established in above standard without damage to equipment.

1.5 PERMITS, FEES AND INSPECTION

- .1 Submit to Electrical Inspection Department and Supply Authority necessary number of drawings and specifications for examination and approval prior to commencement of work.
- .2 Pay associated fees.
- .3 Notify Consultant of changes required by Electrical Inspection Department prior to making changes.
- .4 Furnish Certificates of Acceptance from Electrical Inspection Department and authorities having jurisdiction on completion of work to Consultant.

1.6 MATERIALS AND EQUIPMENT

- .1 All goods and materials shall be new and carry CSA approval seal. Equipment and material to be CSA certified. Where there is no alternative to supplying equipment which is not CSA certified, obtain special approval from the Consultant and the Electrical Inspection Department.

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- .2 No deviation from specified materials shall be allowed, except where alternative materials have been specifically accepted in writing.
- .3 Where materials are not directly specified by catalogue number and manufacturer's name, a high industry specification grade product shall be provided. The Consultant shall be the sole judge of whether this standard is being met.
- .4 Each major component of equipment shall have manufacturer's name, address, catalogue and serial number in a conspicuous place.
- .5 Upon request, provide a complete list of all materials and their manufacture. The contractor will be required to use the materials indicated. Changes in manufactures at a future date will not be acceptable.
- .6 Factory assemble panels and component assemblies.
- .7 All floor mounted equipment shall be mounted on 100 mm concrete housekeeping pads unless otherwise specified.
- .8 Upon request, provide a complete list of all materials and their manufacture. The contractor will be required to use the materials indicated. Changes in manufactures at a future date will not be acceptable.
- .9 Co-operate fully with the Owner to ensure proper arrangement of and provision for all electrical equipment.
- .10 Where outlets or equipment may affect architectural treatment desired, contact Consultant for instructions or detailed drawings.
- .11 Supply and install all motor connections, including starters and overload protection and disconnecting devices at motors where required.
- .12 Supply and install complete wiring requirements for full voltage in-line devices on single phase equipment such as thermostats, multi-speed switches for unit heaters, force flows, cabinet heaters, etc.
- .13 Check existing conditions to ensure that suitable provisions have been provided for all motors. It is possible that some motors may vary in size, numbers and characteristics, depending on the equipment manufacturer's specific requirements. Any variations in this regard will not constitute cause for further consideration.
- .14 Assume full responsibility for layout of this work, and for any damage caused the Owner or other Divisions by improper location or carrying out of this work.
- .15 Before commencing work, examine the existing equipment, and report at once any defects or interference affecting the work under this Division, or the guarantee of same.
- .16 Allow for all hoisting and setting of material and equipment.

1.7 FIELD QUALITY CONTROL

- .1 All work under this Division shall be executed in a workmanlike and substantial manner, neat in its mechanical appearance and arrangement.

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- .2 All electrical work shall be conducted under the on site direction of a journeyman electrician.
- .3 A competent representative shall constantly supervise the work of this Division from beginning to completion and final acceptance. So far as possible, the same supervisor and workmen shall be employed throughout the project's duration.
- .4 Material and workmanship not meeting the standard intended and required by this specification shall, upon instruction from the Consultant, be properly replaced without further charge or consideration.
- .5 Inspection and testing:
 - .1 During construction and up to final acceptance, make accessible any equipment or wiring for inspection purposes.
 - .2 All electrically operating equipment shall be left as a complete installation in perfect operating condition, and receive final test in the presence of the Consultant.
 - .3 Ensure that all circuitry is properly tested and meets the CSA Ground Resistance Requirements. A 600 volt megger or hi-pot procedures shall be used for all such tests.
 - .4 On the request of the Consultant, a staff supervisor shall be made available to assist in this inspection work.
 - .5 At the completion of the installation, voltage tests shall be conducted in the presence of the Consultant.
 - .6 Acceptance tests and commissioning shall be conducted for systems and/or equipment where indicated in the specifications. Acceptance tests shall include, but not be limited to, the following Sections:
 - .1 260521 - Wires and Cables (0-1000 V)
 - .2 260528 - Grounding – Secondary
 - .3 263210 – Emergency Power Generator
 - .4 262823 – Transfer Switches
- .6 Acceptance tests shall meet requirements as required by manufacturer, as outlined in ANSI – NETA 2007 and additional requirements described on drawings and specified herein. All tests shall be documented as per ANSI – NETA 2007 standards and shall include testing results, testing date, testing technician and representative present.
- .7 Certification of all acceptance tests and commissioning shall be submitted to the Consultant for approval. Tests not conducted to the satisfaction of the Consultant shall be repeated, and no further costs will be considered. Written documentation bearing name and signature of Contractor, Consultant and Owner's personnel present during acceptance tests shall be included in certification reports.
- .8 Furnish manufacturer's certificate or letter confirming that entire installation as it pertains to each system has been installed to manufacturer's instructions.
- .9 Provide instruments, meters, equipment and personnel required to conduct test during and at conclusion of project.

1.8 ELECTRICAL DRAWINGS

- .1 They indicate the general location and route of conduit and cable to be installed. Conduit shall be installed in coordination with other services to conserve head room and space through which they pass.
- .2 Install equipment generally in locations and routes shown, close to building structure with minimum interference with other services or free space. Remove and replace improperly installed equipment to the satisfaction of the Consultant at no extra cost.
- .3 Ceiling and floor outlet symbols are scaled to centre line of symbol; symbol does not indicate the size or shape. Mounting height shall be measured to the lowest point on ceiling mounted equipments, and above finished surface for wall mounted equipment.
- .4 Wall outlets are scaled to the perpendicular centre line of the symbol. Mounting heights for all wall mounted outlets shall be measured to the horizontal centre line.
- .5 Where outlets are mounted in masonry walls, outlets should be mounted to the nearest coursing line.

1.9 OWNER SUPPLIED EQUIPMENT

Connect all electrically operated equipment supplied by the Owner, as designated on the drawings.

1.10 SHOP DRAWINGS

- .1 Submit shop drawings for all supplied equipment. Shop drawings shall show detailed dimensional and technical information, and shall properly describe each piece of equipment. Where applicable, shop drawings shall include complete schematics and wiring diagrams. These shop drawings shall be sufficiently detailed to permit the Owner's technicians to trouble-shoot and repair the equipment. Equipment shall not be ordered and/or fabricated until shop drawings have been reviewed by the Consultant.
- .2 Review of shop drawings shall be for general design, arrangement and appearance only. This Division shall check and correct, if necessary, all manufacturer's drawings before submitting, and shall so indicate on each copy, along with a dated approval stamp. All shop drawings must bear an approval stamp and be signed by the Contractor. This review does not relieve this Division from the responsibility for the final installation being correct in all detail, and fully acceptable to the Consultant.
- .3 Refer to General Conditions of the Contract.
- .4 Provide four (4) printed copies and one PDF copy for each Section. Each shop drawing shall be complete with a cover page with the following information:
 - .1 Specification Section and name
 - .2 Project name, Owner's name and address
 - .3 Number of pages in submittal

- .4 Contractor and Supplier's name and contact information
- .5 Approval stamps with room for Consultant's stamp
- .5 Shop drawings for complementary systems and/or equipment shall be submitted at the same time. Partial submittals of related equipment will be rejected or held until all other related shop drawing information has been submitted (i.e. submit all shop drawings for power equipment at the same time). Submittals of shop drawings that are incomplete will be rejected.
- .6 Commissioning forms shall be provided with all shop drawings and the original copy shall be maintained up to date on site. Consultant shall provide commissioning forms prior to shop drawing submittals.

1.11 PROGRESS CLAIMS

Electrical progress claims shall be made on Contractor Progress Report #ES110 provided by the Consultant. A copy of this Progress Report is attached for reference. The Electrical contract price shall be broken down into fifteen (15) parts to facilitate assessment of work done and material supplied. This progress claim shall be submitted simultaneously to the Construction Manager and the Consultant, the latter case in duplicate. Refer to General Conditions for additional requirements. Submit one copy of ES110 immediately after tender award. Progress claims not completed on the ES110 form will not be reviewed.

- .1 The breakdown shall indicate labour and material to the nearest dollar. Overhead, profit and job expense shall be apportioned to all parts. The breakdown shall be as follows:
 - .1 Main services
 - .2 Distribution/Panels
 - .3 Conduit and boxes
 - .4 Wire and cable
 - .5 Motor control
 - .6 Wiring devices
 - .7 Lighting fixtures and lamps
 - .8 Communications systems
 - .9 Security Systems
 - .10 Fire Alarm System
 - .11 Specials
 - .12 Commissioning
 - .13 Miscellaneous - 8% maximum
 - .14 Extras and credits. (Extras in excess of \$100,000 shall be broken down into the above points on a separate ES110 sheet)

1.12 OPERATING INSTRUCTIONS AND SERVICE MANUALS

- .1 Upon completion of the installation, provide three (3) complete and comprehensive identical sets of operating and maintenance manuals.

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- .2 The Consultant shall review the operating and maintenance manuals and approve same prior to the manuals being sent to the Owner.
- .3 The operating and maintenance manuals shall include but not be limited to the following information:
 - .1 Certification reports.
 - .2 Documentation indicating Owner's receipt of operating instructions.
 - .3 Complete list of all materials turned over to the Owner c/w receipts for same.
 - .4 Shop drawings properly indexed and contained in suitably sized envelopes.
 - .5 Commissioning forms.
 - .6 Schematic drawings for all systems indexed and contained in suitably sized envelopes.
 - .7 Catalogue brochures for light fixtures, panelboards, switches, receptacles, fuses, etc.
 - .8 Phase rotation confirmation by the contractor.
 - .9 Certificate of Owner's electrical equipment training.
 - .10 Acceptance Testing and Commissioning reports.
 - .11 Complete electrical load data from operating tests: Voltages on all phases, line to line and line to neutral and ampacity on each phase, with the building in normal operating condition. Measurements to be taken on the main incoming feeder.
 - .12 Recommended maintenance procedures for various systems.
 - .13 Contractors warranty

The above information shall be bound in black, hard-backed, three-ring, letterhead size binders. Incomplete or poorly reproduced manuals will be rejected.

- .4 Maintain, on a daily basis, a complete set of marked-up prints as as-built drawings that show in complete detail the final arrangement and location of all electrical components and the interconnecting wiring. All riser conduits, panel feeds, conduit runs over 200 amp and main communications shall be marked on plans. These are to be maintained in a neat and substantial manner, so as to properly and fully illustrate the way in which the installation has been completed.
- .5 Present finalized as-built mark up drawings to Engineer\Consultant at time of Substantial Performance inspection. Incomplete or inaccurate as-builts will not be accepted and will be returned for completion.
- .6 The Owner's personnel shall be instructed in the operation and maintenance of miscellaneous equipment for a total of two (2) hours.
- .7 The above instructions shall be given by personnel experienced in the operation of the particular system or equipment. Each item or type of equipment, and all controls, shall be operated in the presence of the Owner's personnel to ensure their understanding of equipment function and individual working parts. The Owner reserves the right to set the period or periods during which the instruction shall be given. The contractor shall submit a program of instruction for approval by the Owner.

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- .8 Operating and maintenance manuals shall include written documentation bearing name and signature of Owner's personnel who received the above instructions.
- .9 Operating and maintenance manuals, as well as all Owner instructions, shall be complete before substantial completion (as outlined by the Builders' Lien Act) will be considered. Also, preliminary maintenance manuals must be submitted prior to 70% completion. No further progress payments will be permitted until these preliminary maintenance manuals have been submitted and approved.

1.13 STORAGE AND PROTECTION

- .1 Maintain and protect all work provided under this Division. Store all materials within a protected enclosure to prevent exposure to weather or construction dirt.
- .2 Protect all finished and unfinished work of this and other divisions from damage during the course of construction. Cover floors and other surfaces, if necessary. Any damaged work or finishes shall be repaired or replaced without further charge to the Owner.

1.14 WARRANTY

- .1 All materials and workmanship shall be guaranteed for a period of one year from date of substantial completion. The only exceptions are incandescent lighting, which shall be guaranteed for a period of four (4) months only.
- .2 Properly repair and replace all defective work and other work which becomes defective during the term of warranty.
- .3 Service on equipment or systems critical to the Owner's operation shall be provided on an emergency basis which may necessitate overtime and service outside of normal working hours. The contractor shall ensure that all suppliers comply with this requirement.

1.15 ELECTRIC MOTORS, EQUIPMENT AND CONTROLS

- .1 Supplier and installer responsibility is indicated in Motor, Control and Equipment Schedule on electrical drawings and related mechanical responsibility is indicated on Mechanical Equipment Schedule on mechanical drawings.
- .2 Control wiring and conduit is provided by the Electrical Contractor except for conduit, wiring and connections below 50 V which are related to control systems specified in Division 15 and shown on mechanical drawings.

1.16 FINISHES

- .1 Shop finish metal enclosure surfaces by application of rust resistant primer inside and outside, and at least two coats of finish enamel.
 - .1 Paint indoor switchboards and distribution enclosures light grey ASA 61.
- .2 Clean and touch up surfaces of shop-painted equipment scratched or marred during shipment or installation, to match original paint. Where necessary the entire surface shall be redone.

- .3 Clean and prime exposed non-galvanized hangers, racks and fastenings to prevent rusting.

1.17 ABBREVIATIONS

- .1 Abbreviations used in this specification are common to and in general use within the related trades.

1.18 IDENTIFICATION

- .1 Nameplates shall be provided on each new piece of electrical equipment, including, power panels, distribution panels, lighting panels, transformers, disconnect switches, contactors, telephone panels, miscellaneous systems and panels.
- .2 Nameplates for each new electrical panel shall indicate panel designation, mains voltage and panel and circuit number from which this panel is fed.
- .3 Nameplates for transformers shall indicate transformer primary and secondary voltage and transformer name and designations.
- .4 Nameplates for new disconnects and contactors shall indicate equipment being controlled, and voltage.
- .5 Nameplates for new terminal cabinets shall indicate system and voltage and load of area served.
- .6 Nameplates for Normal Power Equipment shall be made from black-white-black Lamecoid with bevelled edges and white engraved letters. Nameplates for Emergency Power Equipment shall be made from red-white-red lamecoid with bevelled edges and white engraved letters. Nameplates shall be fastened with self tapping metal screws to equipment in a conspicuous location. Flush mounted panels shall have nameplate located on front of panel behind hinged door. Nameplates for Emergency Power Equipment shall be red-white-red lamecoid and Uninterruptible Power Equipment shall be grey-white-grey.
- .7 Typical identification standards shall be used for new equipment throughout the project as follows:

- .1 Lighting, receptacle and power panels shall each be identified with an engraved Lamecoid plate secured to top interior trim as:

Panel 202	10mm high lettering
120/208 volts	6mm high lettering
Fed from Panel 601	6mm high lettering

- .2 Other cabinets and plywood back boards for low voltage systems, such as signals and communications, shall be identified as panelboards with a directory showing circuit numbers and room locations, plus a blank for "Remarks", as well as a Lamecoid plate designation panel name.

EXAMPLE: if cabinet is for telephone
.....TP - 2nd floor

- .3 Equipment not listed above, such as incoming service cables, communicating cables, switchgear, transformers, disconnects, motors, instruments, fire alarm and control panels, shall be identified in a similar manner, showing name and number of the equipment, voltage and load information.
- .4 Identification to be English
- .5 Wording on nameplates and labels to be approved by Engineer Consultant prior to manufacture.

1.19 WIRING IDENTIFICATION

- .1 Identify wiring with permanent indelible identifying markings, either numbered or coloured plastic tapes, on both ends of phase conductors of feeders and branch circuit wiring.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code: to CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.
- .5 Connections in equipment shall be made Phase 'A', 'B', 'C' from left to right when viewing wiring from front or accessible direction.
- .6 Labels:
 - .1 Embossed plastic labels with 6 mm high letters unless specified otherwise.
- .7 Colour coding shall be carried through from incoming utility supply down to and including panels, and shall be as follows:
 - .1 Incoming utility service lines shall be identified by Red - Phase 'A'; Black - Phase 'B'; Blue - Phase 'C'; with colour coded PVC tape.
 - .2 Switchgear buswork in each switchboard and unit substation cubicle shall be banded with 3M tape identified in accordance with service lines colour coding. In addition, where neutral bus is introduced, it shall be banded white. Ground bus shall be banded green.
 - .3 Feeder and sub-feeder bus or conductors shall be banded as above.
 - .4 Lighting and power panels shall conform to the Canadian Electrical Code, and shall have main bus banded with tape as follows:

Red	-	Phase 'A'
Black	-	Phase 'B'
Blue	-	Phase 'C'
White	-	Neutral
Green	-	Ground

1.20 CONDUIT AND CABLE IDENTIFICATION

- .1 Colour code conduits, boxes and metallic sheathed cables.
- .2 Feeder pull boxes and junction boxes shall be identified with waterproof ink, showing feeder or system concerned. Conduit entering junction boxes for communications systems shall be identified with the room number that each conduit serves.
- .3 A small dab of paint shall be applied to inside of each outlet box, pull box and panel as it is installed, using colour code as follows:

Red	- Fire Alarm System
Blue	- Intercom, Public Address, etc.
Yellow	- Alarm Systems
Green	- Telephone/Computer Systems

The outside of the box shall also be identified in this way so as to readily determine the system within the conduit system. The cover of each junction box for branch circuits shall describe the voltage being used by means of a waterproof ink.

- .4 No colour code is required for regular lighting and power circuits, but voltage class shall be displayed on all pull boxes and panels, and 347 volt ballast covers.
- .5 Junction boxes in furred ceilings shall be colour identified on both inside and outside.

1.21 WIRING TERMINATIONS

- .1 Lugs, terminals, screws used for termination of wiring to be suitable for either copper or aluminum conductors.

1.22 MANUFACTURERS AND CSA LABELS

- .1 Visible and legible, after equipment is installed.

1.23 WARNING SIGNS

- .1 As specified and to meet requirements of Electrical Inspection Department and Owner.
- .2 Decal signs, minimum size 175 x 250 mm.

1.24 CONDUIT AND CABLE INSTALLATION

- .1 Install conduit and sleeves prior to pouring of concrete. Sleeves through concrete: plastic, sized for free passage of conduit, and protruding 50 mm.
- .2 If plastic sleeves are used in fire rated walls or floors, remove before conduit installation.
- .3 Install cables, conduits and fittings to be embedded or plastered over, neatly and close to building structure so furring can be kept to minimum.

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- .4 All conduit and tray sealing and all firestopping shall be the responsibility of the Electrical Contractor and shall be as per Specification Sections 07 92 00 Joint Sealants and 07 84 00 Firestopping.

1.25 TEMPORARY AND TRIAL USAGE

- .1 Temporary and trial usage by the Owner, or the Contractor, of any of the electrical apparatus or equipment, or any work or materials supplied under this Division before final completion and written acceptance, is not to be construed as evidence of acceptance of same by the Owner.
- .2 Temporary and trial usage may be made as soon as this Division deems the work sufficiently advanced for making a complete and thorough test of same, and that no claim may be made for the injury to or the breaking of any part of such work which may be so used, whether caused by weakness or inaccuracy of structural parts, or by defective material or workmanship of any kind.

1.26 EXCAVATION/BACKFILL AND SITE WORK

- .1 Any excavation and backfilling work that is necessary to accommodate the work under this Division shall be the responsibility of this Division.

1.27 MATERIAL TO BE TURNED OVER TO THE OWNER

- .1 Materials as indicated in various sections of this specification shall be turned over to the Owner. These materials shall include, but not be limited to the following:
 - .1 Obtain a signed receipt for each item turned over to the Owner. Include receipts in the operating and maintenance manuals.
 - .2 One set of three fuses for each fuse type and size
 - .3 One set of contacts and one holding coil for each size and type of motor starter.

1.28 SITE EXAMINATION

- .1 The contractor shall visit the existing construction site during the tendering period to familiarize himself with the construction conditions and electrical work provided to date. The contractor shall thoroughly satisfy himself that the work contained in these drawings and specifications can be carried out and that all costs have been included in the tender submitted.

1.29 MATERIAL SAFETY DATA AND HAZARDOUS MATERIALS

- .1 The Contractor shall provide material safety data sheets on all materials prior to shipping materials to site. These data sheets shall be submitted in triplicate to the Owner.
- .2 The Contractor shall coordinate and provide necessary information for the Owner's "Work Place Hazardous Material Information System".

1.30 ARC FAULT STUDY

- .1 On newly installed equipment, an Arc Fault study shall be completed. All devices and buses shall be provided with lamacoid labels denoting the relevant information relating to the arc fault hazard present. Refer to specifications on specific requirements for lamacoid labels.

1.31 SCHEDULING OF WORK AND DEMOLITION

- .1 The contractor shall make a thorough study of the main distribution and communications systems to ensure the method required to maintain all existing building services during the construction period. All changeovers shall be done during a period of the day found satisfactory to the Owner.
- .2 The contractor shall submit the method and procedure of all changeovers for approval by the Consultant and the Owner a minimum of fifteen (15) working days in advance.
- .3 The existing fire alarm system shall be maintained in a fully operational state while modifications and additions to the system are installed. Three outages of two hours duration shall be permitted for the purpose of cutting over new portions of the system.
- .4 The above fire alarm outages shall be carried out at dates and times approved by the Owner.
- .5 After the modifications to the fire alarm system are complete, any unused portions of the existing system shall be removed.
- .6 All salvaged materials shall remain the property of the Owner, unless otherwise noted, and shall be stockpiled as per the Owner's instructions.
- .7 Refer to the overall project schedule for further scheduling requirements.

1.32 SMOKING

- .1 The Contractor is cautioned that the building (including grounds) is a **TOTAL NON-SMOKING** facility, and shall make necessary allowances for observance by construction personnel.
- .2 Any violation of or disregard to this situation by construction personnel, will result in the person(s) being forbidden to remain on the premises.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for wire and box connectors.

1.2 REFERENCES

- .1 2015 Canadian Electrical Code
- .2 Canadian Standards Association (CSA International)
 - .1 CAN/CSA-C22.2No.18, Outlet Boxes, Conduit Boxes, Fittings and Associated Hardware.
 - .2 CSA C22.2No.65, Wire Connectors.
- .3 Electrical and Electronic Manufacturers' Association of Canada (EEMAC)
 - .1 EEMAC 1Y-2, 1961 Bushing Stud Connectors and Aluminum Adapters (1200 Ampere Maximum Rating).
- .4 National Electrical Manufacturers Association (NEMA)

1.3 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 MATERIALS

- .1 Pressure type wire connectors: with current carrying parts of copper sized to fit copper conductors as required.
- .2 Fixture type splicing connectors: with current carrying parts of copper sized to fit copper conductors #10 AWG or less.
- .3 Bushing stud connectors: to EEMAC 1Y-2 to consist of:
 - .1 Connector body and stud clamp for round copper conductors.
 - .2 Clamp for round copper conductors.
 - .3 Stud clamp bolts.
 - .4 Sized for conductors as indicated
- .4 Clamps or connectors for armoured cable, aluminum sheathed cable, mineral insulated cable, flexible conduit, non-metallic sheathed cable as required.

Part 3 Execution

3.1 INSTALLATION

- .1 Remove insulation carefully from ends of conductors and:
 - .1 Apply coat of zinc joint compound on aluminum conductors prior to installation of connectors.
 - .2 Install mechanical pressure type connectors and tighten screws with appropriate compression tool recommended by manufacturer. Installation shall meet secureness tests in accordance with CSA C22.2No.65.
 - .3 Install fixture type connectors and tighten. Replace insulating cap.
 - .4 Install bushing stud connectors in accordance with NEMA.
 - .5 Site Tests and Inspections - Indoor Air Quality Control Requirements: Perform work in accordance with IAQ requirements specified in Section 01 81 19.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 20 - Wire and Box Connectors - 0 - 1000 V.

1.2 REFERENCES

- .1 2015 Canadian Electrical Code
- .2 CSA C22.2 No .0.3-96, Test Methods for Electrical Wires and Cables.
- .3 CAN/CSA-C22.2 No. 131-M89(R1994), Type TECK 90 Cable.

1.3 PRODUCT DATA

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

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 BUILDING WIRES

- .1 All conductors shall be copper, minimum No. 12 gauge, unless specifically noted otherwise.
- .2 All conductors # 12 AWG and up shall be rated for minimum 600V RW-90 XLPE. All conductor for motor feeds from variable frequency drives, shall be rated for minimum 1000V RW-90 XLPE.
 - .1 Copper conductors: size as indicated, with 600 V insulation of chemically cross-linked thermosetting polyethylene material rated RW90, RWU90, or R90.
- .3 Grounding conductors: bare copper, or where installed within conduit raceways, grounding conductor shall be insulated.
- .4 Aluminum conductors are not permitted for any wiring unless specifically shown on drawings.
- .5 Conductor utilized in conduit run under slab on grade or in conduit underground shall be Type 'RWU-90'.
- .6 Wire shall be as manufactured by Nexans, Alcan, Pirelli, BICC General Wire or Superior Essex.

2.2 TECK CABLE

- .1 Cable: to CAN/CSA-C22.2 No. 131.
- .2 Conductors:
 - .1 Grounding conductor: copper.
 - .2 Circuit conductors: copper, size as indicated.
- .3 Insulation:
 - .1 Chemically cross-linked thermosetting polyethylene rated type RW90, 600V to 1000V as noted above.
- .4 Fastenings:
 - .1 One hole steel straps to secure surface cables 50 mm and smaller. Two hole steel straps for cables larger than 50 mm.
 - .2 Channel type supports for two or more cables.
 - .3 Threaded rods: 6 mm dia. to support suspended channels.
- .5 Connectors:
 - .1 Watertight approved for TECK cable.

2.3 ARMoured CABLES

- .1 Conductors: insulated, copper, size as indicated.
- .2 Type: AC90.
- .3 Armour: interlocking type fabricated from aluminum strip.
- .4 Type: ACWU90 - flame retardant jacket over armour meeting requirements of Vertical Tray Fire Test of CSA C22.2 No. 0.3 with maximum flame travel of 1.2 m.

Part 3 Execution

3.1 INSTALLATION OF BUILDING WIRES

- .1 Termination for #8 AWG and larger shall be by means of approved solderless connector lug. For parallel conductors, a common lug with separate termination for each conductor shall be employed.
- .2 Conductor splices shall be made in accordance with specifications. Provide sufficient length for joint remake, and no less than 200 mm spare length. On through wiring, leave 300 mm loop.
- .3 Wiring in cabinets, pull boxes, panels and junction boxes shall be neatly trained and held with nylon cable ties.
- .4 Conductors shall be tag identified where passing through junction boxes.

- .5 Conductor length for parallel feeders to be identical.
- .6 All feeders and branch circuits must contain a green bonding conductor, sized to code requirements.
- .7 All wiring shall be installed in raceway. Wiring shall not be permitted to be installed in the free air unless otherwise noted.
- .8 Neutral conductors shall be the same ampacity as phase conductors.

3.2 INSTALLATION OF TECK CABLE 0 -1000 V

- .1 Install cables.
 - .1 Group cables wherever possible on channels.
- .2 Terminate cables in accordance with Section 26 05 20 - Wire and Box Connectors - 0-1000V.
- .3 All cables shall be terminated and spliced with suitable compression type connectors, as recommended by the cable manufacturer. The connectors shall satisfy the bonding and grounding requirements at the supply end.
- .4 All cables shall be single conductor and copper, unless otherwise specified.
- .5 All cable shall be rated for 1000 volts, insulated with cross-linked polyethylene and rated for operation at 90 degrees C. Cable shall have a FT4 rated outer jacket.
- .6 All cable shall meet the CSA requirements for cold bend and impact testing at minus 40 degrees C.
- .7 All cable shall be protected by a corrugated aluminum sheath or by interlocked aluminum armour. PVC jackets shall be required on all metallic sheathed cables.
- .8 The jackets shall meet the FT4 flame spread requirements and be identified on the P.V.C. jacket.
- .9 All cables shall be installed in accordance with the manufacturers recommendations, in suitable cable tray as specified within the specifications.
- .10 The cables shall be terminated at the supply end on a non-ferrous metallic plate and at the load end on a non-metallic rigid fibre board plate. The cable sheaths shall be bonded at the supply end only.
- .11 All cable installed in cable tray shall be installed at one diameter spacing.
- .12 When single conductor cables are direct earth buried they shall be spaced 150 mm apart.
- .13 Tech cabling shall be used only where noted on plans.

- .14 Cables shall be manufactured by Nexans, Alcan, Superior Essex, General Wire or Pirelli.

3.3 INSTALLATION OF CONTROL CABLES

- .1 Install control cables in conduit.
- .2 Ground control cable shield.

3.4 INSTALLATION OF NON-METALLIC SHEATHED CABLE

- .1 Install cables.
- .2 Install straps and box connectors to cables as required.

3.5 IDENTIFICATION

- .1 Colour code metallic sheathed cables.
- .2 Maintain phase sequence and colour coding throughout.
- .3 Colour code to latest edition of CSA C22.1.
- .4 Use colour coded wires in communication cables, matched throughout system.

END OF SECTION

PART 1 General

1.1 REQUIREMENTS

- .1 Electrical equipment and wiring shall be grounded in accordance with the Canadian Electrical Code, Part 1, C22.1-2012, and local inspection authority's rules and regulations.
- .2 The ground bus or pad in each transfer switch, motor control centre, generator control panel, etc., shall be connected to the grounding network by two AWG #3/0 bare copper conductors.
- .3 All metallic raceways and conduits for communications, cable and conductors shall be grounded.
- .4 Bus duct runs, lay-in trays and feeder conduits shall be connected to the building ground bus.

PART 2 Products

2.1 MATERIALS

- .1 All ground conductors shall be bare or insulated, stranded, medium hard drawn copper wire. All insulated ground wires shall be green.
- .2 Exposed copper shall be cleaned to a bright surface, and shall be finished with two coats of clean, insulating varnish.
- .3 All connections to the ground bus or risers shall be thermowelded, or shall utilize the Burndy Hy-Ground compression connections. Clamp type connections shall only be allowed to individual pieces of equipment.
- .4 Where bonds are covered with soil, the conductors are to be coated with anti-corrosion compound "Kopr-Shield" (Thomas & Betts Co.) before compression connector is applied. All bonding shall be done with 'C' tap and lug compression connectors.

PART 3 Execution

3.1 INSTALLATION

- .1 All grounding conductors outside the electrical rooms and closets shall be insulated and installed in conduits, unless otherwise noted.
- .2 Connections to copper water pipes, neutral points and equipment shall be made with thermowelds or brass, bronze or copper bolts and connectors.
- .3 Equipment grounds and transformer system grounds shall be connected to the building grounding network. All non-current carrying metallic parts of equipment shall be connected to the ground network.
- .4 All grounding connectors, conductor and terminations shall be checked and approved by the Consultant prior to concealment by fill or architectural finishes.

- .5 Use mechanical connectors for grounding connections to equipment provided with lugs.
- .6 Install bonding wire for flexible conduit, connected at both ends to grounding bushing, solderless lug, clamp or cup washer and screw. Neatly cleat bonding wire to exterior of flexible conduit.
- .7 Install grounding connections to typical equipment included in, but not necessarily limited to the following list: Service equipment, duct systems, frames of motors, starters, control panels, structure steel work, and distribution panels.

END OF SECTION

Part 1 General

1.1 REFERENCE

- .1 2015 Canadian Electrical Code

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 JUNCTION AND PULL BOXES

- .1 Welded steel construction with screw-on flat covers for surface mounting.
- .2 Covers with 25 mm minimum extension all around, for flush-mounted pull and junction boxes

2.2 CABINETS

- .1 Sheet steel, hinged door and return flange overlapping sides, handle, lock and catch, for surface mounti

Part 3 Execution

3.1 JUNCTION, PULL BOXES AND CABINETS INSTALLATION

- .1 Install pull boxes in inconspicuous but accessible locations.
- .2 Mount cabinets with top not higher than 2 m above finished floor.
- .3 Only main junction and pull boxes are indicated. Provide others as required by code. Install pull boxes so as not to exceed 30m of conduit run between pull boxes.
- .4 Provide lugs in pull box installed for load bank switch so that load bank conductors need only terminate on the lugs without going into the CDP.

3.2 IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 02 - Common Work Results - Electrical.
- .2 Install size 2 identification labels indicating system name, voltage and phase.

END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 2015 Canadian Electrical Code

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 OUTLET AND CONDUIT BOXES GENERAL

- .1 Size boxes in accordance with CSA C22.1.
- .2 102 mm square or larger outlet boxes as required for special devices.
- .3 Gang boxes where wiring devices are grouped.
- .4 Provide deep junction boxes for all communication outlets to allow proper bend radius of cables.
- .5 Provide blank cover plates for boxes without wiring devices.
- .6 Provide combination boxes with barriers where outlets for more than one system are grouped.
- .7 Use conduits where 90° turn required on wall mounted conduit. They shall be of the type where cover screws do not enter the wire chamber and covers are left accessible.
- .8 Where boxes are surface mounted in unfinished areas, such as furnace or boiler rooms, stamped galvanized steel 100 mm square box to accept #8300 series raised covers shall be used.
- .9 Indoors, stamped zinc cadmium plated steel boxes shall be provided and set for each fixture, switch, wall receptacle or other types of outlets, adapted to suit its respective location and designed to accept its particular components.
- .10 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .11 Set boxes plumb and level within 6 mm of finished surface. Mats not permitted.
- .12 Where required, provide voltage separation barriers.

2.2 SHEET STEEL OUTLET BOXES

- .1 Electro-galvanized steel multi-gang flush device boxes for flush installation, minimum size 76 x 50 x 38 mm or as indicated. 102 mm square outlet boxes when more than one conduit enters one side with extension and plaster rings as required.
- .2 Standard octagon boxes shall be 100 mm diameter, 53 mm deep minimum. Increase depth where area fill requires. Equip each box used for fixture hanging with a fixture stud.
- .3 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished walls.
- .4 102 mm square or octagonal outlet boxes for lighting fixture outlets.
- .5 102 mm square outlet boxes with extension and plaster rings for flush mounting devices in finished plaster walls.

2.3 FITTINGS - GENERAL

- .1 Bushing and connectors with nylon insulated throats.
- .2 Knock-out fillers to prevent entry of debris.
- .3 Conduit outlet bodies for conduit up to 32 mm and pull boxes for larger conduits.
- .4 Double locknuts and insulated bushings on sheet metal boxes.

Part 3 Execution**3.1 INSTALLATION**

- .1 Support boxes independently of connecting conduits.
- .2 Fill boxes with paper, sponges or foam or similar approved material to prevent entry of debris during construction. Remove upon completion of work.
- .3 Provide correct size of openings in boxes for conduit, mineral insulated and armoured cable connections. Reducing washers are not allowed.
- .4 Outlet boxes shall be supported independently of conduit capable of supporting weight of fixture or other device. Conduit entering the back of a box shall not enter the centre knockout.
- .5 Flexible conduit to fixture shall be minimum 12 mm diameter, and shall not emanate from outlet box cover. Maximum length of flexible conduit from outlet box to fixture shall be 3000 mm. Outlet box for fixture shall not be located above ducts, pipes, etc. Outlet box shall be within 750 mm (vertically) of the fixture.

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OUTLET, CONDUIT BOXES AND FITTINGS

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END OF SECTION

Part 1 General

1.1 REFERENCES

- .1 Canadian Standards Association (CSA)
 - .1 CAN/CSA C22.2 No. 18 98, Outlet Boxes, Conduit Boxes, and Fittings and Associated Hardware.
 - .2 CSA C22.2 No. 45 M1981(R1992), Rigid Metal Conduit.
 - .3 CSA C22.2 No. 56 1977(R1999), Flexible Metal Conduit and Liquid Tight Flexible Metal Conduit.
 - .4 CSA C22.2 No. 83 M1985(R1999), Electrical Metallic Tubing.
 - .5 CSA C22.2 No. 211.2 M1984(R1999), Rigid PVC (Unplasticized) Conduit.
 - .6 CAN/CSA C22.2 No. 227.3 M91(R1999), Flexible Nonmetallic Tubing.

1.2 WASTE MANAGEMENT AND DISPOSAL

- .1 Remove from site and dispose of all packaging materials at appropriate recycling facilities.
- .2 Collect and separate for disposal paper plastic polystyrene corrugated cardboard packaging material in appropriate on site bins for recycling in accordance with Waste Management Plan.
- .3 Divert unused metal materials from landfill to metal recycling facility as approved by Consultant.
- .4 Fold up metal banding, flatten and place in designated area for recycling.

1.3 REQUIREMENT

- .1 All cable and conductors for power, communications and signal systems shall be installed in conduit as herein specified unless otherwise noted.
- .2 Runs of conduit and cables, where shown, are indicated only by general location and routing. Conduits and cables shall be installed to provide maximum head room, and to interfere as little as possible with free use of spaces through which they pass.
- .3 Holes shall not be cut in structural members without permission being first obtained from the Consultant.
- .4 Junction boxes or cable anchor boxes shall be installed wherever necessary for proper pulling or anchoring of cables. They shall be installed to be accessible after building is completed, and shall be set to come within finished lines of the building.
EMT may be used in furred ceilings, brick or concrete block walls, stud partitions,

or exposed where no danger of mechanical damage exists for 120/208 volt or low voltage wiring.

Part 2 Products

2.1 CONDUITS

- .1 Electrical metallic tubing (EMT): to CSA C22.2 No. 83, with couplings.
- .2 Rigid pvc conduit: to CSA C22.2 No. 211.2.
- .3 Flexible metal conduit: to CSA C22.2 No. 56, liquid tight flexible metal.

2.2 CONDUIT FASTENINGS

- .1 One hole steel straps to secure surface conduits 50 mm and smaller. Two hole steel straps for conduits larger than 50 mm.
- .2 Beam clamps shall be used to attach conduit or cables to exposed steel work. Beam clamps shall be:

Fast Clamp, as supplied by Cantab Industries
Caddy Fasteners as manufactured by Erico Products
- .3 Channel type supports for two or more conduits at 1.5 m oc.
- .4 Threaded rods, 6 mm dia., to support suspended channels.

2.3 CONDUIT FITTINGS

- .1 Set screws and watertight fittings for EMT.
- .2 Condulets shall be of a type wherein cover screws do not enter the wire chamber.
- .3 Steel, double bevel sealing ring for liquid-tight flexible metal conduit. T & B 5200 series or equivalent.
- .4 All others as manufactured for use with conduit specified. Coating: same as conduit.
- .5 Factory "ells" where 90o bends are required for 1 (27) trade size and larger conduits.
- .6 Conduit fittings shall be manufactured by:

Crouse Hinds Kondu
Thomas & Betts Killark
- .7 Running threads not accepted. Use Erickson couplings.

GENERATOR REPLACEMENT

- .8 Flexible conduit entering boxes or enclosures shall be terminated with nylon insulated liquid tight zinc alloy or steel connectors.
- .9 All couplings and connectors for EMT conduit shall be malleable iron or steel.
- .10 EMT entering boxes or enclosures shall be terminated with nylon insulated steel or zinc alloy concrete tight connectors.
- .11 All conduits shall be terminated with a suitable bushing.
- .12 Conduit seals shall be as manufactured by:

Thomas & Betts or approved equal
- .13 Condulets with suitable covers shall be used where condulets are exposed. Each conduit fitting shall be of a type suitable to its particular use, and of a type which will allow installation of future conduits without blocking covers of existing condulets.
- .14 Flexible conduit and EMT connectors shall be of the insulated throat type.
- .15 Flexible conduit connections to all mechanical equipment shall be of 'Sealtite' manufacture.

2.4 FISH CORD

- .1 Empty conduits shall be cleaned of all construction material and be provided with a pullwire or polytwine.

Part 3 Execution

3.1 INSTALLATION

- .1 Conduit shall be installed as close to building structure as possible so that where concealed, necessary furring can be kept to a minimum. Conduits installed in suspended ceilings shall be arranged to provide minimum interference with removal of tiles.
- .2 Conduits and cables in finished areas shall be run concealed, above finished ceilings, under floors, in walls and partitions. Conduit and cables in unfinished areas, such as fan rooms and penthouses, shall be run exposed, and shall be installed at right angles or parallel to building lines, accurate in line and level. Conduit shall not be bent over sharp objects. Improperly formed bends and running threads will not be accepted. Bends and fittings shall not be used together. Proper supports of manufactured channels shall be provided where exposed conduits and cable runs are grouped.
- .3 Install conduits parallel with building lines.
- .4 Group conduits wherever possible on channels.

GENERATOR REPLACEMENT

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- .5 Conduit and cables shall be installed to avoid proximity to water and heating pipes. They shall not run within 150 mm of such pipes, except where crossings are unavoidable, in
 - .6 which case they shall be kept at least 25 mm from covering of pipe crossed. Use electrical metallic tubing (EMT) except where specified otherwise.
 - .7 Conduit shall be of sufficient size to permit easy removal of conductors at any time. Conduit sizes, where shown on drawings, are minimum and shall not be reduced.
 - .8 Cap ends of all conduits to prevent entrance of foreign matter during construction. Manufactured caps shall be employed.
 - .9 Use liquid tight flexible metal conduit for connection to motors, instruments and sensors.
 - .10 No conduit shall be less than 20 mm I.P.S. unless noted otherwise, or where not more than two #12 conductors are run to a dead end. Conduits for communication cables shall not be less than 27mm I.P.S. unless noted otherwise.
 - .11 Bend conduit cold. Replace conduit if kinked or flattened more than 1/10th of its original diameter.
 - .12 Mechanically bend steel conduit over ¾ (21) trade size.
 - .13 Field threads on rigid conduit must be of sufficient length to draw conduits up tight.
 - .14 Expansion joints shall be provided in conduit runs where they cross building expansion joints.
 - .15 Not more than four (4) 90 degree bends or equivalent offsets will be permitted between pull boxes. When maximum number of bends are used, the total run between pull boxes shall not exceed 18000 mm.
 - .16 PVC conduit and non-metallic conduit shall not pass through a fire partition or floor separation. Where it is necessary for PVC conduits or non-metallic tubing to pass through a fire barrier, a transition to EMT or rigid steel conduit shall be provided for 2000 mm on either side of the fire barrier. Also, PVC conduit and non-metallic tubing shall not be used in return air plenums.
 - .17 Conduits and cables shall be supported, at regular intervals, with corrosion resisting clamps. Lead anchors or expansion bolts shall be used to attach clamps to masonry walls.
 - .18 Where conduits become blocked, remove and replace blocked section. Do not use liquids to clean out conduits.
 - .19 Dry conduits out before installing wire.

GENERATOR REPLACEMENT

- .20 Where elbows 45 degree and larger are required to pass through a wall provide a pull box instead.
- .21 Elbows shall not be used for data or telephone conduits provide a pull box instead.
- .22 O.Z. Type WSK wall entrance seals shall be installed where conduits pass through exterior walls below grade.
- .23 Pull boxes utilized for turning corners shall be square and sized at six (6) times the diameter of the largest conduit.
- .24 Pull boxes for straight runs shall be sized at eight (8) times the diameter of the largest conduit in length.
- .25 Expansion joints shall be installed with ground jumper.

3.2 SURFACE CONDUITS

- .1 Run parallel or perpendicular to building lines.
- .2 Locate conduits behind infrared or gas fired heaters with 1.5 m clearance.
- .3 Run conduits in flanged portion of structural steel.
- .4 Group conduits wherever possible on suspended surface channels.
- .5 Do not pass conduits through structural members except as indicated.

3.3 CONCEALED CONDUIT

- .1 Run parallel or perpendicular to building lines.
- .2 Do not install horizontal runs in walls.
- .3 Install conduits and fittings to be embedded or plastered over neatly and close to building structure so furring can be kept to minimum.

END OF SECTION

Part 1 General

1.1 RELATED SECTIONS

- .1 Section 26 05 01 - Common Work Results – Electrical
- .2 Section 26 23 00 – Low Voltage Switchboard
- .3 Section 26 24 02 – Service Entrance Boards.

1.2 REFERENCES

- .1 2015 Canadian Electrical Code
- .2 Canadian Standards Association (CSA)
 - .1 CSA C22.2No.248.12-94, Low Voltage Fuses Part 12: Class R (Bi-National Standard with, UL 248-12 (1st Edition).

1.3 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data described herein and in accordance with Section 01 33 00 - Submittal Procedures and 26 05 02 – Common Work Results, Electrical
- .2 Submit fuse performance data characteristics for each fuse type and size above 50 A. Performance data to include: average melting time-current characteristics.

1.4 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

1.5 MAINTENANCE MATERIALS

- .1 Provide maintenance materials in accordance with Section 01 78 10 - Closeout Submittals.
- .2 Three (3) spare fuses of each type and size installed.

Part 2 Products

2.1 FUSES GENERAL

- .1 Fuses: product of one manufacturer for entire project.
- .2 Fuse interrupting rating shall be 200,000 amperes RMS symmetrical, unless otherwise noted.

- .3 Time delay fuses shall carry 500% of rated current for a minimum of 10 seconds and shall be labeled "Time Delay" by the manufacturer.

2.2 FUSE TYPES

- .1 HRC fuses rated 600 amperes and smaller shall be CSA certified HRC1-J time delay and shall be in accordance with CSA Specification C22-2 No. 106-M92. HRC-1 fuse dimensions and current limiting performance shall be in accordance with the UL Standard 198C

Part 3 Execution

3.1 INSTALLATION

- .1 Install fuses in mounting devices immediately before energizing circuit.
- .2 Ensure correct fuses fitted to physically match mounting devices and electrical circuit.
- .3 Application of all fuses shall comply with the Canadian Electrical Code - Part 1 and local inspection authority regulations.
- .4 All fuses shall be manufactured by Littlefuse, Buss, Ferraz Shawmut, or Edison.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials for moulded-case circuit breakers, and ground-fault circuit-interrupters.
- .2 Read with Sections 26 23 00 and 26 24 02

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 23 00 - Low Voltage Switchboard.

1.3 REFERENCES

- .1 2015 Canadian Electrical Code
- .2 Canadian Standards Association (CSA International).
 - .1 CSA-C22.2 No. 5-02, Moulded-Case Circuit Breakers, Moulded-Case Switches and Circuit-Breaker Enclosures (Tri-national standard with UL 489, tenth edition, and the second edition of NMX-J-266-ANCE).

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data described herein and in accordance with Section 01 33 00 - Submittal Procedures and 26 05 01 – Common Work Results, Electrical
- .2 Include time-current characteristic curves for breakers with ampacity of 50A and over and with interrupting capacity of 22,000 A symmetrical (rms) and over at system voltage.

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 BREAKERS GENERAL

- .1 Bolt-on moulded case circuit breaker: quick-make, quick-break type, for manual and automatic operation with temperature compensation for 40 deg C ambient.
- .2 Common-trip breakers: with single handle for multi-pole applications.
- .3 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting. Trip settings on breakers with adjustable trips.

- .4 Circuit breakers with interchangeable trips as indicated.
- .5 A minimum of 22,000 asymmetrical RMS interrupting capacity rating in CDP's.
- .6 Magnetic instantaneous trip elements in circuit breakers to operate only when value of current reaches setting.
- .1 Trip settings on breakers to have adjustable trips.

2.2 THERMAL MAGNETIC BREAKERS

- .1 Moulded case circuit breaker to operate automatically by means of thermal and magnetic tripping devices to provide inverse time current tripping and instantaneous tripping for short circuit protection.

2.3 SOLID STATE TRIP BREAKERS

- .1 Moulded case circuit breaker to operate by means of solid-state trip unit with associated current monitors and self-powered shunt trip to provide inverse time current trip under overload condition, and long time, short time, instantaneous, tripping for ground fault short circuit protection.
- .2 The main generator breakers and all breakers over 400 amps shall have solid state trip units. All other breakers shown shall be thermal magnetic breakers.

Part 3 Execution

3.1 INSTALLATION

- .1 Install circuit breakers as indicated.

END OF SECTION

Part 1 General

1.1 SECTION INCLUDES

- .1 Materials and installation for fused and non-fused disconnect switches.

1.2 RELATED SECTIONS

- .1 Section 01 33 00 - Submittal Procedures.
- .2 Section 26 05 02 - Common Work Results - Electrical.
- .3 Section 26 23 00 - Low Voltage Switchboard.
- .4 Section 26 28 14 - Fuses - Low Voltage.

1.3 REFERENCES

- .1 2015 Canadian Electrical Code
- .2 Canadian Standards Association (CSA International).
 - .1 CAN/CSA C22.2 No.4-M89 (R2000), Enclosed Switches.
 - .2 CSA C22.2 No.39-M89 (R2003), Fuseholder Assemblies.

1.4 SHOP DRAWINGS AND PRODUCT DATA

- .1 Submit shop drawings and product data described herein and in accordance with Section 01 33 00 - Submittal Procedures and 26 05 02 – Common Work Results, Electrical

1.5 WASTE MANAGEMENT AND DISPOSAL

- .1 Collect and separate waste for reuse, recycling, and other waste diversion strategies in accordance with Waste Management Plan.

Part 2 Products

2.1 DISCONNECT SWITCHES

- .1 Fusible and non-fusible disconnect switch in CSA Enclosure, size as indicated.
- .2 Mechanically interlocked door to prevent opening when handle in ON position.
- .3 Fuses: size as indicated, in accordance with Section 26 28 14 - Fuses - Low Voltage. Switch fuse units shall be available in 30 through 1200 amp standard industry sizes. They shall be readily removable and interchangeable without modification to bus work or mounting rails

- .4 Fuseholders: suitable without adaptors, for type and size of fuse indicated unless noted otherwise.
- .5 Quick-make, quick-break action.
- .6 Fusible switches shall be quick-make, quick-break, visible blades, integral handle mechanism, deionizing arc quenchers, front operation, high pressure fuse clips and recessed live parts.
- .7 Operating handles to have provision for padlocking in either 'on' or 'off' position.
- .8 Handle to be marked to clearly indicate switch contact positions.
- .9 All switches shall be manufactured by Cutler Hammer, General Electric or Schneider Electric.

2.2 EQUIPMENT IDENTIFICATION

- .1 Provide equipment identification in accordance with Section 26 05 02 - Common Work Results - Electrical.
- .2 The handle mechanism shall be metallic.
- .3 Lamecoid nameplates, approximately 75 mm x 25 mm, shall be provided on front doors of each switch for identification, showing the name and rating.

Part 3 Execution

3.1 INSTALLATION

- .1 Install disconnect switches complete with fuses if applicable.

END OF SECTION

PART 1 General

1.1 SYSTEM DESCRIPTION

- .1 This specification defines the requirement for the emergency standby generating control system, consisting of one (1) standby generator and associated equipment.
- .2 All materials, equipment and parts comprising the unit specified herein shall be new and unused, of current manufacture and of highest grade.
- .3 Equipment furnished under this section shall be guaranteed against defective parts or workmanship for one year after acceptance.
- .4 The manufacturer shall be capable of maintaining and servicing this equipment without causing the Owner either to carry expensive parts, or to be subject to the inconvenience of long periods of interrupted service because of lack of available parts.
- .5 Three (3) sets of complete operating, maintenance and parts manuals, drawings, and a sequence of operation covering all equipment for the standby generator control panel, transfer switches, etc., shall be provided. Complete operating instructions shall be installed in a suitable frame, and mounted on a wall adjacent to the generator control panel.
- .6 The standby generator and associated equipment (as shown on the drawings) shall be supplied by one manufacturer.
- .7 The engine shall be in-line of 'V' configuration and directly connected to the generator by a suitable coupling. Vibration caused by misalignment or imbalance will not be accepted. Documentation shall be provided indicating actual vibration levels for the assembled standby generating set.
- .8 The standby generator set shall be suitable for operation at 600m above sea level, and in a maximum ambient temperature of 45°C. Furthermore, the standby plant shall start reliably, without any delay or manual priming, at an ambient temperature of 15°C, and shall deliver full output within 10 seconds from normal commercial power failure.

1.2 SUBMITTALS

- .1 Submit shop drawings in accordance with Section 01 33 00 - Submittal Procedures.
- .2 Before fabrication and/or assembly of the generator set, shop drawings and complete wiring diagrams shall be submitted to the Consultant for review. As part of the shop drawings, provide complete ladder logic diagram showing in detail the control scheme for the system.

1.3 CLOSEOUT SUBMITTALS

- .1 Provide maintenance data for diesel generating units for incorporation into manual specified in Section 01 78 00 - Closeout Submittals.

GENERATOR REPLACEMENT

- .2 Three (3) sets of complete operating, maintenance and parts manuals, drawings, and a sequence of operation covering all equipment for the standby diesel generator, transfer switches, etc., shall be provided. Complete operating instructions shall be installed in a suitable frame, and mounted on a wall adjacent to the generator control panel.

1.4 WARRANTY

- .1 Contractor hereby warrants generating unit, equipment, and accessories against defects and malfunction in accordance with General Conditions, for one year.

1.5 QUALITY ASSURANCE

- .1 Do work in accordance with CAN3-Z299.3.

1.6 MAINTENANCE - EXTRA MATERIALS

- .1 Provide conclusive evidence that local distributor has been established and will stock in Saskatchewan spare parts likely to be required during normal life of engine.
- .2 Provide the following:
 - .1 Provide generator unit with standard set of engine manufacturer's spare parts for one year normal operation of minimum 500 operating hours.
 - .2 Spares to include:
 - .1 Six fuel filter elements for each type of fuel filter/water separator.
 - .2 Three air cleaner elements.

PART 2 Products

2.1 MATERIALS

- .1 The generator set shall operate at 347/600 volt, 3 phase, 4 wire, 60 cycle and shall be sized as shown on the drawings.
- .2 The rated net H.P. of the engine at the generator synchronous speed with all accessories attached, shall not be less than that required to produce the kilowatt rating specified. The H.P. rating shall take into account generator efficiency losses, and accessories such as air cleaners, lubricating oil pump, fuel pump, jacket water pump, governor, etc.
- .3 The entire standby generator set, including engine, shall be capable of delivering rated power at existing site conditions without exceeding the maximum temperature rise, maximum voltage drop or maximum frequency variation. Voltage drop shall not exceed 15%.
- .4 These ratings must be substantiated by manufacturer's standard published curves. Special ratings or maximum ratings are not acceptable.

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- .5 The engine shall be water cooled in-line or Vee type four stroke cycle compression ignition diesel. It shall meet full load when operating on No. 2 or No. 1 domestic burner oil. The engine shall be capable of operating at idle or light loads for extended periods of time.
- .6 Flexible fuel, coolant, exhaust and electrical lines shall be installed on the standby generator in order to absorb the initial vibration caused by engine starting and the normal vibration of the engine under load.
- .7 The engine shall be equipped with a suitable electronic governor to maintain frequency within limits as specified below, by controlling engine and generator speed. Governor shall be electronic, fully enclosed, and capable of providing accurate speed control within 1/2% of rated speed. The speed control shall be designed to limit speed over-shoot on engine starts to less than 102% of rated speed.
- .8 The speed of the engine shall not exceed 1800 r.p.m. at rated output.
- .9 The gear type lubricating oil pump shall supply oil under pressure to the main bearings, crank pin bearings, pistons, timing gears, crankshaft bearings, and valve rocker mechanism. Effective full flow lubricating oil shall be continuously filtered, except during periods when oil is by-passed to protect vital parts such as when filters are clogged. Replaceable resin impregnated cellulose type filter elements shall be accessible and easily removable. The filter system shall be equipped with a spring loaded bypass valve as an insurance against stoppage of lubricating oil circulating in the event filters should become clogged.
- .10 A suitable water-cooled engine mounted lubricating oil cooler shall be provided.
- .11 Provide engine jacket coolant heater complete with immersion type thermostat. Size heater to maintain coolant at required temperature in an ambient temperature found in exterior weatherproof enclosures. Obtain circulation of heated coolant on thermosyphon principle. However, if this does not provide sufficient circulation to avoid hot spots in the system, provide electrical motor driven circulating pump to operate automatically when heater is energized. Motor shall be 120 volt, single phase, splashproof type.
- .12 Fuel system shall be equipped with replaceable fuel filter elements which may be easily removed without breaking any fuel line connections or disturbing the fuel pump, or any other part of the engine. The engine fuel system shall be equipped with a water separator installed at the engine. The fuel filter shall be a centrifugal type capable of filtering the entire fuel flow for the engine plus the injector cooling requirements.
- .13 All cabling 120 volt and above shall be rated Teck 90 cable. All communications / alarm cabling shall be armoured control cable.
- .14 All hot and rotating equipment shall be guarded.
- .15 Provide one or more engine mounted dry type air cleaners of sufficient capacity to protect engine working parts from dust and grit.
- .16 Cooling and combustion air requirements shall be adequately sized to allow the generator set to supply full rating continuously at 40°C ambient.
- .17 The standby generator set shall be mounted on a common channel iron base, which in turn shall be set on a concrete foundation. Rubber or spring type isolators shall be provided between the channel iron base and the enclosure. The rubber isolators shall be

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resilient to oil and other petroleum products, and shall be manufactured by the Stiles Rubber Company or approved equal. The spring type isolators shall be manufactured by Lo-Rez or approved equal.

- .18 The engine shall be equipped with the following gauges:
 - .1 Oil pressure
 - .2 Coolant Temperature
 - .3 Fuel Pressure
- .19 The engine shall be equipped with a 24 V.D.C., electrical start system of sufficient capacity to crank at a speed which will start the engine under normal operating conditions. The starting pinion shall disengage automatically when the engine starts. Heavy duty lead acid storage batteries with sufficient capacity to crank the engine for at least two (2) full cranking cycles at firing speeds, and with capacity for starting the engine a minimum of three (3) times, shall be provided. Necessary stranded battery cable and connections shall be furnished and installed. The batteries shall be located adjacent to the standby unit, enclosed in a heavy gauge poly-resin container with removable lid. The battery box shall be supported by a stand constructed from angle iron. Battery leads shall be equipped with compression type lugs, which in turn shall be bolted to the battery posts and engine starter.
- .20 Crank control with time delay relays shall provide at least three (3) cranking periods. Each cranking period shall be at least fifteen (15) seconds long and the cranking attempt shall be separated by fifteen (15) second rest periods. Total cranking cycle shall not be less than seventy-five (75) seconds. A speed sensing device shall automatically disconnect the starting circuit when the engine has started. If engine has not started, at completion of the starting program, the overcranking alarm shall activate, the engine starting control shall be locked out, and no further starting attempts shall take place until the alarm has been manually reset.
- .21 The alternator shall be a 4 pole, brushless synchronous alternator designed in accordance with NEMA MG1, Part 32 and CSA Standard C282. Construction shall be of a fabricated steel or cast iron frame with cast end plate and coupling adapter. Machine construction shall be drip proof to 30 degrees from horizontal, air ventilated with cast aluminum fan. The alternator shall also comply full with applicable standards as specified be CSA, CEMA, IEC and BS5000, part 99.
- .22 The alternator shall be fitted with a large, terminal box with removable side and top covers. A bus bar terminal board shall be provided inside the terminal box and, where necessary, additional bus bar connecting links shall be provided for re-connection. The machine shall be fitted with long life sealed bearings.
- .23 The stator shall be NEMA Class H insulated and all windings impregnated in a triple dip, thermo setting, moisture, oil and acid resisting Class H varnish.
- .24 The rotor shall be of salient pole form, layer wound with expanding wedges utilized to support the windings. The rotor shall be NEMA Class H insulated, utilizing a solvent-free epoxy system providing high mechanical strength at temperatures of 155°C. and above. A final coat of anti-tracking varnish shall be applied to all wound and unwound components for added moisture protections. The stator and rotor shall have a temperature rise of 105°C. over a 40°C. ambient at an altitude of 1000 metres when operating at 100% load at 0.8 PF and nominal voltage.

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- .25 A fully connected damper winding shall be included and all stator windings shall utilize a 2/3 pitch winding to eliminate 3rd, 9th, and 15th harmonics on the line-neutral waveform.
- .26 The generator control system shall be based on a permanent magnet generator (PMG) which provides excitation power via the automatic voltage regulator to the main exciter. The PMG shall be axially mounted on the main generator shaft. The main exciter output shall be fed into the main rotor windings via a three (3) phase, bridge rectifier incorporating a surge suppressor to protect the diodes against voltage transients, heavy load surges, i.e. short circuits or out-of-phase paralleling.
- .27 The automatic voltage regulator (AVR) shall maintain voltage regulation within $\pm 1\%$ of nominal voltage from no load to full load and vice-versa, including cold to hot variations at any power factor between 0.8 lagging and unity inclusive of speed variations of $4\frac{1}{2}\%$. The regulation shall be based on the average of the three phase voltages. The AVR shall be self-protecting against over-excitation caused by internal or external fault and shall protect the output leads between the generator and the main breaker. The circuit shall collapse the excitation system when a fault occurs. The time of collapse shall be dependent on the severity of the overload. The circuit shall be automatically reset when the generating set is shut down. The AVR shall incorporate an adjustable frequency sensitive circuit providing a voltage characteristic which falls off with reduction in speed of the prime mover.
- .28 Generator controls shall be provided for voltage level and voltage gain controls that are easily accessible for normal operation and adjustments. Voltage adjustment instructions and generator schematic wiring diagrams shall be provided, permanently attached on the inside of the exciter assembly.
- .29 The PMG shall have sufficient capacity to sustain a short circuit at not less than 300% of full load current for not less than 10 seconds without damage to the generator under the following conditions:
 - .1 Three phase symmetrical fault
 - .2 Phase to phase fault
 - .3 Phase to ground fault

Generator decrement and heat damage curves shall be submitted to show fault current sustaining ability.
- .30 The AVR shall be provided with an external fine trimmer with a maximum range of $\pm 5\%$.
- .31 Upon application of full load at 0.8 PF, the generator shall recover to within $\pm 3\%$ of nominal voltage in 0.35 seconds. Total voltage waveform distortion with open circuit between phases, or between phases and neutral shall be in the order of 2%. On a three phase balanced harmonic free load, the distortion shall be in the order of 3.5%. The T.I.F. factor shall be 50 or less, per NEMA MG1, Part 32. All ratings and components shall be based on a maximum allowable voltage of 300 volts.
- .32 The engine and generator components shall be shielded or suppressed for the suppression of radio frequency interference to meet requirements of MIL-1-11683.
- .33 The generator drive shall be free from critical torsion vibration within the range of operating speed.
- .34 Positive ground shall exist:

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- .1 Between generator frame and base through mounting pads, and
- .2 Between generator and engine.
- .35 Overall efficiency of generator shall not be less than 92%.
- .36 The generator and engine shall be oversized as required to facilitate the powering of the loads. The generator shall be oversized to accommodate non linear loads. Increase amount of oversizing to accommodate non-linear loads listed above if required. Provide information as part of the shop drawing submission from the generator manufacturer to substantiate the ability of the system to power the above loads without wave form or other system degradation.
- .37 Cool-down time delay shall be provided to keep engine running for up to five minutes after load has been removed.
- .38 The generator shall be protected by a moulded case circuit breaker. The moulded case circuit breakers shall have adjustable trip unit. As part of the shop drawing, submit circuit breaker time current characteristics and generator heat damage curves to demonstrate that circuit breaker is providing suitable protection.

2.2 FUEL TANK

- .1 The generator unit shall receive its fuel from an existing adjacent exterior above ground fuel tank.
- .2 The electrical contractor shall be responsible for supplying all fuel required for testing of diesel generator unit, as well as fuel supply to leave exterior fuel tank full upon completion of testing. Provide twisted shielded pair Teck cable from the fuel tank level contacts to the generator controller.
- .3 The fuel tank will have an inner tank leak alarm that shall be connected to the generator control panel by the electrical contractor that shall annunciate a warning signal and illuminate a fault light. Provide twisted shielded pair Teck cable from the fuel tank alarm contacts to the generator controller.
- .4 The owner shall be responsible for providing enough fuel to initially fill the tank. The electrical contractor shall be responsible for providing all fuel associated with the required testing and then for leaving the tank full once all testing and training has been completed.

2.3 EXTERIOR WEATHERPROOF ENCLOSURE

- .1 The generator supplier shall supply and install the generator unit and all other equipment within a custom built generator enclosure. The enclosure shall be sized to allow continuous operation of the generator unit without derating of the generator unit. The enclosure shall contain all interconnecting fuel lines, heaters, battery charger, 12 volt trouble light, batteries, circuit breaker, generator controller, and other related and required equipment within. The electrical contractor shall be responsible for supplying all fuel required for testing of diesel generator unit, as well as fuel supply to leave the fuel tank full upon completion of testing.
- .2 The enclosure shall have the following characteristics:
 - .1 Skin-tight, insulated and suitable for local environmental conditions.
 - .2 Walls and roof insulated and covered with suitable steel/aluminum shell.
 - .3 Walk on roof.

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- .4 Exhaust openings provided in the end wall c/w rain shield.
 - .5 Muffler supports provided in the roof.
 - .6 Sound attenuation for enclosure to 75 dB(A) @ 7 metres in a free field condition.
 - .7 A viewing window for external viewing of generator control panel.
 - .8 Two (2) double doors with “D” ring type recessed, lockable door hardware, bulb type weather seals and drip edge.
 - .9 Doors to provide complete access to the generator circuit breaker and control panel, enclosure combination panel and engine compartment
 - .10 Exhaust penetration in the end wall complete with rain shield.
 - .11 Drip mouldings around enclosure perimeter.
 - .12 Provisions for lifting, dragging, and securing unit to ground to ensure stability.
- .3 For enclosure ventilation purposes, the intake air shall enter via lined weather/snow hood with bird screen, insulated (R8) aluminum volume control damper, 120V damper motor. (Spring open / power close). The discharge shall occur through insulated aluminum volume control damper, 120V damper motor, lined weather/snow hood with galvanized bird screen.
- .4 The basic electrical provisions shall be as follows:
- .1 One (1) 12 circuit, 60 amp, 120/240V, 1 phase, 3 wire panel with branch breakers as required.
 - .2 120 volt incandescent/LED lights
 - .3 12VDC incandescent/LED light
 - .4 One (1) 15 amp GFCI Duplex receptacle
 - .5 Required heaters with integral thermostat
 - .6 Alternator heater with integral thermostat wired to the panel
 - .7 120 volt battery warming plates.
 - .8 Electric engine block heater complete with immersion type thermostat controlled to maintain manufacturers recommended engine coolant temperature to meet start-up requirements of NFPA-99 and NFPA-110, Level 1.
 - .9 Battery charger wired to panel
 - .10 Damper motor wiring
 - .11 All electrical devices and wiring shall be CSA approved
 - .12 All wiring shall be in surface mounted EMT conduit or Teck cable.

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- .5 The enclosure shall have suitable clearance on the sides of the genset rails and radiator. The Generator Control panel and circuit breaker shall be installed to face to the side of the engine/generator.
- .6 The painting of the enclosure shall be as follows:
 - .1 The enclosure shall be factory painted and shall perform to meet the requirements of the environment.
- .7 It is the manufacturer's responsibility to ensure that insulation provided for this remote application must be sufficient in order to avoid the prolonged continuous operation of the thermostatically controlled device heaters and to ensure that the generator unit will start when required to do so.
- .8 Factory standard isolators are acceptable. Manufacturer shall be responsible for any problem issues resulting from any specified product deviation.
- .9 The generator enclosure shall include the requirement for recirculating air dampers. The enclosure shall be designed for winter conditions and shall employ factory approved strategies for ensuring that the genset performs as required under the conditions to which it will be exposed.
- .10 Factory standard enclosures are acceptable with the condition that the enclosure provides adequate insulation sufficient to avoid the prolonged continuous operation of the thermostatically controlled device heaters and to ensure that the generator unit will start when required to do so. Variations in insulation and exterior wall metal gauges are acceptable.

2.4 VENTILATION AND EXHAUST

- .1 An engine mounted radiator with blower type fan shall be sized to maintain safe operation at 40°C. maximum ambient temperature. The radiator shall be equipped with a duct adapter flange. Air flow restriction from the radiator shall not exceed 125 Pa. Cooling and combustion air requirements shall be adequately sized to allow generator set to supply full rating continuously at 40°C. ambient. The engine cooling system shall be filled with a solution of 50% ethylene glycol and water. Provide Nalcool coolant additive for the entire system. The engine shall be equipped with an engine driven pump for circulating water through the cooling system.
- .2 Exhaust piping of suitable material shall connect the exhaust manifold of the engine to a Hospital grade class silencer. The muffler shall provide attenuation of 35 to 40 dBA from 63 Hz to 7500 Hz, and shall be located at the engine within the enclosure. Coordinate the exhaust piping installation and size with enclosure manufacturer to ensure the back pressure does not exceed the generator manufacturer's recommendations, and to ensure that the engine is able to produce the maximum power required for this application. A flexible connection shall be mounted between the engine exhaust manifold and the muffler. Supply muffler complete with flexible connectors and a thimble for the penetration through the enclosure. Coordinate with manufacturer for the required size and configuration of the thimble and exhaust piping. The exhaust manifold and piping within the enclosure shall be insulated with a heat-resistant covering to protect personnel.

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- .3 Silencer outlet to be a 45 degree cut with bird screen and will extend out the end of the enclosure above the discharge hood.
- .4 The standby generator manufacturer and supplier shall be responsible for reviewing the mechanical ventilation, fuel and exhaust requirements of their equipment to ensure that the provisions of the enclosure are adequate for their equipment.
- .5 The genset supplier shall be responsible for ensuring and coordinating that the provisions of the enclosure for the above systems are suitable for the proper and desired operation of the genset in the environmental conditions found at this site.

Standby power rating @ 0.8 p.f. 400kW

2.5 BATTERY CHARGER

- .1 A battery charger shall be provided, and shall be capable of operating the control panel and charging the diesel batteries simultaneously. The battery charger shall meet the following requirements:
 - .1 Wall mounted type
 - .2 Input voltage 60 Hz. 120 volt, A.C.
 - .3 Output nominal voltage 24 volt
 - .4 Adjustable float voltage from 95% to 130% of nominal voltage.
 - .5 Adjustable high rate voltage float voltage to 130% of nominal voltage.
 - .6 Voltage stability +0.5% for conditions of 1% to 100% full load, $\pm 10\%$ input voltage variation and $\pm 5\%$ frequency deviation.
 - .7 Ampere minimum 10 amp and taper to 0 amp
 - .8 Automatic charge control that shall automatically switch to high rate if the battery demands full output from the charger.
 - .9 Float and high rate switches
 - .10 Equipped with ammeter and voltmeter $\pm 2\%$ accuracy.
 - .11 Low battery voltage alarm contacts for use with control panel.
 - .12 Battery charger shall not subject batteries to prolonged charging periods or trickle charging.
 - .13 Battery charger shall be capable of recharging fully discharged battery within twelve (12) hours.
 - .14 When battery charging is not occurring, the batteries shall be constantly monitored when battery voltage drops below 24.5 volts, an alarm indicating light on the generator control panel shall be activated along with alarm signal. This monitoring system shall be fully independent of the battery charger and shall monitor the batteries regardless of whether the battery charger is energized.
 - .15 Battery charger shall be SAFT NIFE SLR24-12 or approved equal.

2.6 SHUTDOWN AND ALARMS

- .1 In the building, provide an emergency shutdown pushbutton complete with a safety guard. This should take precedence over the master switch on the diesel control panel. This pushbutton shall shutdown the engine by interrupting the power to the engine controls and by dumping the engine air box or by shutting off

the fuel supply. The engine air box and its configuration if utilized for shutdown shall be designed to facilitate an emergency shutdown without damage to either the engines or the air box.

- .2 Provide the following engine automatic shutdown devices, complete with red indicating light on the generator control panel:

- .1 High coolant temperature
- .2 Low oil pressure
- .3 Engine over speed
- .4 Over crank
- .5 Low coolant level
- .6 Over vibration (use of Murphy switch)

The low oil pressure protection system shall be locked out until the engine speed reaches 90% of rated speed and for a period of twenty (20) seconds after engine start.

- .3 Provide the following advisory alarms complete with alarm indication on the generator control panel:

- .1 Low battery voltage
- .2 Abnormal selector switch position
- .3 Under frequency
- .4 Low fuel
- .5 Low coolant temperature
- .6 Ready to start
- .7 Unit running
- .8 Battery charger fault
- .9 Fuel Tank Leak
- .10 Auxiliary fault (field selectable)

2.7 CONTROL PANEL

- .1 Provide a unit mounted digital control panel. The control panel shall be as detailed on the drawings and shall include, but not be limited to, the following:

- .1 Voltmeter with phase selection
- .2 Hour meter
- .3 Frequency meter
- .4 Ammeter with phase selection
- .5 Engine and electrical automatic shutdown indicator lights
- .6 Advisory alarm indicator lights
- .7 Emergency stop
- .8 Sixteen (16) programmable contact inputs; (7) Contact outputs: (3) 30A dc and (4) programmable 2A dc rated contacts
- .9 RUN/ OFF – RESET/AUTO

- .2 Provide a separate remote digital monitoring and control panel for use within the building installed into the electrical room using Teck cable or conduit/wire. It

shall also be used to display all alarms and pre-alarm conditions. It shall be c/w an audible alarm horn and lamp test and alarm silence switches

- .3 All system controls shall be microprocessor based. Relays and relay based logic will not be permitted. The controller shall be powered from the stand-by generator batteries in an appropriate fashion so as to ensure reliable operation under normal and emergency conditions.
- .4 The electronic governor and control scheme shall be capable of operating with isochronous cross current compensation.
- .5 The entire diesel electric set shall be supplied by Finning (Kramer Tractor), Wajax Power Systems or Generac.

2.8 WORKMANSHIP

- .1 Manufacture and construct equipment free from blemishes, defects, burrs and sharp edges; accuracy of dimensions and marking of parts and assemblies; thoroughness of welding, brazing, painting and wiring, alignment of parts and tightness of assembly screws and bolts.

PART 3 Execution

3.1 INSTALLATION

- .1 Check the site and determine the size and weight of the sections into which the equipment shall be divided for shipment to ensure that they can easily be moved into or out of the electrical rooms, as shown on the drawings. Special arrangements will be required to move the new equipment into the existing building. Protect existing building finishes and repair all damage resulting from installation of new equipment.
- .2 The ground bus shall be connected to the ground network. Refer to Section 260528 and the drawings for further grounding requirements.
- .3 Provide one litre of touch-up paint for each major component color in aerosol cans. Touch up paint finish where required.
- .4 This Division shall supply all fuel for completion of the acceptance tests after which, leave the day tank full.
- .5 Prior to the final acceptance tests, a qualified representative of the manufacturer of the generator control panels shall field verify and correct as necessary, all control circuitry, terminations of field wiring and operation of control systems. The representative shall also provide on site technical assistance to the contractor as required during the course of the installation, and shall also be present during the final acceptance tests. This representative shall visit the site a minimum of three (3) times.
- .6 The final acceptance test shall include, but not necessarily confined to, the following recorded verifications:

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- .1 Engine, generator and control panel nameplate data and operating characteristics.
 - .2 Cooling system, including radiator, piping, motorized louvres and controls.
 - .3 Provide portable meters to facilitate vibration tests. Provide documentation to demonstrate vibration readings are within engine and generator manufacturers tolerances. On completion of the mechanical installation, a complete vibration analysis shall be performed, and a hard copy of the vibration x-y plots provided. The vibration points shall be taken at a minimum of seven points both in the vertical and horizontal plane. All points shall be marked using red paint to ensure that future vibration readings are taken from identical points. Vibration readings shall not exceed 16.5 mm per second at any order within the first five orders of operating speed. The overall vibration reading shall not exceed 0.20 mm filter-out reading.
 - .4 Provide a recording harmonic meter to demonstrate that the generated wave form does not include objectionable harmonic distortion particularly third harmonic.
 - .5 Automatic engine and electrical shutdown protection devices, and all advisory non shutdown alarms.
 - .6 Control panel operation.
 - .7 Battery charger and its operation.
 - .8 Automatic and manual starting, at no load, half load and full load. Voltage, current, frequency, oil pressure, engine water temperature and enclosure temperature shall be recorded.
 - .9 With normal building load, demonstrate automatic start and transfer switch operation. Also demonstrate manual starting.
 - .10 Provide a load bank to demonstrate the unit's capability to carry 100% load continuously for two (2) hours while operating within specified ratings and temperature limits.
 - .11 Demonstrate emergency shutdown at 30% load.
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- .7 On site testing load banks, temporary wiring, instrumentation and all personnel required to satisfactorily complete these tests shall be the responsibility of this Division. A qualified representative of the equipment manufacturer must also be in attendance to certify all test data.
 - .8 Three written reports shall be prepared by the contractor and standby generator supplier, showing all engine gauge readings, all generator meter readings and room ambient temperature during the acceptance test.

- .9 The contractor shall have the installation totally complete and tested for correct operation before the acceptance tests start.
- .10 The Owner's operating and maintenance personnel shall be instructed in the operation of the system for a minimum period of four (4) hours. Written documentation bearing name and signature of Owner's personnel who received the above instructions shall be included in operating instructions and service manuals.
- .11 Connect the generator to the existing fuel tank using steel pipe suitable for diesel fuel with threaded, sealed, flexible connections.
- .12 Exhaust piping to be insulated with aluminum clad insulation.

END OF SECTION

1. SCOPE

1. This specification contains the minimum requirements for the design, manufacture and testing of a UL listed, air-cooled, outdoor weatherproof resistive load bank.
2. The load bank is required for periodic exercising and testing of the (standby) emergency power source. The load bank shall be permanently mounted in a weatherproof enclosure, forced air cooled with remotely mounted control panel.

2. SUBMITTALS

1. The manufacturer shall submit for review technical data including features, performance, electrical characteristics, physical characteristics, ratings, accessories and finishes.
2. Shop drawings shall include dimensional plans, front and side elevations and mounting details sufficient to properly install the load bank. Load bus configuration and load connections termination area shall be clearly identified.
3. Electrical schematic drawings shall be provided to detail the operation of the load bank and the provided safety circuits. Over-current protection and control devices shall be identified and their ratings marked. A system interconnection drawing shall be included for control wiring related to the load bank.

3. STANDARDS

1. The equipment covered by this specification shall be designed with the latest applicable NEMA, CEC, and ANSI standards.
2. The load bank shall be CUL listed.

4. RATINGS

1. The total capacity of the load bank shall be rated 400 KW at 600 Volts, 3-Phase, 3-Wire, 60 Hertz and 50 KW minimum load step resolution.
2. The load bank shall be designed for continuous duty cycle operation with no limitations. The load bank shall operate in an ambient temperature of -28°C to 49°C (-20°F to 120°F).

5. MATERIAL AND CONSTRUCTION

1. The load bank shall be outdoor weatherproof construction, suitable for installation on a concrete pad or structural base. All exterior fasteners shall be stainless steel. The load bank shall include forklift channels in the base for lifting.
2. The load bank shall be constructed of heavy gauge aluminized steel per ASTM A463. Aluminized steel provides superior corrosion protection and extended service life, with a better tolerance to high heat exposure compared to the more common Galvanized steel.

3. The main input load bus, load step relays, fuses and blower/control relays shall be located within the load bank enclosure. A thermostatically controlled heater shall be located within the control section to provide protection to the control devices from the effects of moisture and condensation.
4. Airflow throughout the load bank shall be horizontal. Intake openings shall be designed to prevent objects greater than 0.50" diameter from entering the unit.
5. The load bank exhaust hood shall be angled downward. The exhaust hood shall be constructed of non-corrosive aluminized steel or aluminum.
6. The load bank enclosure shall have a baked polyester powder coated finish with a film thickness of 2.8 +/- 0.4 Mils per coat.
7. Load elements shall be contained in an integral resistor case. Resistors can be individually removed for inspection or service.

6. RESISTIVE LOAD ELEMENTS

1. Load elements shall be Avtron Helidyne™, helically wound chromium alloy rated to operate at approximately ½ of maximum continuous rating of wire. Elements must be fully supported across the entire length within the air stream by segmented ceramic insulators on stainless steel rods. Element supports shall be designed to prevent a short circuit to adjacent elements or to ground.
2. The change in resistance due to temperature shall be minimized by maintaining conservative watt densities.
3. The overall tolerance of the load bank shall be -0% to +5% KW at rated voltage. A -5%, +5% rating allows the load bank to deliver less than rated KW and shall not be used. The load bank must deliver full rated KW at rated voltage.

7. COOLING

1. The load bank shall be cooled by integral TEFC or TEAO motor(s) which is direct coupled to the cooling fan blade. The fan motor must be electrically protected against overload using a motor overload device and short circuit protected using three (3) current limiting fuses with an interrupting rating of f200K A.I.C.
2. The fan blade is to be an airfoil design constructed from aluminum or non-corroding material.

8. PROTECTIVE DEVICES

1. A differential pressure switch shall be provided to detect air loss. The switch shall be electrically interlocked with the load application controls to prevent load from being applied if cooling air is not present.
2. An over-temperature switch shall be provided to sense the load bank exhaust in the heater

case assembly. The switch shall be electrically interlocked with the load application controls to remove load from being applied in the event of an over temperature condition.

3. To provide for major fault protection, branch fuses shall be provided on all three phases of switched load steps above 50KW. Branch fuses shall be current limiting type with an interrupting rating of 200K A.I.C.
4. The exterior of the load bank shall have appropriate warning/caution statements on access panels.

9. CONTROL PANEL

1. The control panel shall be a remote 19" rack mounted panel housed in a NEMA 4 type wall mount enclosure. The control panel shall contain the following manual controls:
 1. Power ON/OFF switch
 2. Blower START/STOP pushbuttons.
 3. Master load ON/OFF switch.
 4. Load step switches for ON/OFF application of individual load steps.
2. Control panel visual indicators shall be as follows:
 1. Power ON Indication light.
 2. Blower ON light.
 3. Blower/Air FAILURE light.
3. A standard remote load dump circuit shall be provided as part of the load bank control circuit. Provisions shall be provided to remove the load bank off-line from the operation of a remote normally closed set of auxiliary contacts from a transfer switch or other device. In the event of the remote contact opening, all load is removed.

10. DOCUMENTATION

1. Installation and operation manuals shall be provided with the equipment and shall include complete details for the installation, commissioning, operation, and maintenance of the load bank.
2. The manuals shall include the electrical schematic and interconnect drawings for the power and control wiring for the load bank and all control devices.
3. A complete parts list with part numbers, device identification, and rating shall be included in the manuals. The original manufacturer's name and part number shall be included in the parts listing.
4. Two (2) sets of manuals shall be provided with the load bank.

11. QUALITY CONTROL

1. The load bank shall be fully tested using a test specification written by the supplier. Tests shall include electrical functional testing, verifying conformance to assembly drawings and specifications. Each load step shall be cold resistance checked to verify proper calibration of

resistive load steps and proper ohmic value.

2. The manufacturer shall maintain this data on file for inspection purposes by the purchaser. Tests using high potential equipment shall be performed to ensure isolation of the load circuits from the control circuits and to determine isolation of the load circuits from the load bank frame. Tests of all safety circuits shall be performed to verify conformance to the specification.
3. All electrical circuits shall have a high potential insulation resistance test performed at twice rated voltage plus 1000 VAC to assure insulation integrity.
4. All quality control test equipment shall be regularly maintained and calibrated to traceable national standards.
5. The Company's Quality System shall be ISO9001 Certified.

12. QUALIFICATIONS OF MANUFACTURER

1. The load bank shall be manufactured by a firm regularly engaged in the manufacture of load banks and who can demonstrate at least twenty five (25) years experience with at least twenty five (25) installations of load banks similar or equal to the ones specified herein.
2. The manufacturer shall have a written Quality Control procedure available for review by the purchaser, which will document all phases of operations, engineering, and manufacturing.
3. Manufacturer must have a field service organization with service personnel having a minimum of an Associate Degree in Electrical Engineering.
4. The load bank shall be as manufactured by: Avron or approved equal.

END OF SECTION